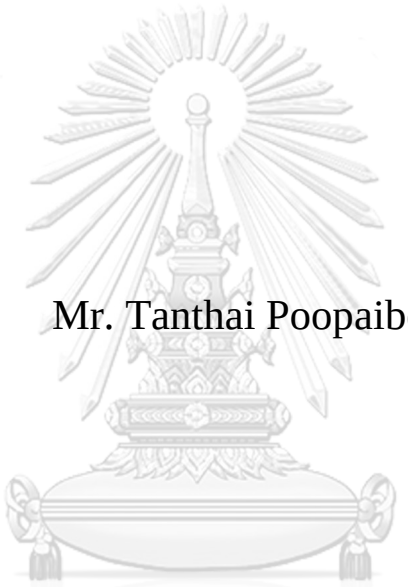
DIGITAL PLATFORM DEVELOPMENT FOR PERFORMANCE MONITORING SYSTEM IN OIL AND GAS EXPLORATION AND PRODUCTION

Mr. Tanthai Poopaiboon



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การพัฒนาแพลตฟอร์มดิจิตอลสำหรับระบบการติดตามประสิทธิภาพในการดำเนินงานสำหรับบริษัทด้านการสำรวจและผลิตน้ำมันและก๊าซธรรมชาติ

นายแทนไท ภู่ไพบูลย์

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต
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Thesis Title	DIGITAL PLATFORM DEVELOPMENT FOR PERFORMANCE MONITORING SYSTEM IN OIL AND GAS EXPLORATION AND PRODUCTION
By	Mr. Tanthai Poopaiboon
Field of Study	Engineering Management
Thesis Advisor	Associate Professor JEERAPAT NGAOPRASERTWONG

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แทนไท ภู่ไพบูลย์ : การพัฒนาแพลตฟอร์มดิจิตอลสำหรับระบบการติดตามประสิทธิภาพในการดำเนินงานสำหรับบริษัทด้านการสำรวจและผลิตน้ำมันและก๊าซธรรมชาติ. (DIGITAL PLATFORM DEVELOPMENT FOR PERFORMANCE MONITORING SYSTEM IN OIL AND GAS EXPLORATION AND PRODUCTION) อ.ที่ปรึกษาหลัก : รศ.จิรพัฒน์ เงาประเสริฐวงศ์

บทความนี้เป็นกรณีศึกษาเพื่อเพิ่มประสิทธิภาพระบบการจัดการประสิทธิภาพสำหรับอุตสาหกรรมการสำรวจและผลิตน้ำมันและก๊าซ แม้ว่าระบบจะได้รับการออกแบบสำหรับอุตสาหกรรมการสำรวจและผลิตน้ำมันและก๊าซ วิทยานิพนธ์นี้สามารถนำไปใช้อย่างมีประสิทธิภาพสำหรับอุตสาหกรรมอื่น ๆ เนื่องจากองค์กรสมัยใหม่ส่วนใหญ่ใช้ตัวบ่งชี้ประสิทธิภาพหลัก (KPI) เพื่อสะท้อนถึงประสิทธิภาพขององค์กร ดังนั้นวิทยานิพนธ์นี้สามารถนำไปประยุกต์ใช้กับองค์กรส่วนใหญ่ได้โดยปรับเปลี่ยนเพียงเล็กน้อยเพื่อให้เหมาะสมกับธุรกิจ ระบบการจัดการประสิทธิภาพขั้นสูงนี้ได้รับการพัฒนาอย่างเป็นระบบโดยการนำระบบดิจิทัลมาใช้ และรวมถึงการวิเคราะห์หาสาเหตุของปัญหา การพัฒนาโครงการดิจิตอล และการวัดผลลัพธ์ของโครงการ เนื้อหาวิทยานิพนธ์เริ่มด้วยการศึกษาวิธีการปรับปรุงกระบวนการทำงานและการพัฒนาโครงการดิจิตอล รวมถึงตัวอย่างการพัฒนาโครงการดิจิตอลในระดับสากล ลำดับที่สอง ได้ทำการวิเคราะห์กระบวนการทำงานและแนวทางปฏิบัติที่มีอยู่เดิมทั้งในมุมมองเชิงคุณภาพและเชิงปริมาณเพื่อระบุปัญหาและแนวทางแก้ไขที่เป็นไปได้ ลำดับที่สาม พัฒนาโครงการดิจิตอลให้เกิดขึ้นจริงและนำไปใช้ในองค์กร สุดท้าย ขั้นตอนการวัดความสำเร็จของโครงการ ผลลัพธ์โครงการประกอบด้วยการลดขั้นตอนการทำงาน การพัฒนาแพลตฟอร์มดิจิตอลสำหรับการทำงานร่วมกัน และพัฒนาหน้าจอแสดงผลตัวบ่งชี้ประสิทธิภาพหลัก (KPI) พัฒนาการคำนวณ KPI อัตโนมัติ และพัฒนาระบบเตือนเมื่อ KPI มีสัญญาณที่จะไม่บรรลุเป้าหมาย ระบบการจัดการประสิทธิภาพขั้นสูงนี้ให้ประโยชน์อย่างมากกับองค์กรโดยลดจำนวนชั่วโมงการทำงานของพนักงานลง 80% ซึ่งทำให้องค์กรสามารถพัฒนาทักษะและจัดสรรทรัพยากรบุคคลนี้ไปทำงานส่วนอื่นที่สำคัญกว่าได้เพื่อมุ่งเน้นให้ทรัพยากรบุคคลมีเวลาคิดหาวิธีการทำงานใหม่เพื่อเพิ่มความสามารถในการแข่งขันขององค์กร เพื่อสร้างมูลค่าเพิ่ม อีกทั้งข้อมูลทางสถิติในระบบสามารถนำใช้ในการวิเคราะห์เพื่อปรับปรุงประสิทธิภาพขององค์กรได้ นอกจากนี้วิทยานิพนธ์นี้ได้ให้คำแนะนำสำหรับโครงการในอนาคตเพื่อขยายขอบเขตของแพลตฟอร์มดิจิทัลไปยังส่วนอื่นๆ ของระบบการบริหารจัดการเพื่อความเป็นเลิศเพื่อรักษาผลการปฏิบัติงานขององค์กรให้ยั่งยืน แม้ว่าพนักงานที่มีความสามารถจะเกษียณจากองค์กรก็ตามไปก็ตาม นอกจากนี้ได้มีการแนะนำ ตัวบ่งชี้ประสิทธิภาพหลัก (KPI) ที่เหมาะสมสำหรับธุรกิจการสำรวจและผลิตน้ำมันและก๊าซที่สามารถนำไปประยุกต์ใช้ได้

สาขาวิชา	การจัดการทางวิศวกรรม	ลายมือชื่อนิสิต .....
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Tanthai Poopaiboon : DIGITAL PLATFORM DEVELOPMENT FOR PERFORMANCE MONITORING SYSTEM IN OIL AND GAS EXPLORATION AND PRODUCTION. Advisor: Assoc. Prof. JEERAPAT NGAOPRASERTWONG

The paper provides a case study to enhance the Performance Management System for Oil and Gas Exploration and Production industry. Although the system was designed for the Oil and Gas Exploration and Production industry, the paper could be applied effectively for other industries because the modern organisation mainly utilised the Key Performance Indicator (KPI) to reflect its performance. So, the paper could be applied to most organisations with minor modifications.

The Advanced Performance Management System was developed systematically powered by digital transformation according to research methodology framework, including research, analysis, project development, and result measurement. The research stage is studying the relevant pieces of literature for work process improvement and solution development. Secondly, the analysis stage analyses the existing work process and practices in both qualitative and quantitative perspectives to identify problems and potential solutions. Thirdly, the project development stage is to develop practical solutions and implement them in the organisation. Lastly, the result measurement stage is the process to measure the success of implementation.

The deliverables of the project consist of shortening the work process, developing the collaboration platform, developing the Key Performance Indicator (KPI) dashboard, developing the automated KPI calculation, and developing the warning system when KPI had a signal to fail.

The Advanced Performance Management System provided significant benefits to the organisation by reducing the workforce by 80% that allowed the organisation to reskill and allocate resources to other vital tasks in the organisation that could generate more value. Interm of qualitative benefits, the project improved the quality of the performance management system resulted from improved KPIs, better visualisation, and available statistical data for analysis.

Besides, the paper provides recommendations for future projects to extend the scope of the digital platform to other areas of the Operational Excellence Management System; including, Procedure, Deployment, and Conformance to sustain the organisation's performance, although the competent staff retired from the organisation. Also, the new KPI hierarchy is recommended to classify the KPIs into four levels: data monitoring, leading KPI, lagging KPI, and Organisation KPI. The recommended KPI hierarchy help reduce the number of KPIs and enable the organisation to focus on the crucial KPIs related to the organisation's strategy.

Field of Study:	Engineering Management	Student's Signature .....
Academic Year:	2020	Advisor's Signature .....

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Tanthai Poopaiboon

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

Chapter 1 Introduction

The introduction chapter will be structured according to the below framework starting from the overview of the Thesis that mainly describes research objectives, the scope of research, and the expected outcomes. Secondly, the literature review will harvest the knowledge and practices from various journals and international standards related to Performance Management Systems and service support technologies. Lastly, the research methodology will present the processes to achieve the Thesis objectives and present the Thesis activities plan.

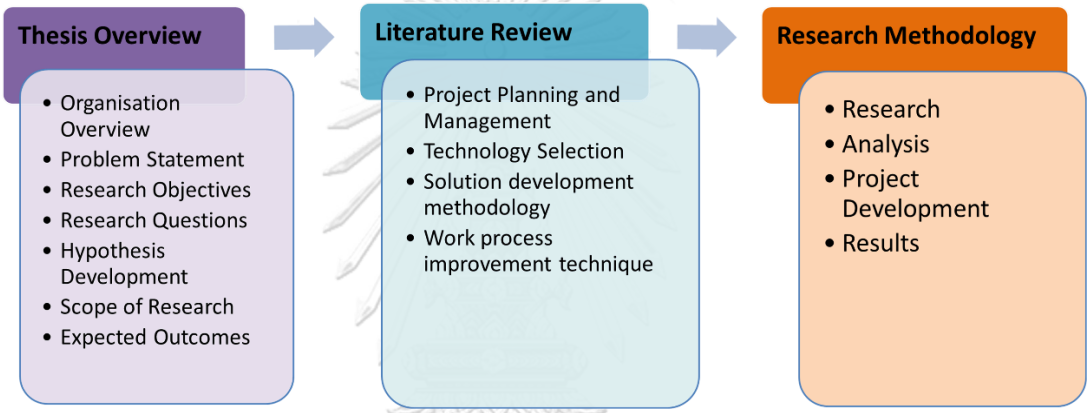


Figure 1: Introduction Chapter Framework (Author)

The oil and gas exploration and production organisation in Thailand will be the case study in the Thesis. The organisation is in a commodity market in which it cannot control the selling prices of products. The cost leadership strategy is an effective strategy that commodity businesses shall focus on (Porter, 1985).

The company in the case study has a head office in Bangkok, Thailand. The company is a state enterprise in Thailand that is responsible for oil and gas exploration and production. The organisation has about 7,000 staff operating mainly in Southeast Asia and the Middle East (PTTEP, 2020). The organisation has a market cap of about 13,300 Million USD as of 31 August 2021 (SET, 2021).

Therefore, the effective performance management system could be a practical enabler to enhance organisational efficiency in various dimensions, resulting in competitive

costs, surviving in a volatile environment, and increasing profits (IOGP, 2014) (Deberdieva, 2015).

Before implementing the Advanced Performance Management System, the organisation manages all performance by a manual process consisting of thirteen (13) processes to complete the performance reporting. The manual process consumed many human resources, about 1,034 manhours per year calculated from the manhour required from related departments to complete the performance management system and the reports, excluding waiting time. The related staff must email their responsible data to the Analyst to calculate Key Performance Indicator (KPI) in an excel spreadsheet and prepare the PowerPoint KPI report for submission to Committee. With the Manual process, the historical performances were not recorded in terms of digital data. The investigation and performance improvement are problematic as a result of the difficulty in performance analysis.

Therefore, the Thesis is established to analyse the current practice to find the improvement areas, develop solutions, and implement them into the organisation. The Thesis will be the crucial enablers to improve the entire organisation's performance management system.

The research methodology consists of four (4) sections. The author was entirely responsible for studying the relevant literature, including work process improvement technique, solution development methodology, technology selection technique, and project planning and management.

Secondly, the author was entirely responsible for analysing the current performance management system with various techniques to identify the improvement areas and potential solutions in the Analyst's role to deeply understand the current work process and identify opportunities for improvement systematically. The analysis started with illustrating the existing work process of the Performance Management System, then analysing the entire work process from both a qualitative perspective and a quantitative perspective. Then, the fishbone diagram will be used to analyse the causes of a specific

problem in various dimensions to identify the potential root causes of the specific problem.

Thirdly, the author was entirely responsible for developing the potential solutions to implement into the organisation and measuring the success of the implementation in the role of Project Manager. The author made the supplier selection to select the supplier and workforce to program and develop the software and application according to the scope and requirements specified by the author and manage the entire project management as a Project Manager from feasibility study until implementation.

Besides, The Thesis also provided the recommendation and application to enhance the Operational Excellence Management System by digitalisation which could be applied to other organisations effectively.

1.1 Problem Statement

Th organization had the corporate strategy to achieve competitive performance by creating the most value from existing assets and maintaining cost competitiveness. However, the current performance management system was not effective enough to achieve the organisation objectives.

The performance management system is currently manually by excel sheets that require many transactions among related staff and managements to collect 111 key performance indicators (KPIs) and report to management.

Overall, the key performance indicator was filled manually into the excel spreadsheet item by item and reported to stakeholders by sending email or memo. There were thirteen (13) processes to report key performance indicators to Committee.

As 111 Key Performance Indicators (KPIs) shall be collected, calculated, and reported to Management monthly and reported to committees quarterly, this task requires enormous efforts from stakeholders to complete the work on time. It could lead to human error because most processes were completed manually. Human error created the repeated work that requires the workforce to correct the data.

Furthermore, when staff received the request from the Analyst, staff would provide the raw data for KPI calculation. After that, the Analyst would calculate KPIs item by item in an excel spreadsheet. Some KPI might require complex calculations depend on the individual KPI characteristic.

Some KPIs were available in the database, but the Analyst must manually access the database and manually fill the raw data into an excel calculation sheet because there was no data linkage between the database system and the KPI system.

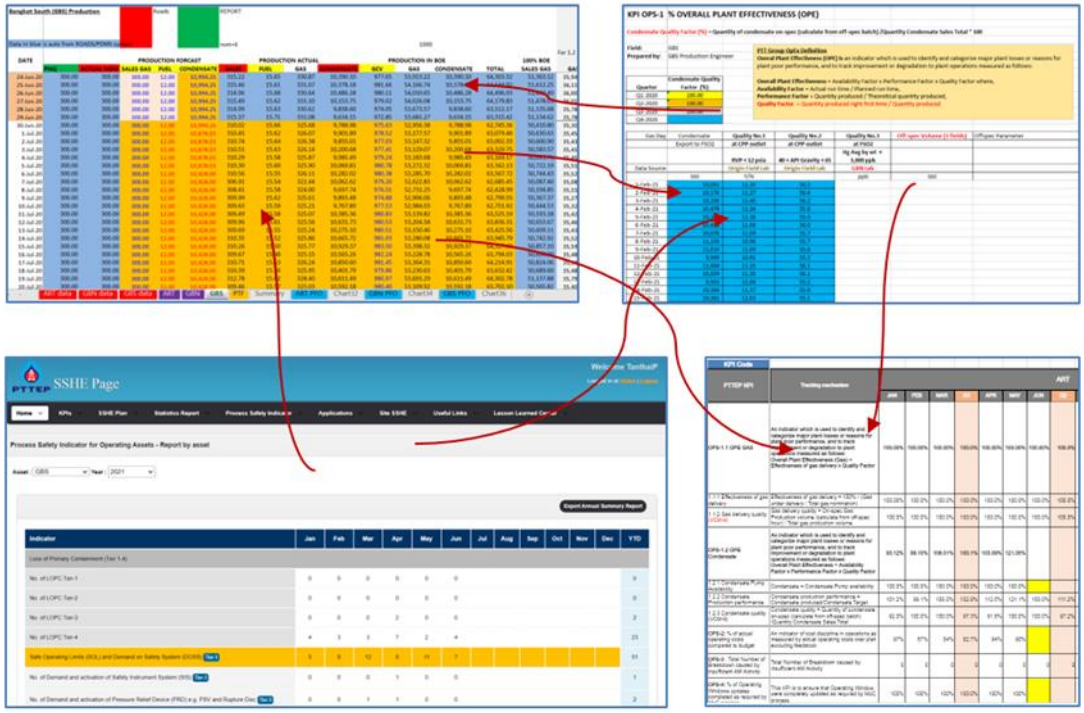


Figure 2**:** Example excel calculation sheet and data transportation

The problem statement of the performance management system could be summarised as below. The detail of the problem will be described in the Analysis section to present how individual work process improvement techniques are used to analyse the performance management system. Overall, the current problem existed because the system was not effectively managed and was not digitalised.

