# Knowledge Management | Thesis

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Manter OEE Dashboard Team

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Made by students

# Contents

# Summary

**Reason** Effective project management and efficient software development are essential for organizations to remain competitive and provide clients with high-quality goods in today's fast-paced and constantly evolving technological environment. Many organisations engage in such practices, including data collection, but oftentimes it can prove hard to overcome the issue of tackling and managing the knowledge aspect.

Manter International BV is such a company. As a leading manufacturer and innovator in the field of commercial and/or industrial weighing and packaging machinery, they collect various amounts of data from their equipment. This data needs to be processed and turned into meaningful information, to which a business need is applied. This turns the entire process into one of managing and creating knowledge.

**Research** The driving force behind the writing of this thesis is answering the question - How can the implementation of knowledge management and SCRUM methodologies enhance the development of the Manter Project? The aim is to provide an overview on Knowledge Management and Agile methodologies, and how this can bring value to the operations of Manter.

**Key Findings** Adopting SCRUM as a means of Agile Methodology leverages its potential for a collaborative work environment and delivering superior software products. A strategic focus on performance indicators in development: The selection of performance indicators will be done thoughtfully, focusing on those that accurately mirror the organization's needs. Lastly, an OEE web application dashboard will be build with special attention to detail.

**Realisation** The combination of the SCRUM methodology, a well-designed information system, and a robust set of Key Performance Indicators aims to build a resilient, efficient, and effective Knowledge Management System. This will optimize the management and enhancement of knowledge production and application within Manter, resulting in a well-informed, agile, and productive workforce, capable of adapting to an ever-evolving business landscape.A web application will be supplied at the end of the project period. The entire process will be thoroughly documented and all the concerned parties will receive the entire documentation collection, such as this thesis, weekly reports and plans as well as guides.

**Conclusion** In conclusion, the study finds that SCRUM is the best framework for putting a KMS at Manter into practice. The effectiveness of the SCRUM implementation will be assessed using the SCRUM KPIs, as well as feedback from project owners and the supervising lecturer. A React Native web application will be built, in order to support and fulfill the need for data analysis with the scope of creating and managing knowledge and generating business value.

# 1. Introduction

This chapter introduces the reader to the most important details of the Manter OEE Dashboard project, such as the project's purpose, reason, goal, and client.

## 1.1 Why

In today's fast-paced and data-driven business environment, organizations are constantly striving to enhance their competitiveness, efficiency, and customer satisfaction. One critical area that can significantly benefit from leveraging technology and knowledge management practices is the monitoring and optimization of production processes and equipment, particularly in the manufacturing sector.

Many organizations have used Agile project management frameworks, such as SCRUM, which place emphasis on collaboration, iteration, and continuous improvement, to overcome these issues. The field of Knowledge Management has also developed as a means of capturing, disseminating, and utilizing organizational information and expertise to improve performance and creativity.

The company under study, Manter International BV, headquartered in Emmen, the Netherlands, specializes in designing and manufacturing machinery for vegetable weighting and packing. Their goal is to provide their clients with high-quality, reliable, complete, and efficient solutions that meet their specific needs and requirements, such as weighing diverse fruits or high-capacity packaging of various shapes, sizes and conditions. However, Manter faces a challenge in accessing and analyzing meaningful data, Key Performance Indicators (KPIs), and other metrics collected by their machinery during operation. This difficulty hampers their ability to monitor machine performance, detect and diagnose issues or anomalies, and make informed decisions on improving operations.

To overcome this challenge, Manter is interested in creating a knowledge management system that can collect, analyze, and present data from their machinery in a user-friendly and informative way. Such a system would enable them to monitor and optimize their production processes, enhance their quality control, and increase their overall efficiency and profitability. Additionally, it would allow them to share some of this data with their clients and dealerships, providing valuable insights into the performance of the machinery they purchased or are trying to market.

## 1.2 For whom

The research project targets multiple stakeholders who have a vested interest in the successful implementation of a knowledge management system at Manter. These stakeholders include:

Manter: The primary beneficiary of this project is the company itself. By implementing a knowledge management system, Manter can improve its ability to monitor and optimize the performance of its machinery, leading to increased efficiency, enhanced quality control, and improved profitability.

Manter's clients: The clients of Manter, which are businesses and organizations involved in vegetable weighting and packing, will benefit from the implementation of a knowledge management system. It will provide them with valuable insights into the performance of the machinery they have purchased, enabling them to make informed decisions and optimize their own operations.

Manter's dealerships: The dealerships that sell Manter's machinery will also benefit from the knowledge management system. They can provide their customers with detailed information about

the performance and capabilities of the machinery, leading to increased customer satisfaction and improved sales.

Knowledge management researchers and practitioners: The research project aims to contribute to the field of knowledge management and manufacturing. Therefore, researchers and practitioners in these fields can benefit from the insights gained through the investigation and implementation of a knowledge management system at Manter.

Lastly, NHL Stenden and the students part of the research and developing group: the project allows them to gain valuable experience into how research is conducted and how a knowledge management systems functions and is created.

## 1.3 What

The goal of this research project is to design and develop a knowledge management system that can improve Manter's ability to monitor and optimize the performance of their machinery. The system will provide up to date, accurate, curated, and actionable insights on key performance indicators (KPIs) to facilitate informed decision-making.

The specific objectives of this project are as follows:

Investigate the current data collection, analysis, and presentation practices at Manter: This involves understanding the existing methods and tools used by Manter to collect, analyze, and present data from their machinery. It aims to identify the strengths, limitations, and opportunities for improvement in these practices.

Explore the potential benefits and challenges of implementing an Overall Equipment Effectiveness (OEE) dashboard: The project will assess the feasibility and potential impact of developing an OEE dashboard that can collect, analyze, and present data from Manter's machinery in a user-friendly and informative manner. This exploration will involve evaluating the advantages, disadvantages, and potential obstacles associated with implementing such a system, as well as determining the correct way of calculating such indexes.

## 1.4 Reading Guide

This paper assumes the reader has a certain familiarity with current technological terminology and is in the possession of at least a high level overview of Agile methodologies. This chapter will briefly describe the format and layout of the thesis at hand.

Introduction: The framework for the research topic is established in the introduction chapter, which also gives a summary of the thesis. It has sections that go over the motivations for the study, the intended audience, and the ultimate goals of the investigation. A reading guide that describes the thesis's organization is also included in the chapter.

Research: The research method itself is one of the main topics of the research chapter, describing how the research was carried out, what tools were used, sample sizes, etc. The main question and the sub-questions that will help direct the inquiry are stated in the section titled "Results." The research approach, including the selected research methods, data sources, and analysis tools, is covered in the chapter. It also contains a conclusion section that summarizes the results and responds to the primary research question before presenting the study findings.

Realization: The practical application of the research project is described in the realization chapter. It provides an overview of the project's process, the tasks carried out, and the finished

item or deliverables. This chapter gives a thorough explanation of how the research was put to use and what was accomplished during the realization phase.

Conclusions and Recommendations: The conclusions and recommendations chapter is using the information obtained during the research and realization phases, this chapter delivers the overall conclusion of the thesis. It offers a retrospective analysis of the study while reflecting on the primary research topic. The chapter ends with recommendations that are based on the learnings from the research and offer ideas for future directions or areas for improvement.

All sources referenced within this document are listed in the bibliography in alphabetical order and styled in the APA format. Additional sources and information referred to within the results are linked within the Appendix, if needed. A project plan, assignment description, feedback form and SCRUM artifacts are also attached to the annex.

## 1.5 Terminology and abbreviations

**KMS** : Knowledge Management System
**KPI(s)** : Key Performance Indicator(s)
**MQ** : Main question
**SQ** : Sub question
**OEE** : Overall Equipment Effectiveness
**JS** : JavaScript
**MVC** : Model-View-Controller architecture

# 2. Research

This chapter introduces the reader to the research done by the team, in order to gain more insight and knowledge about the tasks, approaches and methodologies to use during the project.

## 2.1 Research Question

### 2.1.1 Main Question

How can the implementation of knowledge management and SCRUM methodologies enhance the development of the Manter Project?

### 2.1.2 Sub Questions

1. What is Knowledge Management?
    1.1. What are the different types of knowledge management?
    1.2. What are the different tools used in knowledge management?
    1.3. What are the use cases of knowledge management in the real world?
2. What is SCRUM?
    2.1. What kind of Scrum Artifacts and activities are essential to a Scrum based project?
    2.2. What are the key principles and practices of SCRUM methodology?
    2.3. What are the benefits and drawbacks of implementing SCRUM in software development projects?
3. How can these tools be used in the realization of the project?
    3.1. How can Knowledge Management be utilized for the realization of the project?
    3.2. How can SCRUM be utilized for the realization of the project?
    3.3. What technologies would facilitate the development of such a product?

## 2.2 Research methods

This chapter elaborates the research strategies used, as well as the methods provided by the HBO ICT research methods pack. According to the original wiki (*Methods - ICT Research Methods*, n.d.), the research methods pack include five strategies: Library, Field, Workshop, Lab, and Showroom. Based on the available time and the goal of the research, Library and Field are the most suitable strategies to answer the research questions as they provide effective results and requires the least amount of time and effort to gather the information, and knowledge. Workshop, Lab, and Showroom are not suitable as used strategies because they require more time to get valuable results, furthermore, their implementation are harder as most of the included methods require third party, or an already existing knowledge management system by the company, that can be tested and analysed.
Library research provides with already existing information, theories that can be easily accessible through the internet. The selected methods from this category are available product analysis, best good and bad practices, and literature study. These methods are also used to answer SQ1 and part of SQ3 as the information is already provided by previous research and documents.

Field research is done in a way to provide application context. This strategy is used to get to know the end user's needs and the organizational context. This concept is furthermore relevant to the research as it may be necessary later for the team to study the diverse range of client's organization and contexts, using various aspects of case studies, surveys, and social network analysis. The selected methods from this category are Document analysis, Interview, and Problem analysis. These methods are used to answer SQ2 and SQ3 as these questions need to have an organizational context to successfully answer them.

**SQ1: What is Knowledge Management System?**

This specific SQ's objective is to provide an explanation for the Knowledge Management term that will only be relevant to the client's project. Therefore, using the Literature Study methodology would be the most appropriate as it would entail systematically searching and examining academic and industry publications related to Knowledge Management. This would then allow the researchers to identify common theme, definitions, and models of Knowledge Management, and synthesize the findings into a coherent understanding of the topic.

**SQ2: How can Knowledge Management be applied to support the business needs of Manter?**

A combination of library and field research techniques can be used to address this research question. While field research can shed light on Manter's business demands and setting, library research can offer a theoretical framework for knowledge management.

To comprehend the various Knowledge Management systems and technologies that can be applied to Manter's business demands, library research can be undertaken through literature study, best practices analysis, and available product analysis. Understanding the various varieties of knowledge management systems, including knowledge repositories, knowledge networks, and communities of practice, is possible thanks to this research.

To learn more about Manter's unique needs, objectives, and issues, field research can be done through document analysis, interviews, and problem analysis. The team can examine Manter's current knowledge management procedures, speak with key individuals to learn about their viewpoints and needs, and conduct a problem analysis to find areas where knowledge management processes can be strengthened.

The team can find the best Knowledge Management system for Manter's business requirements by combining library and field research, and they can create a unique solution that can successfully support their goals and objectives.

**SQ3: How can SCRUM be used to support the process of this project?**

This chapter details the research strategies and methods used in a study on implementing the SCRUM methodology and its components in the processes of planning and software development, with a focus on the HBO ICT research methods pack. Based on the available time and the research objectives, Library and Field strategies were deemed the most appropriate to answer the research questions. The Library strategy provides access to existing information, theories, and literature study, while the Field strategy is utilized to understand the end user's needs and the organizational context through document analysis, interviews, and problem analysis. The surveys and interviews will be used to gather data from the project team members on their perception of the effectiveness of SCRUM methodology in the project management process, such as: expected challenges and benefits based on the team's previous experience, strategies implemented in previous projects with the goal of improving the accuracy of the project's estimation as well as

customer satisfaction and necessities. By utilizing SCRUM, a MVP can be created, showcased to the client and improved based on the client's feedback weekly, thus ensuring a successful and timely product delivery Moreover, based on the outcomes of the weekly demos, sprint velocity, burn-down, success rate, team morale, cycle time and defect rate can be gathered and analysed which in turn could provide on-going proof and improvement of this study. Th e document analysis will involve the review of project management documents such as project plans, project reports, and project schedules to assess the extent to which SCRUM methodology was applied. Moreover, an analysis of the data collected from the surveys, interviews and document analysis will enable the researcher to identify themes and patterns in the data and provide an in-depth understanding of the effectiveness of SCRUM methodology in project management.

## 2.3 Research quality

### 2.3.1 Introduction

Throughout the course of this research project, the team has meticulously adhered to a set of guidelines to guarantee the appropriate and reliable use of research sources. This chapter delineates the evaluation criteria employed for assessing he research sources and demonstrates the team's compliance with the established guidelines for the proper use of research sources.

### 2.3.2 Evaluation Criteria

To appraise the quality and pertinence of the research sources, the following criteria were utilized:

**Relevance**

The research team ascertained that the content of each source corresponded with the research objectives. Journal articles were examined by perusing abstracts and introductory paragraphs, and the publication date was verified to confirm its applicability to the research needs.

**Timeliness**

The team examined the publication date of each source to ensure the currency of the information. Depending on the research requirements, both contemporaneous materials and current accounts of historical events were taken into consideration.

**Reliability**

To establish the reliability of each source, the team cross-referenced the facts and data with other documents addressing the same subject matter. This procedure facilitated the corroboration of the accuracy and dependability of the information presented.

**Validity**

The research team meticulously scrutinized the provenance of the information presented in each source. The type of documentation, such as personal opinions, original research, laboratory experiments, or bibliographies, were considered to ascertain the validity of the source.

**Credibility**

The credentials of each source's author were evaluated to ensure their subject-matter expertise. Biographical reference sources and Google searches were employed to obtain information on the author's background and qualifications.

**Perspective**

The team considered the author's point of view, as well as their cultural, political, social, and economic background. This assessment facilitated the identification and accounting for potential biases in the information presented.

**Purpose**

The purpose of each source was scrutinized to determine its congruence with the research objectives. The team analyzed whether the source aimed to persuade, inform, provide an overview, or incite controversy.

**Commercialism**

The team assessed whether the source contained advertisements or other forms of commercialism that might influence the information provided. The impact of commercial pressures on the source's content was carefully evaluated.

**Intended Audience**

The research team appraised the target audience of each source to ensure its suitability for the research objectives. The author's style and the intended audience of the source were considered.

**Sophistication**

The team evaluated the quality of the source's presentation of key information. Sources were selected that were approximately two steps above the team's current knowledge level, ensuring that the information was comprehensible yet insightful.

**Type of Source**

The research team classified each source as popular, trade, or scholarly, based on its characteristics and intended use.

### 2.3.3 Source Selection

Upon assessing each source using the criteria, the research team determined whether to incorporate it into the research paper. The rationale for inclusion or exclusion was documented to maintain transparency in the source selection process.

### 2.3.4 Conclusion

By adhering to the established guidelines for the proper use of research sources, the research team ensured that the sources employed in this study were pertinent, reliable, and credible. This rigorous evaluation process has contributed significantly to the overall quality and trustworthiness of the research findings.

### 2.3.5 Sample sizes

The sample of this research comes from different sources. This includes the employees, and managers of Manter by providing organization context for the Field research strategy, also, existing products (software), case studies and reports on the implementation of good and best practices of similar projects, and other relevant already published research papers, books that can provide information and theories for the Library research strategy.

**SQ1: What is Knowledge Management System?**

The sample for this specific SQ would be the collection of Internet web page sources, online academic articles, physical and digital books, and other publications that are relevant to the SQ. These samples will be gathered by the researchers searching the materials on the Internet and BlackBoard Library as well as finding the physical materials in the university's library of NHL Stenden Emmen. These research samples would be then selected based on a comprehensive search of relevant databases and sources and would typically include a broad range of perspectives and viewpoints that the team will have to evaluate of.

