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Digitalization in Knowledge Management Systems for Project and Operational Management in Software Development to Increase Efficiency

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Abstract

PT Snack Sehat is a manufacturing company that produces healthy snacks and beverages in Indonesia. Its IT division has a software department that manages all creation and maintenance of information system projects. Although the software department planned and monitored project development thoroughly during their work, 42% of projects were late in 2020. Those late projects' costs led to financial loss and kept rising through 2020-2021. Digitalization is how technologies affect several aspects of life, like social interactions, business operations, and how people work. Digitalization improved and sped up knowledge-sharing processes within the organization. Since knowledge sharing is done more frequently, the absorptive capacity will also be improved. This brings up the question of how to design a KM program with digital tools that will help PT Snack Sehat to increase its efficiency in project development and operation support. The primary data for this research was gathered from KM Assessment using APO KM Framework and focus group discussion with top and middle-level managers from PT Snack Sehat. To develop a KM program, the research will use Six Steps KM Processes, which consist of KM Project, KM Assessment, KM Planning, K-Development, KM Implementation, and KM Evaluation. The development steps will include defining the objectives of the KM program, answering questions related to the knowledge management components (people, process, and technology), determining the knowledge management strategy based on KM objectives, and setting the action plan to get ten commitments from top-level management. The results show several processes and methods that need to be added to the current KM: KM Orientation & Training, Shadowing, Sharing Knowledge Checklist, Lesson Learned Document, Document Validation, and Document Organization. The complete knowledge management process will also be mapped in a Knowledge Stock and Flow Diagram using SECI Matrix.

Keywords: *Project Development, Operational Management, Six Steps KM Processes, SECI Matrix, Digitalization, Absorptive Capacity, Efficiency*

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INTRODUCTION

Project management plays a big part in software development. Excelling in project management practices becomes one of four success factors in IT project management, along with managing strategy and stakeholders, mastering technology and content, and having a capable team (Bloch, Blumberg, & Laartz, 2012). Poor project management will lead to missed deadlines, cost overruns, poor project quality, project rework, uncontrolled expansion of the project, company reputation loss, unsatisfied stakeholders, and failure to meet the objectives of the project (Project Management Institute, 2017). So, in project management, each project will be planned and

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calculated first to identify the purpose of the project, the time used to develop the project, and the spent budget needed.

PT Snack Sehat is one of the manufacturing companies that produce healthy snacks and beverages in Indonesia. In its IT division, they have a software department that manages all creation and maintenance of information system projects, such as ERP system, internal application, websites, reports, and business intelligence. The whole software development process involved two teams, which are the project development team itself and the operation team. The process itself consists of eight phases, which are pre-requirement, requirement, analysis & design, development, testing & revision, live, babysitting, and support.

During their work, although the software department has planned and monitored project development thoroughly, the data show that in 2020, there are 22 of 52 projects (42.3%) were late. This condition only improved slightly in 2021, when 39.4% (41 from 104) projects were late. Those late projects' costs led to financial losses, which kept rising in 2020-2021. In 2021, the top three project development issues were development issues (54%), implementation issues (22%), and planning issues (12%).

Development issue happens during project development. It includes miscommunication that happens because things discussed and decided were not adequately documented and information loss due to changes in team dynamics (such as resignation, resource transfer, or change of priority). Planning issues happen during Pre-Requirement, Requirement, and Analyze & Design phases. This issue happens due to a lack of readiness for digitalization. Each division develops applications based on its needs without considering the overall business flow. A similar application was often built twice due to miscommunication across the different divisions. Strategic apps are often built without proper basic skills and rebuilt to fit the proper business process and development standards. Another issue related to planning is project estimation. In some projects, development takes longer time because the realization is often more complicated than the planned estimation. Because of that, the project scope often changed during development, and costs increased due to replanning.

The last issue, the implementation issue, occurs because the project status was not exposed promptly to every stakeholder, so they did not know about the last update of the project. Therefore, stakeholders were not prepared to use the finished application. For example, they had not finished cleaning up master data when the application went live. So, the project was prolonged, waiting for them to complete their data. In 2021, the number of late projects caused by this issue increased to 22%. This rise indicates that miscommunications still happen between the project development team and the stakeholders.

Unlike the project development team, the operation support team handles technical support for other departments. They get requests in the form of tickets from the user and help them solve their issues. In contrast with the project development team, which has consistent resources, operation support has non-permanent resources. People there keep changing based on resource availability and needs. Because of that, they often have a knowledge-sharing session to transfer tacit knowledge of handling requests from one handler to his successor. However, this sharing of knowledge is not effective. The successor often asked back to the predecessor or even the previous project management team to solve issues. Therefore, they need to improve their knowledge-sharing and storing processes.

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From the data shown in previous paragraphs, lateness and inefficiency in project development will be the primary business issue in this research. For the operation support team, the focus will be more on efficiency, about how the operation support team reduces the lead time of their ticket response and resolution time.

Knowledge management itself can give several benefits to the company. A literature survey by (Anand & Singh, 2011) listed 28 benefits of KM in organizations. Some of the most researched benefits are how knowledge management encouraged the best decision-making, improved productivity/efficiency, helped the organization increase sales/profits, improved responsiveness, increased speed of innovation, and helped employees in sharing best practices. Research by (Davenport, De Long, & Beers, 1998) shows that eight specific factors lead to successful knowledge projects, which are a link to economic performance or industry value, technical and organizational infrastructure, standard and flexible knowledge structure, knowledge-friendly structure, clear purpose, and language, change in motivational practices, multiple channels for knowledge transfer, and senior management support. Adopting technologies with digitalization will support several of those factors, especially in the knowledge transfer process. Using video calls instead of face-to-face meetings, for example, will broaden the knowledge-sharing channels and increase the speed and efficiency of knowledge-sharing from one person to another.