- Require high effort for data collection of 111 KPIs and reporting KPIs to approximately 40 persons monthly.
- Difficulty in reporting and analysing performance indicators.
- Incorrect Data from human error due to lots of manual works.

- Delay in reporting, analysing and planning due to delay of data collection and less connectivity among related persons.
- No warning signal for each Key Performance Indicator (KPI) because of the delay in reporting
- No connection among KPI because of the different channel and scattered data sources.

1.2 Research Objectives

To survive in the industry, the organisation shall focus on improving the performance management system that is crucial to create the most values from existing assets and reduce the operating cost as low as reasonable for today and long-term perspective.

Therefore, the research focus on improving the performance management system by analysing the work process to identify the improvement areas. Then utilising the available service support technologies that could enhance visualisation for the Performance Management System, provide a single source of truth, and reduce manual efforts for a performance management system.

Table 1: Research Objective

Improvement Area	Before	After
Work Process	13 work processes (100% manual)	6 processes (2 manual processes)
Man-Power, yearly	1,034 man-hour	205 man-hour
Improvement of Key Performance Indicator (KPI)	111 items	Now: 86 items Future: 62 items
Visualization	Tables	Interactive Dashboard
Collaboration	Not effective	Effective
KPI Calculation method	Input data by manual leads to human error	Blockchain: 100% automation. Input data by digital (no human error)
Warning System	Not provided	Provided

Note: Manpower is calculated yearly from the manhour required from related departments to complete the performance management system and report, excluding waiting time.

1.3 Research Questions

The Thesis has questions to analyse the company's practices regarding the performance management system by comparing to relevant literature and journals to evaluate the effectiveness in various perspectives.

1.4 Hypothesis Development

The following hypothesis was developed based on relevant literature and practices according to research objectives and research questions.

A Digital Platform for Performance Management System is the crucial success factor in reducing the operating cost, creating the most value from existing assets, and sustaining competitive advantages (Elhuni and Ahmad, 2017).

A Digital Platform for Performance Management System should consist of converting decentralised databases to centralised databases, establishing single platforms for easy access by multi persons, and adjusting data collection to parallel work processes. The practical performance management system is powered by effective service support technologies such as database systems, automated workflow, and business intelligence (BI).

In addition to utilising digitalisation for the performance management process, the methodology and best practices for KPI development and KPI management will be applied to improve the organisation's Key Performance Indicator (KPI) by referencing the recommended KPIs and KPI hierarchy (Elhuni and Ahmad, 2017).

1.5 Scope of Research

Although the oil and gas organisation has many functions to support business execution, the Thesis focuses on twelve (12) operational excellence management system functions that significantly contribute to existing businesses' operating costs and significantly impact the organisation's revenues and profits.

Figure 3: Function Groups within the Operational Excellence Management System (Sander and Reid, 2012) (PTTEP, 2021)

The operational excellence management system has the vision as “The most admired national oil company for Operational Excellence” with objectives to be best-in-class in safety performance, highly reliable asset performance, and best-in-class in operation performance.

The operational excellence management system consists of four main processes: Procedure, Deployment, Conformance, and Performance. The procedure is the document that describes the strategies and methodologies for doing business in various functions; secondly, the deployment is management's communication about strategies or procedures to employees. Thirdly, conformance is the conformity of an employee's actions and procedures; lastly, the performance is the actual performance of an organisation or functions.

The operation excellence management system is the comprehensive methodology to improve organisation performance and sustain good performances although the best employees retired or relocated to other functions.

The research focuses on improving the performance section for management of 111 Key Performance Indicators (KPIs) because the performance management system is

the most critical success factor to reflect the organisation performance. Without an effective performance management system, the organisation cannot benchmark performance with competitors and improve organisational performance.

Not only improving KPI reporting and management process, but also the current company's KPIs were assessed and analysed according to the relevant literature to improve the individual KPI and establish the KPI hierarchy according to the methodology, best practice, and the recommended KPIs for oil and gas companies (Elhuni and Ahmad, 2017).

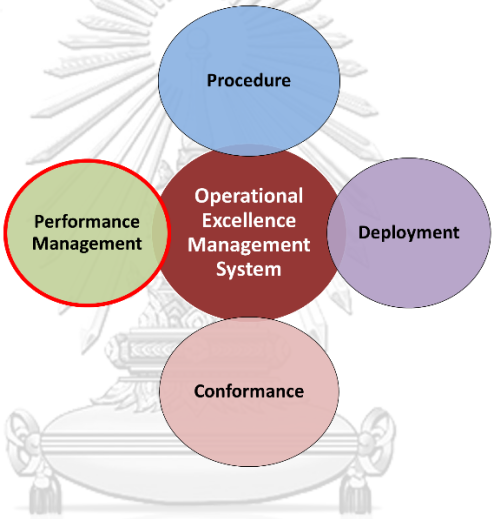


Figure 4: Overall Operational Excellence Management Process (Adapted from IOGP, 2014)

In Chapter 7, the Thesis will also recommend the recommendation for future development that covers the entire Operational Excellence Management System since Procedure, Deployment, Conformance, and Performance Management to be the comprehensive operational excellence management system that could be applied to other organisations.

1.6 Expected Outcomes

After completing research, the expected outcome is to develop the Advanced Performance Management System for Oil and Gas Exploration and Production that could provide the expected outcomes as follow;

- **Quantitative**

  - Work Process Improvement
  - Man-Power Reduction
  - Key Performance Indicator (KPI) Improvement

- **Qualitative:**

  - Quality Enhancement through Users' Satisfaction Level
  - Warning System Establishment
  - Future improvement opportunities identification

The expected outcomes could be classified for individual stakeholder as follow.

Table 2: Expected Benefits for Stakeholders

Stakeholder List	Current Roles and Responsibility	Expected Impact
Staffs – KPI reporter	Collect data and manual input data in excel	Reduce manhours for data collection and reporting by automated workflow.
Analyst – Operational Excellence	Review raw data, calculate and report KPIs	Easier reporting and analysis sources of problems through historical KPIs
Staffs – Functional Manager	Review KPI reports and provide solutions to staff	Be able to access the KPI data anytime and be able to solve problems effectively.
Top Management	Review KPI reports and provide policy and suggestions to functional manager	Receive the automated KPI reports routinely.

The conceptual design of Digital Platform for Performance Management could be presented as below figure. The digital platform development consists of a redesign work process, establishing a centralized database, providing integration with legacy systems, and establishing a visualization dashboard.

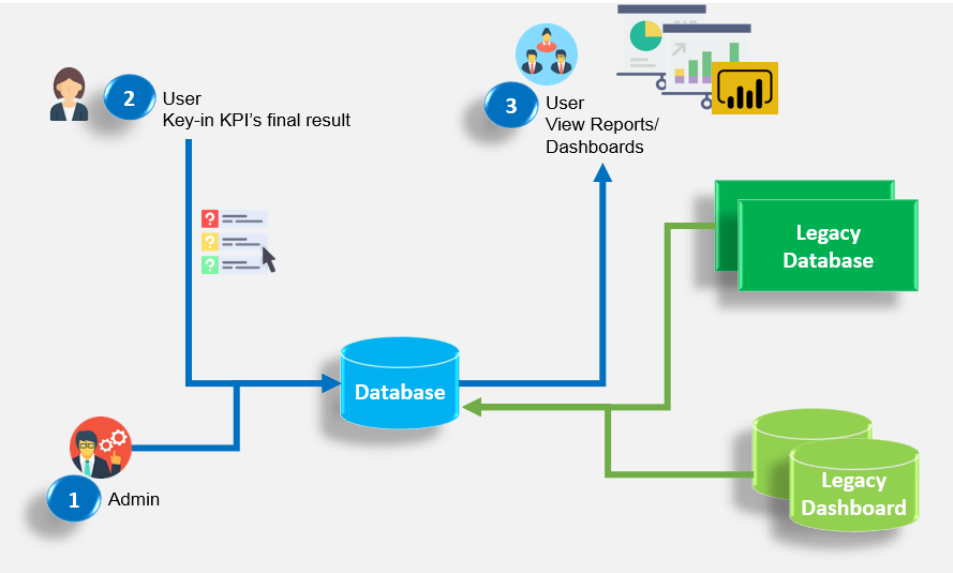


Figure 5: Conceptual Design of Digital Platform for Performance Management System (Author)

Chapter 2 Literature Review

The followings are the lists of literature reviews associated with the development of the Thesis proposal.

2.1 Strategic Development Framework

The performance management system will be developed with a well-understanding of users' pain points to achieve the Thesis's objective. The strategic development framework will be utilised as a guideline for design and continuously improve the performance management system.

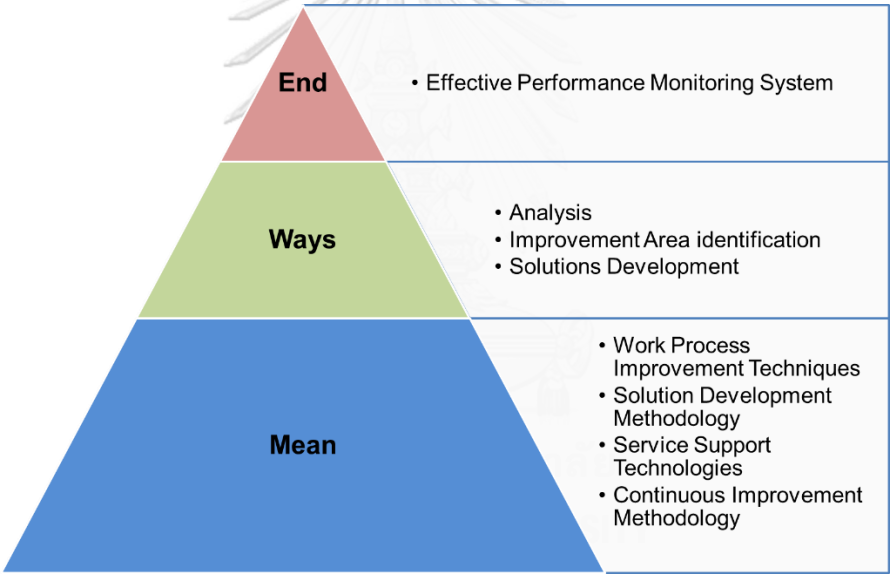


Figure 6: Strategic Development Framework (Macintyre, 2020) (Porter, 1996)

2.2 Work Process Improvement Techniques

The work process analysis is the starting point to understand the existing practice and seek opportunities for improvement. The following work process improvement methodologies will be used in the Thesis to analyze the work process and identify potential improvement areas.

2.2.1 Customer Journey Mapping (CJM)

The first work process improvement that will be utilized in the Thesis is Customer Journey Mapping (CJM). The CJM method will be used to assess and analyze the current performance management practices in terms of practicality and user-friendly.

The CJM helps map the user needs with our products or services, then reflects user experiences from both management and staff level then provides the customer perspectives to the existing system.

Table 3: Customer Journey Mapping Template for Performance Management System (Macintyre, 2020)

High Level Process	PROCESS 1	PROCESS 2	PROCESS 3	PROCESS 4	PROCESS 5	PROCESS 6
Customer Need						
Moments of Truth						
Positive Customer Experience Negative						
Customer Perspective						

2.2.2 LEAN Methodology

LEAN methodology is a well-known technique to eliminate wastes and improve work processes in top organizations. It started from manufacturing industries and extended to services industries (Spector R., 2006). LEAN manufacturing has described a methodology to deliver the uppermost value to the customers by eliminating non-value-added activities and wastes in the process (Shah and Ward, 2003). LEAN

manufacturing is being an integrated practice to improve operation efficiency and satisfy customers (Datoh, 2020).

LEAN methodology focuses on eliminating wastes according to seven (7) types of wastes in the work process and identifying the potential areas of improvement.

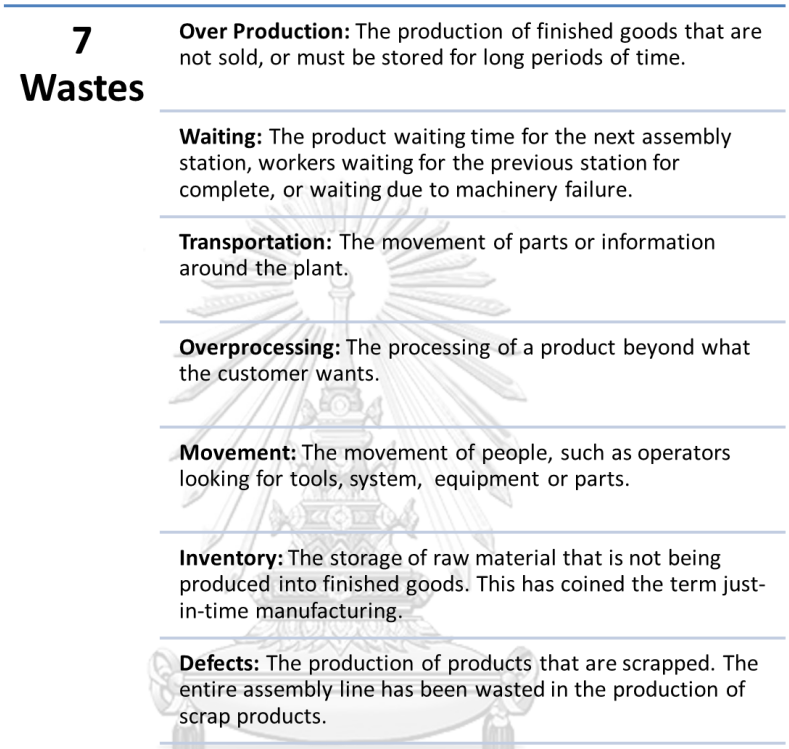


Figure 7: Seven (7) Wastes Category per LEAN manufacturing (Roseke, 2019)

In this research, the LEAN manufacturing will be a major analytic technique to classify the value-added activities (VA), non-value-added activities (NVA), and business-value activities (BVA) in the entire work process of the Performance Management System to identify the wastes and classify that wastes according to seven (7) wastes category (Hall and Scott, 2016).

Based on the manufacturing work process, the definition of the value-added activities (VA) is the activities required to complete the work process that added value to the final product, such as assembly work. Without the value-added activities (VA), the final product could not be produced (Ung, 2013).

On the contrary, the activities required but they do not add value for either internal process or customers called the non-value-added activities (NVA). The most common NVA in the organization is manual communication, movement of goods, and inspection process. These activities could be optimized through the optimization process and digitalization. Another good example of NVA is the activity required by law or regulations; however, they cannot be eliminated. Therefore, it does not mean that all NVAs are a waste.

For business-value activities (BVA), a good example of BVA is the human resource (HR) activities or IT activities that support the business. Surely, that hiring employees or IT activities are not specified in the manufacturing work process to produce any products. However, these activities are an important process that supports other departments.

2.2.3 Fishbone Diagram

The Fishbone diagram is a well-known methodology to analyse the causes of a specific problem in various dimensions such as machines, materials, methods, and environment (Ishikawa, 1990). The problems or effects will be located at the skeleton's head, while the causes will be located at the branch of the fishbone.

The results of analysis by fishbone diagram is a potential root cause of the specific problem. However, the fishbone does not provide the solutions or action plan to solve problems. It requires additional techniques for solving the root causes.

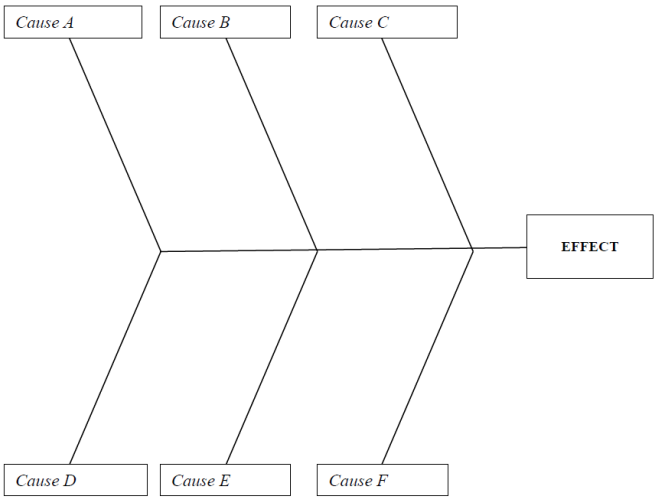


Figure 8: Fishbone Diagram (Coccia, 2017)

Eventually, the analysis result from Customer Journey Mapping (CJM), LEAN methodology, and fishbone diagram will be summarized and identify the common improvement areas to enhance the Oil and Gas Exploration and Production Performance Management System.

2.3 Solution Development Methodology

From the analysis result, all problems will be solved using the Design Thinking approach as a guideline to develop the solutions by empathising with users, defining users' actual needs, ideating possible solutions, and developing a prototype for testing with users.