**SQ2: How can Knowledge Management be applied to support the business needs of Manter?**

Manter's employees and managers, as well as current knowledge management methods and practices, will make up the sample's two key sources. Manter's staff members and managers will discuss the organization's unique knowledge management requirements and difficulties. They will be chosen based on the degree of their involvement in knowledge management inside the firm and how relevant they are to the research issue.

The team will examine current knowledge management techniques and systems in addition to the feedback from Manter's staff and managers. Case studies, studies, and best practices from firms that have successfully implemented knowledge management systems will be included.

**SQ3: How can SCRUM be used to support the process of this project?**

The sample for this study was drawn from various sources, including employees and managers of Manter for providing organizational context, existing software products, case studies, and reports on the implementation of good and best practices of similar projects, and other relevant already published research papers and books for the Library research strategy, as well as previous projects of team members in which the SCRUM methodology has been applied.

### 2.3.6 Research validity, reliability, and generalizability

In general terms, according to Scribbr, validity refers to the extent to which a study measures what it intends to measure. In this research validity is ensured by selecting the appropriate research methods for each research question and using the correct and right amount of sample. According to an educational website (*Research Guides: Evaluating Sources: The CRAAP Test*, n.d.), CRAAP is used to find reliable sources for already existing studies by checking the currency, relevance, authority, accuracy, and purpose of the source which in this research is evaluated based on 1-5 scoring system. Furthermore, interviews and problem analysis are used to ensure that the collected data is aligned with the perspectives of the organizational context. This is ensured by providing weekly sprint meeting, planning and daily stand ups.

According to the previous source, reliability, on the other hand, refers to the consistency and replicability of the findings. This is provided in multiple ways. The research team utilized structured interview questions during interviews, that can be find on Teams environment, and to increase the reliability of previous findings, a smaller size of sample is used from the list that was created during the CRAAP checklist.

According to the same source, generalizability refers to a situation where the result of the study can be applied in a broader context. The generalizability of the current research is limited due to multiple factors:

- **Specific sample size:** Part of the sample consist of employees and managers of Manter, which may not be representative of other organizations.
- **Focus on ICT project:** The research focuses on an ICT problem and solution that may not be utilized in different companies.

Although the generalizability is limited, it is not impossible if the correct methods are used such as a literature study to draw up already existing research and theories, that could be tested in different contexts and sample types. Furthermore, by utilizing correct Field research methods such as interviews and problem analysis, the future researcher can gain insight into the perspectives of different organizations, departments, or employees.

**SQ1: What is Knowledge Management System?**

The three concepts of research validity, reliability, and generalizability are important for the researchers to address, as it is crucial for them employ the proper methods and techniques when answering a research question after defining those three concepts.

- Validity: refers to the extent to which the results obtained from a research study accurately reflect the issue being studied. In this context of SQ, the validity would concern whether the document has answered the full scope of Knowledge Management using the appropriate research method. This SQ would be deemed invalid if it only answers and studies one aspect of Knowledge Management, thus making the result not applicable for the broader concept of Knowledge Management.
- Reliability: refers to the consistency and stability of the results obtained from a research study. In this context of SQ, the reliability could be concerning different researchers obtain different results when attempting to define and describe Knowledge Management. One solution to avoid this is the use of clear and well-defined criteria for selecting source literatures.
- Generalizability: refers to which the findings of a research study can be applied to other contexts or populations beyond the sample studied. For this SQ, the context of this concept would be limited to a specific industry or geographical region, in which would be the client's organization in Emmen.

**SQ2: How can Knowledge Management be applied to support the business needs of Manter?**

Validity: To make sure that the data obtained measures what it is intended to measure, the research team used the right research procedures and sample sizes for each study topic. To make sure that the information gathered is in line with the perspectives of the organizational setting, interviews and problem analysis were also carried out.

Reliability: Structured interview questions were utilized during the interviews to verify the accuracy and repeatability of the results. To lessen the impact of individual prejudices or experiences and to observe the results from various angles and contexts, a sizable sample size was also utilised. The validity of the sources for the literature study was also checked using the CRAAP approach.

Generalizability: Because of the small sample size and the study's concentration on an ICT issue that might not apply to other businesses, the study's generalizability is constrained. However, future researchers can gain insight into the perspectives of various organizations, departments, or employees by using appropriate research methods, such as a literature study to draw upon already

existing research and theories, and by using correct Field research methods, such as interviews and problem analysis. This increases the generalizability of the findings.

**SQ3: How can SCRUM be used to support the process of this project?**

In this study, validity refers to the extent to which the study measures what it intends to measure. To ensure validity, appropriate research methods were chosen for each research question, and the correct sample size was used. The reliability of the findings was ensured by utilizing structured interview questions during interviews and a large sample size consisting of the clients, teachers and fellow programmers to reduce individual biases and view the findings from different perspectives and environments. Generalizability is limited due to factors such as the specific sample size and focus on ICT projects, but a literature study and proper Field research methods such as interviews and problem analysis can provide insight into different contexts and sample types.

### 2.3.7 Limitations

The effectiveness of SCRUM and Knowledge Management practices is only limited on the project that the team is currently doing, may be differ on different projects as it is influenced by factors such as team composition, project size and scope, and organizational culture and scope. This is because this research is made solely on helping the team itself to apply both Knowledge Management and SCRUM to their project, and not to the general audience.

To address these limitations, the team could use mixed methods approaches to collect both quantitative and qualitative data and consider a range of industries and organizational contexts. The readers are also encouraged to conduct pilot studies or experiments in their specific software development projects and adapt them based on their unique needs and constraints.

**SQ1: What is Knowledge Management System?**

There are several things that should be taken into consideration when answering this SQ. Before designing, answering, and interpreting a research question, it is critical to consider these limitations in mind, along with using appropriate ICT research methods and analytical techniques to address these limitations as much as possible. Some of these limitations include:

- **Lack of consensus**: there is no definition of Knowledge Management that is universally agreed upon. Its various definitions by scholars and practitioners can make it difficult to compare and synthesize the results of various investigations.
- **Bias**: participant's self-reporting of the Knowledge Management practices or researcher bias in the interpretation of the data may lead bias in the data.
- **Different level of complexity**: Knowledge Management is a complicated and multifaceted subject that involves various dimensions such as people, processes, technology, among other things. It might be challenging to pinpoint and quantify the essential elements of efficient Knowledge Management due to the complexity of the topic.
- **Contextual factors**: the organizational and cultural contest in which Knowledge Management strategies are used have a significant impact on their effectiveness. It can be difficult to generalize results across different context since what works in one organization or context may not work in another.
- **Limited empirical research**: while there is a significant body of literature on Knowledge Management, there has only been a relatively small amount of empirical research that

has examined the effectiveness of different Knowledge Management practices. This limits and hinders the ability to make a definitive conclusion about how Knowledge Management affects organizational performance.

- **Difficulty in measuring outcomes**: it can be difficult to measure the benefits of Knowledge Management, especially when it comes to intangible benefits such as information sharing, creativity, and innovation. This may make it more difficult to evaluate the effectiveness of various Knowledge Management strategies.

**SQ2: How can Knowledge Management be applied to support the business needs of Manter?**

The limited sample size employed in this study, which might not be typical of the greater population, is one of its weaknesses. Additionally, the study was limited to a single ICT project at Manter, therefore it might not be generalizable to other businesses or projects of various kinds.

Furthermore, the findings' generalizability is constrained by Manter's distinct organizational culture, its focus on ICT initiatives, and its limited scope. The results might not thus be applicable to other businesses or organizations. By examining the relevance of the findings in various circumstances, future research may be able to overcome this constraint.

Finally, it should be mentioned that the present study did not address potential obstacles or difficulties that can appear when knowledge management approaches are used in a business environment. Therefore, to ensure the successful adoption of knowledge management strategies across various businesses, future study might concentrate on identifying and overcoming these impediments.

**SQ3: How can SCRUM be used to support the process of this project?**

The effectiveness of SCRUM is limited to the project that the team is currently working on and may vary on different projects due to factors such as team composition, project size and scope, and organizational culture and scope. The study was conducted solely to help the team apply SCRUM in the planning and development processes of the project and not for the general audience. To address these limitations, a mixed methods approach can be used to collect both quantitative and qualitative data,and a range of industries and organizational contexts can be considered.

## 2.4 Results per sub question

### 2.4.1 What is Knowledge Management?

There are many definitions of knowledge management, thus, the research focuses on the one that is most suitable for the Manter project. Based on the clients' vision, the definition that is most suitable must follow the requirements of:

- shared knowledge (in the project it's the database that holds valuable information when put it into context).
- multiple organizational members.
- knowledge is used to improve future decisions, actions.
- profit making by accessing and using the shared knowledge.

Based on this the perfect definition of knowledge management is defined by IBM (n.d.) is meant to identify, organize, store, and disseminate knowledge within an organization. Knowledge can be defined as information that has been contextualized, interpreted, and analysed to create value. By managing knowledge effectively, organizations can leverage their intellectual capital and create a sustainable competitive advantage. It can also help to improve their decision-making processes, enhance innovation capabilities, and increase overall performance.

**Knowledge management processes**

Organizations go through three stages of knowledge management processes to achieve an effective knowledge management system:

- Knowledge Creation: New knowledge must be created, or existing knowledge must be identified that organization wish to share.
- Knowledge Storage: The knowledge is stored in an information technology system that meets the repository's requirements.
- Knowledge Sharing: The knowledge is shared throughout the organization via various processes, which may spread at different rates depending on the organizational culture. Companies that incentivize and promote knowledge sharing will have a significant advantage over their competitors in the industry.

**What are the different types of knowledge?**

Based on the IBM website (n.d), there are mainly three types of knowledge:

- Tacit knowledge: Refers to the knowledge that is acquired through experience, and it is understood intuitively. Tacit knowledge can include language, facial recognition, leadership skills. In the Manter project all of these are represented among the stakeholders and their actions, however, this is not the main type of knowledge.
- Implicit knowledge: Some literature put it as the same category as tacit knowledge, however, it is mostly separated from it. Implicit knowledge does not necessarily have the problem of difficulty of codifying. This knowledge has yet to be documented. It tends to exist within processes, also referred as "know-how" knowledge. As this form is not hard to understand and codifiable, explicit knowledge from the future Manter KMS must be transferred into implicit knowledge.
- Explicit knowledge: This knowledge is captured within various document types like manuals, reports, and guides. It allows the organization to easily share this knowledge among each other. It might be the most well-known and includes assets such as databases, white papers, and case studies. This is the main knowledge that the Manter project utilizes as form of a database. In this environment the explicit knowledge is easily transformable but for customers and other internal workers that are not educated enough in the business area are hard to understand. Thus, the KMS system to be developed must transform it to implicit knowledge.

### 2.4.2 What is SCRUM?

According to the SCRUM.org Glossary, which was created by Scrum co-creator Ken Schwaber (*Scrum Glossary.* [Scrum.org], n.d.), SCRUM is an Agile project/ product management framework that is widely used in software development projects, although it also has been used in other fields including research, sales, marketing, and advanced technologies.

As an Agile framework, the structure of the SCRUM is defined by the developing team and the project requirements. The development team of Manter project has decided upon having the Sprints last 1 week. The scrum team assesses progress in time-boxed daily meetings of up to 15 minutes, called daily scrums. At the end of the sprint, the team holds two further meetings: one sprint review intended to demonstrate the work done for stakeholders and solicit feedback, and one retrospective intended to enable the team to reflect and improve.

The team will use Jira in order to facilitate all the required SCRUM artifacts, such as user stories, tasks, sprints and other project management artifacts. Jira is a proprietary issue tracking product developed by Atlassian that allows bug tracking and agile project management, as well as interactive online SCRUM boards. As Jira is a very modular platform the team will be using a modified standard template. SCRUM is centred around a set of roles, ceremonies, and artifacts that facilitate collaboration and communication between team members. The roles in SCRUM include the Product Owner, Scrum Master, and the Development Team. The Development team consist of 6 students, our team's project roles are as follows:

| **Role** | **Name** |
|---|---|
| Product Owner \| Manter | Robin de Boer |
| Contact Person \| Manter | Cor Ausema |
| Contact Person \| Manter | Hilbert Ensinga |
| Scrum Master \| NHL Stenden | Mate Soos |
| Development Team Leader \| NHL Stenden | Robert Rachita |
| Development Team Member \| NHL Stenden | Stefan Untura |
| Development Team Member \| NHL Stenden | Levente Stieber |
| Development Team Member \| NHL Stenden | Christopher Sulistiyo |
| Development Team Member \| NHL Stenden | Aleksei Skorjak |

One of the key benefits that SCRUM Methodologies brings to the Manter project is flexibility and adaptability. It allows teams to respond quickly to changing requirements and priorities, and to continuously improve their processes and outcomes. By using SCRUM, the team can ensure that Manter will receive a product which was delivered by cooperation and focus of the whole team, making the product be a shared goal for all the interested parties.

**What kind of Scrum Artifacts and activities are essential to a Scrum based project?**

The correct application of the Scrum methodology in a project is crucial for the success of the project and the satisfaction of the stakeholders. A Scrum Master would be responsible for following through with the described structure of the Scrum Artifacts. Ensuring that the methodologies are properly implemented and respected by the team using Jira workflow. Moreover, essential components such as the product backlog, spring backlog, sprint goals, sprint retrospectives, sprint reviews will be compiled and delivered by the team in order to manage the tasks efficiently and provide a transparent continuous overview to the client. Lasty, every aforementioned component will be discussed and adjusted accordingly by use of daily stand-ups.

**What are the key principles and practices of SCRUM methodology?**

Another key principle of SCRUM is the dual recognition that customers will change the scope of what is wanted (often called requirements volatility) and that there will be unpredictable challenges – for which a predictive or planned approach is not suited. These changes come from a

variety of sources, but according to SCRUM, understanding why is irrelevant, and change should simply be accepted, embraced, and analysed for benefits.

**What are the benefits and drawbacks of implementing SCRUM in software development projects?**

Implementing SCRUM in software development projects has several benefits and drawbacks, as outlined below:

Benefits:

- Enhanced openness: SCRUM encourages openness and visibility into the development process, making it simpler for stakeholders to keep track of developments, spot problems, and make informed choices.
- Flexibility and adaptability: SCRUM enable quick changes and adjustments depending on input from stakeholders or modifications to the project specifications.
- Collaboration and teamwork are stressed in SCRUM, encouraging developers, product owners, and other stakeholders to cooperate to achieve a common objective.
- Early delivery of functional software: SCRUM focuses on releasing functional software in tiny, incremental steps, enabling earlier stakeholder validation and input.
- Improvement over time: SCRUM encourages improvement over time by holding frequent retrospectives during which the team considers what went well and what could be improved in the development process.

Drawbacks:

- Learning curve: To ensure that team members comprehend and adhere to the process properly, SCRUM calls for a sizable investment in education and training.
- Time-consuming: With daily stand-up meetings, sprint planning meetings, and other SCRUM ceremonies, SCRUM needs a great amount of time and effort from the development team.
- Lack of predictability: Because SCRUM depends on self-organizing teams and ever-changing requirements, it can be less predictable than conventional project management techniques.
- Limited scope: Because SCRUM concentrates on delivering tiny, independent features during each sprint, it may not be appropriate for large, complicated software projects with various dependencies.
- Limited documentation: Compared to conventional project management methods, SCRUM places less emphasis on documentation, which might make it challenging to follow progress or interact with stakeholders who are not involved in the SCRUM process.

In conclusion, even if incorporating SCRUM into software development projects can have several advantages, it is crucial to think about any potential negatives and make sure the method is appropriate for the team and project. Effective training, mentoring, and communication can lessen implementation difficulties and guarantee SCRUM's success.