In the digital era, however, the role of KM is not focused only on the documentation of past and current knowledge but is divided into two parts, which are Operational KM as a stabilizer and Strategic KM as a catalyst (North, Maier, & Haas, 2018). Stabilizer aims for the availability of knowledge at the right time to support employees on an operational basis. Contradictory catalyst means that KM takes the role of an innovator, which keeps questioning the old learning system and establishes behavior and practices. KM also aimed to help organizations develop their dynamic capabilities to organizations to reconfigure, realign, and integrate their core competencies.

However, digitalization in knowledge management projects depends on which role they should play during the process. Technology helps the continuation and expansion of knowledge management projects but is considered immature in the area of cognitive behavior (Mohamed, Stankosky, & Murray, 2006). It still needs some support from socio-cultural inputs. Software, hardware, and other technologies must be in sync with company practices and environments. Therefore, the selection of knowledge management tools should be evaluated and matched within the context of the entire company.

The objectives of this research for the project development team are divided into three parts. The first objective is to retain the knowledge when projects are handed over from one project manager to another using digitalization so that the knowledge for those projects will stay inside the company with a minimum information gap. The second objective is to enrich existing knowledge by learning from old projects, avoiding past mistakes, and applying best practices in the software development process. Last, the company can use knowledge management to innovate itself, so that project managers can see the business and information flow existing across all divisions and propose new business processes or integration based on that knowledge.

Another objective of this research is intended for an operation support team. There are two primary goals. The first is to know and gather tacit knowledge from operational agents as project documentation in one place so that the following agents can access them easily. The second

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objective is to retain knowledge from previous agents and people related to projects. Therefore, it can be used to solve recurring issues and investigate how to solve new ones.

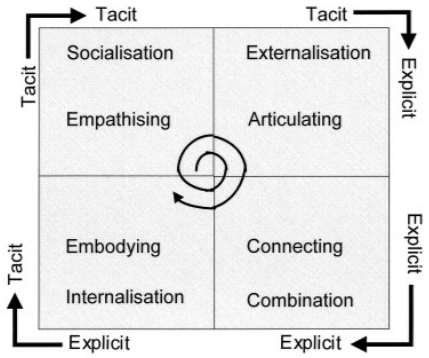
LITERATURE REVIEW

Knowledge Management Definition

Knowledge management (KM) has several definitions. Concluding from (Barth, 2000), (Bergeron, 2003), (Milton, 2009), and (Koenig, 2018), the common similarity in knowledge management is managing data and information to give value and competitive advantages to the organization. It involves how information is collected, shared, then used to increase individual and organizational capabilities.

Before planning a KM program, it will be great to know about types of knowledge first. In his research, Tjakraatmadja (2021) stated that there are two types of human knowledge, which are tacit and explicit knowledge. Tacit knowledge is knowledge in concept mode that uses theories and experiences as its media. Explicit knowledge is knowledge in the form of skill and cognitive elements, which are expressed in the form of systems, rules, and working procedures.

Both tacit and explicit knowledge can be created and converted depending on their usage in real life. Nonaka, Toyama, & Konn (2000) pictured the process of knowledge creation based on the conversion of tacit and explicit knowledge in a spiral model, widely known as the SECI matrix, as in Figure 1 below. SECI stands for Socialization, Externalisation, Combination, and Internalization. Through socialization, a person can share his tacit knowledge with another. In an organization, spending time together with employees, sharing sessions from seniors to their juniors, and company engagement are examples of socialization. Externalisation is where tacit knowledge is changed into explicit, making it a basis of new knowledge. The combination is the process of gathering existing explicit knowledge from inside or outside the organization to form a new one that will be more complex and systematic. It also includes the process of breaking down explicit knowledge into smaller ones. Internalization is often known as 'learning by doing', which happens when people read an organization's explicit knowledge and form new tacit knowledge for themselves.



(source: Nonaka, Toyama, & Konno, 2000)

Figure 1. SECI Model

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Digitalization's Impact on Knowledge Management

Digitalization is one of the popular terms nowadays when technology improves more and more each day. Research by (Parviainen, Tihinen, Kääriäinen, & Teppola, 2017) defined digitalization or digital transformation as changes in ways of working, roles, and business offerings caused by the adoption of digital technologies in an organization or the operating environment of the organization. Different from Parviainen, Bloomberg (2018) said that digitalization did not have a single clear definition. He used several definitions and concluded that digitalization is how technologies affect several aspects of life, like social interactions, business operations, and people's work. It supports process efficiency and improves data transparency which will benefit the company.

Three different perspectives that identify the impact and goals of digitalization in an organization are internal efficiencies, external opportunities, and disruptive change (Parviainen, Tihinen, Kääriäinen, & Teppola, 2017). Table 1 lists several examples of digitalization in knowledge management and its impacts on several companies and industries. In this research, digitalization will focus more on internal efficiencies and aims for improvement in the project development process. By changing manual processes, digitalization is hoped to bring improvement in business process efficiency, quality, consistency, and accuracy. With digital and analog integration, organizations can also get faster real-time data and forecast their growth in the bigger picture.

Research from (Liao, Fei, & Chen, 2007) concludes that knowledge sharing has a positive effect on absorptive capacity. The term absorptive capacity itself is the ability to recognize the value of new information, assimilate it, and apply it to commercial ends (Cohen & Levinthal, 1990). Frequent knowledge sharing between employees will benefit the organization's innovation capability. Aligning this research with digitalization, digitalization improved the knowledge-sharing processes within the organization. For example, posting information on enterprise social networks will reach a wider audience at a faster speed rather than spreading it to others one by one by phone. Since knowledge sharing is done more frequently due to digitalization, the absorptive capacity also improved and hopefully will lead to the company's growth.