With this methodology, the Performance Management System called Digital Platform for Performance Management System in Oil and Gas Exploration and Production will be effective, user-friendly, and effectively solve users' pain points.

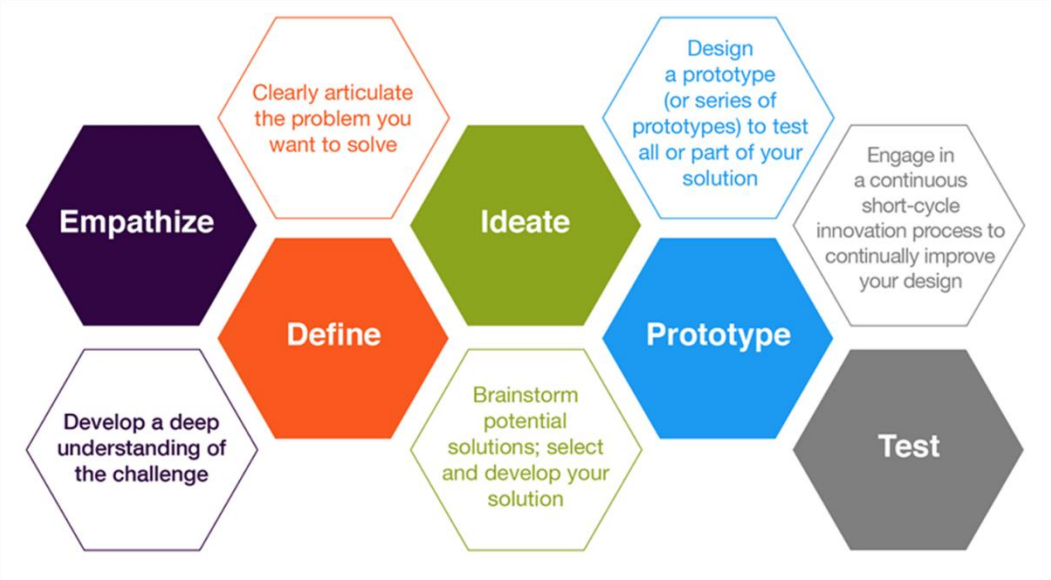


Figure 9: Stanford d. School Design Thinking Process (Stanford d. School, 2010)

2.4 Service Support Technology

Technology plays a vital role in today performance Management. It will be more crucial in the future, according to the technology industry growth. So, the oil and gas company could utilise the available technologies in the market to improve its performance Management system.

This research will use the concept of enterprise resource planning (ERP) implementation (Wallace and Kremzar, 2001) for technology selection and implementation. The technology strategy and service support technologies will be assessed and evaluated according to the operation strategy to ensure the selected technologies align with the operation strategy.

Figure 10: Technology Strategy Framework (Modified from Angela, 2020)

2.5 Project Planning and Management

In order to succeed in the development of a Performance Management System, the project will be planned, managed, and control by using the relevant project planning management and control methodologies and MS project software (Gemmell, 2019). The project schedule, quality, and cost will be managed to achieve the project objective. The workforce will be managed using the MS Project software to track the workforce used for individual tasks and summarise the workforce cost (Kharbanda et al., 1987).

Besides, risk management which is the critical success factor for project management (Gemmell, 2019), will be conducted to prepare the mitigation plan and action plan for individual risk.

Eventually, the supplier evaluation will be conducted for both technical and commercial evaluations to select the best suitable supplier for the project, which could deliver the project successfully and align with the organisation strategies.

2.6 Continuous Improvement Methodology

After implementing the new products or services, the PDCS (Plan-Do-Check-Act) approach will be applied as a continuous improvement framework by identifying and evaluating the improvement opportunities.

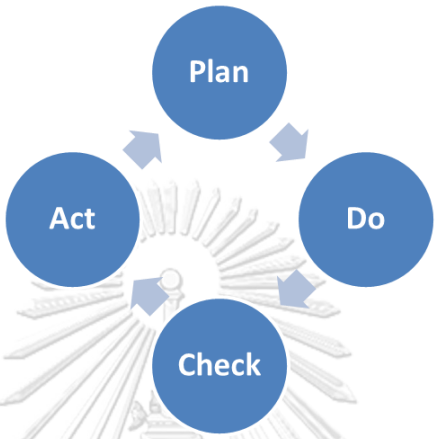


Figure 11: PDCA Framework (Imai, 1986)

- **Plan**: Identify problems, analyse problems, and develop potential solutions.
- **Do**: Test potentials solutions and measure the results.
- **Check**: Analyse the results and identify the lesson learned.
- **Act**: Document the results, inform stakeholders about the process changes and provide recommendations for the future PDCA cycle.

The PDCA cycle will be a crucial framework to sustain the operation efficiency of a new platform.

2.7 Key Performance Indicators (KPIs) Improvement

The researched methodology and best practice to develop Key Performance Indicators (KPIs) for sustainable production evaluation will be used to analyse and evaluate the current company's KPI compared to the recommendation in the literature. The KPI hierarchy concept from the literature will be applied to the organisation to group the KPIs and improve KPI quality (Elhuni and Ahmad, 2017).

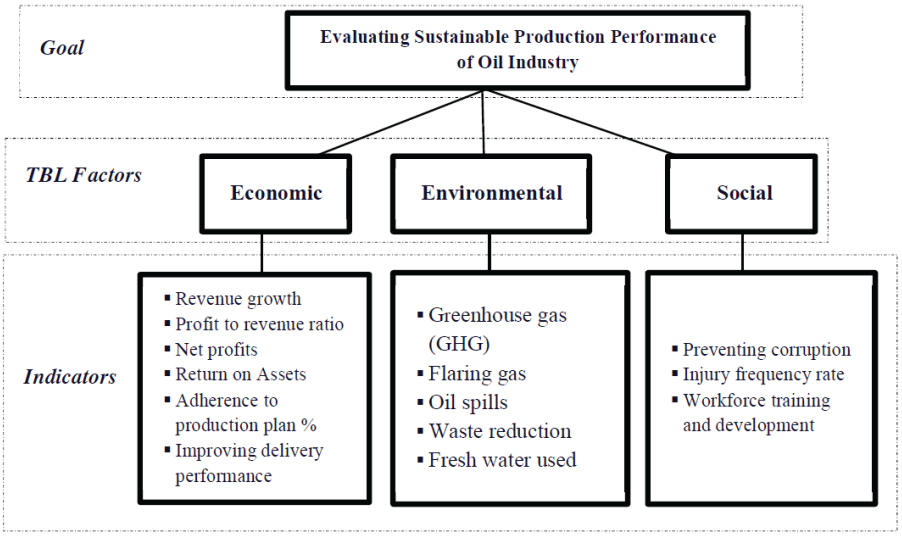


Figure 12: KPI Hierarchy (Elhuni and Ahmad, 2017)

2.8 Best Practice for Digital Performance Management System

The best practice for digital performance management cited from SAP will be used as a guideline to digitize the current performance management system. The digital performance management system could enhance the effectiveness of managing employee performance resulting in the alignment of strategies and goals and accurately evaluate individual performance (SAP, 2021).

The digital performance management shall continuously update staff efforts and success probability in individual KPI with features like mobile applications. Also, the KPI system should encourage more continuous communication between management and staff through the KPI tracking system and providing feedback to staff. The system shall be accessible to authorized persons, and the KPI results shall be accurate (SAP, 2021).

In conclusion, the literature review could be summarised as below table to understand the relationship between the literature review and the Thesis.

Table 4: Relationship Summary of Literatures Review and the Thesis (Author)

Core Competency	Associated Literatures and Journals's Contents	Bibliography
Strategic Development Framework	- The relationship between business strategy and operation strategy. - Strategic Development Framework	(Porter, 1996) (Macintyre, 2020)
Work Process Improvement Techniques	- Customer Journey Mapping (CJM) - LEAN Manufacturing - Fishbone diagram	(Macintyre, 2020) (Roseke, 2019) (Datoh, 2020) (Coccia, 2017)
Solution Development Methodology	- Design Thinking Process	(Stanford d. School, 2010)
Service Support Technology	- Technology Selection Strategy - Enterprise Resource Planning (ERP) - Business Intelligence (BI)	(Wallace and Kremzar, 2001) (Angela, 2020)
Project Management and Project Control	- Project Planning Management and Control	(Gemmell, 2019) (Kharbanda, et. al, 1987)
Continuous Improvement Methodology	- Plan-Do-Check-Act (PDCA) methodology	(Imai, 1986)
KPI Improvement	- KPI improvement methodology - The Recommended KPIs for oil and gas industry - KPI hierarchy and KPI weighting	(Elhuni and Ahmad, 2017)
Best Practice for Digital Performance Management System	Enterprise Resource Planning (ERP) for Performance Management	(SAP, 2021)

Chapter 3 Research Methodology

The research methodology for the Thesis could be illustrated as the following framework starting from studying the relevant literature; secondly, analysing the existing performance Management system to identify areas of improvement. Thirdly, doing project development and finally implementing the proposed solutions in the organisation.

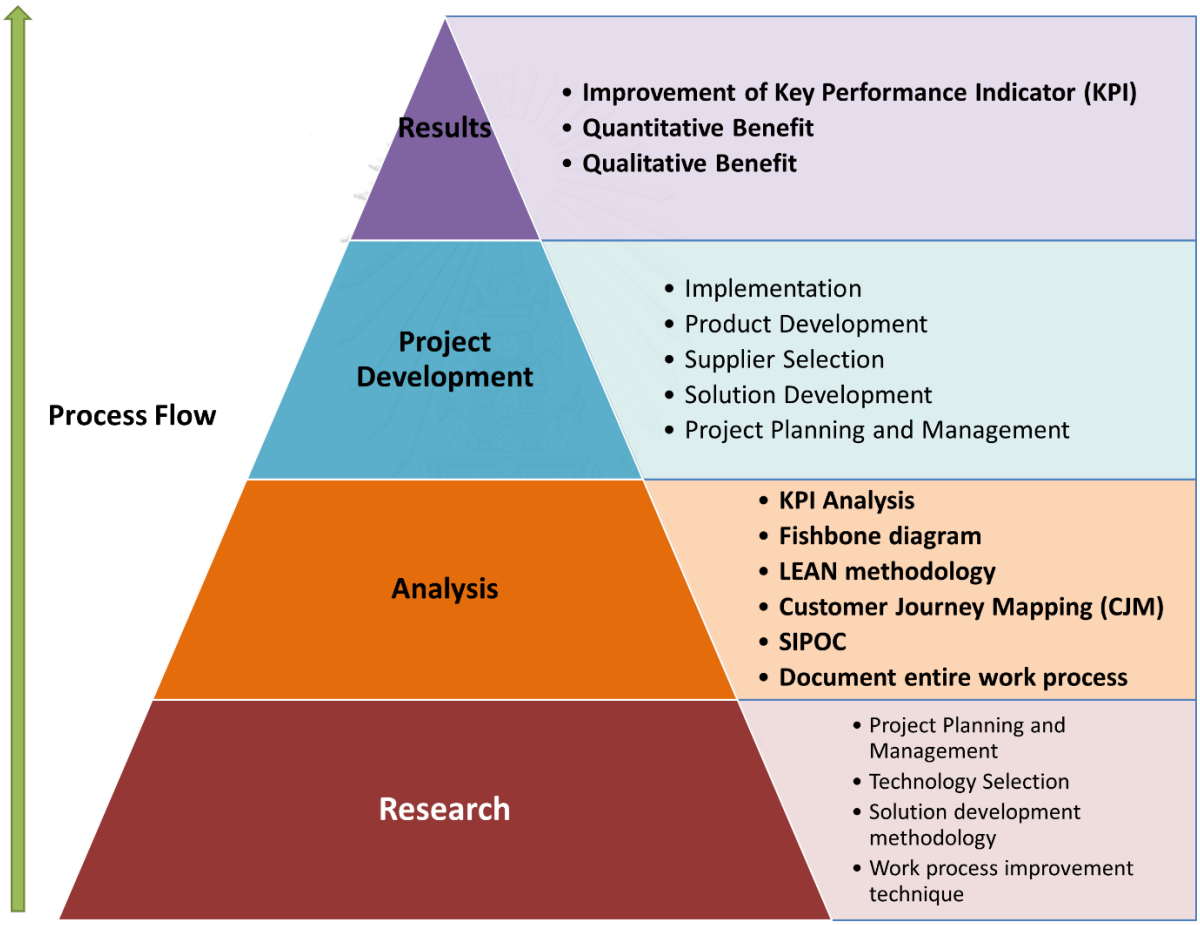


Figure 13: Research Methodology Framework (By Author)

3.1 Research

The objectives of the research stage are to study various literature related to the Performance Management System for the oil and gas industry and work process

improvement techniques to assess and analyse the current Performance Management System and roughly identify the opportunities for improvement.

The solution development tools are researched to ensure that the developed solutions could solve the problems of users and organisations. Besides, the technology selection is studied to ensure the alignment of technology strategy, organisation context, and organisation strategy.

3.2 Analysis

The analysis stage is to utilise the work process improvement techniques to analyse the existing Performance Management System of the organisation to deeply understand the current work process and identify opportunities for improvement systematically.

The analysis will start with illustrating the existing work process of the Performance Management System; then, analyse the entire work process according to the Customer Journey Mapping (CJM) method to present the customer experiences level and the different expectations between customer needs and customer perspective.

Secondly, the LEAN methodology will be utilised to analyse the entire activities within the performance Management's work process and classify the activities into three (3) types; value-added activities (VA), non-value-added activities (NVA), and business-value activities (BVA). Eventually, to identify the wastes and classify those wastes according to seven (7) wastes categories.

Thirdly, the fishbone diagram will be used to analyse the causes of a specific problem in various dimensions to identify the potential root causes of the specific problem. However, the fishbone does not provide the solutions or action plan to solve problems.

3.3 Project Development

The project development framework shall be developed to clearly define the roadmap for developing an effective performance Management system, as below figure.

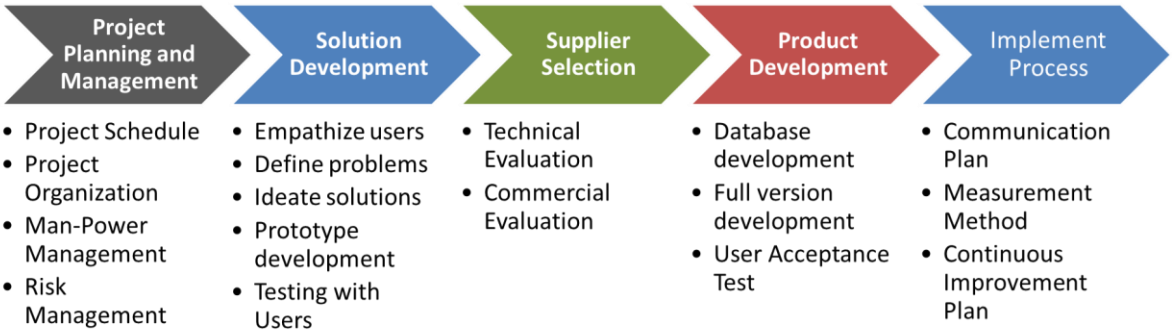


Figure 14: Project Development Framework (modified from Angela, 2020) (Roger, 2019)

3.3.1 Project Planning and Management

The first step of project development is project planning and management, which have the ultimate objective to control the time, cost, and quality of the project. The project planning and management phase consist of preparing pf project schedule (Appendix-A), organisation chart, manpower management, and risk management, respectively.

3.3.2 Solution Development

Solution development is the process of developing the prototype for testing with users according to the analysis results and users' recommendations in the workshop. The prototype will be tested with users in the early stage to harvest feedbacks and improvement opportunities before developing the full version of a solution. This methodology of solution development is designed per design thinking approach to ensure that the solution definitely solves the users' pain point and be friendly for users.

3.3.3 Supplier Selection

The Supplier selection process will be the process for doing technical evaluation and commercial evaluation of suppliers to select the best suitable suppliers and technologies for the organisation. The supplier selection process is the crucial process that could minimise the project investment and operating cost.

3.3.4 Product Development

After supplier selection, the next stage of project development will be product development, which includes database system development, the full version of Digital Performance Management Platform, and user acceptance test. The user acceptance test will be conducted as the stage-gate and acceptance gate before implementing the Digital Performance Management Platform.

3.3.5 Implementation

- **Communication Plan**

After developing the Digital Performance Management Platform, the communication plan will be one of the key success factors for successfully implementing the new process and digital platform into the organisation. All stakeholders will be communicated and engaged in utilising the new digital platform.

- **Measurement Method**

The measurement method will be prepared to measure the benefit and success of the project after implementation. The benefits will be measured in the following dimensions.

- Qualitative Benefits

The qualitative benefits measurement method will be scoring and comparing the customer experience level between the existing system and the new system conducted by interview and testing the digital platform with some users in both management and staff.

Also, this section will present the consequence benefits in terms of data visibility that could be applied for data analysis and prediction model to support the decision-making process in future.