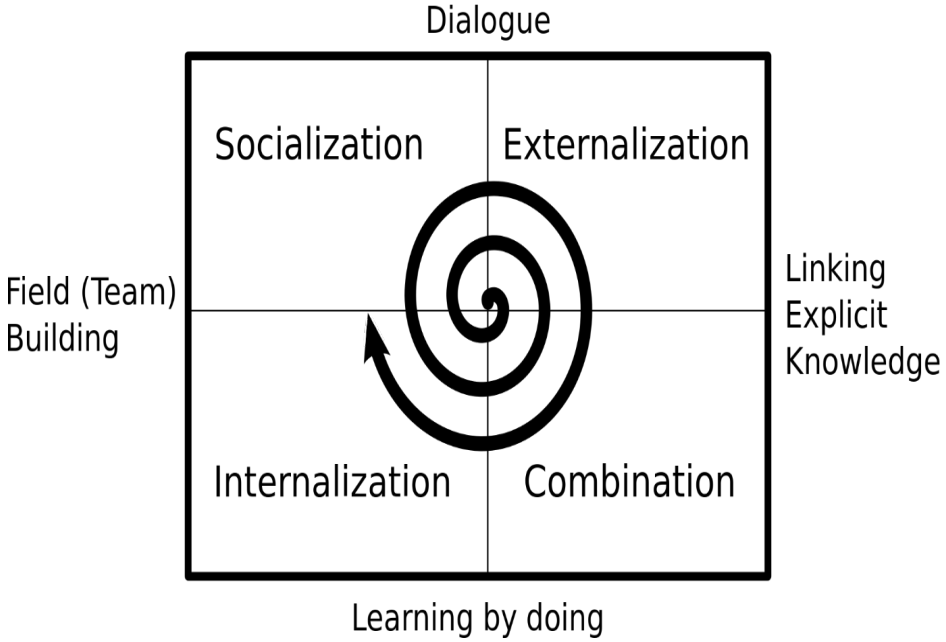


Figure 1: The Knowledge Spiral (Nonaka, 1994)

#### 2.4.3 How can these tools be used in the realization of the project?

**How can Knowledge Management be utilized for the realization of the project?**

As stated beforehand in the SQ2, Knowledge Management is the process that involves a cycle of exchanging tacit knowledge and converting it to explicit knowledge and then reformulating it through an individual's experience and other factors (such as belief, perspective, and values) back into tacit knowledge.

There are essentially two main types of knowledge which are tacit and explicit. Tacit knowledge refers to personal knowledge embedded in individual experience and involving intangible factors. This type of knowledge can be very difficult to transfer. On the other hand, explicit knowledge refers to the one that has already been documented and articulated into formal language and can be much more easily accessible and transferred among individuals. Hence, one of the key functions of a KM strategy is to make tacit knowledge explicit.

Success of an organization depends on how well it converts tacit knowledge into explicit. There are 4 types of knowledge conversion between tacit and explicit knowledge (Nonaka, 1999). According to his model of knowledge creation and transformation, tacit knowledge is exchanged with tacit knowledge through socialization. Tacit knowledge can be converted to explicit knowledge through externalization where the hidden know-how is expressed and articulated through metaphors, models, concepts, equations, and other forms of explanation. Explicit knowledge can be exchanged and developed through communication. Explicit knowledge is converted into tacit knowledge through internalization where individuals absorb it through experience, testing and/or simulating their use of operational knowledge. Hence, these four different types of conversion can promote the generation of important intangible knowledge assets which contribute to long lasting competitive advantage.

Furthermore, there are 4 components of Knowledge Management to implement for a successful knowledge management program:

- **People**: regardless of the size of a company, knowledge always need people to lead, sponsor, and support knowledge sharing.
- **Process**
- **Content/ IT**: these are the tools that connect the right people to the right content at the right time.
- **Strategy**

Nowadays, software developers are expected to ingest and retain massive amounts of information every day, and by doing so effectively is simply not realistic without some kind of external help, such as knowledge management tool. Such information that software developers is expected to retain for example are about commercial off-the-shelf (COTS) technologies such as React, Tailwind, and Redis; and there is also information about proprietary system that the team might have built or has built. Simply pertaining all the knowledge in software development is just not possible, software developers tend to specialize in a particular field, for example website front-end development, website back-end development, network programming, computer security, full-stack development, mobile development, data science and database development, etc. They would then collaborate with other developers specializing in different expertise to make a complete succession of a software development project. In addition, it is important to create an effective communication when working with other developers, especially if it involves sharing tacit knowledge. This is where the Knowledge Management comes into play.

Knowledge Management (KM) plays a huge role in software development projects by ensuring that the knowledge is shared and leveraged effectively throughout the project lifecycle. Some ways that KM can be utilized in the Manter project:

- Knowledge sharing: KM can the team and the client exchange knowledge. Wikis, forums, and knowledge bases are just a few of the different communication tools that can be used to do this. In this case, the knowledge that will be shared between the team and the client would be the best practice to visualize data based on the weigher machines' manufacturing metrics and KPIs for the client's customer to keep track of.
- Best Practices: KM can be used to find and share software development-related best practices. This can be achieved through documenting and exchanging lessons learned, performing knowledge audits, and developing standards and guidelines.
- Retention of knowledge: by capturing and documenting the expertise of subject matter experts and seasoned team members, KM can aid in knowledge retention throughout the firm. This information can be utilized to enable continuous development, teach new team members, and lower the risk of knowledge loss due to employee turnover.
- Collaboration: by giving team members the chance to exchange knowledge, cooperate, and solve problems, KM may promote cooperation and teamwork. This can be facilitated using collaboration tools like instant messaging, video conferencing, and shared workspaces.
- Innovation: KM can promote innovation by capturing and disseminating fresh concepts and creative fixes. Utilizing brainstorming sessions, concept management software, and innovation challenges can help with this.

Knowledge management software is any technology platform that helps businesses better capture, organize, manage, and make use of the knowledge and expertise of their employees. This can include information about processes, best practices, policies, procedures, and other important information that is relevant to the organization. Knowledge management software, or KM software, supports an integrated approach to identifying, capturing, retrieving, and sharing information assets that have a strong focus on—how to accomplish a task, how to handle a situation, how a process works, and how to get a job done. These assets may include text documents, presentations, images, audio and video files, and other data types.

The purpose of knowledge management software is to capture and distribute knowledge, allowing members of an organization, along with its partners and customers, to effectively access and use the information. Having a centralized repository where this knowledge is stored helps to create a single source of truth in an organization, eliminating confusion and reducing the time taken to find information.

Below are some of the use cases that the team, consisting of 6 software developers might have for a Knowledge Management System:

- Code-based diagram for design proposal: it is necessary for the team to have design proposals to show and discuss with the client before developing the software. In software development design proposals, it is necessary to provide diagrams that set out a plan for designing the project so that the client can know the value that the team is offering to them. KM software facilitate the ability to create diagrams from code, so that the team can iterate on them quickly. Code-based diagrams are very useful as a team member can easily change one or two lines in their code and will get a new diagram immediately when he/ she receive feedback in the design review for the team from the client.
- Tracking knowledge: if a teammate has learned some new knowledge for the project that the other team members have yet to learn, he/ she can simply write it down in an organized way so that it can be retrieved or shared later without too much trouble, so that the other teammates can learn it from there as well.
- Meeting notes: KM software allow making notes in markdown and it can be helpful in creating notes during a meeting as markdown allows text formatting as the user is typing. This would therefore hinder a teammate missing out on what people are saying just because he/ she still need to format their text.
- Vim key bindings: For someone who is well-versed in Vim keystrokes, it is particularly helpful for KM software to support these Vim motions since it enables them to navigate a document or code very rapidly and increases their capacity to manage their knowledge more effectively.

Below are some of the Knowledge Management applications out there that have all the use case functionalities so that the team could utilize to assist them in this project:

- Notion
  - More focus on aesthetic appeal.
  - Has a free-tier lifetime subscription.
- Bear
  - Only available on iOS and macOS.

  - Has a clean and super minimalist interface.
- Inkdrop
  - Has aesthetically appealing interface.
  - Allows user to organize their knowledge in a hierarchical way (notebooks, notes, and sub-notebook).
  - Has a Vim plugin for the user to combine with all the keyboard shortcuts that the Inkdrop has to create a mouse-free experience.
  - Has a free 30-day trial.
- Obsidian
  - Known for its graph view that lets users visualize all the connections between their notes.
  - Has a plugin architecture and there are a lot of community plugins to make use of.
- Dendron
  - Unlike the others, it is a VS Code plugin.
  - Very developer friendly.
- Mermaid

**How can SCRUM be utilized for the realization of the project?**

Both lean management and agile methodologies have proven their worth as integrated systems for helping in the improvement of planning and project development performance. However, before settling on a decision of purely adapting SCRUM, an analysis of the benefits of both methodologies, their differences and drawbacks must be made.

For over 70 years, Lean management has been an effective approach to value creation in organizations. It originated in the Toyota Production System during the 1940s and has since spread to various departments and functions in companies, governments, and non-governmental institutions worldwide, including service operations. Lean organizations seek to identify and eliminate activities that do not add value to the customer or end-user. By systematically analyzing processes and value streams to reduce waste, variability, and inflexibility, they achieve improved performance in cost control, product quality, customer satisfaction, and employee engagement simultaneously. Additionally, they adopt a continuous improvement mindset and flexible working processes in which all employees contribute new ideas and suggestions for the organization's betterment over time. This allows people to concentrate more on what matters to customers as they are freed from non-value-generating tasks.

Agile is a more recent approach that originated in software development during the 1990s, gaining momentum after the release of the Agile Manifesto in 2001. Over the past decade, agile has rapidly expanded into other industries such as telecommunications and banking, and more recently, into heavy industries like mining and oil and gas. Agile approaches differ from traditional product or service development, which were highly sequential and time-consuming. Instead, agile is faster and more flexible, with iterative development that aims to get an early prototype of a new product or service into customers' hands as quickly as possible. Teams capture feedback and iterate via quick cycles, refining the product or service over time. Agile approaches have expanded beyond

the realm of product development, and companies are increasingly adopting agile organization across all their activities.

There exists a widely held misconception that lean management and agile are incompatible approaches with disparate guiding principles and restricted applicability to specific types of activities. It is often claimed that lean management is only suited for repetitive, predictable tasks, while agile is only useful in creative endeavors or project management. Consequently, organizations, departments or functions are forced to choose one or the other to the exclusion of all other approaches.

However, this argument betrays a fundamental misunderstanding of both lean management and agile. Contrary to popular belief, both systems have achieved considerable success across a range of settings, and both share a similar set of fundamental goals. These include efficiently delivering value to customers, constantly striving to learn and improve through better work practices, creating transparency in the connection between strategy and objectives to provide teams with a sense of purpose, and empowering people to reach their full potential.

The aims outlined are applicable to any team or undertaking within an organization. Nevertheless, there are varied approaches to realizing these goals. Lean management and agile offer diverse team structures, methodologies, and toolsets, which can be flexibly adapted by an organization to meet its requirements (as depicted in Figure 2). As both systems are founded on comparable principles, their respective components complement each other remarkably well. Moreover, operational excellence is frequently unattainable through lean management or agile methodologies in isolation, but rather through a fusion of the two systems, supplemented by their associated toolkits.

The optimal team structure, working methodology, and technology employed will vary based on the type of activity at hand. While initially developed for highly routine and foreseeable procedures, lean management has evolved to encompass expert coordination, where intricate interactions are managed efficiently. On the other hand, agile methodologies have originated from customer-centric, creative environments, but are increasingly applied to back-office functions through the use of multifunctional and self-governing agile teams. Therefore, the most effective approach could be a blend of both lean management and agile, tailored to the specific needs of the situation. (as depicted in Figure 3).

By utilizing agile management techniques individuals as well as the development team are provided great aid in managing intricate tasks by breaking them down into smaller units and adopting a horizontal supervisory structure instead of a top-down approach. This approach not only increases task efficiency but also expedites decision-making. Conversely, organizations that are unable to fully implement agile management practices tend to encounter challenges in various areas of the organization, leading to reduced performance. Furthermore, taking human factors such as leadership competencies into account plays a vital role in reducing organizational complexities and improving overall performance.

Based on the comparison and analysis conducted, the development team for the knowledge management system requested by Manter can firmly state that the implementation of the SCRUM methodology and of an agile mindset will aid into increasing the planning and development performance as well as boost the quality of the deliverable product. Moreover, in order to boost team performance and the SCRUM methodology application efficiency, an analysis of several essential KPIs can be made both during the SCRUM implementation as well as after the product delivery.

Several essential KPIs can be identified and analyzed in order to gain insights into the effectiveness

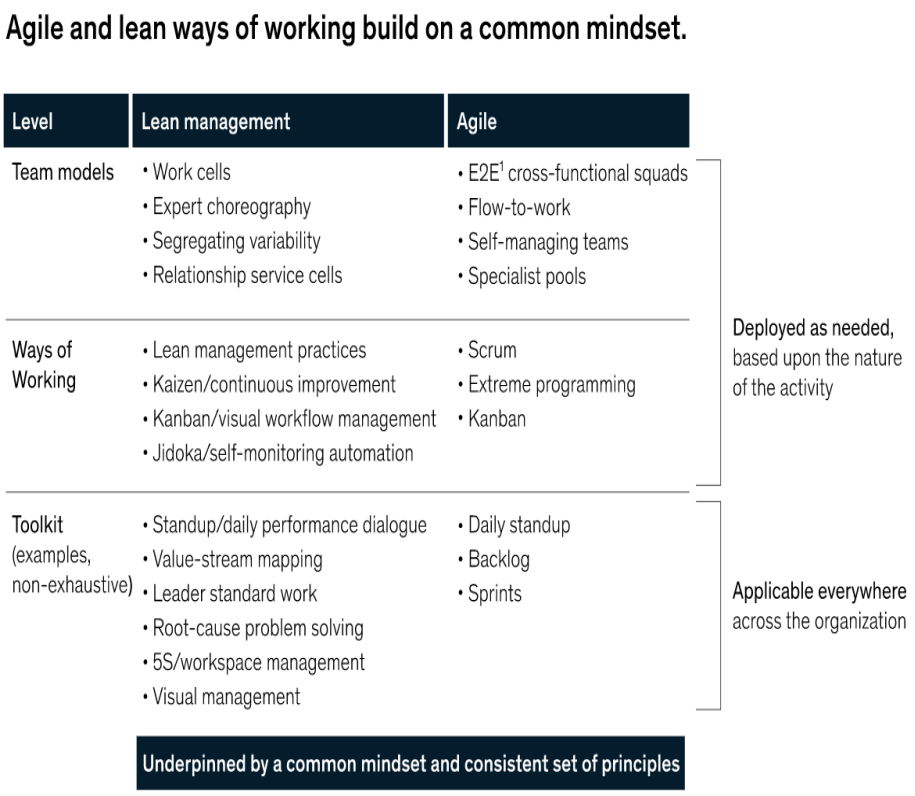


Figure 2: Team models, ways of working and toolkits of development methodologies

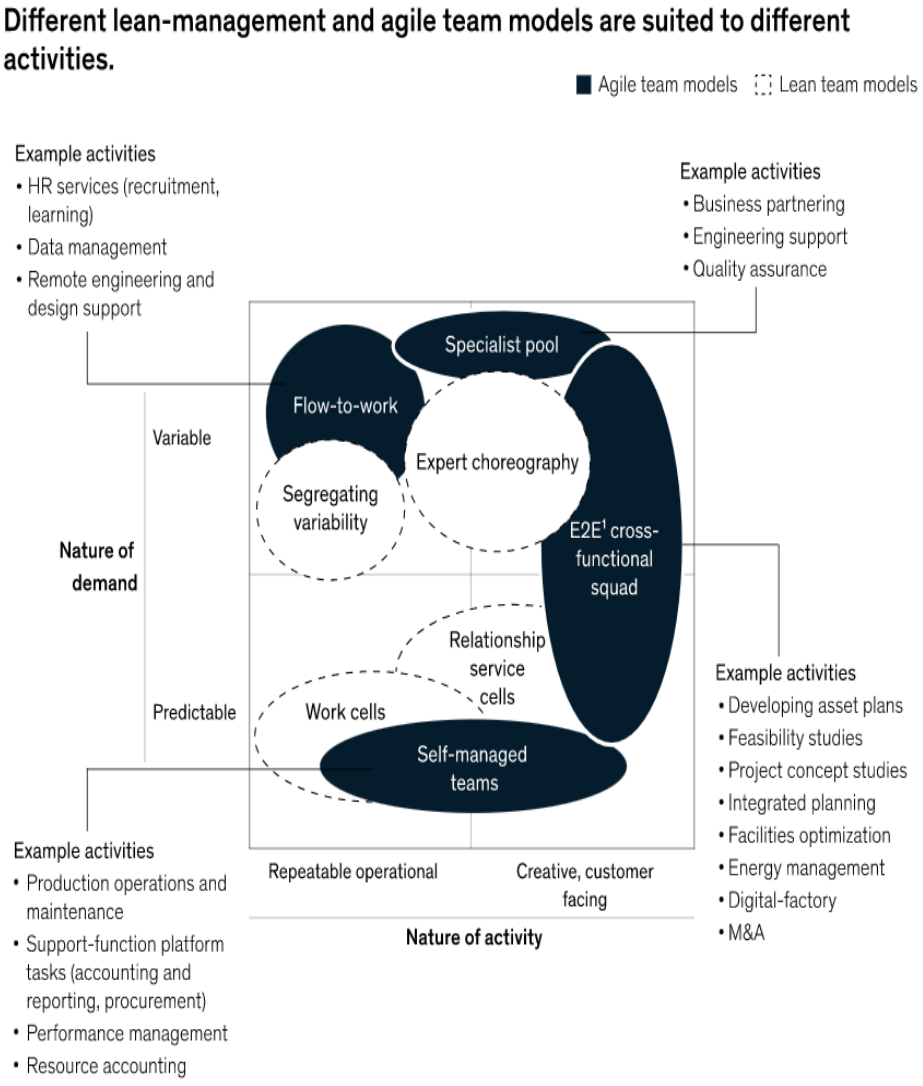


Figure 3: Development methodologies models and examples of their applicability

of SCRUM methodology in regard to the project development:

- Sprint velocity - the amount of work completed by the team during a sprint. A higher sprint velocity indicates that the team can complete more work in a shorter amount of time.
- Sprint burn-down - progress of the team during a sprint by tracking the amount of work remaining to be completed. A consistent and gradual decrease in the amount of work remaining throughout the sprint is an indication of an effective SCRUM implementation.
- Sprint success rate - the percentage of sprints that are completed successfully, i.e., all the planned work is completed within the timebox of the sprint.
- Customer satisfaction - the satisfaction of the customer or stakeholders with the product or service delivered by the team. A higher customer satisfaction rate indicates that the team is meeting the needs of the customer effectively.
- Team morale - the motivation and satisfaction level of the team. An effective SCRUM implementation should lead to improved team morale and job satisfaction. This metric can be gathered through surveys or plain interviews.
- Cycle time - the time it takes to complete a work item from the moment it is added to the backlog to the moment it is completed. A shorter cycle time indicates a more efficient and effective SCRUM implementation.
- Defect rate - the number of defects or bugs found in the product or service delivered by the team. A lower defect rate indicates that the team is producing higher quality work.

**What technologies would facilitate the development of such a product?**

Choosing the right programming language and framework is crucial to ensure efficient communication between the web application and the underlying MySQL database, while providing a seamless user experience and facilitating future scalability. To aid in this decision-making process, we delve into the characteristics, capabilities, and suitability of several popular programming languages and frameworks, such as Node.js, React, React Native, ASP.NET, and others. The following list enumerates the industry's most common programming languages and frameworks:

- Node.js: Node.js is a JavaScript runtime that allows developers to build scalable and efficient web applications. It has a vast ecosystem of libraries and frameworks that can help in building a robust backend for any web application.
- Express.js is a popular framework for building web APIs with Node.js. It focuses on speed and modularity. It is designed for building web applications and APIs. It has been called the de facto standard server framework for Node.js
- React: React is a JavaScript library for building user interfaces. It allows developers to create interactive and responsive web applications. With React, one can build the frontend of a web app, providing a seamless and dynamic user experience.
- React Native: If a mobile app is planned in the future, React Native can be a great choice. It is a framework that allows developers to build native mobile apps using JavaScript and React. By sharing code between the web and mobile app, development time and effort can be saved.
- ASP.NET: ASP.NET is a framework developed by Microsoft for building web applications. It is based on the .NET framework and supports multiple programming languages, including

C# and Visual Basic. With ASP.NET, it is possible to build a powerful backend for any performance intensive application and easily integrate it with a MySQL database.

- Django: Django is a high-level web framework written in Python. It follows the model-view-controller (MVC) architectural pattern and provides a robust set of tools for building web applications. Django has excellent support for working with databases, including MySQL.
- Ruby on Rails: Ruby on Rails, often referred to as Rails, is a popular web application framework written in Ruby. It follows the MVC pattern and emphasizes convention over configuration, allowing for rapid development. Rails has good support for connecting to MySQL databases.

## 2.5 Conclusion

SCRUM has become a widely adopted framework for Agile project management and is used by many organizations around the world to deliver high quality software products in a collaborative and efficient manner. Despite, the wide range of available project management methodologies adopted on the market, based on the analysis of benefits, differences and drawbacks of a multitude of methodologies, the development team has come to the decision of proceeding with the implementation of SCRUM and measure its success, performance and impact on the project based on several KPIs outlined, such as: burn-down charts, team project activity hours, project owners and supervising lecturer's feedback.

Incorporating the SCRUM framework, our team will extend the scope of the project for Manter's Knowledge Management System (KMS) to integrate a comprehensive information system. The aim of this system is to capture a suite of valuable Key Performance Indicators (KPIs), thereby enabling effective oversight and control of the organization's knowledge production.

The KPIs in focus include averages drawn from production indicators, deviations between current and target indicators, and total indicators. These KPIs have been thoughtfully selected to provide an accurate portrayal of the company's production state, and to ensure alignment with Manter's strategic goals. Through the integration of these KPIs, the aim is to improve the transparency and understanding of the production processes. This approach will provide a foundation for continuous KMS improvement. These metrics will enable Manter to evaluate the effectiveness of their KMS, facilitating necessary adjustments to enhance knowledge sharing and application within the organization.

Moreover, additional brainstormed metrics will be incorporated as part of the project planning phase. These metrics will offer a detailed perspective on the impact of the KMS, supporting a thorough analysis. This will ensure the creation of a KMS that is not only efficient but also tailored to address Manter's specific needs and business environment.

To conclude, by combining the SCRUM methodology with a carefully designed information system and a robust set of KPIs, the aim is to build a resilient, efficient, and effective KMS for Manter. This methodology is designed to optimize the management and enhancement of knowledge production and application within the organization, resulting in a well-informed, agile, and productive workforce, capable of adapting to an ever-evolving business landscape.

### 2.5.1 Analysis sub questions

The answer to the first sub-question provides a clear definition of knowledge management and its importance in organizations. It emphasizes how important knowledge management is to finding, classifying, preserving, and sharing knowledge within a company. The report underlines how efficient knowledge management can boost innovation capacity, enhance decision-making procedures, and increase overall performance. Knowledge management's potential advantages can be recognized in the context of the Manter Project by comprehending its concept. Investigating the various forms of knowledge and how they relate to the project, the analysis makes a distinction between tacit, implicit, and explicit knowledge. It emphasizes that while tacit and implicit knowledge are also present among the stakeholders, explicit knowledge—represented by the project's database—plays a significant role in the project. Understanding the different types of knowledge enables us to pinpoint the processes through which explicit knowledge might become implicit knowledge, which is important for the project's successful completion. The KMS should make it easier for knowledge to be created, stored, and shared within the company. The group may choose the best strategy for establishing a KMS in the Manter Project by taking into account the tools and technology that are currently available for knowledge management.

The answer to the second sub-question provides an overview of SCRUM as an Agile project management framework. It describes how frequently it is used in software development projects and how the Manter Project might use it. The analysis demonstrates the value of cooperation and teamwork and the flexibility and adaptability that SCRUM gives to project management. it may be evaluated how SCRUM's deployment can improve the progress of the Manter Project by comprehending its tenets and procedures. The product backlog, sprint backlog, sprint targets, sprint retrospectives, sprint reviews, and daily stand-ups are only a few of the specific elements mentioned. Jira's utility as a project management platform for facilitating SCRUM artifacts is also highlighted in the report. It can be decided how SCRUM can be applied to the completion of the Manter Project by comprehending its core components and processes. SCRUM's iterative and adaptive processes enable flexibility in responding to shifting project dynamics or requirement needs. The project's emphasis on cooperation, self-organization, and regular feedback encourages good teamwork and communication. Project scope and priorities can be managed through the usage of artifacts like product backlogs and sprint backlogs. Implementing SCRUM technique can, in general, speed up the project's development process and increase its likelihood of success.

The last sub-question focuses on the potential advantages of knowledge management implementation. The report emphasizes how knowledge management can boost innovation potential, enhance decision-making processes, and boost overall performance. The project team may make the most of the already-existing expertise, exchange insightful information, and promote a learning culture throughout the company by managing knowledge effectively. This may result in better problem-solving, less redundancy, and better resource management.

### 2.5.2 Answer main question

The main question of this research project is "How can the implementation of knowledge management enhance the development of the Manter Project?" the group has looked at the ideas of knowledge management and SCRUM techniques throughout the analysis and debate in order to determine how they might affect the progress of the Manter OEE Dashboard Project. It's appropriate to give the main question its concluding response at this point.

The development of the Dashboard can be greatly accelerated by the adoption of knowledge management techniques. Capturing, organizing, storing, and distributing knowledge within an

organization are all parts of knowledge management. The project team may harness existing expertise, encourage collaboration, and cultivate a learning culture by managing knowledge effectively. The Manter Project may gain from this in a number of ways:

- A better ability to make decisions is provided by knowledge management, which guarantees that users have access to current and accurate information, which facilitates better decision-making.
- Improved Innovation: Knowledge management promotes communication among project team members on ideas, experiences, and lessons gained. This encourages a culture of creativity by facilitating the discovery of novel strategies, imaginative problem-solving, and the investigation of potential solutions.
- Performance Improvement: Knowledge management enables the transfer of explicit knowledge from the project's database to the tacit knowledge of individuals inside the company. Explicit knowledge includes written processes and directives. This enables project teams to carry out their duties more successfully and productively.
- Implementing knowledge management procedures guarantees that important project knowledge is retained and is available for reuse in other projects. Project teams can access lessons learned, best practices, and effective strategies that have been documented. In addition to saving time and effort on subsequent projects, this also advances organizational knowledge and promotes long-term viability.

In conclusion, knowledge management implementation can significantly improve the progress of the Manter Project. The project team may make better decisions, promote innovation, enhance performance, encourage continuous development, and conserve important knowledge for later use by efficiently utilizing knowledge. A complete framework for managing projects and ensuring their success is provided by integrating knowledge management approaches with SCRUM methodologies.

### 2.5.3 Introduction Realisation

The preceding chapter offered a thorough response to the primary research question, illuminating how knowledge management techniques might improve the outcome of the Manter Project. It will be examined how this response results in the implementation of a successful project in this chapter, along with the practical ramifications it entails.

The theoretical understandings must be transformed into practical advice for the Manter Project in order for the research findings to be realized. The project team can start developing and realisation phase. The major elements of this realization are described in the sections below:

- Knowledge management must be implemented within the Manter Project according to a well-defined plan in order to be successful. Goals, objectives, and anticipated results for knowledge management projects should be determined by the project team. Setting up clear rules, roles, and duties for knowledge management procedures is essential. The team should also create a communication strategy to engage with the project owner.
- Knowledge Capture and Documentation: Gathering and preserving pertinent knowledge is the first step in achieving successful knowledge management. Lessons learnt, best practices, project documentation, and individual knowledge can all fall under this category. The project team should put in place procedures for methodically gathering and arranging knowledge, such as building a central knowledge repository or leveraging collaborative tools.

To maintain consistency, clear documentation procedures and templates should be put in place.

- Sharing & Dissemination of Knowledge: Once knowledge has been recorded, it needs to be distributed across the project team members. This can be enabled in a variety of ways, including through workshops, mentorship programs, knowledge sharing sessions, and online collaboration platforms. The team should promote a culture that values open dialogue, engaged involvement, and information sharing.
- Integration with SCRUM Methodologies: Knowledge management methods should be implemented in a way that is consistent with the current SCRUM methodologies.
- Continual Learning and Improvement: A dedication to continual learning and improvement is necessary to reap the rewards of knowledge management. Regular reviews and effectiveness assessments of knowledge management projects should be conducted by the project team. This can be intertwined with the retrospectives.

Applying the principles of a knowledge management system to an information management application, such as the one requested by Manter, paves a clear path into maximising the business value.

# 3. Realization

This chapter describes the realization phase of the project, including design, methodologies used, activities carried out and further information about the delivered product.

The chapter starts by detailing the Agile methodology that was used. It then discusses how Agile techniques fit with knowledge management initiatives, putting a focus on iterative improvement, collaboration, continual feedback, and adaptability. The next section of the chapter focuses on the particular tasks carried out during the realization phase, such as the development of a product backlog, sprint planning and execution, continuous integration and testing, sprint reviews and retrospectives, incremental delivery, stakeholder engagement, and monitoring and evaluation. Additionally, it details the supplied solution, an OEE dashboard-style knowledge management system that enables Manter to track and improve the operation of their weighing machines through data analysis, key performance indicators, and user-friendly design. The chapter ends by highlighting the product's capacity to support Manter's informed decision-making, cooperation, and continuous development while also noting the features and limitations of the tool.

## 3.1 Design

In order to ensure that the client receives a knowledge management system of the best possible quality, the group has conducted an additional research on what points give Manter the most value. Displaying meaningful information/knowledge on the dashboard can greatly benefit Manter and their clients by providing valuable insights into various aspects of their operations. In the context of the project, there are several metrics that can be calculated and presented on the dashboard to offer meaningful information, such as:

- *Average runtime per preset*: This metric is calculated by dividing the total time the preset is run by the total number of times the preset is used. It provides insights into the usage patterns of different presets and allows for optimization of production scheduling and resource allocation. By analyzing the average runtime per preset, Manter can identify which presets are frequently used or underutilized, enabling them to make informed decisions regarding production planning, inventory management, and resource allocation. This information can help streamline operations, improve productivity, and optimize overall efficiency.
- *Average weight per bag*: This metric measures the average weight of the bags produced. By monitoring the average weight per bag, Manter can ensure product quality and compliance with standards. Deviations from the desired weight range can indicate potential issues with the production process, such as improper calibration or equipment malfunctions. By promptly identifying and addressing such issues, Manter can maintain consistent product quality, minimize waste, and meet customer expectations. Additionally, this metric can provide insights into material usage and enable cost optimization by identifying opportunities for material efficiency.
- *Compare production time to show the efficiency of a preset over one machine type:* Comparing the manufacturing times of several presets using a particular machine type constitutes this measure. Manter can determine which presets are more effective and lead to shorter production cycles by examining the production time for each preset. By concentrating on the most time-efficient settings, they are able to optimize their production processes utilizing this knowledge. They may organize production jobs and distribute resources more effectively as a result, increasing output and reducing bottlenecks. This statistic allows for

data-driven decision-making to increase overall efficiency and offers insightful information on the performance of various presets.