Table 1. Knowledge Management Digitalization Example in Several Companies

Company Name	Industry	Goals	Digital Tools Used in KM	Impacts
Southwest Airlines (Bloomfire, 2022)	Travel and Leisure	• Internal efficiency	• Customer insights portal	• Operation efficiency
Kiron project at Nucleode Srl (Dal Mas, Piccolo, Edvinsson, Skrap, & D'Auria, 2020)	Healthcare	• Internal efficiency • External opportunities	• Mixed/augmented reality and Cloud computing as a repository and sharing portal	• Resources efficiency • Better planning • More accurate surgery
COSTAR at 7 UK Engineering Companies (Sung, Ritchie, Lim, Liu, & Kosmadoudi, 2012)	Engineering	• Internal Efficiency	• Automatic knowledge capture using the VR platform (COSTAR)	• Improve lead time in capturing knowledge • Improve knowledge value by changing the format from written to video clips

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Company Name	Industry	Goals	Digital Tools Used in KM	Impacts
US Government response to Haiti Earthquake (Yates & Paquette, 2011)	Emergency Management	• Internal efficiency • Disruptive changes	• Knowledge transfer, translation, and transformation (3-T) using social media • Collaborative tools for knowledge sharing	• Increased knowledge reuse • Leadtime reduction in transferring knowledge • Find old documents and information faster
Taylor Woodrow (Coakes, Bradburn, & Blake, 2005)	Housing and development	• Internal efficiency	• Global knowledge repository by adding extranets • Helpdesk and information center	• Increased efficiency • Global availability • Cost reduction • Leadtime reduction • Productivity Improvement
Development of Know-CoM for European dies and molds SMEs (Bayer, Enparantza, Maier, Obermair, & Schmiedinger, 2005)	Dies and molds SMEs	• Internal efficiency • Disruptive changes	• Decentralized knowledge management system for industry	Targeted results: • Cost reduction • Reduce individual knowledge gap • Tackle the old centralized knowledge management system

However, (Liao, Fei, & Chen, 2007) also said that knowledge shared by employees could not be taken as is, as it might be just an opinion or thought with no solid base. Therefore, it should be monitored and reprocessed to make use of that knowledge for the organization.

APO KM Assessment Tools

Asian Productivity Organization (APO) is an intergovernmental organization created in 1961 to increase productivity in Asia-Pacific through mutual cooperation. As on their website, their mission is to contribute to the sustainable socioeconomic development of Asia and the Pacific by enhancing productivity (Asian Productivity Organization, 2021). Their goals include sustained productivity growth, a robust innovation ecosystem, inclusive engagement, and shared prosperity across countries in their region. In 2021, APO had 21 countries as its member, which are Bangladesh, Malaysia, Cambodia, Mongolia, the Republic of China, Nepal, Fiji, Pakistan, Hong Kong, Philippines, India, Singapore, Indonesia, Sri Lanka, the Islamic Republic of Iran, Thailand, Japan, Turkey, Republic of Korea, Vietnam, and Lao PDR.

APO KM Assessment Tools is a set of questions developed by APO to help organizations assess their readiness for knowledge management by knowing its strength and weakness. It consists of 42 questions, divided into seven categories based on the APO KM Framework (Young, 2020), which are KM Leadership, Process, People, Technology, Knowledge Process, Learning and Innovation, and KM Outcomes.

The first category is KM Leadership, which evaluates the organization's leadership capacity while responding to the challenges of a knowledge-based economy. KM leadership is assessed in terms of KM policies and strategies in place in the organization. Leadership capacity is also assessed in terms of the organization's efforts to initiate, guide, and sustain KM practices in the organization.

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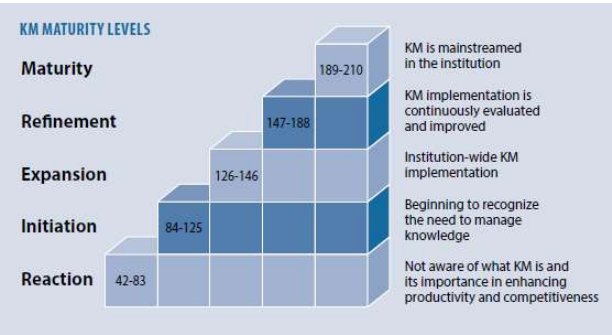
The second, third, and fourth categories are Process, People, and Technology. Questions in the Process category aimed to assess the use of knowledge in managing, implementing and improving the organization's key work processes. They also assess the extent to which the organization continually evaluates and improves its work processes to achieve better performance. Continuing Process category, the People category aims to assess the organization's ability to create and sustain an organizational knowledge-driven and learning culture. The organization's efforts to encourage knowledge sharing and collaboration among its employees are evaluated, including the development of employees as knowledge workers. After that, the fourth category, Technology, review the organization's ability to develop and deliver knowledge-based solutions such as collaborative tools and content management systems used in the Process by the People. It assesses the reliability and accessibility of existing knowledge management tools the company uses.

The fifth category is Knowledge Processes. Questions in this category evaluate the organization's ability to identify, create, store, share, and apply knowledge systematically. The assessment focused on how the company minimizes work duplication by including the sharing of best practices and lessons learned in the working process. The sixth category focused on Learning and Innovation. It determines the organization's ability to encourage, support, and strengthen learning and innovation via systematic knowledge processes. This category also assesses management's efforts to embed values of learning and innovation and provide incentives for the sharing-knowledge process.

The last category, KM Outcomes, measures the organization's ability to enhance value to customers and citizens through new and improved products and services. It evaluates the organization's ability to increase productivity, quality, profitability, and sustainable growth through the effective use of resources and as a result of learning and innovation.



