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Knowledge Management

Research Report | Manter

Knowledge Management, SCRUM and the OEE Dashboard

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Summary

Background

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 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.

This research was conducted as part of the assignment of researching Knowledge Management and SCRUM for the team to utilize them both to their project. In this research, the team seeks to explore the potential benefits of and challenges of utilizing SCRUM and Knowledge Management practices in a software development project. Through this research, the team aims to identify best practices and strategies for integrating these approaches to enhance the effectiveness and efficiency of software development projects, and to contribute to the growing body of knowledge in this field.

Knowledge Management (KM) is an interdisciplinary field that focuses on the creation, acquisition, organization, dissemination, and utilization of knowledge within companies. KM research aims to understand how organizations can effectively manage their knowledge resources to achieve their strategic objectives and competitive advantage. KM is particularly relevant in today's fast-paced business environment, where organizations need to continuously innovate and adapt to changing market conditions. As a result, KM research has attracted significant attention from scholars, practitioners, and policymakers alike, leading to a rich and diverse body of literature on the topic.

Scrum is a widely used agile framework for software development that has gained popularity in recent years. It is a highly flexible approach that allows teams to collaborate and adapt to changing requirements, leading to higher levels of productivity and quality. Scrum focuses on iterative and incremental development, with a strong emphasis on customer feedback and continuous improvement. Despite its widespread use, there is still a need for further research to understand the benefits and limitations of Scrum, as well as how to effectively implement and manage it within different organizations and industries.

The first research question of this paper will provide an overview of KM research, including its key concepts and theories, research methods, and current trends and challenges. The second research question of this research paper aims to provide a comprehensive overview of the existing information on SCRUM, including its origins, principles, and practices, as well as the empirical studies and case reports that have investigated its effectiveness in various contexts. Additionally, this paper will identify gaps in the current literature and propose areas for future research to advance the current understanding of this popular Agile methodology.

Key Findings

Adoption of Agile Methodology: The choice has been made by the team to leverage SCRUM, a celebrated and often-used Agile methodology, due to its track record of fostering collaborative environments and delivering superior software products.

Leveraging Performance Indicators: Different yardsticks, including burn-down charts, hours spent by the team on project activities, and feedback from the project owner and the supervising faculty, will be used to assess the influence, efficiency, and overall success of SCRUM in the project.

Broadening the Project Horizon: There's a plan to widen the scope of Manter's KMS project. This will be done by weaving in a holistic information system designed to capture meaningful performance indicators, thereby enhancing control and insight over the organization's knowledge production.

Strategic Focus on Performance Indicators: The selection of performance indicators will be done thoughtfully, focusing on those that accurately mirror the organization's production status and align with Manter's strategic objectives. These include average metrics from production indicators, discrepancies between present and goal indicators, and cumulative indicators.

Focus on Iterative Improvement: The integration of these performance indicators into the KMS is intended to shed more light on production processes, laying the groundwork for ongoing enhancements. This will equip Manter with the means to examine and tweak the effectiveness of their KMS as necessary.

Incorporating Additional Metrics: As part of the project planning phase, more brainstormed metrics will be included to provide an in-depth view of the KMS's impact and ensure it is tailored to Manter's specific business environment and requirements.

Building a Robust KMS: By marrying the SCRUM methodology with a thoughtfully engineered information system and a solid set of performance indicators, the goal is to construct a resilient, effective, and efficient KMS. The anticipated outcome is an optimized management and enhancement of knowledge production and application at Manter, leading to a nimble, well-informed, and productive workforce that can pivot to accommodate an ever-changing business landscape.

Resilient and Efficient KMS: The combination of the SCRUM methodology, a well-designed information system, and a robust set of KPIs aims to build a resilient, efficient, and effective KMS. 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.