- *Bar charts of bags and weight dumped by each machine*: By displaying a bar chart showcasing the bags and weight dumped by each machine, Manter can gain insights into the production output of each machine. This information can help identify any imbalances or discrepancies in production capacity. By analyzing the data, Manter can optimize resource allocation, identify under performing machines, and take necessary actions to improve overall production efficiency.
- *Pie chart of the ratio of errors by each machine*: A pie chart illustrating the ratio of errors by each machine provides valuable information about the performance and reliability of individual machines. It allows Manter to identify machines that frequently encounter errors or malfunctions. With this knowledge, Manter can implement targeted maintenance strategies, allocate resources for repairs, and improve the overall reliability of their machinery.
- *OEE calculations*: Overall Equipment Effectiveness (OEE) calculations provide a comprehensive assessment of the efficiency and effectiveness of Manter's machinery. By calculating OEE, which takes into account factors such as availability, performance, and quality, Manter can identify areas for improvement in their production processes. This knowledge can guide them in optimizing machine uptime, reducing downtime, enhancing performance, and maximizing product quality, resulting in increased overall productivity and profitability.
- *Pie chart of how much weight and how many bags go to which bagger*: A pie chart illustrating the distribution of weight and bags to different baggers provides insights into the workload distribution among the bagging machines. Manter can identify any imbalances or bottlenecks in the bagging process. This information enables them to optimize the workload distribution, allocate resources efficiently, and streamline bagging operations to ensure smooth and consistent production.
- *Pie chart of most used presets*: By visualizing the most used presets in a pie chart, Manter can identify the preferences and trends in their production processes. This knowledge helps them understand customer demands, optimize inventory planning, and focus on developing and improving the most popular presets. It also facilitates data-driven decision-making for product development, resource allocation, and production scheduling.
- *Table about production runs with differences*: A table presenting production runs with differences allows Manter to analyze variations in production outcomes. By comparing expected results with actual results, they can identify deviations, potential causes, and areas for improvement. This knowledge helps them refine their production processes, identify and address issues promptly, and enhance product consistency and quality.
- *Calculations of how much money the company can save by using machines instead of human workers*: By calculating the cost savings achieved through the use of machines instead of human workers, Manter can evaluate the financial benefits of their automation efforts. This knowledge helps them justify investments in machinery, quantify cost reductions in labor-intensive tasks, and make informed decisions regarding resource allocation and workforce planning.
- *Pie chart about how many times each machine was serviced and a table about details*: A pie chart showing the frequency of machine servicing and a table providing detailed information about each servicing instance enable Manter to monitor and maintain their machines effectively. By visualizing the servicing patterns, they can ensure timely maintenance,

reduce the risk of unexpected breakdowns, and extend the lifespan of their machinery. The detailed table provides a record of maintenance activities, facilitating historical analysis, identifying recurring issues, and enabling continuous improvement of maintenance practices.

By presenting these metrics on the dashboard, Manter and any third party can have up to date access to critical information that enables data-driven decision-making, and gain valuable insights into various aspects of production efficiency, error prevention, quality control, and maintenance planning. The dashboard serves as a centralized platform for monitoring key performance indicators, facilitating performance analysis, and identifying areas for improvement. Meaningful information displayed on the dashboard empowers Manter to optimize their operations, enhance productivity, minimize downtime, ensure quality control, and ultimately deliver better products and services to their clients.

## 3.2 Methodology

This section emphasizes the technique used throughout the Manter Project's realization phase, emphasizing the usage of Agile approaches and their applicability to formal procedures. The chapter examines how agile methodologies, which are renowned for their adaptability, flexibility, and teamwork, fit with the dynamic nature of knowledge management projects, putting a focus on iterative improvement, collaboration, continuous feedback, and the customization of agile to suit the project's particular needs and context.
Agile approaches are renowned for their progressive, iterative approach that emphasizes adaptability, flexibility, and teamwork. This methodology enables continual improvement based on feedback and changing project requirements, which is in line with the dynamic character of knowledge management projects.

Agile approaches, like Scrum (the one used by the group), Kanban, or Lean, provide a number of benefits that make them excellent for putting knowledge management practices into practice:

- *Iterative and incremental approach*: This strategy enables the project team to concentrate on particular knowledge management goals within a set timeframe, encouraging a sense of progress and accomplishment. The team can receive input, make changes, and continually improve the use of knowledge management principles by working iterative.
- *Flexibility and Adaptability*: Agile methodologies promote adaptability and flexibility in response to changing project needs. New insights and requirements may surface as knowledge management programs progress. Agile enables the project team to act quickly in response to these alterations, modify the order of importance, and add new knowledge management procedures or tools as necessary. This adaptability makes sure that the realization process keeps up with the project's changing goals and increases its efficiency.
- *Collaboration and Cross-Functional Teams*: Agile approaches promote cross-functional team participation and collaboration. Collaboration is essential for efficiently transferring knowledge in the context of knowledge management. Daily stand-up meetings, sprint reviews, and retrospectives are just a few of the platforms and times for collaboration that agile frameworks offer. These procedures promote knowledge exchange, encourage a culture of learning, and increase the general efficacy of knowledge management projects.
- *Continuous Improvement and Feedback*: Through frequent feedback loops, agile approaches encourage a culture of continuous improvement. This is in line with knowledge management's core principles of learning, adapting, and improving. Agile methodologies, such sprint

retrospectives, offer chances to think back on the implementation process, pinpoint areas that might use improvement, and make the appropriate improvements. This loop of iterative feedback makes sure that knowledge management techniques develop and improve over time, producing better results.

Although Agile methodologies have a lot to offer for implementing knowledge management practices, it should be noted that that these advantages are not limited to formal approaches like Agile. As the name itself implies, the methodology can be modified to fit the unique requirements and situation of creating the OEE Dashboard. The "secret" is therefore to apply knowledge management in a way that promotes adaptability, teamwork, and ongoing progress.

At the beginning, a backlog of user stories and tasks has been created by the group. User stories detailed the eventual output of the work and effort put into developing, while tasks aimed to split the story into manageable and individually assignable work parts for the team. According to Quintor, this aproach yields better results with complex tasks, because it promotes dividing a composite issue into accomplishable undertaking.

This backlog was signed off by the project owner and the supervisors. For more details about this, please consult the board on Attlasian's Jira, the Project plan and the Scrum Artifacts in the Appendix 4.

## 3.3 Activities

Several tasks were carried out to guarantee the effective completion of the project goals during the development of knowledge management strategies for the Manter Project. The results and significant learning from the realization process will be examined in this paragraph. For the Manter Project to successfully achieve the targeted goals, a number of activities were carried out during the realization of knowledge management techniques. The following significant actions were taken:

- *Creation of a Product Backlog*: A product backlog, or prioritized list of knowledge management procedures, tools, and features that must be implemented, was produced. The project's goals, stakeholder demands, and identified knowledge management needs served as the foundation for the product backlog. The backlog items were created in a way that permitted continual value delivery and gradual development throughout the project.
- *Sprint planning*: The project team had sprint planning meetings to lay out the parameters and goals for each sprint. Within the Agile paradigm, sprints are time-boxed iterations that typically run 1-4 weeks. The team decided which backlog items to deploy during the upcoming sprint during sprint planning, taking into account their priority and viability. Estimating the effort needed for each backlog item and figuring out the team's capability for the sprint were additional tasks included in the sprint planning sessions. This process grew gradually, from discussion after the retrospective to planning before the meetings with the client and project owner.
- *Sprint execution:* Implementing the chosen backlog items was a part of the sprint execution process. The team worked closely together to implement the necessary knowledge management methods by utilizing their cross-functional skills. Daily stand-up meetings were held to give team members a platform to coordinate their efforts, talk about progress, and identify and resolve any roadblocks or difficulties.
- *Continuous Integration and Testing*: Continuous integration and testing were done throughout the realization process to make sure the knowledge management techniques were reliable

and of high quality. The goal of continuous integration was to quickly discover and fix any integration problems by merging and testing changes made by various team members. Testing was done to confirm the implemented practices' performance, usability, and functionality to make sure they achieved the desired goals.

- *Sprint Review and Retrospective*: A sprint review and retrospective were held at the conclusion of each sprint. During the sprint review, stakeholders were shown the knowledge management techniques that had been used, and their opinions were solicited in order to confirm that the goals had been achieved. The retrospective session gave the team a chance to consider the sprint's achievements and difficulties, pinpoint areas for growth, and make changes for upcoming sprints.
- *Incremental Delivery and Stakeholder Engagement*: Throughout the course of the project, the realization process aimed to provide stakeholders with incremental value. After each sprint, new or improved knowledge management techniques were made available. It was made sure that stakeholders' increasing needs and expectations were taken into account and incorporated into succeeding sprints through regular involvement and input from them.
- *Monitoring and evaluation*: The realization activities included monitoring and evaluating the implemented knowledge management practices. Key performance indicators were established to assess the effectiveness and impact of the practices on knowledge sharing, collaboration, and decision-making within the project. Monitoring and evaluation activities helped identify areas of success, areas requiring improvement, and opportunities for further optimization.
- *Documenting the process:* Documenting the research and development process is crucial for maintaining a clear record of the project's objectives, methodologies, and outcomes. The thesis documentation serves as a comprehensive narrative, capturing the context, problem statement, research objectives, literature review, methodology, implementation details, results, and conclusions Initially, an overall project plan was established, outlining the major milestones, deliverables, and timelines. This plan acted as a high-level roadmap for the entire project. Additionally, detailed sprint plans were created for each iteration, outlining the user stories to be addressed, tasks to be completed, and estimated effort required. These sprint plans were refined during sprint planning meetings and served as a reference point throughout the development process.
- *SCRUM Artifacts:* The key Scrum artifacts utilized during the development of the knowledge management software product include: a. Product Backlog: The Product Backlog represents an evolving list of prioritized user stories and requirements. It serves as the single source of truth for the project and was continuously refined and reprioritized based on feedback and changing needs. b. Sprint Backlog: The Sprint Backlog is a subset of the Product Backlog, containing the user stories and tasks that the development team committed to completing within a specific sprint. It provided a clear scope for each iteration and helped track progress. c. Burndown Chart: The Burndown Chart visualizes the progress of work throughout the project. It illustrated the remaining effort (in story points) against time, allowing the team to identify any deviations from the planned trajectory and make necessary adjustments.
- *Tracking Hours Worked:* Time-tracking tools were utilized to capture the time spent on various activities, including development, testing, meetings, and research. This data was collected in an Excel sheet and can be found attached with this document.

- *Manuals*: Clear and comprehensive documentation is vital for any software products to ensure ease of use and smooth adoption by end-users and developers. Developer manuals were compiled, documenting the system architecture, APIs, libraries, and any other technical details necessary for extending or maintaining the software.

The Manter Project ensured a systematic and iterative deployment of knowledge management principles by engaging in these activities. The Agile methodology promoted adaptability, teamwork, and continual improvement, which led to the achievement of the project's goals. It will be examined the results and takeaways from the realization process in the next subsection.

## 3.4 Product

In this subchapter, the focus is on the description of the delivered product, assessing whether it meets the expectations, and outlining its functionalities and limitations. Key Performance Indicators (KPIs) and Knowledge Management points are used in the dashboard-style knowledge management system created for Manter to track the performance of their weighing machines and give insightful data.

A complete dashboard that analyzes and presents data from Manter's weighing equipment is part of the knowledge management system that was created for them. It functions as a central platform for managing and enhancing the efficiency of the machines. The dashboard offers a user-friendly interface that makes it simple for Manter and its stakeholders to access precise and carefully selected data regarding the performance and effectiveness of the machines.

In order to achieve this, and after the results of the research, a React Native web application, in combination with a NodeJS/Express API was deemed to be the best solution for the problem at hand. The successful creation of the API and React Native app demonstrates the ability to architect and implement a robust and scalable solution in a professional context.

The API was designed following the principles of a RESTful architecture to ensure a stateless and scalable backend solution. he architectural components, such as the server, database, and API endpoints, were carefully designed to meet the requirements of the application. Emphasis was placed on designing a modular and extensible API structure to facilitate future enhancements and feature additions. As the database proved to be quite large and to hold large amounts of data, it was deemed best to create SQL procedures for the most common queries used for fetching data in the Dashboard.

The choice of programming language and framework was made based on factors such as performance, community support, and developer familiarity. React Native and NodeJs are both built on top of Javascript. JS was selected as the primary language for its robustness, scalability, and extensive ecosystem. The Express framework was employed to streamline API development, facilitate routing, and handle data persistence. Core API endpoints were developed to handle only the Read part of CRUD operations, but also authentication, and data validation.

For the OEE Dashboard, React Native was chosen as the framework for developing the cross-platform mobile application. The decision was based on factors such as code re-usability, performance, and the ability to leverage existing web development skills. The app was structured using a component-based architecture, which promotes code re-usability, modularity, and maintainability. Components were split into individual files to enable easy collaboration among developers and ensure better maintainability.

React Native components were implemented to render views, handle user interactions, and manage app state. Integration with the API was established using asynchronous API calls, ensuring efficient data retrieval and synchronization. It should be noted that the API and the Dashboard are self standing and independent products, although a connection to the API is needed for the Dashboard to retreive and show any data past the landing page.

Thorough the developmnt unit tests were developed to validate the functionality and behavior of API endpoints, as well as the functionality and performance of the React Native app. Integration tests were conducted to ensure seamless interaction between different API components. Code reviews, linting, and static analysis tools were utilized to enforce coding standards and maintain code quality.

Git was utilized to track and manage the source code throughout the development process, as version control. Each developer had a local copy of the repository, enabling them to work independently and merge their changes seamlessly. The ability to create branches facilitated parallel development, experimentation, and the isolation of new features or bug fixes. No branches were deleted or archived, in order to document individual contributions and progress. GitHub served as a collaborative platform, allowing developers to share their code, review each other's work, and provide feedback. Pull requests were used to propose changes and initiate code reviews, promoting collaboration and ensuring code quality. Through GitHub's issue tracking system, bugs, feature requests, and other tasks were documented, assigned, and tracked.

At the completion of each sprint retrospective, a release was created to package and deploy the software product. This practice ensured that incremental improvements and new features were made available to end-users in a controlled and systematic manner.

The following characteristics are provided by the product:

- *Data analysis*: To produce actionable insights, the gathered data is prepared for processing and analysis. To find trends, patterns, and anomalies in machine performance, the system makes use of sophisticated algorithms and statistical approaches.
- *Key Performance Indicators* (KPIs): The dashboard displays important metrics including Overall Equipment Effectiveness (OEE), a crucial KPI for assessing the effectiveness of the weighing equipment. To give a thorough performance picture, additional KPIs pertaining to productivity, downtime, quality, and maintenance are also included.
- *User-Friendly Design:* The dashboard's interface is simple to use and visually appealing, making it simple for users to navigate and interpret the data being displayed. Different graphs, charts, and visualizations enable simple understanding of machine performance.

The finished product meets Manter's requirements. It offers a strong knowledge management system that enables the business to efficiently monitor and improve the performance of its weighing devices. The dashboard responds to the unique requirements and difficulties experienced by Manter by providing insights, reliable data analysis, and an easy-to-use interface.

The system satisfies the requirements by having the following metrics:

- Performance monitoring is made easier because to the dashboard, which enables Manter to keep track of how well their scales are working and take proactive steps to fix problems before they arise.

- Enabling Informed Decision-making: The solution gives Manter the knowledge essential to make data-driven decisions, boosting production procedures, quality assurance, and overall efficiency. This is accomplished by offering thorough insights and reports.
- Collaboration and knowledge exchange are improved thanks to the knowledge management system, which encourages these activities inside the company. Access to and sharing of pertinent data among stakeholders promotes a culture of knowledge consumption and continual improvement.

Although the produced product satisfies the primary goals and meets expectations, it is crucial to recognize its functionalities and limitations: Functionality:

- Data collection and analysis from weighing machines.
- Presentation of key performance indicators (KPIs) such as Overall Equipment Effectiveness (OEE).
- User-friendly interface with interactive visualizations.
- Generation of comprehensive reports and insights.
- Customization options for personalized data visualization and reporting.

Limitations The system's effectiveness heavily relies on the availability and accuracy of data collected from the weighing machines. To ensure trustworthy insights, data integrity and consistency should be maintained. As the team was not allowed to work with Manter's actual data, this way up to date live data analysis and collection could not be executed.

There is no tested mobile application at the time of writing, although the code base is very flexible and should work on such devices regardless. There is also no user authentication and management system implemented, even though some research and code was written for attaching oauth login system.

Despite these drawbacks, Manter can monitor and optimize the operation of their weighing equipment with the help of the knowledge management system, which gives the company the opportunity to make data-driven decisions and raise overall productivity and profitability.

# 4. Conclusions and recommendations

In this chapter, an overall conclusion will be drawn from the research and the realization phase of the project, alongside a retrospective and a recommendations sub-chapter to evaluate the possible areas where the product and/or the research can be improved.

## 4.1 Overall conclusion

The research has highlighted the significance of the SCRUM framework as a widely adopted and effective approach for Agile project management. SCRUM has been found to be the most acceptable framework for the implementation of the Knowledge Management System for Manter after a thorough review of several project management approaches, including their advantages, differences, and disadvantages.

The development team intends to use SCRUM key performance indicators, including burn-down charts, team project activity hours, and input from project owners and the supervising lecturer, to evaluate the success, performance, and influence of SCRUM on the project. By incorporating SCRUM, the project's scope will be expanded, allowing for the thorough integration of an information system into Manter's KMS.