(source: Young, 2020)

Figure 2. KM Maturity and Readiness Level

Each section in APO KM Assessment Tools consists of six questions that can be rated from 1 (doing very poorly or nothing at all), 2 (doing poorly), 3 (doing adequately), 4 (doing well), and 5 (doing very well). Multiplied them all, the possible maximum score is 210 points, with a maximum of 30 points for each category. The scores were then mapped into five level of maturity levels, as in Figure 2, which shows the use of KM in the company. If the score is in the range of 42-83, then the company's maturity level is in level 1, Reaction Level. It means that the organization has not

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implemented KM yet. It does not seem aware of KM and its importance in enhancing productivity and competitiveness. A score of 84-125 means that the company is in Level 2, Initiation Level. At this level, the organization already knows what KM is and begins to recognize the need to manage knowledge in the company. It is also possible that the company may already initiate a pilot KM project. Level 3, Expansion Level, is where KM is already fully implemented and deployed. At this level, the KM implementation and use are already stable, and the company begins to look for new ways to expand and improve its KM. The fourth level, Refinement, is in the range of 147-188. At this level, the implementation of KM is continually evaluated for continuous improvement. The last stage is Level 5, Maturity, where the company reaches 189-210 in the score. As the last stage, KM in the company is considered mature because it is already fully mainstreamed within the organization. By knowing its readiness level, the company can develop a strategy to close the gap and seek opportunities to improve itself.

RESEARCH METHOD

The flow diagram in Figure 3 illustrates the research methodology for this research. It starts with defining business issues. Then, the next step is to gather the primary and secondary data needed. Primary data is obtained from three steps. At first, KM readiness at PT Snack Sehat will be assessed using APO KM Assessment Tools. After the result is collected, the second step, focus group discussion (FGD), will be held separately between the project development and operation team. The manager of the SW department and the leaders of the team will participate in the FGD. The purpose of this FGD is to convey the current situation of knowledge management to the leaders of the team and discuss the gap in the score. During FGD, the last step, root cause analysis, is also being done to summarize the root cause to find the main issue causing inefficiency in the current project development and operation support process. The result of the root cause analysis will then be used as the basis of analysis to define the knowledge management process that fits with PT Snack Sehat.

Internal documents such as procedures, reports, and documentation from PT Snack Sehat are the first source of secondary data for this research. Another source comes from literature reviews from journals and books focused on knowledge management, digitalization, project development, operational support, and project efficiency. These secondary data will be used to provide supporting theories in the analysis and formulation of knowledge management solutions.

After gathering data, the next step of the research is business issue analysis to find the solution. It starts with a knowledge management development process based on the Six Steps of KM Processes (Tjakraatmadja, 2021). The steps are KM Project, KM Assessment, KM Planning, K-Development, KM Implementation, and KM Evaluation. The first step, KM Project, is done to determine the scope of this research, which is the KM program in the Project Development and Operation Support team in PT Snack Sehat. In this step, first, knowledge management components (people, process, and technology) have been determined by gathering secondary data from internal documents, such as the list of employees in the project development and operational support team, project development and operational support procedures, and list of used tools during project management and operational support process.

After determining the scope of the research, the second and third steps, which are KM Assessment and KM Planning, are done alongside each other by assessing KM readiness using APO

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KM Assessment Tools to all people in Project Development and operation Management team and doing a Focus Group Discussion to determine the root cause of inefficient project development and operation support process based on assessment results. In this part, literature reviews from books and journals related to knowledge management benefits, project management, digitalization, and software development efficiency are being used to define steps of the assessment process and help participants of the discussion to know more about the topic and do the brainstorming effectively.

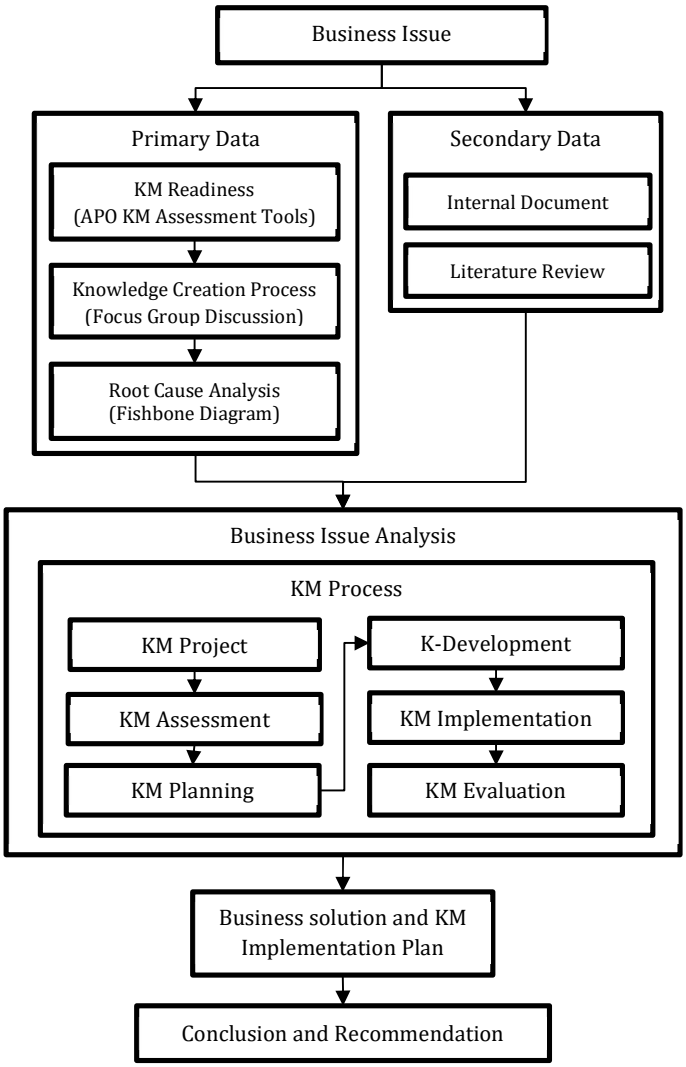

Figure 3. Research Methodology

After concluding the root causes, the KM development process will be continued to the fourth step, K-Development. The analysis includes combining primary and secondary data from the literature review and internal documents and designing processes that fit the existing condition of