- Quantitative Benefits

The measurement method for quantitative benefits will be comparing the number of processes and the amount of process time used for data collection and visualisation of key performance indicators (111 KPIs). The new system is expected to significantly reduce the number of processes and amount of process time used for data collection and reducing the workforce used for the Performance Management System.

Table 5: Measurement Method for Quantifiable Efficiency (Adapted from Macintyre, 2020)

Level Process	PROCESS 1	PROCESS 2	PROCESS 3	PROCESS 4	PROCESS 5	Total Number of Process Required	Total Process Time Used
Existing System							
New System							

The reduction of manpower from minimising manual work could benefit in reduction of manpower cost and provide the opportunities to utilise existing manpower for important tasks in an organisation that could generate value to the company.

- **Continuous Improvement Plan**

Continuous Improvement Plan will be prepared to sustain the effectiveness of the Performance Management System according to the PDCA method. The feedback channel will be provided to users for further investigation and improvement.

3.4 Results

The result section will present the benefits after implementation of Digital Platform for Performance Management System into the organisation. The result consists of Qualitative Benefit, Quantitative Benefit, and Key Performance Indicator (KPI) improvement, respectively.

Chapter 4 Analysis

According to the defined scope of The Thesis, the Thesis focused on twelve (12) functions in the operational excellence management system that significantly contributes to businesses' operating costs and significantly impacts the organisation's revenues and profits.

The analysis stage is to utilise the work process improvement techniques to analyse an organisation's existing Performance Management System to deeply understand the current work process and identify opportunities for improvement systematically.

4.1 Existing Workflow and Practice for Performance Management System

The author assessed the existing work process for performance management throughout the entire work process as following.

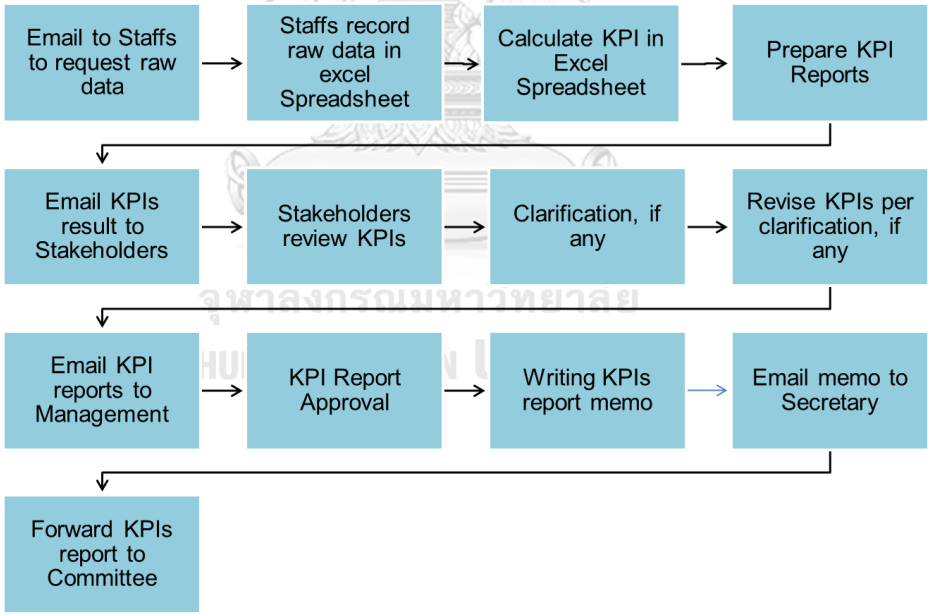
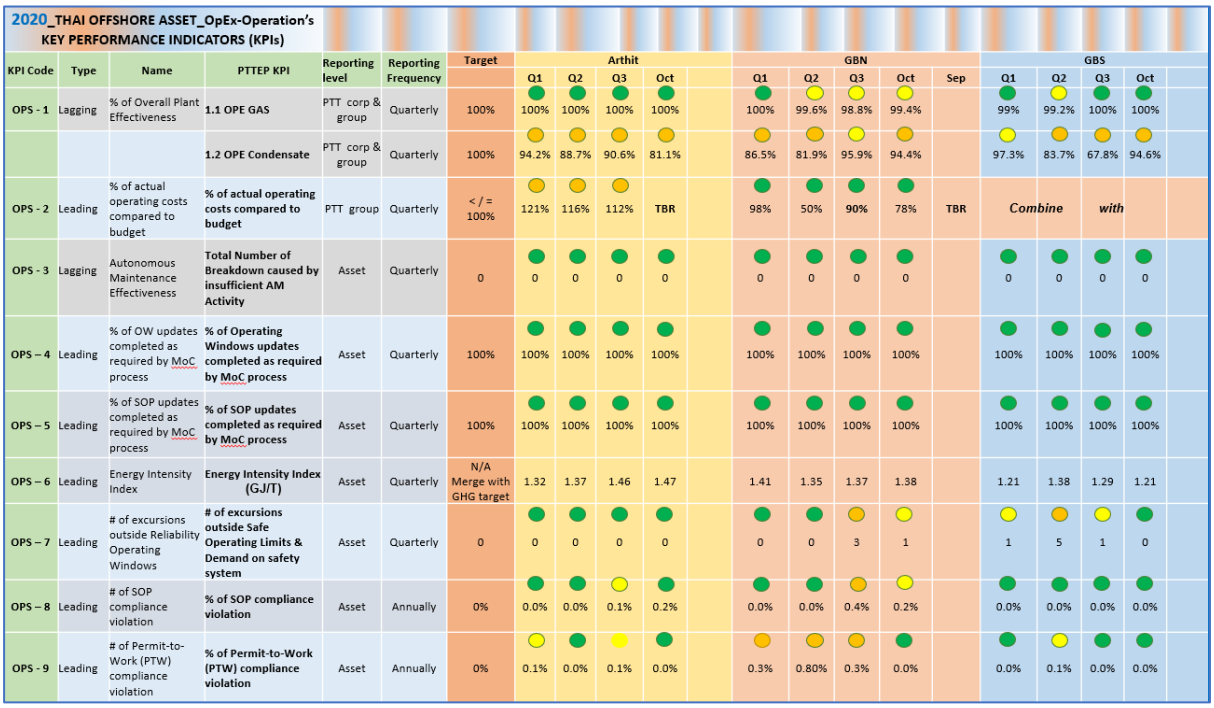


Figure 15: Existing Workflow for Performance Management and Reporting System

Overall, the key performance indicator was filled manually into the excel spreadsheet item by item and reported to stakeholders by sending email or memo. There were thirteen **(13) processes** to report key performance indicators to Committee.

As **111 Key Performance Indicators (KPIs)** shall be collected, calculated, and reported to Management monthly and reported to committees quarterly, this task requires enormous efforts from stakeholders to complete the work on time. It could lead to human error because most processes were completed manually. The human error created the repeated work that requires the workforce to correct the data.

Table 6: Example of Existing Key Performance Management (KPI) Report (partly)



2020_THAI OFFSHORE ASSET_OpEx-Operation's KEY PERFORMANCE INDICATORS (KPIs)

KPI Code	Type	Name	PTTEP KPI	Reporting level	Reporting Frequency	Target	Arthit Q1	Arthit Q2	Arthit Q3	Arthit Oct	GBN Q1	GBN Q2	GBN Q3	GBN Oct	GBN Sep	GBS Q1	GBS Q2	GBS Q3	GBS Oct
OPS - 1	Lagging	% of Overall Plant Effectiveness	1.1 OPE GAS	PTT corp & group	Quarterly	100%	100%	100%	100%	100%	100%	99.6%	98.8%	99.4%		99%	99.2%	100%	100%
			1.2 OPE Condensate	PTT corp & group	Quarterly	100%	94.2%	88.7%	90.6%	81.1%	86.5%	81.9%	95.9%	94.4%		97.3%	83.7%	67.8%	94.6%
OPS - 2	Leading	% of actual operating costs compared to budget	% of actual operating costs compared to budget	PTT group	Quarterly	< / = 100%	121%	116%	112%	TBR	98%	50%	90%	78%	TBR	*Combine*		*with*	
OPS - 3	Lagging	Autonomous Maintenance Effectiveness	Total Number of Breakdown caused by insufficient AM Activity	Asset	Quarterly	0	0	0	0	0	0	0	0	0		0	0	0	0
OPS – 4	Leading	% of OW updates completed as required by MoC process	% of Operating Windows updates completed as required by MoC process	Asset	Quarterly	100%	100%	100%	100%	100%	100%	100%	100%	100%		100%	100%	100%	100%
OPS – 5	Leading	% of SOP updates completed as required by MoC process	% of SOP updates completed as required by MoC process	Asset	Quarterly	100%	100%	100%	100%	100%	100%	100%	100%	100%		100%	100%	100%	100%
OPS – 6	Leading	Energy Intensity Index	Energy Intensity Index (GJ/T)	Asset	Quarterly	N/A Merge with GHG target	1.32	1.37	1.46	1.47	1.41	1.35	1.37	1.38		1.21	1.38	1.29	1.21
OPS – 7	Leading	# of excursions outside Reliability Operating Windows	# of excursions outside Safe Operating Limits & Demand on safety system	Asset	Quarterly	0	0	0	0	0	0	0	3	1		1	5	1	0
OPS – 8	Leading	# of SOP compliance violation	% of SOP compliance violation	Asset	Annually	0%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.4%	0.2%		0.0%	0.0%	0.0%	0.0%
OPS - 9	Leading	# of Permit-to-Work (PTW) compliance violation	% of Permit-to-Work (PTW) compliance violation	Asset	Annually	0%	0.1%	0.0%	0.1%	0.0%	0.3%	0.80%	0.3%	0.0%		0.0%	0.1%	0.0%	0.0%

4.2 Qualitative Analysis

4.2.1 SIPOC Diagram and Customer Journey Mapping (CJM)

The Customer Journey Mapping (CJM) is selected to be the first analysis tool to analyse the existing Performance Management System focussing on customer needs, customer experience, and customer perspective in every process to evaluate and score customer experience level in each process.

The CJM analysis would start by creating a SIPOC diagram and Customer Journey Mapping (CJM) to illustrate customer experiences throughout the entire work process. Then, the different expectations would be identified to evaluate touchpoints and present

the customer satisfaction result. However, the CJM analysis could not identify the source of the problem and solutions.

The SIPOC diagram is mapping the work process and visualising the input and output of individual processes. As the SIPOC was prepared for individual processes, the customer would be the supplier of the following process.

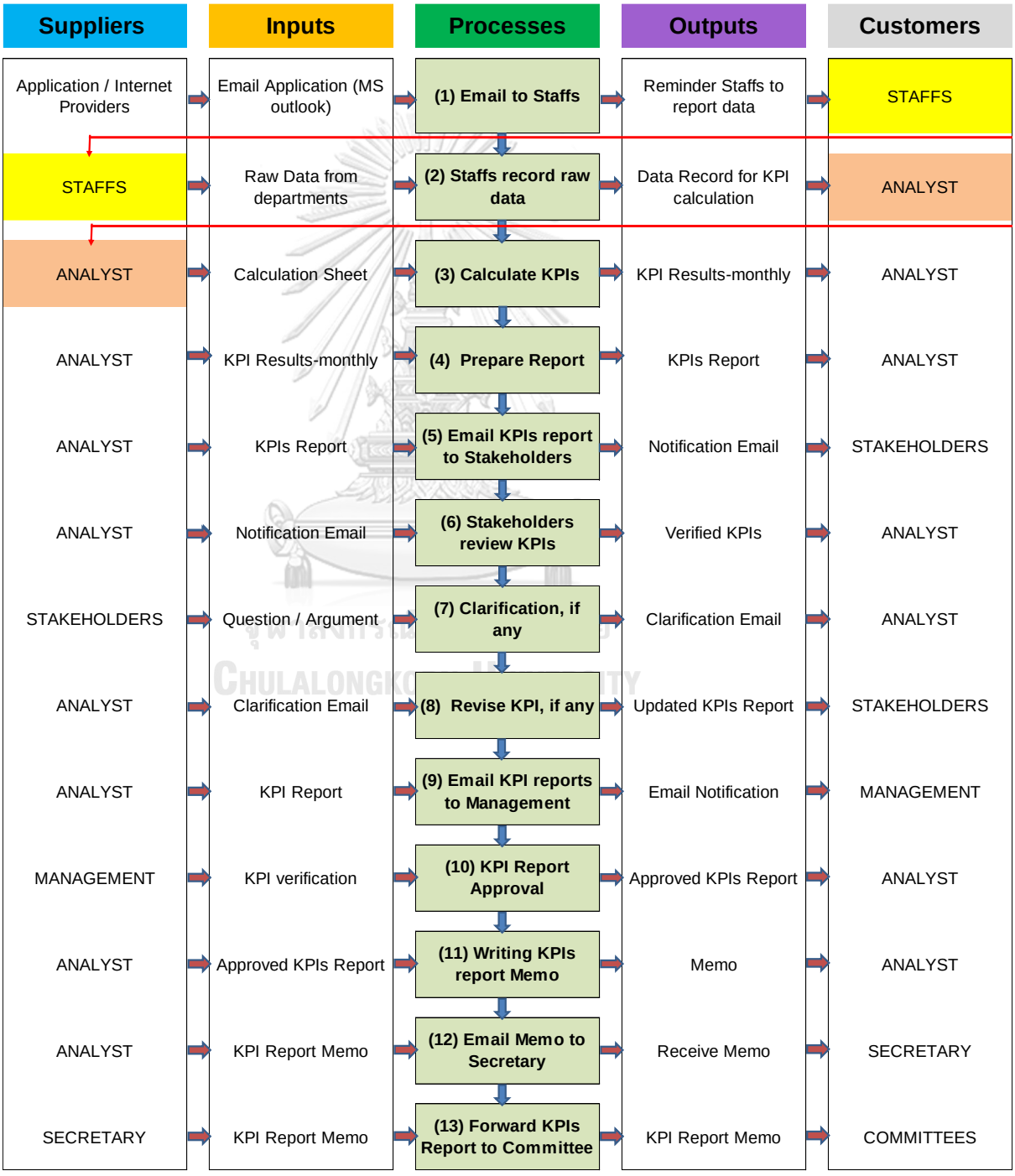


Figure 16: SIPOC diagram of Key Performance Indicator (KPI) Management System (Macintyre, 2020)

According to the SIPOC diagram, the following will present the Customer Journey in detail for the Key Performance Indicator (KPI) reporting process. Then, Customer Journey Mapping (CJM) will be presented.

1. Email to Staffs to request raw data

Every month, the Analyst would email staff requesting the raw data to calculate the key performance indicator.

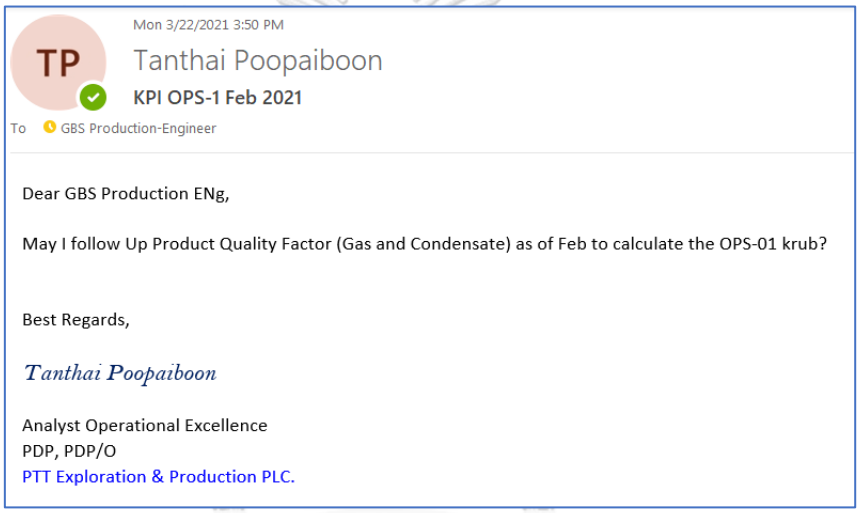


Figure 17: Example email to Staffs requesting raw data

2. Staffs record raw data

When staff received the request from the Analyst, staff would provide the raw data for KPI calculation.

Figure 18: Example email from Staffs reporting raw data

3. Calculate Key Performance Indicators (KPIs)

When staff received the request from the Analyst, staff would provide the raw data for KPI calculation. After that, the Analyst would calculate KPIs item by item in an excel spreadsheet. Some KPI might require complex calculations depend on the individual KPI characteristic.

Some KPIs were available in the database, but the Analyst has to manually access the database and manually fill the raw data into an excel calculation sheet because there is no data linkage between the database system and the KPI system.