The chosen KPIs—production indicators, deviations from target indicators, and total indicators—have been carefully picked to offer a reliable evaluation of the business's production state and to be consistent with Manter's strategic objectives. The transparency and comprehension of the production processes will be increased by the integration of these KPIs, laying the groundwork for ongoing KMS development. With this strategy, Manter will be able to assess the KMS's efficiency and make the required modifications to improve knowledge transfer and application inside the company. Additionally, other indicators developed during the project planning stage will provide a thorough perspective on the KMS's impact, providing a customized and effective system that takes into account Manter's unique needs and business environment.

In conclusion, the SCRUM approach, a properly planned information system, and a strong set of KPIs work together to provide a KMS for Manter that is durable, effective, and efficient. The management and improvement of knowledge creation and application inside the firm will be optimized by this methodology, creating a knowledgeable, adaptable, and productive workforce that can adjust to the ever-changing business environment. The study backs up the choice to move forward with SCRUM implementation and emphasizes its potential for effective project outcomes and enhanced knowledge management techniques.

## 4.2 Retrospective

It's crucial to go back on the research that was done for this thesis and to consider the research questions, method, and general process. The goal of the study was to determine how well the SCRUM way of working yielded results when Manter decided to construct a Knowledge Management System (KMS). Consider the research's salient points listed below:

- Research Questions: The research questions were developed to look into the applicability of SCRUM for the deployment of KMS, the choice of suitable KPIs, and the potential effects on knowledge exchange and application within the business. These inquiries gave the study a distinct emphasis and direction, directing the inquiry and analysis.
- Approach: The research method included a thorough examination of the advantages, disadvantages, and variations of several project management methodologies. This compara-

tive study assisted in determining the advantages and disadvantages of various strategies and, in the end, resulted in the choice of SCRUM as the best framework for the KMS implementation.

- Data collection and analysis: Both qualitative and quantitative data were used in this study. While quantitative data entailed the use of KPIs and analytics, qualitative data was obtained through literature reviews, case studies, and expert comments. The systematic data collection method had as its goal acquiring pertinent data that would support the study's goals.
- Limitations: It's critical to recognize some of the research's limitations. First off, the research was restricted to the analysis of case studies and the literature that was already in existence, which may not have included all possible experiences and circumstances. Second, due to limitations, the research did not include real-time data analysis or primary data acquisition from Manter. The depth and scope of the research findings may have been altered by these constraints.

Overall, the research process highlighted the need of proper KPIs, emphasized the significance of aligning the methodology with the particular needs and circumstances of the business, and gave insightful information into the choice of SCRUM as the framework for the KMS implementation.

Insights into the efficiency of the implementation process can be gained by thinking back on the realization phase of the project, which involved the development methodology, design decisions, and activities carried out. The following elements merit thought:

- Development Approach: The realization phase was well-suited for the use of Agile approaches, particularly SCRUM. Agile techniques' iterative and incremental approach, flexibility, adaptability, cooperation, and continual improvement were ideally suited to the project's dynamic character. Agile development and progress monitoring were made possible by the use of sprints, sprint planning, execution, continuous integration and testing, sprint reviews, and retrospectives.
- Design Decisions: During the realization phase, Manter's comprehensive knowledge management system was the main goal of the design decisions taken. Key design factors included the incorporation of key performance indicators (KPIs), a user-friendly interface, data analysis tools, and customizable choices. These decisions intended to guarantee that the finished result satisfied Manter's expectations and offered useful information for making decisions.
- Activities: During the realization phase, a systematic and iterative application of knowledge management concepts was assured through the construction of a product backlog, sprint planning, execution, continuous integration and testing, sprint reviews, and retrospectives. The realization phase was successful in part due to the involvement of stakeholders, incremental delivery, and monitoring and evaluation activities.
- Limitations: The realization phase included some restrictions, just like the research phase did. The efficiency of real-time data processing and collecting was constrained by the inability to work with live database from Manter's weighing machines. However, by concentrating on the dependability and precision of the gathered data, this constraint was attempted to be overcome.

As it is the case with any projects, some parts did not go as smooth as it could have been possible. For instance, sometimes communication suffered some "hick-ups" and appeared one sided, from the developing group's side. Additionally, as it has been noted in the feedback form, the retrospective and overall the meeting's planning could've been more structured and to the point.

Overall, the realization phase illustrated how agile methodologies—especially SCRUM—are excellent in controlling the development process. The design decisions made were in accordance with Manter's specifications, and the tasks completed guaranteed a methodical and gradual roll-out of the knowledge management system.

In conclusion, taking time to consider the research and realization phases offered insightful information about the project's advantages and disadvantages. By examining several project management approaches, the research phase built a strong foundation by deciding that SCRUM was the best framework. The realization phase, which took into account design decisions and activities that were in line with the project objectives, effectively implemented the selected framework. The retrospective study highlights the significance of research, methodology choices, and agile development techniques for successful project outcomes and provides lessons learned and recommendations for upcoming initiatives.

## 4.3 Recommendations

The knowledge management system (KMS) and Manter's effectiveness can be further improved by following the recommendations that can be made based on the findings and insights from the realization phases:

- Improving the user experience: Constantly collect user and stakeholder feedback to pinpoint areas where navigation, interface design, and user experience should be enhanced. To maintain a seamless and simple user experience, apply user-centric design principles and continually update the system based on user feedback.
- Advanced Data Analysis Features: Look into incorporating advanced data analysis methods, like machine learning algorithms, to improve the system's analytical capabilities. As a result, users may receive insightful knowledge and useful information thanks to more complex data processing, predictive analytics, and personalized recommendations.
- Implement additional KPIs: By utilising on a constant basis the Dashboard, it could be determined that more knowledge and indicators are needed to maximise the potential and the value. As such, these could be implement in a future version of the application.
- Mobile Accessibility: Create a mobile application or adapt the KMS for mobile devices so that staff members may easily access and contribute to the system from anywhere. Especially for remote and field workers, mobile accessibility can greatly increase user engagement and adoption.

The research and realization phases have provided valuable insights, but there are still areas that warrant further investigation. Consider the following areas for future research:

- A longitudinal research should be conducted to evaluate the long-term effects of the deployed KMS on knowledge application, knowledge exchange, and organizational performance. In-depth knowledge of the system's prospective drawbacks as well as its long-term advantages would be gained as a result.
- Organizational Culture and Change Management: Examine how organizational culture and change management techniques can affect a KMS's ability to be adopted and used successfully. Examine methods for fostering a culture of information sharing, overcoming change resistance, and guaranteeing widespread adoption inside the company.

Apart from the specific project-related advice, there are a number of things about Manter that can be noted that can aid in the expansion and success of the project and business related needs:

- Encourage the organization's leadership to support and publicize the knowledge management activities. The participation and support of the leadership are essential for promoting cultural transformation and a collaborative work environment.
- Continuous Learning and Professional Development: Stress the value of ongoing professional development. Take a more involved approach to the development of the products.
- Cross-Functional Collaboration: Encourage communication and cross-functional cooperation across teams and departments. Collaboration, innovation, and knowledge sharing are made easier with the help of tearing down silos, which enhances organizational performance.
- Data Privacy and Security: Ensure that suitable safeguards are put in place to guard sensitive data and safeguard the privacy of workers and clients. To reduce potential hazards, periodically review and update security procedures, user access restrictions, and data backup systems.

These suggestions can help Manter improve the KMS even more, promote knowledge sharing within the company, and encourage ongoing development.

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# Appendixes

## Appendix 1: Assignment Description

**Assignment Manter – Dashboard for the machines**

Our weighers are running a database that collects all kinds of data. Now we are looking for a dashboard that can present the available data in a format. For example: - Which machine is it, which software version is running on it. - How long has the weigher been running - How did the machine "feel": what was its average performance compared to the maximum? - How long has the weigher been waiting for feed, or for the packer? - How long did the weigher stand idle? - What have been the breakdowns

For this assignment Manter has a database available that can be drawn from for setting up a dashboard herein. Ideas for data that can be collected and presented are welcome.

## Appendix 2: Project plan

# Version control

| Version | Activities | Date |
|---|---|---|
| Initial version 1.0 | Draft version | 17/04/2023 |
| Release version 1.1 | Initial version | 21/04/2023 |

Remarks

Any changes and new developments that have a significant impact on the project proceedings will be noted here.

# Chapter I – General Information

This document provides a detailed description of the project planning, research, and execution of the main project of “Knowledge Management” course. In this assignment, the team will be developing a dashboard for Manter’s weigher machines to monitor their performance and detect faults.

The project will be executed by students of the NHL Stenden University of Applied Sciences, which is based in the north of the Netherlands and offers a large variety of courses in both Dutch and English. The schooling has a heavy emphasis on group and practical project-based work, supported by a thorough theoretical education.

With NHL Stenden being an international educational institution, there are campuses across the country as well as abroad. The one of relevance for this project is in Emmen and offers four international courses, Information Technology is one of which. Conducting the project will be a group made up of third-year students of the international IT class. All concerned parties may rely on the team leader, Robert Răchită, as the primary contact person for the duration of this effort.

As the details of this commission have yet to be finalized, this document is subject to change and any alterations will be shared promptly and marked accordingly.

## Layout of the Project Plan

**General information:** Provides an overview of both the sponsoring organizations well as the organization in which the project is to be carried out.

**Project objectives:** Consists of the objectives which are determined by the client as well as the projects' intended results.

**Project activities:** Defines the tasks that need to be performed for the realization of the project, while taking into consideration the prioritization of certain tasks based on significance.

**Project boundaries:** States the project boundaries and the project duration.

**Products and Interim Results:** Specifies the products and results, which extends non-physical products such as client meetings.

**Quality:** Provides an overview of how the quality of the work will be monitored and eventually assessed.

**Project Organization:** Comprised of organizational information regarding the team and its inner workings, as well as details regarding the correspondence with the sponsoring organization.

**Planning and Scheduling:** will show the schedule of tasks to be done as well as their dependence on other tasks for their completion or quality. Including various charts and diagrams, it will outline the time-scope as well as the desired time-consumption of the tasks.

**Costs and Benefits:** Discusses the time and resources required, while taking the benefits of the sponsoring organization into consideration.

**Risk Analysis:** Gives a detailed account of potential internal and external risks.

# Chapter II – Project Objectives

The primary objective of this assignment is to design and develop a dashboard that can present Manter's weigher machines' data in a meaningful and actionable way. The dashboard should be user-friendly and offer a summary of each machine's performance. Users should be able to delve further into data points to investigate and identify any faults or issues. The dashboard should also give users insights into each machine's performance in relation to its maximum capacity and help users identify opportunities for improvement. Overall, the goal is to provide a tool that can assist Manter in making informed decisions about their machines' maintenance and utilization.

The specific objectives of the project are:

1. To develop a user-friendly and intuitive web / native OEE (Overall Equipment Effectiveness) dashboard that will allow the company's employees, dealers, and customers to access the relevant data and insights related to the machinery's performance, maintenance, and errors.

2. To allow the company to use the dashboard internally to visualize the collected data.

3. To allow the company to showcase the products to clients in an easy manner.

4. To ensure that the dashboard is scalable and can be easily adapted to accommodate future changes and additions to the company's product line.

5. To ensure that the dashboard access is secure, and that all sensitive data is protected from unauthorized access or manipulation.

6. To deliver the project on time, within spec, and to the satisfaction of the client.

# Chapter III – Project activities

Project Activities details all activities sorted by category that are needed to successfully complete the project.

## 3.1 Planning

- Initial contact with the client.
- Create a team convention and set roles.
- Gather information about the project, its boundaries, and goals.

- Have meetings and interviews with the clients to discuss and discover further boundaries and project specifics.
- Research project planning and management, study available materials
- Make a draft version of this document (Project Plan)
- Discuss the draft version in-team.
- Discuss the project plan with the clients and receive feedback.
- Assess the received feedback in-team.
- If required, implement the changes proposed by the client and/or teachers.
- Make a definitive project plan.
- Set up a project backlog and a Scrum board.
- Write User Stories and Tasks
- Create Sprint backlogs based on user stories.
- Track when tasks are being completed and trend in burndown charts.
- Receive the previous code and documentation from the previous iteration of this project.

## 3.2 Research

- Gather information about the project commissioner.
- Gather information about Scrum and knowledge management.
- Set up research document on knowledge management, SCRUM, and the project requirements.
- Create research questions.
- Discuss research questions.
- Analyze existing project done by previous project team.
- Look up programming resources and proprietary integrated development environments.
- Brainstorming to define tasks for the product backlog.
- Determine feasible tasks.
- Determine out of scope tasks.
- Determine out of range tasks.
- Make a list of the proposed features.
- Make a list with the required hardware if any.

- Present the list and ideas to the clients.
- Create an advice report for the clients and stakeholders backed up by theory.
- Discuss concepts, ideas, and tasks with the client.
- Write down the findings and discussion in a research report document.
- Analyze the feedback from the clients in-team.
- Create a feature/task priority document, set up the backlog board accordingly.
- Discuss a draft variant of the research report.
- Implement the feedback and/or task ideas from the client into the task list.
- Discuss the final concept and list both in team and with the clients.
- Finish the research phase and all related documents.

### 3.3 Design

- Create a coding convention.
- Create a team identity.
- Create the visual design of the platform.
- Create a test plan, making sure the platform works as planned.
- Create a document for user stories, explaining what the system will do.
- Create a user manual, explaining to the users how to use the system.
- Choose the required hardware.
- Decide on fonts, color palette and other design elements.
- Outlining required languages and components
- Make a definitive choice of our concepts.
- Sketch the final product.
- Visualizing the final product with mock-ups (if applicable).

### 3.4 End Product

- Finalize and use the definitive version of the concepts and tasks.
- Develop the product.
- Develop the responsiveness of the product.

- Plan weekly sprints and sprints reviews.
- Test the product according to the test plan and requirements and log the results.
- Implement the professional product in accordance with the frameworks and requirements of the stakeholders.
- Make sure the professional product meets the given standards.
- Respect the testing plan and scheduling.
- Discuss and implement feedback coming out of the testing phase.
- Make a report on the final product.
- Wrap up all the documentation, proofread and finalize.

### 3.5 Presentation

- Clean up the project (code).
- Sort and archive all documents.
- Make sure the connections, the live version and the database are working.
- Collect essentials for the final presentation.
- Build a coherent presentation detailing both the product and the road to achieving it.
- Presenting the definitive product to the project commissioner, as well as clients
- Receive feedback.
- Reflect on what has been done, and what could have been done better. (Retrospective)

## Chapter IV – Project Boundaries

This chapter will give further insight into what the final product will consist of and what is not within the scope for this project. Should there be any changes to the scope of this project, this section will be updated accordingly.

### 4.1 Duration

The project will take place throughout period 4 of the third year of the team's study, incisively from 17/04/2023 to 19/06/2023. The duration of the project is 10 weeks excluding 1 week of vacation.

## 4.2 Scope

No budget is given for this project.

This project is, in part, a continuation of a previous project done by another ICT Dutch student group in their 2nd year of their study at NHL Stenden Emmen. As stated by the client from the initial meeting, the final product of the project would be a web-based application that implements a JavaScript framework in the form of a dashboard. For this project to be successful, the dashboard will need to fulfill certain criteria. The dashboard needs to be able to display certain meaningful data from the database architecture of both 7.0 and 6.1 software versions of the machines. Additionally, the dashboard should be run on multiple platforms (desktop and Android/mobile).

In brief the dashboard application should be capable of the following:

1. The dashboard should be able to display data in a meaningful user-friendly way from the company's database as to help the customers visualise the data easier. The data that will be displayed should implement 3 best practices of system manufacturing KPIs (Key Performance Indicator):
    - OEE (Overall Equipment Effectiveness)
    - Predictive Maintenance
    - Graphs
2. The dashboard should be able to display which software is running on the weigher machines. The software version of the machines consists of 6-digit numbers, in which the manner of the sequence is the following:
    - The year where the machine is made, with the second digit being removed (year 2023 would be 223)
    - Minus sign in between (-)
    - The last 3 digits would be the incremental number of the machine (e.g., 223-001)
3. The dashboard should be able to display how long has the weigher been running.
4. The dashboard should be able to recognize and display the status of the weighers.
    - If a weigher is idle and store how long has the time passed.
    - If a weigher is waiting for feed, or for the packer.
    - Average bags packed per minute.
5. The dashboard should be able to display the current performance of the machines, and how it is compared to their average and maximum performance.