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PT Snack Sehat or need to be initiated to increase the efficiency of project development and operational support process. Besides the document analysis, the development also includes internal discussion to define the objectives of the KM program, answer questions related to the knowledge management components (people, process, and technology), determine the knowledge management strategy based on KM objectives, and set the action plan to get ten commitments from top-level management (Garfield, 2016). The outputs of K-Development are several recommendations to improve the current knowledge management system of PT Snack Sehat by adding several processes and methods using digitalization.

In this research, however, the fifth and sixth steps, KM Implementation and KM Evaluation, will not be included. The implementation and evaluation plan will be discussed and used internally.

FINDINGS AND DISCUSSION

The APO KM Assessment Tools (Young, 2020) is conducted among all people in the Software Department, which consists of 18 people from Project Development and Operation Support Team with various roles, as in Table 2 and Table 3. For project management, everyone in the project development team will answer the APO questions. These people consist of twelve people in total, including the manager of the software department, 4 (four) business function leads, and 7 (seven) business analysts and project managers. For operational management, the APO questions will be spread to everyone in the operation support team, a total of 5 (five) people, which consists of the manager of the SW department, the operation lead, and 3 (three) operation team members.

Table 2. People from the Project Development Team

Project Development Team			
Hierarchical Role	**Initial**	**Working Time in PT Snack Sehat**	**Number of People**
Software Department Manager – top-level manager	Mrs. I	14 years and became manager for eight years	1
Business Function Lead (BFL) – middle-level manager	Mrs. E	12 years	4
	Mr. G	Four years, became BFL for two years	
	Mr. H	Four years, became BFL for two years	
	Mrs. J	Two years and four months became BFL for two years	
Business Analyst / Project Manager	Mr. A	Two years and seven months	8
	Mr. AK	Two years	
	Mr. B	Two years and eight months	
	Mrs. M	Two years and eight months	
	Mr. N	Two years and seven months	
	Mrs. R	Three years and three months	
	Mrs. S	Two years and eight months	
	Mr. V	Two years	

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Table 3. People from the Operation Support Team

Operation Support Team			
Hierarchical Role	**Initial**	**Working Time in PT Snack Sehat**	**Number of People**
Software Department Manager – top-level manager	Mrs. I	14 years and became manager for eight years	1
Operation Lead – middle-level manager	Mrs. D	Nine years	1
Operation Team (Agent)	Mrs. K	17 years	3
	Mr. R	Three years and nine months	
	Mr. W	Three years and eight months	

The respondents will be given all 42 questions as listed in 0. They will give a rate from 1-5 for each question. Then, the results will be grouped based on their hierarchical levels, which are implementers (consisting of business analysts, project managers, and operational agents), middle-level managers (consisting of business function and operational lead), and top-level managers (software department manager). The score and gaps among all roles in each category will then be discussed in a focus group discussion (FGD) with the manager and lead only as the decision-makers. In that FGD, the root cause analysis will also be conducted.

Table 4 summarizes the result from the assessment of the project development team, which shows that all the total scores from each role have already reached the refinement level. At this level, KM is already implemented during project development and should be evaluated and improved continuously. The next step should focus more on aligning KM with processes used in the organization. Therefore, the solution of KM in PT Snack Sehat will not be building the KM program from the start but focused more on improving and using effective KM processes during the project development process.

In the project development team, the lowest three average scores started from the smallest are KM Leadership, KM Outcomes, and People. In Table 4, although People and KM Outcomes have the lowest score, the gap between each role is not so far between the top and middle-level managers (BFL and manager). However, from the implementer's perspective, the scores are higher than the others. As discussed in FGD, the reason for this gap is the unaligned expectations from managers to implementers. Implementers felt that they already provide complete documents to be used. On the other hand, managers could not make full use of the information in the document provided by implementers.

Table 4. APO KM Assessment Tools Result for Project Development Team

	Category	Average BA/PM	Average BFL	Manager	Avg All
1	KM Leadership	23.43	19.00	16.00	19.48
2	Process	23.71	24.00	23.00	23.57
3	People	23.00	21.50	21.00	21.83
4	Technology	27.86	23.75	26.00	25.87
5	Knowledge Processes	23.86	22.00	23.00	22.95
6	Learning and Innovation	23.86	22.75	24.00	23.54

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	Category	Average BA/PM	Average BFL	Manager	Avg All
7	KM Outcomes	23.00	21.00	20.00	21.33
	Total Scores	**168.71**	**154.00**	**153.00**	**158.57**
		Refinement	**Refinement**	**Refinement**	**Refinement**

For the operation support team, Table 5 summarizes the result of the APO KM Assessment. As in Table 5, the Knowledge Processes category has the lowest average score, with 19.56 out of 30. Since the gap is relatively small in each role, all operation and support teams agreed that this category is one of their weaknesses.

However, the total score is quite different from each level. Agents' and managers' scores showed that KM is already reaching the refinement level. On the other hand, the operational lead gives a total score of 144.00, which puts the maturity level as expansion, where KM has just been implemented in the department. This gap happens because the operational lead, as a middle-level manager, does most of the KM planning and development all by herself so that KM is seen as good enough at both the agent and manager levels.