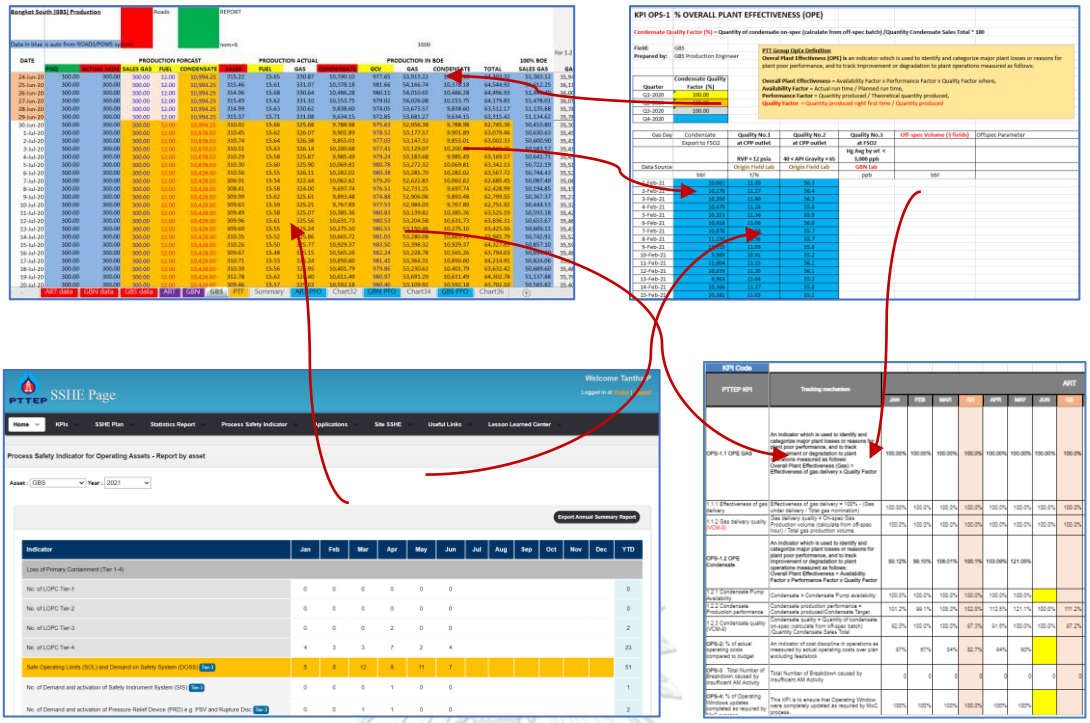


Figure 19: Example excel calculation sheet and data transportation

4. Prepare KPI Report

When the Analyst finished calculating KPI in an excel spreadsheet, the Analyst had to prepare the KPI report in PowerPoint to visualise the KPI result.

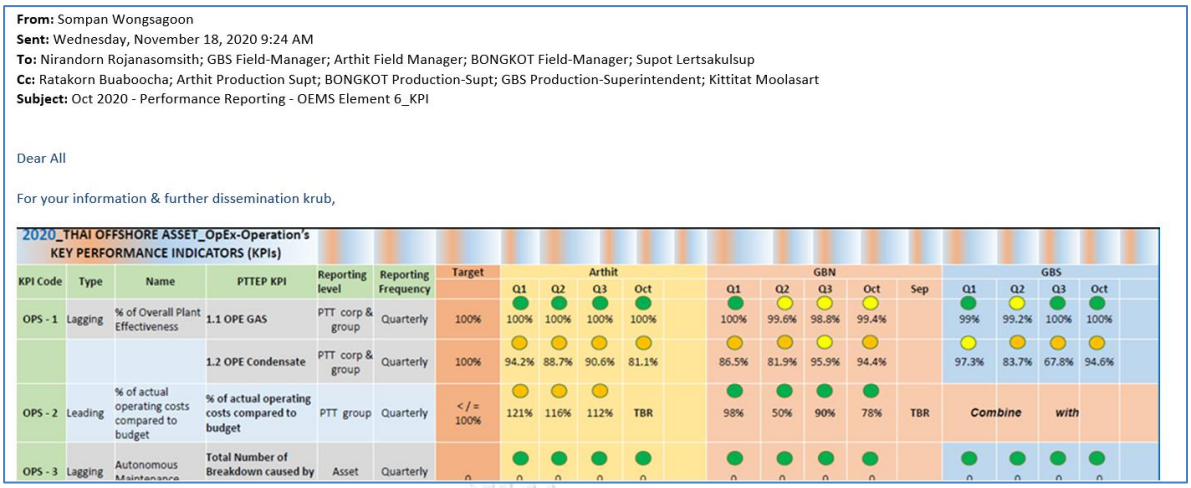
Table 7: Example KPI report (Partly)

2020_THAI OFFSHORE ASSET_OpEx-Operation's KEY PERFORMANCE INDICATORS (KPIs)

KPI Code	Type	Name	PTTEP KPI	Reporting level	Reporting Frequency	Target	Arthit				GBN					GBS			
							Q1	Q2	Q3	Oct	Q1	Q2	Q3	Oct	Sep	Q1	Q2	Q3	Oct
OPS - 1	Lagging	% of Overall Plant Effectiveness	**1.1 OPE GAS**	PTT corp & group	Quarterly	100%	100%	100%	100%	100%	100%	99.6%	98.8%	99.4%		99%	99.2%	100%	100%
			1.2 OPE Condensate	PTT corp & group	Quarterly	100%	94.2%	88.7%	90.6%	81.1%	86.5%	81.9%	95.9%	94.4%		97.3%	83.7%	67.8%	94.6%
OPS - 2	Leading	% of actual operating costs compared to budget	**% of actual operating costs compared to budget**	PTT group	Quarterly	< / = 100%	121%	116%	112%	TBR	98%	50%	90%	78%	TBR	*Combine*		*with*	
OPS - 3	Lagging	Autonomous Maintenance Effectiveness	**Total Number of Breakdown caused by insufficient AM Activity**	Asset	Quarterly	0	0	0	0	0	0	0	0	0		0	0	0	0
OPS – 4	Leading	% of OW updates completed as required by MoC process	**% of Operating Windows updates completed as required by MoC process**	Asset	Quarterly	100%	100%	100%	100%	100%	100%	100%	100%	100%		100%	100%	100%	100%
OPS – 5	Leading	% of SOP updates completed as required by MoC process	**% of SOP updates completed as required by MoC process**	Asset	Quarterly	100%	100%	100%	100%	100%	100%	100%	100%	100%		100%	100%	100%	100%
OPS – 6	Leading	Energy Intensity Index	**Energy Intensity Index (GJ/T)**	Asset	Quarterly	N/A Merge with GHG target	1.32	1.37	1.46	1.47	1.41	1.35	1.37	1.38		1.21	1.38	1.29	1.21
OPS – 7	Leading	# of excursions outside Reliability Operating Windows	**# of excursions outside Safe Operating Limits & Demand on safety system**	Asset	Quarterly	0	0	0	0	0	0	0	3	1		1	5	1	0
OPS – 8	Leading	# of SOP compliance violation	**% of SOP compliance violation**	Asset	Annually	0%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.4%	0.2%		0.0%	0.0%	0.0%	0.0%
OPS - 9	Leading	# of Permit-to-Work (PTW) compliance violation	**% of Permit-to-Work (PTW) compliance violation**	Asset	Annually	0%	0.1%	0.0%	0.1%	0.0%	0.3%	0.80%	0.3%	0.0%		0.0%	0.1%	0.0%	0.0%

5. Email KPI report to Stakeholders

When the Analyst finishes the KPI report, the report would be emailed to all stakeholders for review.



From: Sompan Wongsagoon
Sent: Wednesday, November 18, 2020 9:24 AM
To: Nirandorn Rojanasomsith; GBS Field-Manager; Arthit Field Manager; BONGKOT Field-Manager; Supot Lertsakulsup
Cc: Ratakorn Buaboocha; Arthit Production Supt; BONGKOT Production-Supt; GBS Production-Superintendent; Kittitat Moolasart
Subject: Oct 2020 - Performance Reporting - OEMS Element 6_KPI

Dear All

For your information & further dissemination krub,

2020_THAI OFFSHORE ASSET_OpEx-Operation's KEY PERFORMANCE INDICATORS (KPIs)

KPI Code	Type	Name	PTTEP KPI	Reporting level	Reporting Frequency	Target	Arthit				GBN					GBS			
							Q1	Q2	Q3	Oct	Q1	Q2	Q3	Oct	Sep	Q1	Q2	Q3	Oct
OPS - 1	Lagging	% of Overall Plant Effectiveness	1.1 OPE GAS	PTT corp & group	Quarterly	100%	100%	100%	100%	100%	100%	99.6%	98.8%	99.4%		99%	99.2%	100%	100%
			1.2 OPE Condensate	PTT corp & group	Quarterly	100%	94.2%	88.7%	90.6%	81.1%	86.5%	81.9%	95.9%	94.4%		97.3%	83.7%	67.8%	94.6%
OPS - 2	Leading	% of actual operating costs compared to budget	% of actual operating costs compared to budget	PTT group	Quarterly	< / = 100%	121%	116%	112%	TBR	98%	50%	90%	78%	TBR	Combine		with	
OPS - 3	Lagging	Autonomous Maintenance	Total Number of Breakdown caused by	Asset	Quarterly	0	0	0	0	0	0	0	0	0		0	0	0	0

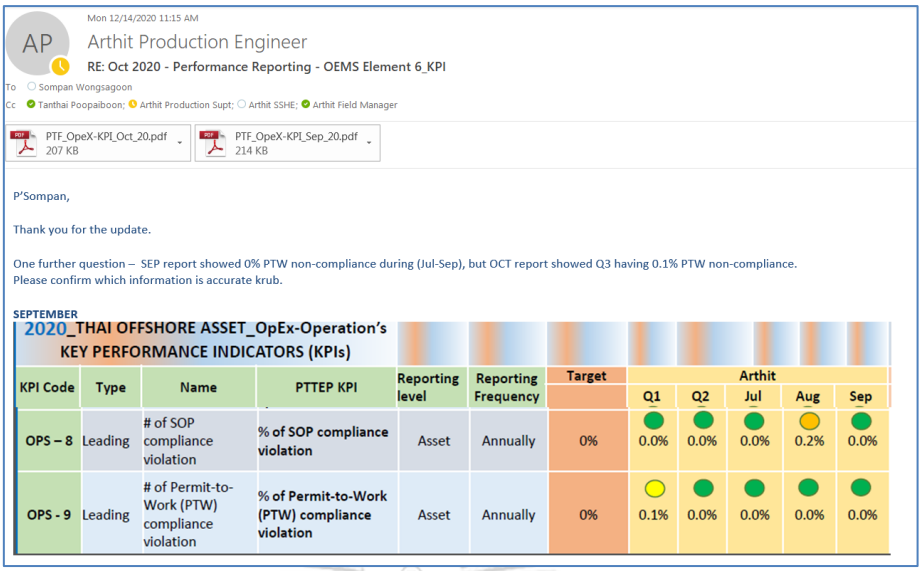
Figure 20: Example Email for KPI report

6. Stakeholders review KPIs report

Stakeholders would review the KPI report from the received email and acknowledge it back to the Analyst.

7. Clarification

In case the stakeholders had clarification regarding the KPI result, they would email back the Analyst. This process might require many communications until the clarification would be closed.


Mon 12/14/2020 11:15 AM

AP Arthit Production Engineer

RE: Oct 2020 - Performance Reporting - OEMS Element 6_KPI

To Sompan Wongsagoon

Cc Tanthai Poopaiboon; Arthit Production Supt; Arthit SSHE; Arthit Field Manager

PTF_OpeX-KPI_Oct_20.pdf 207 KB | PTF_OpeX-KPI_Sep_20.pdf 214 KB

P'Sompan,

Thank you for the update.

One further question – SEP report showed 0% PTW non-compliance during (Jul-Sep), but OCT report showed Q3 having 0.1% PTW non-compliance. Please confirm which information is accurate krub.

SEPTEMBER

2020_THAI OFFSHORE ASSET_OpEx-Operation's KEY PERFORMANCE INDICATORS (KPIs)

KPI Code	Type	Name	PTTEP KPI	Reporting level	Reporting Frequency	Target	Arthit				
							Q1	Q2	Jul	Aug	Sep
OPS – 8	Leading	# of SOP compliance violation	% of SOP compliance violation	Asset	Annually	0%	0.0%	0.0%	0.0%	0.2%	0.0%
OPS - 9	Leading	# of Permit-to-Work (PTW) compliance violation	% of Permit-to-Work (PTW) compliance violation	Asset	Annually	0%	0.1%	0.0%	0.0%	0.0%	0.0%

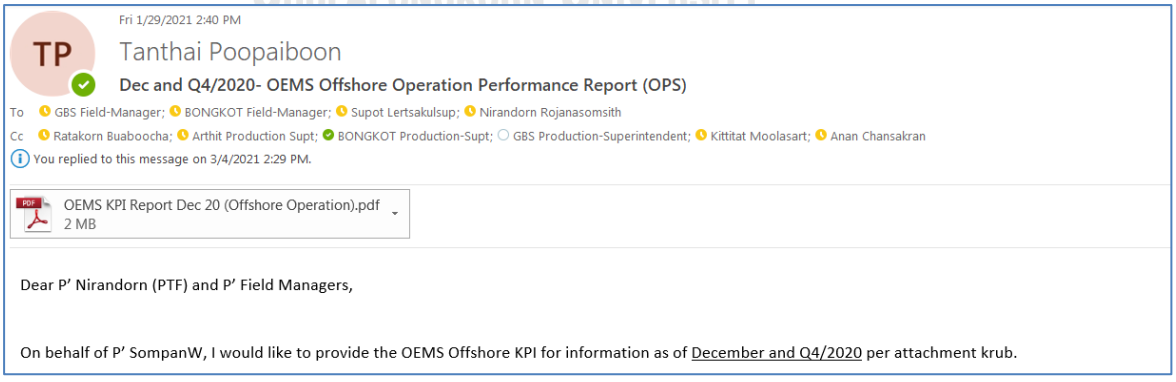
Figure 21: Example of Clarification Email from stakeholders

8. Revise KPI Report

In case the original KPI report was incorrect, the Analyst had to update the KPI report manually.

9. Email KPI Report to Management

After the Analyst finished the KPI report, the Analyst emailed the official report to Management for approval.


Fri 1/29/2021 2:40 PM

TP Tanthai Poopaiboon

Dec and Q4/2020- OEMS Offshore Operation Performance Report (OPS)

To GBS Field-Manager; BONGKOT Field-Manager; Supot Lertsakulsup; Nirandorn Rojanasomsith

Cc Ratakorn Buaboocha; Arthit Production Supt; BONGKOT Production-Supt; GBS Production-Superintendent; Kittitat Moolasart; Anan Chansakran

You replied to this message on 3/4/2021 2:29 PM.

OEMS KPI Report Dec 20 (Offshore Operation).pdf 2 MB

Dear P' Nirandorn (PTF) and P' Field Managers,

On behalf of P' SompanW, I would like to provide the OEMS Offshore KPI for information as of December and Q4/2020 per attachment krub.

Figure 22: Example Email for KPI report to Management

10. KPI report approval

When Management received the KPI report, they would review and approve it by email or telephone for further action.

11. KPI report memo writing

After receiving approval from Management, the Analyst would write the memo.

12. Email KPI report memo to Secretary

After completed the memo, the Analyst would email the memo to the Committee's Secretary.

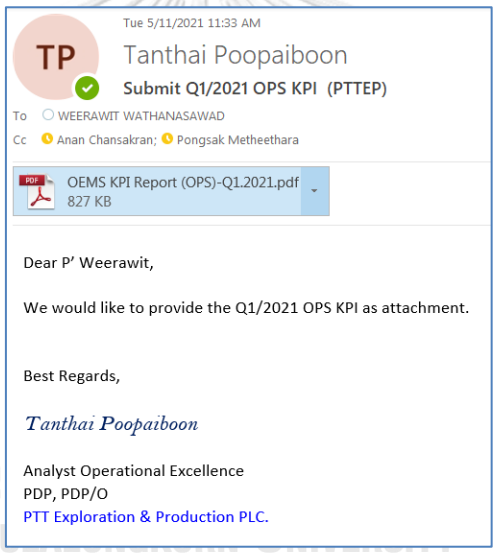


Figure 23: Example Email for KPI memo to Committees' secretary

13. Secretary forward KPI report memo to Committee

The last process was to forward the KPI report to the Committee to present the organisation key performance indicator (KPI).

Eventually, the Customer Journey Mapping (CJM) could be summarised to illustrate the customer needs, customer experience, and perspective.