6. The dashboard should be updated every 20 minutes with the new data from the central database.
7. The dashboard should be able to list all the breakdowns or manual stops, or other incidents that have happened.

### 4.3 Preconditions

Below are listed conditions that should be met for the project succeed:

- The team needs to implement SCRUM Agile management framework in the project.
- Deliver the required research documents.
- Deliver the OEE dashboard product in accordance with the client's wishes and requirements.

The team has been asked to develop the platform with scalability in mind, as this will not be the final iteration of this product and might be carried out further by other development teams later down the line.

## Chapter V - Products & Interim Results

Within this chapter, the expected deliverables and interim results of both periods are listed and briefly explained. This section will be updated should the need for further documentation or products arise during the project.

### 5.1 Documentation

The documentation of the project will be comprised of a project plan, a research report, minutes of the most informative team meeting, advisory documentation based on the research report (potentially as part of one of the aforementioned documents), a product backlog made up of tasks based on the prepared user stories, user manuals and a project report.

The documentation of working hours is done by means of an excel file that allows each team member to enter their individual hours with a brief description what was achieved in that time. Based on the product backlog, burndown charts, that are updated and reviewed weekly, as well as detailed sprint backlogs are created for the realization phase.

### 5.2 Research and Concept Specifications

This will contain the different concepts thought of during the project and the definitive concept chosen with clear reasoning and arguments. These include – a study title, a working group and investigators, background and rationale, specific aims, and analysis framework.

Furthermore, extensive research will be conducted on scrum and knowledge management, and how they can be used in the realization of the project.

This documentation will help to keep track of the progress of the overall product conceptualization and the intermediate products, that will be stated in the final project plan. The backbones of this will be represented by the research report, to ensure educated choices are made for the selection of methods and overall approach for the product development.

## 5.3 Design architecture

Software architecture refers to the fundamental structures of a software system and the discipline of creating such structures and systems. Each structure is comprised of software elements, relations among each other, and properties of both elements and relations.

The architecture of a software system is a metaphor, analogous to the architecture of a building. It functions as a blueprint for the system and the developing project, laying out the tasks necessary to be executed by the teams. Different ideas will be explored to see what fits the project the best, and a definitive choice will be made in consultation, together, with the clients.

The database architecture is provided by the client. Database architecture refers to the organization of data within a database system. It defines how data is stored, organized, and accessed by the users and applications that interact with the database.

## 5.4 Test Products

The product will undergo a rigorous testing process, which will be planned and documented using a minimum of three test design techniques. The approach of testing laid out in the test plan documentation is to be reflected in the resulting reports, and parts that have been found to not be applicable will be marked as such. As part of the planning, a risk analysis is conducted, to help prioritize the most vital areas of the product in testing.

## 5.5 Final Product

At the end of the agreed project allocated timeframe, a complete final product will have been delivered.

## 5.6 End Presentation

Once the allotted time for the project concludes, the results of which will be shared in a manner specified by both the client as well as the lecturers, to display the results as well as give a general insight into the project timeline and working methods.

## 5.7 Period 4 - Interim Products Overview

The table below shows the various documents that need to be finished during this period along with their respective deadlines.

| Task | Deadline |
|---|---|
| **Minutes / Documentation of important meetings:** Transcripts of the most important meetings, and emerging information to be shared with all involved parties. | As needed |
| **Daily Scrum meetings** | Daily |
| **Hours Document (Accountability):** A table showing the team's working hours, that is to be updated by 5pm each Friday at the latest. | Weekly overview, fill in daily |
| **Code of Conduct:** A document detailing expectations and rules regarding work ethics, signed by all team members | Week 1 |
| **Project Plan (Initial Version):** A document to provide insight into the scope and purpose of the project. | Week 1 |
| **Research Document:** All research necessary for the realization phase compiled in one document. | Week 1-2 |
| **Product backlog:** A prioritized list of features, requirements, and enhancements that need to be developed for the product. | Week 1-2 |
| **Midterm evaluation** | Week 4-5 |
| **Sprint review** | Week 2-10 |
| **Sprint retrospective** | Week 2-10 |
| **Sprint backlog** | Week 1-10 |
| **Mutual Peer Evaluation** | Week 10 |
| **Presentation of realization phase results** | Week 10 |
| **Thesis** | Week 9 |
| **Knowledge Management Information System** | Week 10 |
| **Individual assessments** | Week 10 |
| **Version Control** | Per document |

*Table 1: Interim Products*

# Chapter VI - Quality

## 6.1 – End Product

The product of this project is to deliver a working, easily scalable and maintainable web application where the client can view the statistics of any machines they have produced, as well as their clients should be able to access these data of their machines. The information can be seen for each machine one by one and can also be visualised from a graph.

This web application must be easily accessible, each component must be created in a separate environment so that each part can be managed easily or scaled up if there is the need to, without breaking the rest of the features or containers.

Special attention needs to be put in the security aspect. Access must be limited to logged users, and each incident listed must be manually curated by approved users. The database must also be protected from any injections or security flaws and the data must be sanitised and uniformised, if possible. More info about the database structure can be found in the Database Architecture document.

## 6.2 – Control

Code wise, everything will be managed in GitHub, as all the team members will follow the quality of code guidelines, which consists of several programming conventions such as Comment conventions, Indent style conventions, Line length conventions, Naming conventions, Programming practices and Programming principles and Ethics Principles. To control the quality of the code, uploading requires the code review and authorisation from at least one other team member, as checking the code pre-emptively will reduce unnecessary time spent fixing the program and thus delays. Changes to the most upper branch are forbidden, each new update needs to be committed from a separate branch that has been pulled from the most current safe build.

The interim results such as documentation and various features of the program will be checked by all group members and proofread by the members delegated to this, and feedback will be requested from university staff and the client.

The team will have both Teams and WhatsApp group for communication, but also physical meetings, in the building of NHL Stenden or Manter. To make sure that the project is going smoothly and both parties are on the same page regarding what is being created and what must be made, weekly report sessions will be held between the developing team and the clients, with the possibility to the group's supervisor to join.

## 6.3 – Testing techniques and programs

Testing will be done in stages. First while developing it, the team will have sessions to test the different parts, accordingly to the Test Documents and the

user cases that have been written for it. This phase will also focus more on code quality. The second part will involve the clients and possible external parties, which will produce feedback. This part will focus on the features available and how they work.

Having several groups of testers, in different stages, with a variety of methods, ensures that the product is of excellent quality and that issues when it comes to the product launch are kept to a minimum.

As basis, the Master Test Plan document will be used, along with the Acceptance Test Plan document. Whereas the system tests that are executed with the introduction of a larger new feature are logged in a table and repeated if they fail. The plan for said tests is contained within the MTP.

# Chapter VII - Project organization

## Team members

There are six students in the team.

| | | | |
|---|---|---|---|
| Robert Răchită | robert.rachita@student.nhlstenden.com | +31 6 20730281 | Team leader |
| Levente Stieber | levente.stieber@student.nhlstenden.com | +36 20 330 2216 | Developer |
| Stefan Untura | stefan.untura@student.nhlstenden.com | +31 6 85454829 | Developer |
| Aleksei Skorjak | aleksei.skorjak@student.nhlstenden.com | +31 6 16054757 | Developer |
| Máté Soós | mate.soos@student.nhlstenden.com | +36 70 6106818 | Scrum master/Dev. |
| Christopher Sulistiyo | christopher.sulistiyo@student.nhlstenden.com | +31 627553451 | Developer |

## Product owner and contact persons

There are three contact persons from Manter.

| | | | |
|---|---|---|---|
| Hilbert Elsinga | h.elsinga@manter.com | +31 6 431 22 717 | Product owner |
| Cor Ausema | c.ausema@manter.com | N/A | Backend developer |
| Robin de Boer | r.deboer@manter.com | N/A | GUI dev./Designer |

Additional contact phone number: +31 591 62 63 00.

## Availability

The team is available on Mondays until Fridays between 8:30-18:00. They can be contacted by email, WhatsApp, SMS, or a call. Outside of these times the project members are not expected to be working on the project but may be reached out due to the flexibility of certain team members, special occasions, i.e., shortly upcoming deadlines or goals not achieved according to the scrum or activity board. However, the deadline will be kept in mind and the working hours might be adjusted based on that.

Any absence will have to be explained by the absent team member. The group will decide how to proceed, putting the project completion as the main objective. Also, any and all hours must be recorded in the Working Hours document on Teams with a brief description of what was achieved. Inability to do so will result in a warning at the end of the week, as specified in the set of rules.

## Team roles

There are a couple of roles within the team:

- The team leader is responsible for coordinating tasks within the group and making sure those tasks are completed on time and meet the quality expectations. Moreover, they are responsible for piloting the project in the right direction and acting as a bridge in communicating between the clients, teachers, and the group. They also schedule meetings with the teachers and client if needed.
- The developers are focused on doing the assigned tasks and what they are told to do. They can also assist the team leader with certain tasks, such as taking the minutes.
- Scrum master is focused on facilitating the backlog among the developers, and making sure that the Scrum team carries out every sprint perfectly.
- Product owner defines the why is it worth to develop the product, who it is for, and what features, requirements should it contains, and to main the product backlog.

## Reporting

The team will meet at least once a week with the product owner to discuss progress for individual tasks and overall project progress. Moreover, every member gets to speak up about their concerns to the group. This is to ensure that there are no unspoken conflicts or issues. All this will be taken down in the meeting minutes available in the Teams environment. Using the weekly quota, the team can plan and adjust the needs of the project going forward. Furthermore, the team has decided to use WhatsApp and Teams as the main ways of communication. Email has been chosen for contact between students, lecturers, and clients, with MS Teams as an alternative.

Initially, during the research and documenting phase, a hybrid project planning method will be used. Whenever work must be done, tasks will be created and assigned to one or more team members along with a deadline. To keep track of current and past tasks, Jira will be used, along individual tracking of hours and progress. At least 2 weekly meetings will take place where the tasks will be discussed, and new tasks will be added.

During the period where SCRUM method is being used, group members are expected to keep their tables detailing the work hours up to date, as well as accurately noting down what feature they have worked on when in the burn down charts. Once a sprint concludes, the sprint is reviewed together with the entire group and new user stories for the following one are selected based on the product backlog. This backlog is also updated with any new tasks that may have popped up during the sprint and unfinished tasks are updated and reentered.

Finally, the team came to an agreement to use GitHub as the digital tool for collaborating within the project group. This will enable a smooth workflow for the team members, as well as securing older product versions in case of a mishap. This platform will be able to show the working progress of the members during the project, as well as keep track of the SCRUM tasks by using its Project feature. This method of work will be implemented during the developing stage of this project.

# Chapter VIII - Planning and Scheduling

As effective planning and scheduling are essential for delivering a high-quality software application within budget and on time, by taking a structured approach to project planning, the development team can ensure that it is working efficiently and effectively towards achieving the project objectives.

Below the prioritization of project deliverables, estimation of their timeframes and a Gantt chart depicting set time frames are described.

## Project realization Phase (17.04.2023-19.06.2023)

| **Code** | **Task** | **Weeks** | **Can only take place after:** |
|---|---|---|---|
| A | Team role assignments | 1 | - |
| B | Code of Conduct | 1 | A |
| C | Project Plan (draft version) | 1 | B |
| D | Research KM | 1 | C |
| E | Research SCRUM | 2 | C |

| Code | Task | Weeks | Can only take place after: |
|---|---|---|---|
| F | Product Backlog & Epics | 2 - 9 | - |
| G | Sprint Backlog | 3 | E |
| H | Research Document (draft version) | 4 | E |
| I | Research Document (final version) | 8 | H |
| J | Evaluation | 9 | I |
| K | Self-reflection | 9 | K |
| L | Presentation | 9 | I |
| M | Weekly reports | 1-9 | - |
| N | Client meetings | 1-9 | - |
| O | Sprint tasks | 2-9 | - |

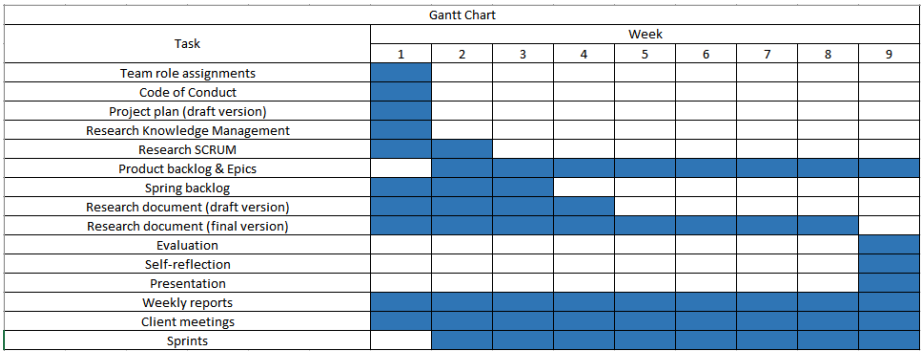


*Chart 1: Gantt Chart*

It is important to note that unexpected hurdles may arise during the execution phase, leading to deviations from the original plan. These deviations may arise due to factors such as prolonged feedback and approvals from clients or situations where activities require more resources than initially anticipated as well as plain lack of knowledge. Therefore, it is crucial that the team and the planning remain flexible and provide enough room to accommodate changes as required to ensure successful project completion and customer satisfaction.

# Chapter IX - Cost and benefits

This chapter will discuss various costs and benefits relating to this project.

### 9.1 Cost

For this project there is no budget set. However, should the team require anything in terms of software, the university and/or the client may provide this.

Building the project should not prove expensive since the product is a software application. The expenses may come with hosting and maintenance of the product, for which the development team is not responsible.

9.2 Benefits
The project will provide benefits in terms of allowing the project commissioner, as well as its clients, to have data visualisation of the gathered data for internal use or client/dealers usage. The dashboard will ultimately enable Manter to improve the efficiency of their weighing and packaging machinery by providing data and insights related to their performance and maintenance.

As for the students, : Building a web dashboard for a real client will provide students with real-world experience and an opportunity to apply their knowledge and skills in a practical setting.