Table 5. APO KM Assessment Tools Result for the Operation Support Team

	Category	Average Agent	Avg Operation Lead	Manager	Avg All
1	KM Leadership	23.67	22.00	20.00	21.89
2	Process	25.67	21.00	24.00	23.56
3	People	22.33	20.00	23.00	21.78
4	Technology	24.67	25.00	27.00	25.56
5	Knowledge Processes	20.67	19.00	19.00	19.56
6	Learning and Innovation	22.33	20.00	25.00	22.44
7	KM Outcomes	23.33	17.00	24.00	21.44
	Total Scores	**162.67**	**144.00**	**162.00**	**156.22**
		Refinement	**Expansion**	**Refinement**	**Refinement**

As seen in Table 5, the highest gap in the Operation Support team is on KM Outcomes, with 6.33 points from agents to operation lead and 7 points from operational lead to manager. Operational lead put a lower score in KM Outcomes because although KM is done better and better each year, there is still no appropriate measurement to rate how KM benefits daily operational work. For the Process, the main obstacle is to change people's behavior and encourage them to do the KM process as a habit. Another problem is aligning the agent's assignment from one application to another. It is hard to track the changes and match agents with the applications they handle.

From the KM Readiness Assessment result, the focus group discussion was held to find the root cause of the main business issue, and why project development was late and done inefficiently. Based on KM Assessment above and the focus group discussion, three main root causes for this research are determined. They are low priority in doing KM, no validation or assigned people or team to validate captured knowledge and monitor the role and responsibility in KM, and no aligned KM goal and expectation. The result shows that PT Snack Sehat already has collected knowledge in one place, but difficult to maintain and update the content of knowledge if changed. These root causes are similar to other companies that have already implemented the KM systems and reached

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Refinement Level. For example, the second root cause, no validation to validate and monitor roles and responsibilities, is similar to the problem in the research from a company named Jurnal.id (Pramudita & Ghazali, 2019), when they faced no proper standard for documentation and archiving. The third root cause, no aligned KM goals or expectations, is also similar to one of their issue about unclear KPI measurement and its evaluation in Jurnal.id's current KM system. In similar research with PT XYZ by (Baskara, Kurniawati, & Athari, 2021), the KM in the company itself has already reached the Refinement Level. Although employees there have gathered knowledge in the form of documentation, there are still some issues regarding how to increase employees' responsibility in KM to maintain their tacit knowledge from resigned employees.

The knowledge management program for PT Snack Sehat is designed based on the Six Steps of KM Processes (Tjakraatmadja, 2021), which include KM Project, KM Assessment, KM Planning, K-Development, KM Implementation, and KM Evaluation. The development steps will include defining the objectives of the KM program, answering questions related to the knowledge management components (people, process, and technology), determining the knowledge management strategy based on KM objectives, and setting the action plan to get ten commitments from top-level management (Garfield, 2016).

Based on KM Assessment, the average score of PT Snack Sehat has reached the refinement level. It means that the company already has proper knowledge management. The company should focus on evaluating and improving its KM program. To enhance the current knowledge management system in PT Snack Sehat, there are several additional processes as recommendations to be added, which are KM Orientation Training, Shadowing, Sharing Knowledge Checklist, Lesson Learned Document, Document Validation, and Document Organization. As in the assessment result, the lowest scores for Project Development Team are in KM Leadership, KM Outcomes, and People categories. For Operation Support Team, the lowest scores are in Knowledge Process, KM Outcomes, and People categories. Table 6 shows these additional processes and their relations to improve the lowest score categories in both teams.

Table 6. Additional Processes Added to Improve Lowest Score Categories

	Additional Process Added	**Will Improve**	
		Project Development Team	**Operation Support Team**
1	KM Orientation Training	KM Leadership, People	People, Knowledge Process
2	Shadowing	KM Leadership, People	People, Knowledge Process
3	Sharing Knowledge	People, KM Outcomes	Knowledge Process, KM Outcomes
4	Lesson Learned Document	People	People, Knowledge Process
5	Document Validation	People, KM Outcomes	People, KM Outcomes
6	Document Organization	People, KM Outcomes	People, Knowledge Process, KM Outcomes

As the result of this research, Figure 4 illustrates the complete KM Stock and Flow diagram for PT Snack Sehat. It consists of the project development and operation support process, people involved, and tools used in the current KM process, divided into SECI matrix. Additional KM processes for PT Snack Sehat are highlighted in blue.