High Level Process	Email to Staffs	Staffs record raw data	Calculate KPIs	Prepare KPI Report	Email KPI report to stakeholder	Stakeholder review KPIs	Clarification, if any	Revise KPI, if any	Email KPI report to Management	KPI Report Approval	Writing KPI report Memo	Email Memo to Secretatry	Secretary forward KPI report to Committee
Customer Need	- Early receive the request with enough time for data preparation - Cleary defind the due date.	- Staffs could record data easily. - If some data was available in database, the KPI system automatically extract data from database.	- Automate calculation after input raw data from staffs.	- Easily prepare KPI report. - Automately generate KPI Report.	- Automately email KPI Report to Stakeholders.	- KPI report is well visualized and easy understanding.	- Stakeholer could clarify to Analyst and receive response quickly.	- Analyt could revise KPI report easily.	- Automately email KPI Report to Management.	- KPI report is well visualized for easy understanding.	- Automately generate memo.	- Automately email to Secreatary.	- KPI report is well visualized for easy understanding.
Moments of Truth	😢	😐	😭	☹️	😐	😐	😀	☹️	😐	😟	☹️	😐	😢
Customer Experience (Positive / Negative)													

Customer Perspective	- Sometimes, Staffs received email late and did not have enough time for data preparation. - Email did not specify the due date.	- Staffs had to collect some data manually although the database was available.	- Analyst had to calculate the raw data by excel spreadsheet.	- Analyst had to manually prepare KPI report by MS power point.	- Analyst had to email KPI report to stakeholders mannually.	- Stakeholders feel difficult in understanding KPI report.	- Stakeholders received response from Analyst quickly.	- Analyst had to revise both KPI calculation sheet and KPI report.	- Analyst had to email KPI report mannually.	It is difficult to understand the KPI report because of enormous data in table.	- Analyst had to write memo manually every month.	- Analyst had to email memo mannually.	It is difficult to understand the KPI report because of enormous data in table.

Figure 24: Customer Journey Mapping (CJM) of Key Performance Indicator (KPI) Reporting

After assessing Performance Management System and KPI Reporting, the followings are the different expectations between customer needs and customer perspective to the existing system. The different expectations were summarised from the customer experience level, which got red and orange. Only one touchpoint is positive, while most touchpoints are negative, which shall be improved.

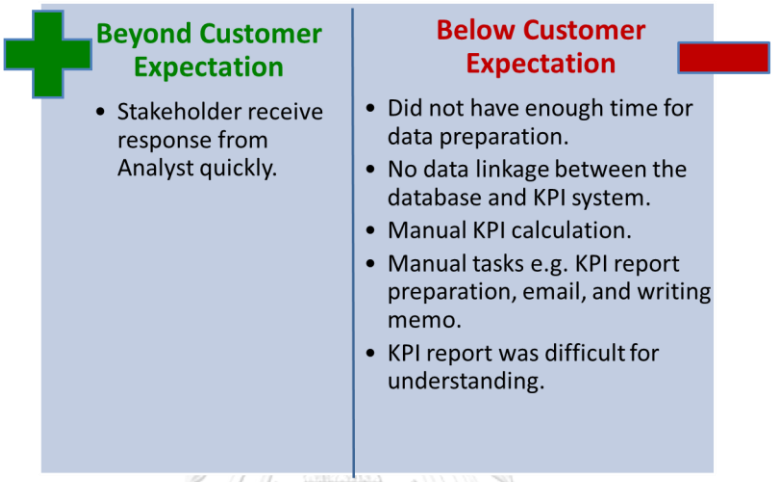


Figure 25: Different Expectations between Customer Needs and Customer Perspective for existing Performance Management System

When customers contacted touchpoints during their journey, customers could evaluate and compare their prior perception of that system and provide their perspectives to the system (Stein and Ramaseshan, 2016). As the above different expectations between customer needs and customer perspective for existing performance Management system, the touchpoints could be described as following.

Beyond Customer Expectation:

Only one positive perspective from the customer was the response from the Analyst when the stakeholders had clarification to the Key Performance Management (KPI) report. The Analyst provides the answer to all stakeholders suddenly and are willing to answer the clarification.

Below Customer Expectations:

- Did not have enough time for raw data preparation

Sometimes, staff did not have enough time for raw data preparation because staff received the notification email requesting raw data late. Also, the notification email did not specify the due date of the data request.

- No linkage between the database and KPI system

Although some raw data were available in the database, the staff had to collect that data manually and email that data to the Analyst for KPI calculation, which consumed the staff's workforce unnecessarily.

- Manual KPI calculation

As 111 KPIs shall be calculated and reported monthly to the Management and quarterly basis to the Committee, the calculation process to convert raw data into KPIs results in an enormous workforce unnecessarily. Besides, the Analyst could be stressed in daily work because of time constraints to finish the report.

- Manual tasks

Many tasks require manual work, including KPI report preparation, email, and writing a memo. Those tasks could be automatic if there were service support technologies. Reducing manual tasks could reduce the workforce required for performance reporting and relocate staff to other important tasks.

- KPI report was difficult in understanding

With an enormous number of KPIs (111 KPIs) required for reporting, the KPI report was not easy to understand and confused reviewers at both the staff and management levels. The data visualisation was not user-friendly, and the historical KPI was not ready for reviewing and benchmarking in the report.

In addition, when some KPI missed the target, the reason for missing target was not specified and described in the report; so, the reviewer could not understand the source of the problem and could not provide the mitigation or improvement plan accurately.

4.3 Quantitative Analysis

4.3.1 LEAN Methodology

The LEAN methodology is utilised to identify the activities required to complete the performance management and reporting process.

After assessing the thirteen (13) high-level processes, twenty-three (23) activities are required to complete the entire work process. The entire activities also are analysed in detail to specify the man-hour required to complete the individual activity (Table 8).

Table 8: LEAN Methodology Analysis

High Level Work Process (13 processes)	Activity (23 items)	Man-Hours		Activities Classification		
		Hour	Minute	Value-Added (VA)	Non-Value-Added (NVA)	Business-Value-Added (BVA)
Email to Staffs	Analyst write 12 emails for 12 departments to request raw data	-	30		YES	
	Analyst email to 12 department	-	15		YES	
Staffs record raw data	Staffs search data from the operators or stakeholders.	16	-	YES		
	Staffs search data from the database	48	-		YES	
Calculate 104 KPIs	Waiting time for receiving raw data from 12 departments	16	-		YES	
	Analyst copy raw data into the multiple calculation sheets	-	30		YES	
	Analyst calculate individual KPI	10	-	YES		
Prepare KPI Report	Analyst copy 104 KPI from MS excel to MS power point	2	-		YES	
	Analyst prepare 12 KPI report for 12 department	5	-	YES		
Email KPI report to stakeholder	Analyst write 12 emails of KPI report to stakehholders in 12 department.	-	30		YES	
	Analyst email to stakeholders in 12 departments	-	15		YES	
Stakeholder review KPIs	Stakeholder review KPI report	-	30		YES	
Clarification, if any	Waiting time to receive response from Stakeholders	16	-		YES	
	Stakeholder email the clarification to Analyst	-	15		YES	
Revise KPI, if any	Analyst update KPI report in various calculation sheet and report per clarification	1	-		YES	
Email KPI report to Management	Analyst write email to Management	-	15		YES	
	Analyst issue KPI report to Management	-	2	YES		
KPI Report Approval (monthly)	Management review KPI report	1	-	YES		
	Waiting time for Management approval	16	-		YES	
Writing KPI report Memo	Analyst write KPI report memo	-	30		YES	
Email Memo to Secretatry	Analyst issue KPI Report to Secretary	-	5			YES
Secretary forward KPI report to Committee	Waiting time for Secretary to forward KPI report to Committee	4	-		YES	
	Secretary forward KPI report to Committee	-	1		YES	

Besides, the activities are classified into three categories; value-added activities (VA), non-value-added activities (NVA), and business-value activities (BVA) to identify the wastes. According to the LEAN methodology definition, the value or product of the Performance Management System is the Key Performance Indicator (KPI) report that could reflect the organisation performance in various dimensions resulting in supporting the decision-making process of the management team and committee.

After analysis, overall, the total process time required for Performance Management System is 1,626 hours per year (intermittent), including the waiting time between the individual process. On the contrary, the total man-hour required for Performance Management System is 1,034 man-hours per year because the waiting time was not included in the man-hour calculation (Table 9). This analysis presents that the 25.76% of total process time used is the waiting time which is the apparent opportunity for improvement.

Table 9: Total Process Time and Man-Hour

Total Process Time / Man-Hour	Hours	Minutes	Approx. Total Hours
Total process time required for reporting KPI to Management per month	131	182	134.0
Total process time required for reporting KPI to Committee per quarter	4	36	4.5
Total Process Time required for Performance Monitoring System (Yearly-hour, intermitent)	**1,626**		
Total manhour used for reporting KPI to Management per month (Exclude waiting time)	83	182	86
Total man-hour used for reporting KPI for reporting KPI to Committee per quarter (Exclude waiting time)	0	36	0.5
Total Man-Hour used for Performance Monitoring System (Yearly-man-hour):	**1,034**		

When analysing the detailed activities (Table 9), the value-added activities (VA) that produced the KPI report include five (5) activities from twenty-three (23) activities or 21.74 percentage. In comparison, **the non-value-added activities (NVA)** that do not add value to the KPI report **are seventeen (17) activities or 73.91 percentage**, and the business-value activity (BVA) includes one activity or 4.35% of total activities.

The total process time used for NVA was 1,242 hours (yearly, intermittent) or **76.39%** of total activities, which could be calculated to man-hour as **650.4 man-hours or 62.88% yearly**. This analysis result represents the apparent opportunity to lean the work process of the performance management system that undoubtedly contributes to cost optimisation due to man-hour reduction.

Table 10: Summary Activities Analysis

Summary of Activities Analysis	Activities		Total Process Time (yearly-hour, intermittent)		Total Man-Hour (yearly-man-hour)	
	No. of Activity	Percentage	Process Time (Hour)	Percentage of total	Man-Hour	Percentage of total
Value-Added Activities (VA)	5	21.74%	384	23.61%	384	37.12%
Non-Value-Added Activities (VA)	17	73.91%	1242.4	76.39%	650.4	62.88%
Business-Value-Added (BVA)	1	4.35%	5 minutes	< 0.01%	5 minutes	< 0.01%

Although the non-value-added activities (NVA) do not produce the KPI report, all NVA could not be classified as waste per LEAN methodology. However, the Thesis will seek the opportunities to optimise NVA by redesign the work process and utilising digitalisation. According to LEAN methodology analysis, most of the NVA could be identified as wastes in the performance management process (Table-11).

Table 11: Seven (7) Wastes Identification

Activity (23 items)	Man-Hours		Activities Classification			Waste Identification	
	Hour	Minute	Value-Added (VA)	Non-Value-Added (NVA)	Business-Value-Added (BVA)	Waste	Category
Analyst write 12 emails for 12 departments to request raw data	-	30		YES		Y	Overprocessing
Analyst email to 12 department	-	15		YES		Y	Transportation
Staffs search data from the operators or stakeholders	16	-	YES			N	-
Staffs search data from the database	48	-		YES		Y	Movement
Waiting time for receiving raw data from 12 departments	16	-		YES		Y	Waiting
Analyst copy raw data into the multiple calculation sheets	-	30		YES		Y	Transportation
Analyst calculate individual KPI	10	-	YES			N	-
Analyst copy 104 KPI from MS excel to MS power point	2	-		YES		Y	Transportation
Analyst prepare 12 KPI report for 12 department	5	-	YES			N	-
Analyst write 12 emails of KPI report to stakehholders in 12 department.	-	30		YES		Y	Overprocessing
Analyst email to stakeholders in 12 departments	-	15		YES		Y	Transportation
Stakeholder review KPI report	-	30		YES		N	-
Waiting time to receive response from Stakeholders	16	-		YES		Y	Waiting
Stakeholder email the clarification to Analyst	-	15		YES		Y	Transportation
Analyst update KPI report in various calculation sheet and report per clarification	1	-		YES		Y	Transportation
Analyst write email to Management	-	15		YES		Y	Overprocessing
Analyst issue KPI report to Management	-	2	YES			N	-
Management review KPI report	1	-	YES			N	-
Waiting time for Management approval	16	-		YES		Y	Waiting
Analyst write KPI report memo	-	30		YES		Y	Overprocessing
Analyst issue KPI Report to Secretary	-	5			YES	N	-
Waiting time for Secretary to forward KPI report to Committee	4	-		YES		Y	Waiting
Secretary forward KPI report to Committee	-	1		YES		Y	Transportation

Overall, **16 of 17 NVAs are the waste** in the performance management system except for the stakeholder to review the KPI report. This process is necessary because it is a quality control process. It provides the channel for stakeholders to verify the calculated KPI, and stakeholders could clarify the reason of KPI which missed the target.

When summarising into seven (7) categories, four (4) primary wastes are associated with the performance management system, including; Waiting, Transportation, Over-processing, and Movement. The summary of wastes classification is presented as follow.

Table 12: Seven (7) Category for Performance Management System

Waste Category	List of Activities
Over Production	Not Applicable
Waiting	- Receiving raw data - Stakeholder review KPI report - Management Approval - Secretary forward KPI report to Committee
Transportation	- Communications among departments by email - Copy raw data into multiple calculation sheets - Copy 104 KPIs from MS excel to MS power point - Secretary forward KPI report to Committee
Overprocessing	- Write email to various department and management. - Write memo to secretary
Movement	- Search data from database
Inventory	Not Applicable
Defects	Not Applicable

The listed activities in the LEAN methodology will be significant inputs for the fishbone diagram to analyse the source of problems and other solution development processes.

4.3.2 Causes and Effect Analysis

Fishbone diagram is utilised to analyse causes of problems listed from LEAN methodology analysis in various dimensions, including; manpower, methods, process, technology, and integration. The four (4) problems from wastes identification, including long waiting time, many data transportation, over-processing, and unnecessary movement, are located at the head of each skeleton. In contrast, the causes of the specific problem area are located at the branch of each fishbone.

The fishbone analysis results are the potential root causes of the specific problem for the further problem-solving process, which will be described in section-5.