Keywords

- (KM) Knowledge management
- (KMS) Knowledge Management System
- (KPI) Key Performance Indicator
- Agile
- Knowledge sharing
- Distributed
- Global software development

1. Introduction

Background & Goal

1.1 Research Background

In today's fast-paced and data-driven business environment, organizations need to leverage the power of technology and knowledge management practices to enhance their competitiveness, efficiency, and customer satisfaction. One critical area that can benefit from such practices is the monitoring and optimization of production processes and equipment, based on the collection of raw data, particularly in the manufacturing sector.

Manter is a company that specializes in designing and manufacturing machinery for vegetable weighting and packing. They aim to provide their clients with high-quality, reliable, complete, and efficient solutions that meet their specific needs and requirements, such as weighting diverse fruits or high-capacity packaging of various shapes and sizes. However, one of the challenges that they face is the difficulty of accessing and analysing meaningful data, Key Performance Indicators (KPIs), and other metrics that are collected by their machinery during operation. This makes it hard for them to monitor the performance of their machines, detect and diagnose any issues or anomalies, and make informed decisions on how to improve their operations.

To address this challenge, Manter is interested in creating a knowledge management system that can collect, analyse, 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 enable them to share some of this data with their clients and dealerships, providing them with valuable insights into the performance of the machinery they purchased/trying to market.

To design and develop such a knowledge management system, a thorough understanding of the company's operations, data practices, and technological requirements is essential. Therefore, this research project aims to investigate the current data collection, analysis, and presentation practices at Manter and explore the potential benefits and challenges of implementing an Overall Equipment Effectiveness (OEE) dashboard. By doing so, this project seeks to contribute to the field of knowledge management and manufacturing by providing a practical and innovative solution to a common problem faced by many companies in the industry.

1.2 Research Goal

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 by providing real-time, accurate, curated, and actionable insights on key performance indicators (KPIs). Specifically, this project aims to investigate the current data collection, analysis, and presentation practices at Manter and identify their strengths, limitations, and opportunities for improvement, changing or adapting them if necessary. Moreover, it will investigate exploring the potential benefits and challenges of implementing an Overall Equipment Effectiveness (OEE) dashboard that can collect, analyse, and present data from their machinery in a user-friendly and informative way, and will provide recommendations and guidelines for the implementation and adoption of such systems.

Additionally, the research will feature several sub-questions with the goal of clearing more the findings. These concern the topics of knowledge management, what a knowledge management system is and how can such a system align with the needs of the client, as well as how the development process can be shaped by using SCRUM and agile development methodologies, to ensure a collaborative, iterative, and user-centred approach that meets the evolving needs and expectations.

By achieving these goals, this research project seeks to contribute to the field of knowledge management and manufacturing by providing a practical and innovative solution to a common problem faced by many companies in the industry. Additionally, this will allow for the designing and developing of a prototype of an OEE dashboard that can meet the specific requirements and needs of Manter and that aligns with best practices and standards in knowledge management and manufacturing and evaluate the usability and client satisfaction of this through user testing, feedback, and more data analysis.

This research is conducted as cogent verbatim evidence that the team has gained adequate ample apprehension on the principles of Knowledge Management and SCRUM, so that they can apply them in this specific project of Knowledge Management. In addition, this document serves as a grading criterion from the Knowledge Management project of the third year international ICT course curriculum of NHL Stenden University of Applied Sciences as stated in the module book attached to the course.

2. Conceptual and theoretical framework

2.1 Reading Guide

The executive summary gives a concise overview of the document's contents, starting with the background and reason for conducting the research. It also contains the key findings, giving the reader an immediate insight into what to expect. An introduction serves as a quick answer to the why's and how's of the creation and writing of the paper, alongside a reading guide and definitions of terms.

The chapter of most interest in readers, the results chapter, contains all research results presented in a factual and unbiased manner, to be further investigated and theorized upon in the following chapters. The conclusion and discussion chapter answers the research's main problem in a concise, conclusionary manner, based on the information procured and detailed in the preceding chapter.

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.

2.2 Definition of Terms

Terms and definitions retrieved from:

IT terms Glossary. (n.d.). Dataprise.com. Retrieved November 28, 2022, from <https://www.dataprise.com/it-glossary>.