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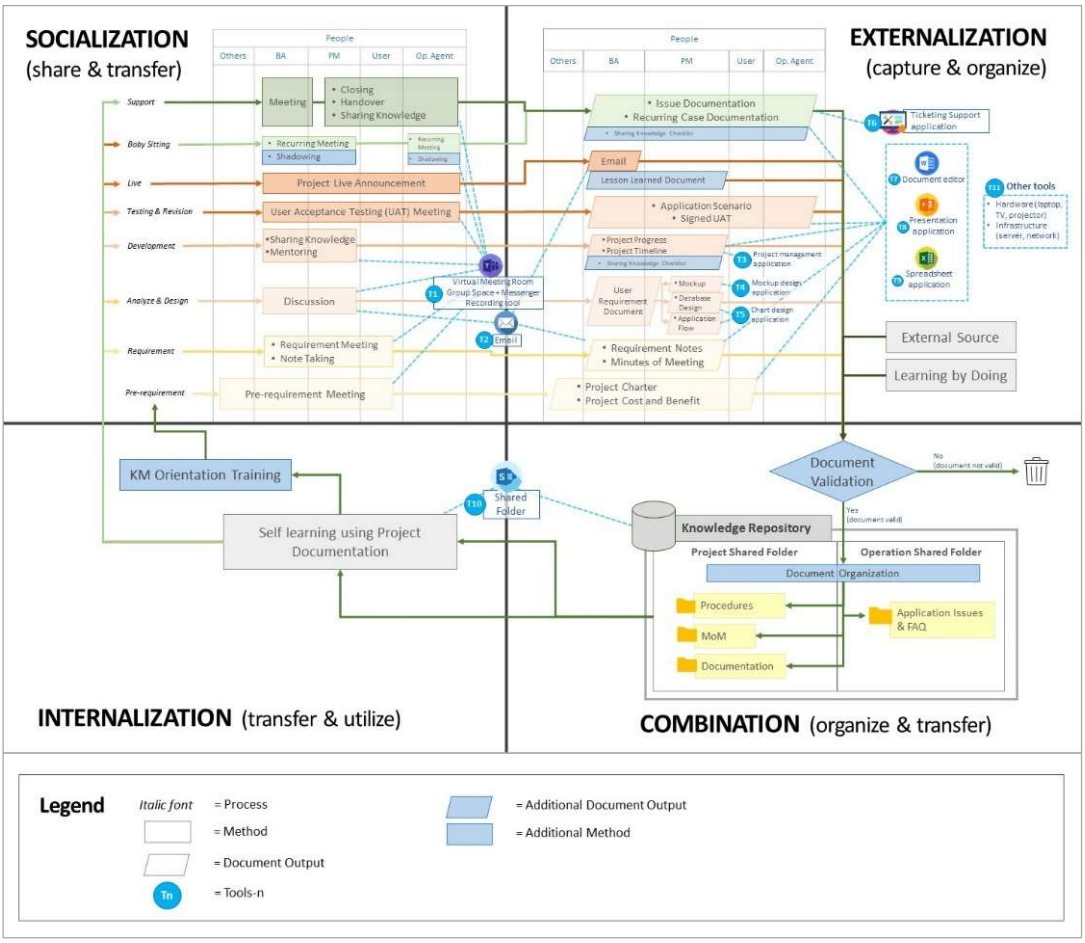

Figure 4. KM Stock and Flow for Project and Operation Management in PT Snack Sehat

During this research, the APO KM Assessment tool is used in three hierarchical roles, which are implementers (Business Analyst/Project Manager/Operation Agents), middle-level managers (Business Function Lead and Operation Lead), and top-level managers (Software Department Manager). In each of those roles, the maturity levels are already reached the refinement level. However, the standard quality of the refinement level is different for each level. An example of this problem is in questions 25 and 27 in Category 5.0: Knowledge Processes. Question 25 asked if the organization has systematic processes for identifying, creating, storing, sharing, and applying knowledge. Clearly, the organization has already had those KM processes. However, the refinement level answered by the implementer and top-level manager has different qualities and standards for each process. Question 27 asked if knowledge accrued from completed tasks or projects is documented and shared. Again, from the implementer's perspective, documented and shared means creating detailed documents and saving them in a shared folder. In top-level management, documented means that the documentation should be ready to use as a project report. However, the top-level manager still gives a refinement score because the middle-level manager mostly did

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the alignment. So, although the APO KM Assessment tool is dependable at the macro level, it is not practical to be used at the micro level because it cannot align each maturity level standard for different hierarchical roles.

Another finding from this research is how knowledge management is related strongly to the business process of the organization. KM standardization should be followed by business process standardization. In this research, instead of adding the KM process only, the current project development process should be aligned with the KM process implementation. Every milestone in each project development phase should reach the same level of standardization and quality for every hierarchical role, starting from the implementer, middle-level manager, and top-level manager. Therefore, it is also recommended to audit and recheck the current project development phase before implementing the KM process, whether it needs to be restructured or not.

CONCLUSION AND RECOMMENDATION

In this research, the main business issues are lateness and inefficiency during project development. For the operation support team, efficiency is also an issue, especially about how they keep their knowledge and use it to reduce the lead time of their ticket response and resolution time. Therefore, this research is conducted to implement digitalization in project development dan operational support to increase their efficiency during their work.

During this research, KM readiness assessment and focus group discussion is conducted to find the root causes of the late and inefficient project development process in PT Snack Sehat. The findings are low priority in doing KM in both implementer and managers, no one validate captured knowledge and monitor the role and responsibility in the team, and no aligned KM goal and expectation.

Based on KM Assessment, the average score of PT Snack Sehat has reached the refinement level. This means the company already has proper knowledge management. The company should focus on evaluating and improving its KM program. By using the Six Steps of KM Processes (Tjakraatmadja, 2021), the company can review the KM practices in its business process and put several KM tools and processes in addition to the current KM system. In PT Snack Sehat, to enhance the current knowledge management system, there are several additional processes as recommendations to be added, which are:

1. KM Orientation Training
2. Shadowing
3. Sharing Knowledge Checklist
4. Lesson Learned Document
5. Document Validation
6. Document Organization

For PT Snack Sehat, the recommendation is to review the current business processes in project development and operational support. The current processes, roles, and responsibilities should be aligned along with KM process implementation. Therefore, it is also recommended to audit and recheck the current project development phase before implementing the KM process, whether it needs to be restructured or not.

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LIMITATIONS & FURTHER RESEARCH

This research is done in the IT division of PT Snack Sehat. So, the research and result also may not be suitable and applicable to project management in other companies due to different environments and conditions. From all three KM components, this research focused more on improvement and efficiency in the Process and People side, especially about validation and aligning KM goals and expectations to all project development teams. Although additional processes are added, some policies still need to be defined to make sure this process aligned will play all roles in the project development process. There are also many things to be explored further from the People component, such as choosing people as the validator, converting the KM process to become a habit during daily work, or motivating employees by giving rewards. For the Technology component, one of the issues in the company is a limitation of access for different roles. Therefore, further research about enabling KM access for everyone without breaking the company's rules needs to be analyzed. In addition, choosing technology components that will match the company's sociocultural environment also need to be evaluated further.