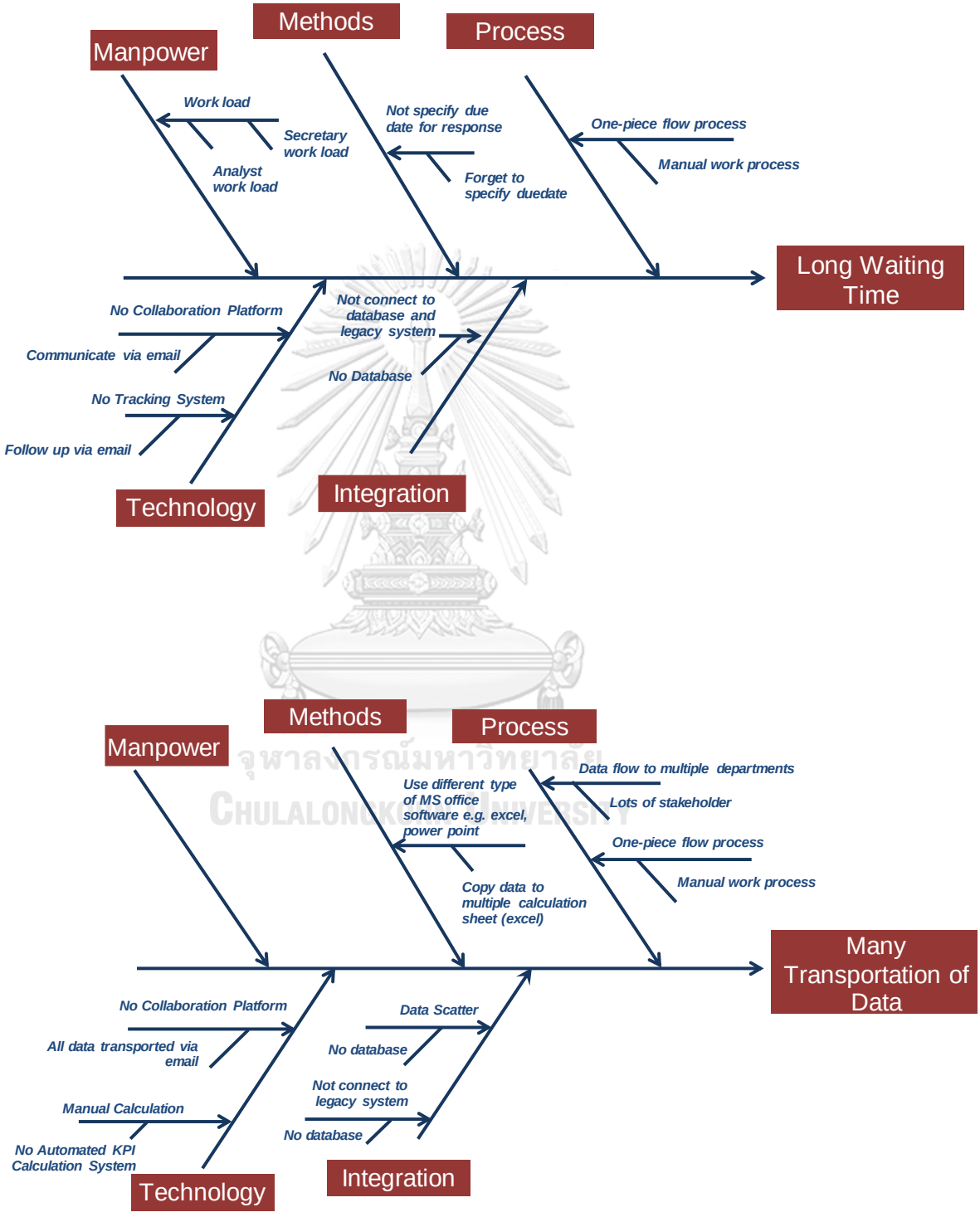


Figure 26: Fishbone Diagram for Performance Management System

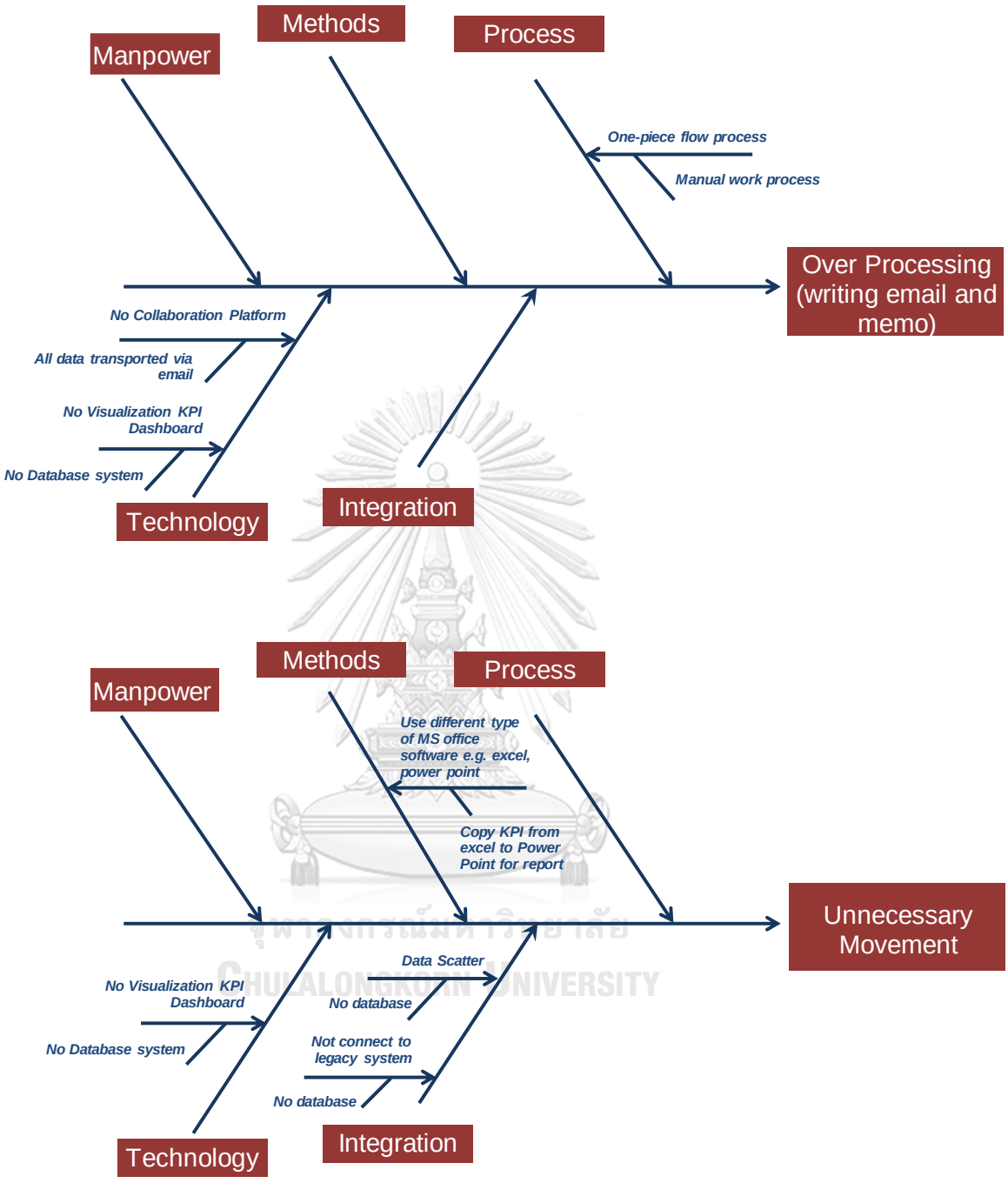


Figure 27: Fishbone Diagram for Performance Management System (continue)

In conclusion, the causes and effect analysis by fishbone diagram could be summarized as table-12 including; categories, root causes, and potential solutions to enhance the Oil and Gas Exploration and Production Performance Management System.

Table 13: Summary of root causes and potential solutions

Root Causes Category	Root Causes	Potential Solutions
Man-power	Analyst work load	- Minimize workload of Analyst by **redesign work process** and **utilizing service support technologies.**
	Secretary work load	
Technology	All communication conducted through email	**Develop the Collaboration Platform** that have following features; - Automated email for notification and reporting. - Action Tracking System to remind and follow up. - Database. **Develop KPI Dashboard** that provides the following feature; - Data visualization to staffs, analyst, management, and committee. - Automated Report to all stakeholders. - Warning System when KPI has signal to fail.
	No tracking system	
	All data transported via email	
	No Automated KPI Calculation System	
	No Database system	
	No Visualization KPI Dashboard for KPI Report	
Method	Not specify due date for response	**Develop the automated KPI calculation system and the automated KPI report**
	Need to copy data from stakeholders to multiple calculation sheet	
	Different type of MS office software e.g. MS excel for calculation and MS power point for report	
Process	One-piece flow process	**Redesign work process to parallel work process** that data could flow into the database and the collboration platform at the same time.
	Data flow to multiple departments	
Integration	Not connect to database and legacy system	- **Develop the integration with legacy systems** to extract data from legacy system automatically and minimize manual work. **- Centralized Database.**
	Data scatter in many departments	

The potential solutions could be summarized as follow. The potential solutions also could solve the qualitative problem identified from the qualitative analysis.

- Redesign work process to parallel work process
- Develop the database system
- Develop the collaboration platform
- Develop the performance Management dashboard
- Develop the automated KPI calculation system and automated KPI report
- Develop the integration with legacy system

4.4 Key Performance Indicator (KPI) Analysis

All 111 Key Performance Indicators (KPIs) were analysed (Appendix-B) to deeply understand the individual KPI's characteristics, categorise those KPIs, and identify the improvement area according to the methodology and best practice for sustainable performance evaluation in the oil and gas industry (Elhuni and Ahmad, 2017). The KPI hierarchy concept is applied to the organisation to categorise all 111 KPIs into six (6) categories; Environment, Maintenance, Operations, Reputation, Resources, and Safety.

The definition of each KPI category can be described as follow;

- Environment: The KPIs in the environmental category measure the parameters that affect the environment created from the company operating, such as Greenhouse Gas Emissions (GHG), oil spills, wastes amounts, and freshwater used.
- Maintenance: The KPIs in the maintenance category measure the performance of equipment and system maintainability to ensure the integrity and safety of equipment and system for use. The example KPIs are the plant availability and maintenance cost index.
- Operations: The KPIs in the operation category measure the performance of the operation in terms of economics, operation optimisation, and quality control. The example KPIs are production target achievement, logistic cost, unit cost, production quality, and inventory.
- Reputation: The KPIs in the reputation category measure the indicators related to the company's reputation and regulatory compliance. Examples of KPIs are customer satisfaction scores, projects to support the community, non-compliance procurement, and contract deviation.
- Resources: The KPIs in the resource category measure the performance of resources management. The example of KPIs is competency development achievement, critical positions filled by high-potential talents, employee engagement score, and training progress.
- Safety: The KPIs in the safety category measure the performance of safety management throughout organisation operations. Examples of KPIs are Loss

Time Injury Frequency (LTIF), numbers of significant incidents, Standard Operating Procedure (SOP) compliance, and alarm numbers.

Table 14: Summary of Key Performance Indicators (KPIs) Analysis (Applied from Elhuni and Ahmad, 2017).

KPI Category	Count of Leading	Count of Lagging	Count of Data Monitoring	Count of Duplicate
Environment	1	5	1	2
Maintenance	5	6	1	1
Operations	26	16	8	15
Reputation	3	9	5	2
Resources	6	4	2	2
Safety	18	12	7	3
Grand Total	**59**	**52**	**24**	**25**

Besides, all KPIs could be classified into two (2) types of KPIs regarding the influence of individual KPI as Leading and Lagging KPI. Leading KPI could influence other key performance indicators (KPI), while Lagging KPIs are the results of Leading KPIs. So, the organisation still shall monitor both leading and lagging KPI for flawless operation.

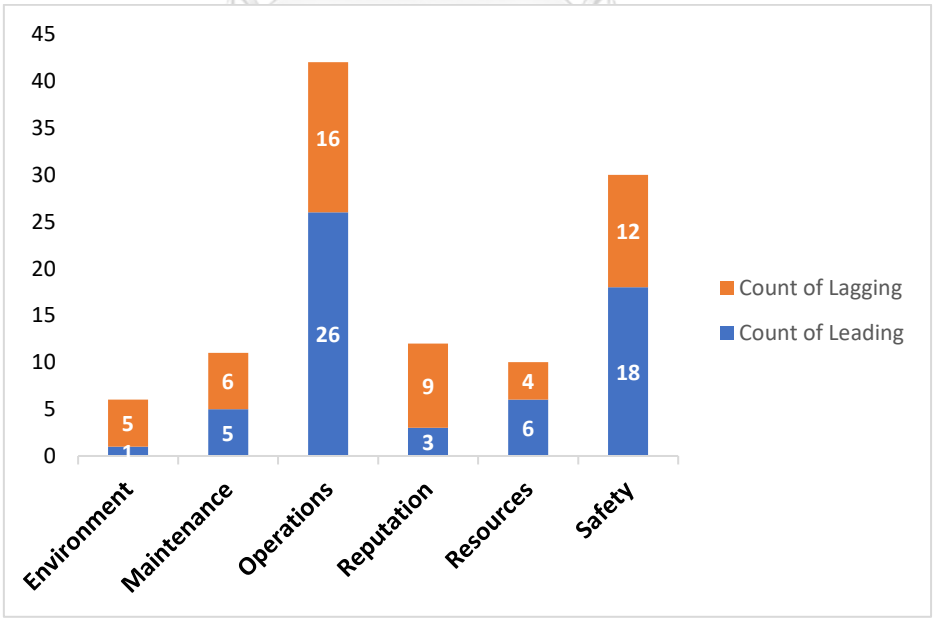


Figure 28: KPI Leading and Lagging Analysis Result

However, there were 25 KPIs that are duplicated, or there is the same KPI calculation method, but that duplicated KPIs are recorded and reported to Management. These duplicated KPIs could be classified as waste in the system. Besides, there were 24 KPIs that could be eliminated in the KPI report and changed to only data Management because these 24 KPIs are not significant and should not be reported to Management and Committee.

Therefore, the duplicated KPIs for 25 items were deleted suddenly from the KPI management and report. The additional recommendation is to delete the unnecessary KPIs for 24 items, which could reduce the workforce for KPI collection, calculation, and reporting.

Table 15: The Recommended KPI Improvement - duplicated KPI removed (Applied from Elhuni and Ahmad, 2017)

KPI Category (Future Project)		
	Environment (4 items)	3 Lagging KPIs
		1 Data Monitoring
	Maintenance (10 items)	5 Leading KPIs
		4 Lagging KPIs
		1 Data Monitoring
	Operations (27 items)	12 Leading KPIs
		7 Lagging KPIs
		8 Data Monitoring
	Reputation (10 items)	6 Lagging KPIs
		4 Data Monitoring
	Resources (8 items)	4 Leading KPIs
		2 Lagging KPIs
		2 Data Monitoring
	Safety (27 items)	13 Leading KPIs
		7 Lagging KPIs
		7 Data Monitoring

Table 16: Example of Duplicated Key Performance Indicators (KPIs)

KPI Code	KPI	Formula
OPS - 1	Overall Plant Efficiency	= **Effectiveness of gas delivery x Quality factor**
VCM - 1	**% production target achieved**	= (Actual Production / Planned Production) x 100%
VCM - 10	**% of in-process quality** compliance (e.g. BS&W, Calorific Heating Value)	= (Quantity produced right first time / Quantity produced) x 100%

KPI Code	KPI
CPM-2	**Total recordable incident rate (TRIR)** **Loss time injury frequency rate (LTIF)**
OEMS-3	**Loss Time Injury Frequency (LTIF)** (Number of lost time injuries case x 200,000) / Total number of hours worked)
SSHE-4	**Loss Time Injury Frequency (LTIF)**
SSHE-2	**Total recordable injury Rate (TRIR)** (Number of recordable incidents x 20,000) / Total number of hours worked)

Table 17: Example of Unnecessary Key Performance Indicators (KPIs)

KPI Code	KPI	Rational
SSHE - 1	# of work related fatalities	No fatality for long
OEMS-1	# of repeated incidents due to identified risks	Most risks were identified
SM-7	# of violations of the PTT Sustainable Suppliers Code of Conduct and supplier environmental, social, and governance (ESG) requirements	**Must** follow Procedure and Regulation
MCS-9	# of non-compliance procurement	**Must** follow Procedure and Regulation
MCS-4	# of contractors / suppliers non-compliance to PTT MCS requirements (Terms and conditions, SSHE, SM, etc.)	**Must** follow Procedure and Regulation

Chapter 5 Project Development

According to the analysis results, the Advanced Performance Management System will be developed according to the following project development framework that clearly defines the roadmap and activities to complete the project. Project development aims to utilise the recommendation from the analysis stage to improve the work process and develop the solution to implement in the organisation.

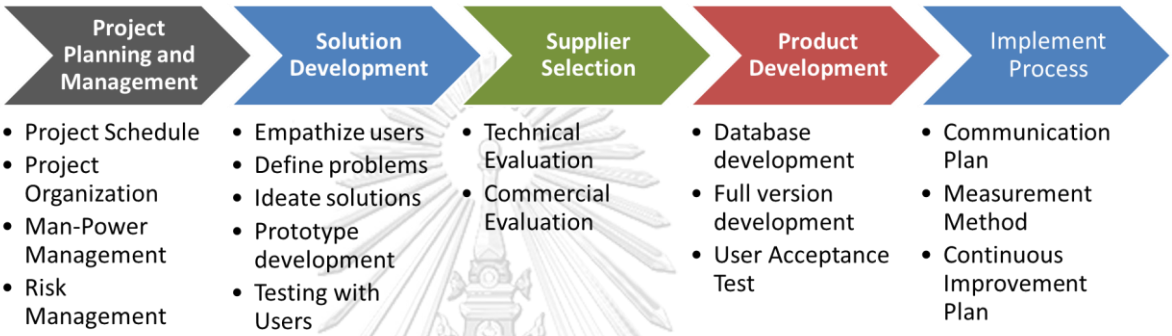


Figure 29: Project Development Framework (Modified from Roger, 2019)

The author was responsible for managing resources and schedule for solution development and implementing the solution into the organisation. The author made the supplier selection to select the supplier and workforce to program and develop the software and application according to the scope and requirements specified by the author and manage the entire project management as a project manager from feasibility study until implementation.

5.1 Project Planning and Management

Project Planning and Management is the critical success factor of developing the Performance Management System to control three project outcomes: Cost, Time, and Quality of project. The tools were used for the project planning and management could be presented as follow;

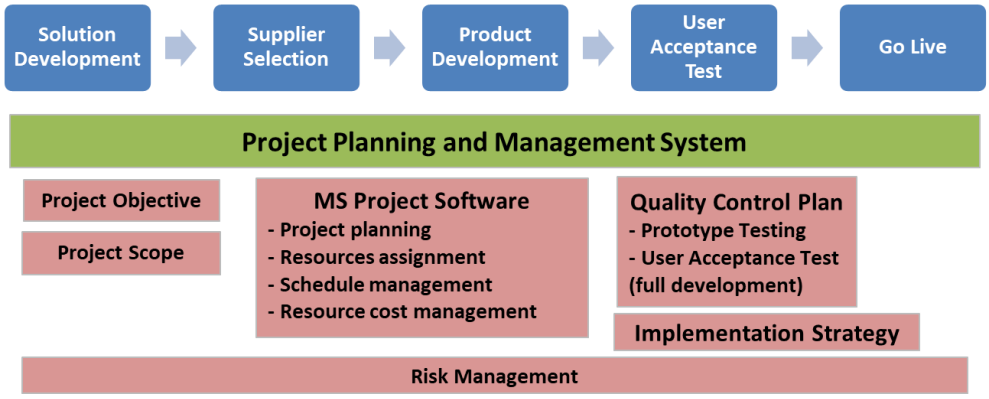


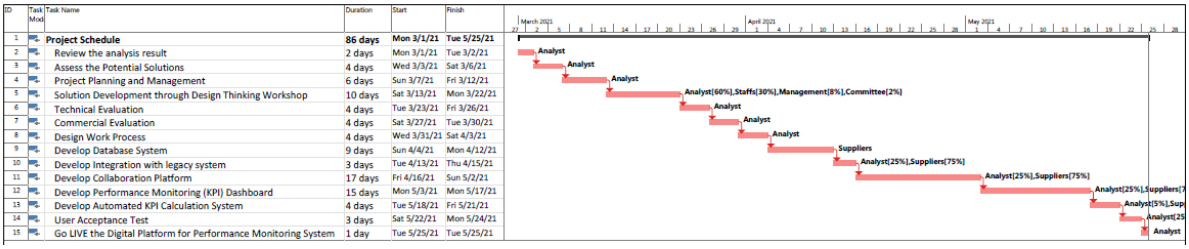
Figure 30: Project Planning and Management System (Roger, 2019)

The MS project software will be used as the primary tool for project planning and management, including project planning, project organisation, schedule management, and workforce management. The project management by MS project covers the time and cost management while the quality will be managed through the prototype testing and the user acceptance testing process, respectively.