Database – “A collection of information organized so that a computer application can quickly access selected information; it can be thought of as an electronic filing system. Traditional databases are organized by fields, records (a complete set of fields), and files (a collection of records). Alternatively, in a Hypertext database, any object (e.g., text, a picture, or a film) can be linked to any other object.

Oxford Language Dictionary

3 Methodology

This document is comprised one main research question and three sub-questions which serve the purpose of clearing up more the principal point. All these questions are focused on gathering

qualitative data by means of desk research and personal experience. The researcher has ensured that the information was sourced from reputable outlet and direct observations.

3.1 Research Question(s)

What knowledge management system can be developed for Manter to improve their business by making their operations more efficient and effective in utilizing their existing data, given the unique characteristics of their industry and target customer segments?

- What is Knowledge Management?
- How can Knowledge Management be applied to support the business needs of Manter?
- How can SCRUM be used to support the process of this project?

3.2 Research Design

3.2.1 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, KPIs such as 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. The 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.

3.2.2 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.

3.2.3 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.

3.2.4 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 context 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.

Chapter 3.4: Rigorous Evaluation and Utilization of Research Sources

3.4.1 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 the research sources and demonstrates the team's compliance with the established guidelines for the proper use of research sources.

3.4.2 Evaluation Criteria

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

3.4.2.1 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.

3.4.2.2 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.

3.4.2.3 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.

3.4.2.4 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.

3.4.2.5 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.

3.4.2.6 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.

3.4.2.7 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.

3.4.2.8 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.

3.4.2.9 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.

3.4.2.10 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.

3.4.2.11 Type of Source

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

3.4.3 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.

3.4.4 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.

4 Results

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.

4.1.1 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.

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. 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
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.

4.2.1 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. Lastly, every aforementioned component will be discussed and adjusted accordingly by use of daily stand-ups.

4.2.2 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.

4.2.3 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.

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

4.3.1 How can Knowledge Management be utilized for the realization of the

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.

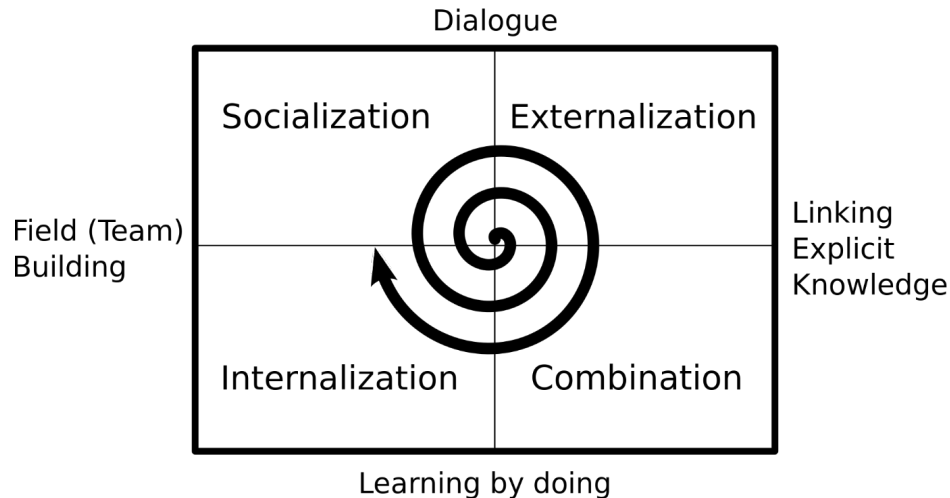


Figure 1: The Knowledge Spiral (Nonaka, 1994)

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

4.3.2 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.

Agile and lean ways of working build on a common mindset.