## Chapter X – Risk Analysis

This chapter handles the possible risks that may be encountered during the project and ways to handle the problems. This is visualized on the table below.

| **Risk** | **Possibility** | **Possible Outcome** | **Prevention** | **Measure taken** |
|---|---|---|---|---|
| Contracting COVID-19 | Less likely | Team will have to quarantine for 2 weeks, and the project will be set back. | Maintain 1.5-meter distance and use face masks when needed | Team will have to work during down time not to fall behind, getting vaccines and respecting measures |
| Common illness | Less likely | The team will be set back for a moment. | Good health care and communicate properly with team | Assume tasks of ill members |
| Tasks not finished on time | Possible | Set back until tasks are finished | Proper planning and time management | Sprint reviews, plan next sprints differently, issue warnings if other causes |

| Risk | Possibility | Possible Outcome | Prevention | Measure taken |
|---|---|---|---|---|
| Insufficient task | Less likely | Set back until task schedule is done correctly | Actively ask members for document / peer review, proof-reading. | Plan next sprint accordingly |
| Lack of technical knowledge | Less likely | Team might not be able to realize certain parts of the project. | Research proper technical skills needed, practice these and ask for assistance if needed | Research what skills the team is lacking, |
| Departure of a project member | Very unlikely | Team will be set back | Proper communication between members to be able to react to signs of a member dropping out quickly and effectively. | Assume the tasks of the dropped member, change team roles |
| Loss of data | Unlikely | Loss of data/files. The amount depends on the most recent back-up. | Frequent back-ups / version control | Restore files from latest back-up / revert to an earlier version |
| Insufficient testing | Possible | End-product of lesser quality | Structured Test Plans and sufficient time to complete the tests | Review test reports and run tests again |
| Hardware malfunction | Unlikely | Set back until hardware is replaced | Actively check if hardware is in working condition | Order a new part as fast as possible and replace it |

| Risk | Possibility | Possible Outcome | Prevention | Measure taken |
|---|---|---|---|---|
| Lack of proper communication with client | Possible | This will slow the development of the project. | Frequent communication with the client, follow up emails, messages through WhatsApp, calling on the phone in case of emergency | Weekly meetings, multiple ways of communication and reaching out |
| Security issues | Unlikely | Personal information could be stolen. | Testing for security issues. | Consultation regarding Secure Programming and following best security practices |
| Security issues on the libraries used | Possible | Update on the libraries, or change the libraries | Use newer, community trusted libraries, with frequent updates. | Check for updates and be sure that the libraries used can be applied in the future. |
| Additional research required by the client | Possible | The team's progress will be slowed down, causing troubles with keeping the deadline. | Good communication between the team and the client. | The team will try to communicate as efficiently as possible with the client to avoid any misunderstanding. |

| Risk | Possibility | Possible Outcome | Prevention | Measure taken |
|---|---|---|---|---|
| Workload Too Heavy | Possible | Due to the possibility of the team being unfamiliar with some of the subject matter, there is a possibility there may be miscalculations in regards to the sprint planning | Reassess progress frequently and communicate any setbacks with the other team members and clients. | Plan sprints accordingly and have weekly sprints reviews. |

*Table 2: Risks*

## Appendix 3: Feedback form Manter

NHL STENDEN
university of applied sciences

# Company Supervisor Feedback Form Knowledge Management

## ICT & CT
## Information Technology Bachelor Emmen

Version 2022-2023-1.0

| | |
|---|---|
| **Student names:**<br>**Levente Stieber**<br>**Robert Răchită**<br>**Stefan Untura**<br>**Aleksei Skorjak**<br>**Máté Soós**<br>**Christopher Sulistiyo** | **Student numbers:**<br>4843339<br>4859367<br>4839161<br>4561139<br>4923294<br>4850025 |
| **Work placement company:**<br>**Manter International B.V.** | **Company supervisor:**<br>Robin de Boer |
| **Date:**<br>**22-06-2023** | **Signed by company supervisor:** |

# TABLE OF CONTENTS

# 1 INSTRUCTIONS COMPANY SUPERVISOR FEEDBACK FORM WORK PLACEMENT

Specify your (advisory) assessment by ticking the coloured box in the feedback form (next page) that reflects the student's current performance level.

The coloured boxes are indicative of the grade. Yellow indicates that the student performs at the level expected of a new Bachelor of information technology.

The meaning/grade distribution of the colours in this respect is as follows:

| <4 | 4 - 5.4 | 5.5 – 6.9 | 7 - 8.4 | >=8.5 |
|---|---|---|---|---|

Specify your assessment by marking an 'X' in the box behind the component. Write any additional comments under *3: Company supervisor's remarks.*

Mark any non-applicable components with an 'X' in the n/a field.

Besides completing the X-list the company supervisor is requested to briefly describe the student's performance under *3: Company supervisor's remarks.*

## 2 COMPANY SUPERVISOR FEEDBACK FORM WORK PLACEMENT [1]

| **Dublin descriptor 1: Knowledge and understanding** | | | | | | | | **n/a** |
|---|---|---|---|---|---|---|---|---|
| Demonstrable knowledge | Unsatisfactory | | | | | | Satisfactory | X |
| Consulting specialist literature | Unsatisfactory | | | X | | | Good | |
| Theoretical understanding | Unsatisfactory | | | X | | | Good | |
| Practical understanding | Unsatisfactory | | | | | | Good | X |
| **Dublin descriptor 2: Applying knowledge and understanding** | | | | | | | | |
| Professionalism | Unsatisfactory | | | | X | | Good | |
| Reasoning | Unsatisfactory | | | | X | | Good | |
| Solving problems | Unsatisfactory | | | X | | | Good | |
| Methodical approach | Disordered | | X | | | | Well-ordered | |
| Monitoring progress (planning) | Unsatisfactory | | | X | | | Good | |
| Originality | Little | | | X | | | Much | |
| Creativity | Little | | | | X | | Much | |
| Work discipline (meeting commitments) | Unsatisfactory | | | | X | | Good | |
| Independence | Wait-and-see attitude | | | | X | | Enterprising | |
| Quality of the work performed/products delivered | Unsatisfactory | | | X | | | Good | |
| Quantity of the work performed/products delivered | Unsatisfactory | | | X | | | Good | |
| Value of the achieved results | Low | | | X | | | High | |
| Cost-conscious approach | Unsatisfactory | | | X | | | Good | |
| **Dublin descriptor 3: Formation of judgement** | | | | | | | | |
| Collecting data | Unsatisfactory | | | | X | | Good | |
| Interpreting (Analysis and implementation) | Unsatisfactory | | | X | | | Good | |
| Formation of judgement | Unsatisfactory | | | X | | | Good | |
| **Dublin descriptor 4: Communication** | | | | | | | | |
| Ability to express oneself verbally when dealing with specialists | Awkward | | | | X | | Articulate | |
| Ability to express oneself verbally when dealing with non-specialists | Awkward | | | | | | Articulate | X |
| Ability to express oneself in writing when dealing with specialists | Sloppy | | | | X | | Polished | |
| Ability to express oneself in writing when dealing with non-specialists | Sloppy | | | | | | Polished | X |
| Functional cooperation (Cooperation) | Awkward | | | | X | | Articulate | |
| Positive but critical attitude | Unsatisfactory | | | | X | | Good | |
| Timely feedback | Unsatisfactory | | | | | X | Good | |
| **Dublin descriptor 5: Learning skills** | | | | | | | | |
| Learning to learn | Unsatisfactory | | | X | | | Good | |

[1] The feedback form is based, among other things, on the *Dublin descriptors*. An explanation is provided in Appendix 1.

.

## 3 COMPANY SUPERVISOR'S REMARKS [2]

No remarks

Company supervisor's initials: R. de Boer

[2] Appendices 2 and 3 contain guidelines in support of your remarks. Appendix 2 contains an explanation relating to the assessment factors of the intern based on the *domain description Bachelor of information technology*. Appendix 3 contains an explanation relating to the intern's professional performance. In addition, we request that you pay special attention to the practice, process and knowledge of the student and the connection from school with regard to the internship period.

# APPENDIX 1 DUBLIN DESCRIPTORS

| | **Bachelor's qualifications** |
|---|---|
| **Knowledge and understanding** | The (future) bachelor:<br>• Has *demonstrable knowledge*, understanding and skills in a field of study, building on the preceding level;<br>• Generally performs at a level that requires knowledge of the latest developments in the field of study, supported by *specialised literature..* |
| **Applying knowledge and understanding** | The (future) bachelor has the ability to apply said knowledge, understanding and skills so as to perform on a professional level. More specifically:<br>• *Professionalism* is evidenced by a methodical, project-based and/or problem-driven approach, whilst solutions to issues are viewed from several professional perspectives.<br>• *Reasoning* is evidenced by a logical structure (cause & effect chain) in recognisable steps when formulating a line of reasoning.<br>• *Solving problems* is evidenced by the level of creativity, the feasibility of solutions and the choice of alternatives. |
| **Formation of judgement** | The (future) bachelor has the ability to collect and interpret relevant data and from that data form an opinion that is also based on social and ethical considerations. More specifically:<br>• *Data* is collected in a purposeful fashion with a view to the goal, completeness and a balanced distribution.<br>• *Interpreting* is evidenced when the (future) bachelor processes the collected data and can explain the importance of the data.<br>• *Formation of a judgement* is ultimately evidenced by the opinion that is formed on the basis of the data and which can be deduced logically from the data. The considerations mentioned recur explicitly and consistently. |
| **Communication** | The (future) bachelor has the ability to:<br>• Communicate about information, ideas and solutions with *specialists and non-specialists*. This is evidenced, among other things, by the extent to which findings, ideas and solutions are translated into understandable, logical terms and into a logical and coherent argument.<br>• *Cooperation* with others in a *multidisciplinary* and/or international environment, meeting the requirements of participating in an organisation. |
| **Learning skills** | The (future) bachelor's learning skills are sufficient for taking a post-graduate course with a high level of self-sufficiency. The (future) bachelor's skills are sufficient to carry out the internship assignment with a reasonable amount of self-sufficiency and within a short-term time frame. *(Learning to learn)* |

# APPENDIX 2 INTERNSHIP ASSESSMENT FACTORS

| | Criteria |
|---|---|
| **Management** | • *Methods, techniques and/or tools*: described, choice justified, suitable for the assignments, correctly applied?<br>• *Quality of operation and management:* properly organised? Required continuity ensured? Transferable: Management responsibilities and procedures described? All the consequences of change proposals for exploitation and continuity of the product assessed?<br>• *Quality of the process:* implemented according to plan, professional choices made and justified? Checked in the interim whether operational and management plan meet guidelines, requirements and wishes? |
| **Analysing (research)** | • *Methods, techniques and/or tools*: which analysis/research methods have been used and are they described properly? Is the choice justified, suitable for the assignment and applied properly? Are the analysis/research questions suitable for and consistent with the problem definition/assignment? Does the sum of the sub-questions correspond with the key question? Is the development methodology in accordance with the research into the requirements and the context? Was relevant and current literature used in relation to the assignment? Is international literature being used?<br>• *Quality of the analysis/research:* current situation described and desired situation mapped out? Context analysed (target group/user, content, company)? Is obtained information sufficient and relevant to the goal? Interpreted on the basis of the analysis/research questions? Research questions answered and conclusions drawn? Clear reporting/presentation of the results and how they were achieved? Clear conclusions, recommendations? Action plan drawn up, categorised, prioritised and geared to the assignment?<br>• Quality of the analysis/research process: implemented according to plan, adequately documented? Checked in the interim whether the research is conducted in a manner that meets the initial question and research methods? |
| **Advising** | • *Methods, techniques and/or tools:* sufficiently described, alternatives considered, choice justified, suitable for the assignment and properly applied?<br>• *Quality of advice:* based on analysis/research results and suitable for the problem definition, professionally substantiated, clear and convincingly presented? Proposals made for follow-up?<br>• *Quality of the advisory process:* performed according to plan, alternatives considered, feasibility assessed, support created? |
| **Designing** | • *Methods, techniques and/or tools:* sufficiently described, alternatives considered, choice justified, suitable for the assignment and properly applied?<br>• *Quality of the design:* complies with wants and needs, consistent, how innovative is it? Sufficiently documented and suitable for realisation by third parties? Functional design and/or transfer document?<br>• *Design process:* according to plan, professional design choices made, justified and adequately documented? Alternative design solutions investigated and considered? Interim designs evaluated in consultation with the client and/or target group? |
| **Realising** | • *Methods, techniques and/or tools:* sufficiently described, choice justified, suitable for the assignment and properly applied?<br>• *Quality of the realisation:* product realised in accordance with the design and applicable guidelines? Quality requirements imposed and secured? Product introduced? Product transferable?<br>• *Quality of the realisation process:* implemented according to plan, professional realisation choices made and justified? Checked in the interim that product meets design, guidelines, requirements and wishes? |
| **Evaluation** | • *Methods, techniques and/or tools:* described, choice justified, suitable for the assignment and properly applied? Feasible roadmap drawn up? Targets systematically formulated and used for each evaluation component? Geared to regular situations, exceptions and borderline situations?<br>• *Evaluation results:* checked whether the realised system or product meets the formulated requirements and whether it has achieved the initial objective? Results clearly presented? Conclusions drawn? Proposals for improvement formulated? Deviations analysed?<br>• *Quality evaluation process:* conducted according to plan, professional choices made and justified? Was the evaluation operationally feasible (measurable, testable, etc.) and economically sound (i.e., evaluation components forceful enough and number of components no more than necessary)? |

# APPENDIX 3 PROFESSIONAL PERFORMANCE

| | **Criteria** |
|---|---|
| **Communi-cating** | • *Communicates correctly, both verbally and in writing:* goal and target group oriented, gets the message across with the correct structure, style, and usage. Tests whether the target group has got the message. Usage is grammatically correct and spelling is correct. Has the ability to distinguish matters of primary and minor importance. |
| **Working systematically** | • *Preparation:* Action plan worked out in sufficient detail? Project method: approach described and justified? Realistic planning? Milestone products: specifically defined?<br>• *Quality of implementation and evaluation:* proceeded in accordance with action plan? Project method actively adopted? Progress of the project phases described and justified? Milestone products achieved according to plan? Results described and substantiated? Reference to action plan and to the problem formulated in that action plan? Progress monitored and quality evaluated? Kept to planning? Milestone products achieved according to plan? Any deviations to above points justified? |
| **Cooperation** | • *Working arrangements:* consults on division of tasks and makes relevant agreements, coordinates the execution of his/her own tasks with team members, sticks to agreements?<br>• Personal contribution: makes meaningful contribution during meetings, takes responsibility for the (multidisciplinary) cooperation, calls upon the expertise of others if necessary, shares knowledge and experience with team members? |
| **Reflection** | • *Explanation, justification and reflection:* domain competencies and indicators exemplified, justified and reflected in his/her own professional practice? Points requiring improvement stated? Already working on improvements? Searched actively for sources of knowledge and open to other views and opinions? |

## Appendix 4: Scrum Artifacts

For more information, please refer to the online SCRUM board on Jira.


Figure 4: Velocity Chart

Note: Due to document readability and size restrictions, the Backlog is attached separated as a .csv file.

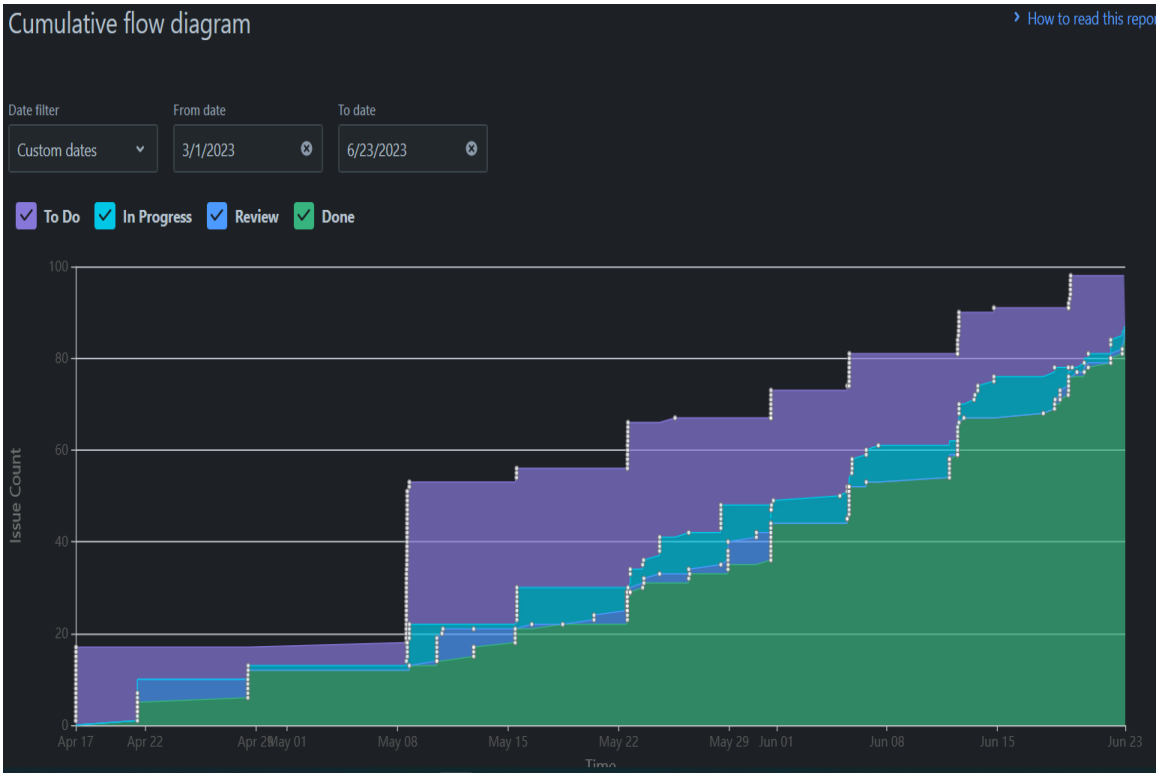


Figure 5: Cumulative Flow Chart