During this research, the APO KM Assessment tool is used in three hierarchical roles, which are implementer (Business Analyst/Project Manager/Operation Agents), middle-level manager (Business Function Lead and Operation Lead), and top-level manager (Software Department Manager). In each of those roles, the maturity levels have already reached the refinement level. However, the standard quality of the refinement level is different for each level. An example of this problem is in questions 25 and 27 in Category 5.0: Knowledge Processes. Question 25 asked if the organization has systematic processes for identifying, creating, storing, sharing, and applying knowledge. Clearly, the company has already had those KM processes. However, the refinement level answered by the implementer and top-level manager has different qualities and standards for each process. Question 27 asked if knowledge accrued from completed tasks or projects is documented and shared. Again, from the implementer's perspective, documented and shared means creating detailed documents and saving them in a shared folder. In top-level management, documented means that the documentation should be ready to use as a project report. However, the top-level manager still gives refinement scores because the middle-level manager mostly did the alignment. So, although the APO KM Assessment tool is dependable at a macro level, it is not practical to be used at a micro level because it cannot align each maturity level standard for different hierarchical roles. For further research, because APO KM Assessment Tools cannot help when used at a micro level, this research can be done using different methods and frameworks. New frameworks or tools for assessing KM maturity at the micro level can also be developed.

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APPENDIX A. Questions in APO KM Assessment Tools

Cat 1.0: KM Leadership
1. The organization has a shared Knowledge Vision and Strategy strongly linked to the organization's vision, mission, and goals.
2. Organizational arrangements have been undertaken to formalize KM initiatives (i.e., central coordinating unit for knowledge/information management, Chief Knowledge/Information Officer, ICT team, quality improvement teams/ Communities of practice, knowledge networks).
3. Financial resources are allocated for KM initiatives.
4. The organization has a policy for safeguarding knowledge (i.e., copyrights, patents, KM, and knowledge security policy).
5. Managers role-model the values of knowledge sharing and collaborative working. They spend more time disseminating information to their staff and facilitating the horizontal flow of information between their staff and with staff of other departments/divisions/units.
6. Management promotes, recognizes, and rewards performance improvement, organizational and employee learning, sharing of knowledge, and, knowledge creation and innovation.

Cat 2.0: Process
7. The organization determines its core competencies (strategically important capabilities that provide a competitive advantage) and aligns it to their mission and strategic goals.
8. The organization designs its work systems and key processes to create value to customers and achieve performance excellence.
9. New technology, knowledge shared in the organization, flexibility, efficiency, and effectiveness are factored into the design of processes.
10. The organization has an organized system for managing crisis situations or unforeseen events that ensures uninterrupted operations, prevention, and recovery.
11. The organization implements and manages its key work processes to ensure that customer requirements are met and business results are sustained.
12. The organization continually evaluates and improves its work processes to achieve better performance, to reduce variations, to improve products and services, and to be updated with the latest in business trends, developments, and directions.

Cat 3.0: People
13. The organization's education, training, and career development program build employee knowledge, skills, and capabilities, support achievement of overall objectives, and contribute to high performance.
14. The organization has a systematic induction process for new staff that includes familiarity with KM and its benefits, the KM system, and tools.
15. The organization has formal mentoring, coaching, and tutoring processes.
16. The organization has a database of staff competencies.
17. Knowledge sharing and collaboration are actively encouraged and rewarded/corrected.
18. Employees are organized into small teams/groups (i.e., quality circles, work improvement teams, cross-functional teams, communities of practice) to respond to workplace problems/concerns.

Cat 4.0: Technology
19. Management has established an IT infrastructure (i.e., Internet, intranet, and website) and has developed capabilities to facilitate effective KM.

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20. The IT infrastructure is aligned with the organization's KM strategy.
21. Everyone has access to a computer.
22. Everyone has access to the Internet/intranet and an email address.
23. Information delivered in the website/intranet is updated on a regular basis.
24. Intranet (or similar network) is used as a major source of organization-wide communication to support knowledge transfer or information sharing.
Cat 5.0: Knowledge Processes
25. The organization has systematic processes for identifying, creating, storing, sharing, and applying knowledge.
26. The organization maintains a knowledge inventory that identifies and locates knowledge assets or resources throughout the organization.
27. Knowledge accrued from completed tasks or projects are documented and shared.
28. Critical knowledge from employees leaving the organization is retained.
29. The organization shares best practices and lessons learned across the organization so that there is no constant re-inventing of the wheel and work duplications.
30. Benchmarking activities are conducted inside and outside the organization, the results of which are used to improve organizational performance and create new knowledge.
Cat 6.0: Learning and Innovation
31. The organization articulates and continually reinforces the values of learning and innovation.
32. The organization regards risk taking or committing mistakes as learning opportunities, so long as they are not performed repeatedly.
33. Cross-functional teams are organized to tackle problems/concerns that cut across the different units in the organization.
34. People feel empowered and that their ideas and contributions are generally valued by the organization.
35. Management is willing to try new tools and methods.
36. Individuals are given incentives to work together and share information.
Cat 7.0: KM Outcomes
37. The organization has a history (and maintains measures) of successfully implementing KM and other change initiatives.
38. Measures are in place for assessing the impact of knowledge contributions and initiatives.
39. The organization has achieved higher productivity through reduced cycle time, bigger cost savings, enhanced effectiveness, more efficient use of resources (including knowledge), improved decision-making, and increased speed of innovation.
40. The organization has increased its profitability as a result of productivity, quality, and customer satisfaction improvements.
41. The organization has improved the quality of its products and/or services as a result of applying knowledge to improve business processes or customer relationships.
42. The organization has sustained growth as a result of higher productivity, increased profitability, and better quality product and services.

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