Level	Lean management	Agile	
Team models	<ul style="list-style-type: none"> • Work cells • Expert choreography • Segregating variability • Relationship service cells 	<ul style="list-style-type: none"> • E2E¹ cross-functional squads • Flow-to-work • Self-managing teams • Specialist pools 	Deployed as needed, based upon the nature of the activity
Ways of Working	<ul style="list-style-type: none"> • Lean management practices • Kaizen/continuous improvement • Kanban/visual workflow management • Jidoka/self-monitoring automation 	<ul style="list-style-type: none"> • Scrum • Extreme programming • Kanban 	
Toolkit (examples, non-exhaustive)	<ul style="list-style-type: none"> • Standup/daily performance dialogue • Value-stream mapping • Leader standard work • Root-cause problem solving • 5S/workspace management • Visual management 	<ul style="list-style-type: none"> • Daily standup • Backlog • Sprints 	Applicable everywhere across the organization
Underpinned by a common mindset and consistent set of principles			

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

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).

Different lean-management and agile team models are suited to different activities.

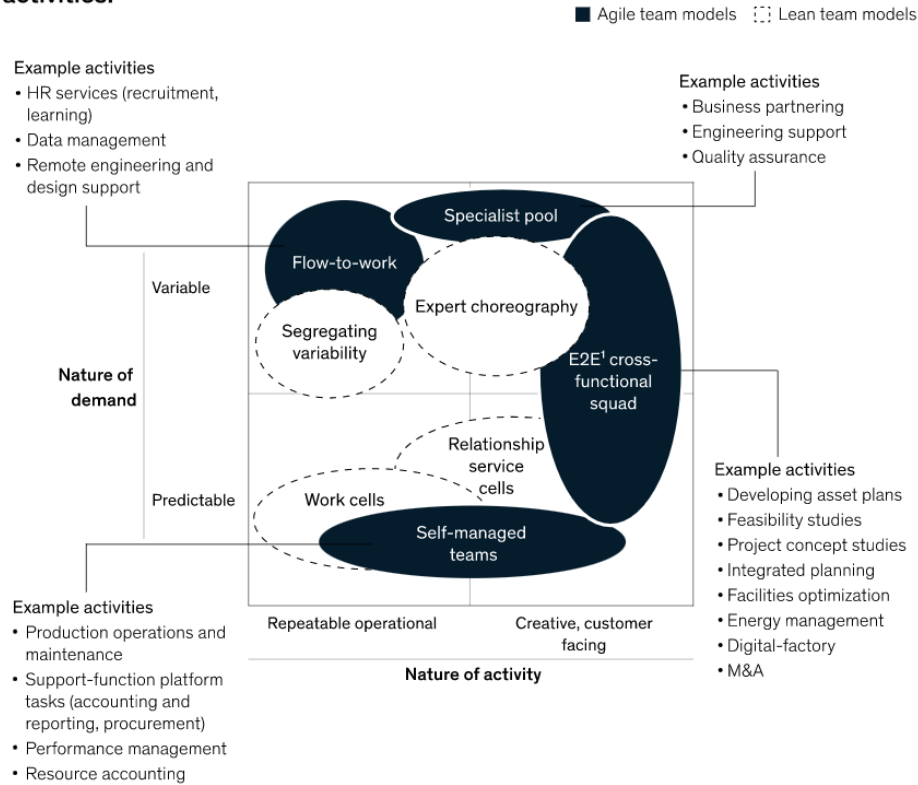


Figure 3: Development methodologies models and examples of their applicability

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 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.

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 owner's 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, we aim 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, we will incorporate additional brainstormed metrics 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, we aim 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.

6 Discussion

The information's scope was condensed to concentrate on the functionality and potential usability of the paper, both for educational purposes as well as for making an educated business decision in procuring or upgrading computers.

The data gathered was sourced from the Internet from reputable tech publications and reviewers, as well as from tool such as Google Scholars and Microsoft Learn.

Additionally the team will utilize CRAAP methodology with insights from specialists in the field of research such as Simon Peyton Jones and validation from project supervisor Niels Doorn.

Future, more extensive research can use this document as a starting basis, with the hope that the industry and the field publications will also take a more direct interest in such topics.

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