Eventually, the implementation plan will be prepared to ensure that the product and service will be effectively implemented into the operation and well communicated throughout the organisation.

5.1.1 Project Schedule

The project schedule is prepared (Appendix-A), representing the required activities, schedule, and the required resources to complete individual activities throughout the project. Overall, there are 15 tasks required to complete the project within 86 days project duration. The first activity is reviewing the analysis result, and the last activity is announcing the Digital Platform for Performance Management System throughout an organisation.



ID	Task Mode	Task Name	Duration	Start	Finish
1		**Project Schedule**	**86 days**	**Mon 3/1/21**	**Tue 5/25/21**
2		Review the analysis result	2 days	Mon 3/1/21	Tue 3/2/21
3		Assess the Potential Solutions	4 days	Wed 3/3/21	Sat 3/6/21
4		Project Planning and Management	6 days	Sun 3/7/21	Fri 3/12/21
5		Solution Development through Design Thinking Workshop	10 days	Sat 3/13/21	Mon 3/22/21
6		Technical Evaluation	4 days	Tue 3/23/21	Fri 3/26/21
7		Commercial Evaluation	4 days	Sat 3/27/21	Tue 3/30/21
8		Design Work Process	4 days	Wed 3/31/21	Sat 4/3/21
9		Develop Database System	9 days	Sun 4/4/21	Mon 4/12/21
10		Develop Integration with legacy system	3 days	Tue 4/13/21	Thu 4/15/21
11		Develop Collaboration Platform	17 days	Fri 4/16/21	Sun 5/2/21
12		Develop Performance Monitoring (KPI) Dashboard	15 days	Mon 5/3/21	Mon 5/17/21
13		Develop Automated KPI Calculation System	4 days	Tue 5/18/21	Fri 5/21/21
14		User Acceptance Test	3 days	Sat 5/22/21	Mon 5/24/21
15		Go LIVE the Digital Platform for Performance Monitoring System	1 day	Tue 5/25/21	Tue 5/25/21

Figure 31: Project Schedule (Roger, 2019)

5.1.2 Resource Assignment

The resources are well assigned to an individual task with resource cost for workforce cost calculation and management. Although some tasks require multiples resources, the MS Project software provides flexibility for project management by allowing the project owner to assign multiple resources for each task with different efforts for an individual resource.

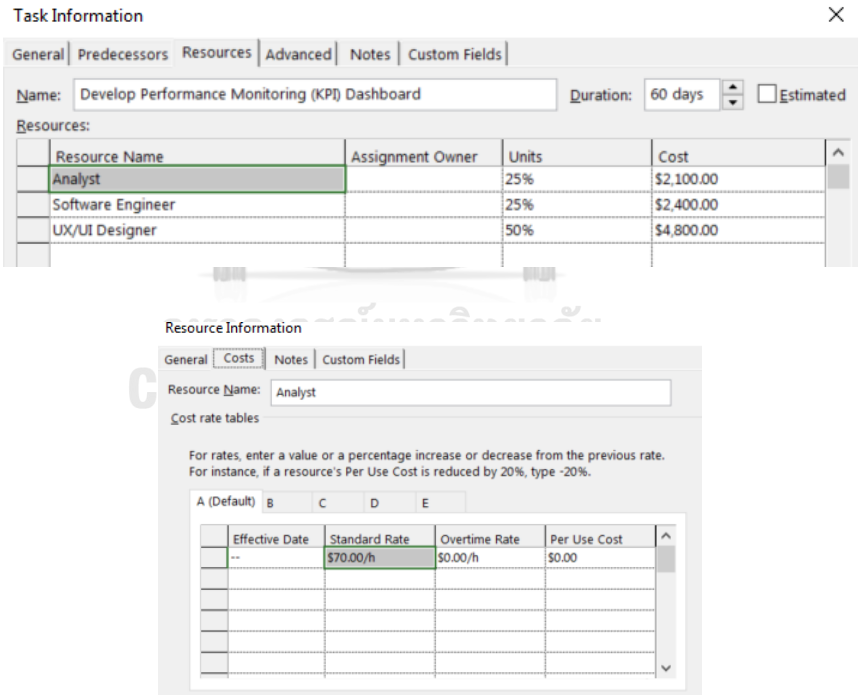


Figure 32: Examples of Resource Assignment and Resource Cost

5.1.3 Schedule Management

The MS project software is used for project management. The project progress would be automatically updated when users input the progress completion of individual activity.

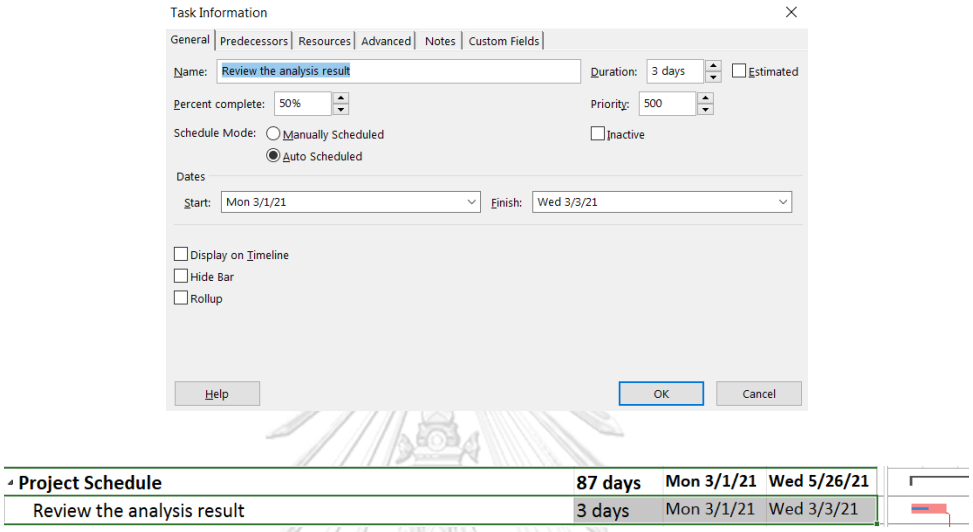


Figure 33: Example of Schedule Management

When the assigned people completed the individual task and input the progress in the MS project, the project progress would be updated and tracked automatically, including duration used and resources used to complete an individual task. After project completion, the summary of the schedule and workforce could be presented.

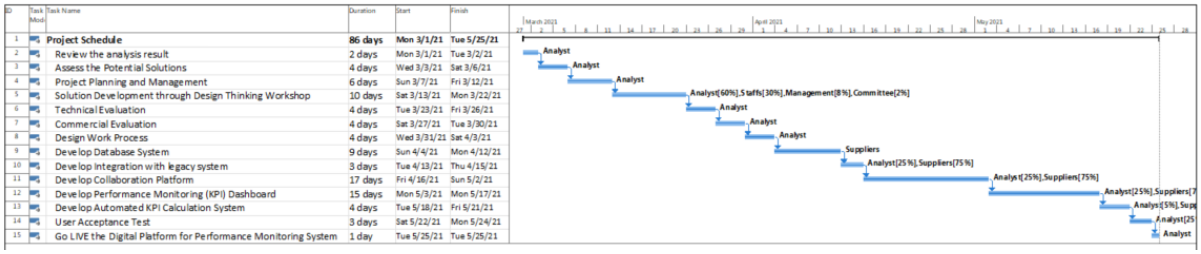
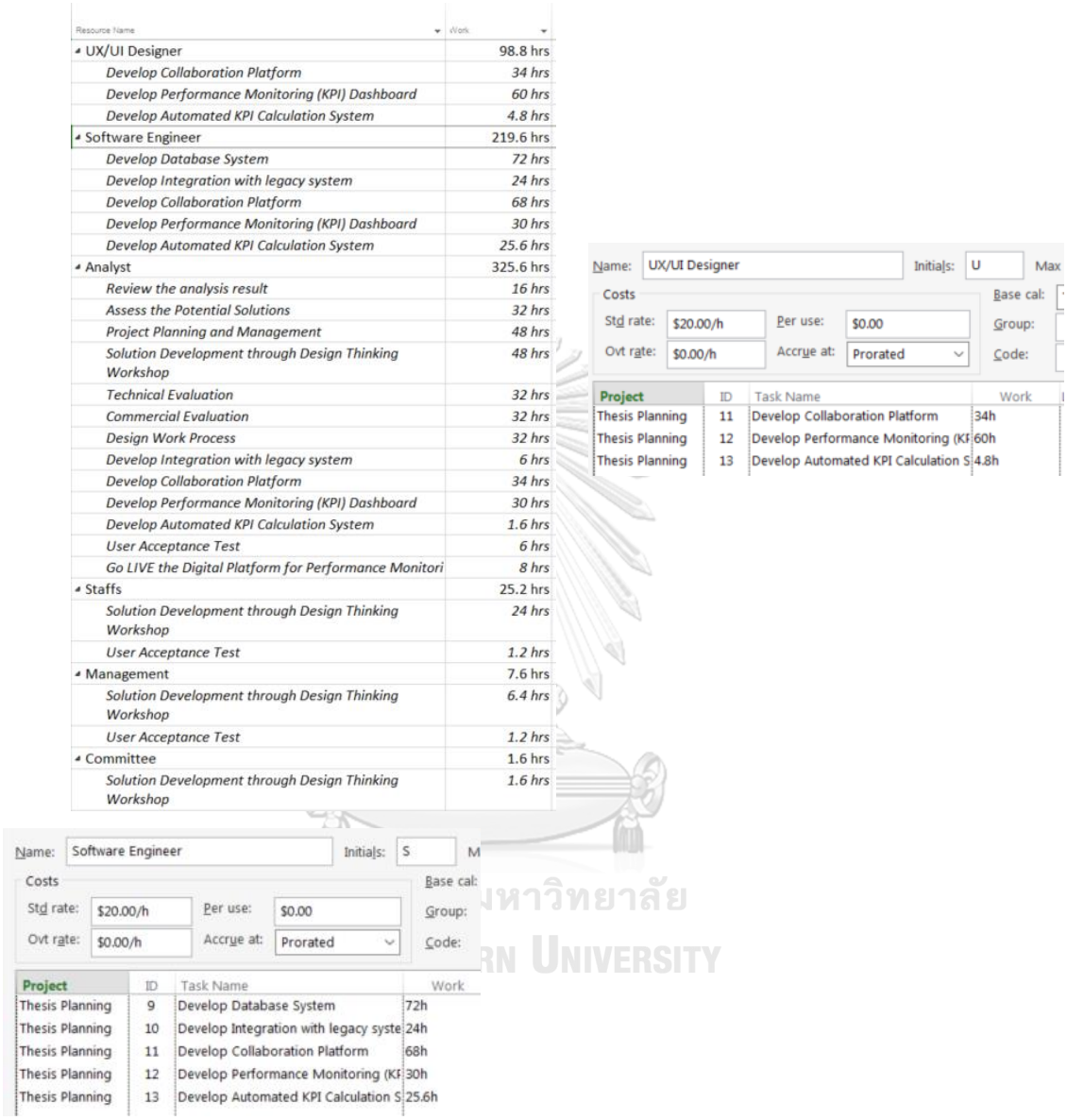


Figure 34: Project Schedule after Project Completion

5.1.4 Man-Power Management

In the detail of workforce management, the assigned resources well understand their assigned tasks. The MS project summarised related tasks for each resource and tracked

the workforce used throughout the project until project completion. The total costs used for resources were summarised for the financial process.



Resource Name	Work
UX/UI Designer	98.8 hrs
Develop Collaboration Platform	*34 hrs*
Develop Performance Monitoring (KPI) Dashboard	*60 hrs*
Develop Automated KPI Calculation System	*4.8 hrs*
Software Engineer	219.6 hrs
Develop Database System	*72 hrs*
Develop Integration with legacy system	*24 hrs*
Develop Collaboration Platform	*68 hrs*
Develop Performance Monitoring (KPI) Dashboard	*30 hrs*
Develop Automated KPI Calculation System	*25.6 hrs*
Analyst	325.6 hrs
Review the analysis result	*16 hrs*
Assess the Potential Solutions	*32 hrs*
Project Planning and Management	*48 hrs*
Solution Development through Design Thinking Workshop	*48 hrs*
Technical Evaluation	*32 hrs*
Commercial Evaluation	*32 hrs*
Design Work Process	*32 hrs*
Develop Integration with legacy system	*6 hrs*
Develop Collaboration Platform	*34 hrs*
Develop Performance Monitoring (KPI) Dashboard	*30 hrs*
Develop Automated KPI Calculation System	*1.6 hrs*
User Acceptance Test	*6 hrs*
Go LIVE the Digital Platform for Performance Monitori	*8 hrs*
Staffs	25.2 hrs
Solution Development through Design Thinking Workshop	*24 hrs*
User Acceptance Test	*1.2 hrs*
Management	7.6 hrs
Solution Development through Design Thinking Workshop	*6.4 hrs*
User Acceptance Test	*1.2 hrs*
Committee	1.6 hrs
Solution Development through Design Thinking Workshop	*1.6 hrs*

Name: UX/UI Designer Initials: U Max

Costs

Std rate: $20.00/h Per use: $0.00 Base cal:

Ovt rate: $0.00/h Accrue at: Prorated Group:

Code:

Project	ID	Task Name	Work
Thesis Planning	11	Develop Collaboration Platform	34h
Thesis Planning	12	Develop Performance Monitoring (KI	60h
Thesis Planning	13	Develop Automated KPI Calculation S	4.8h

Name: Software Engineer Initials: S M

Costs

Std rate: $20.00/h Per use: $0.00 Base cal:

Ovt rate: $0.00/h Accrue at: Prorated Group:

Code:

Project	ID	Task Name	Work
Thesis Planning	9	Develop Database System	72h
Thesis Planning	10	Develop Integration with legacy syste	24h
Thesis Planning	11	Develop Collaboration Platform	68h
Thesis Planning	12	Develop Performance Monitoring (KI	30h
Thesis Planning	13	Develop Automated KPI Calculation S	25.6h

Figure 35: Examples of Man-Power Management

Overall, the resources used to complete the project could be illustrated below, including man-hour distribution, resource cost distribution, and total resource cost.

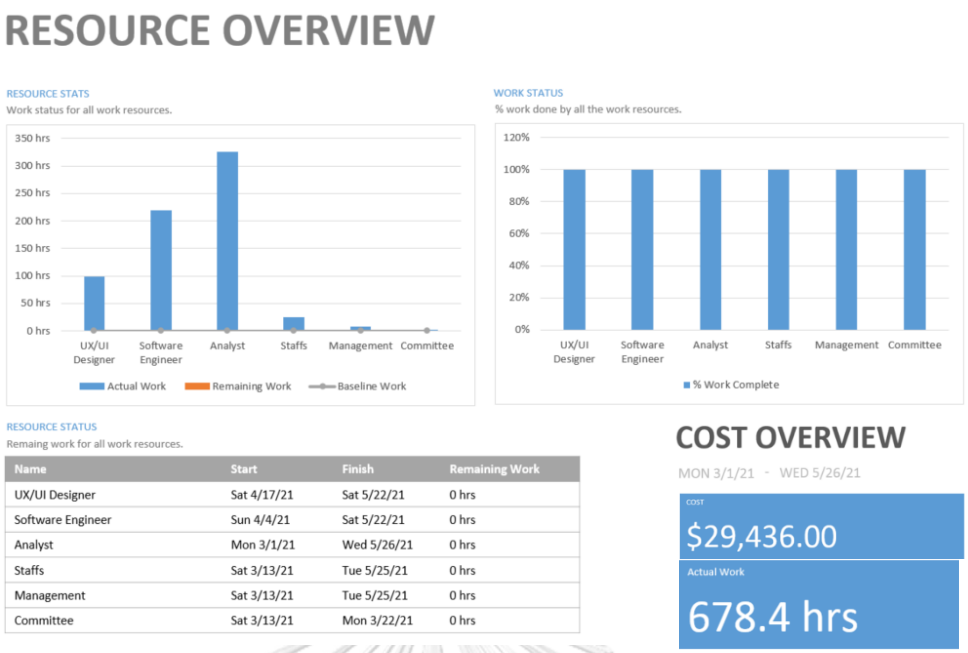


Figure 36: Resources Statistic Report

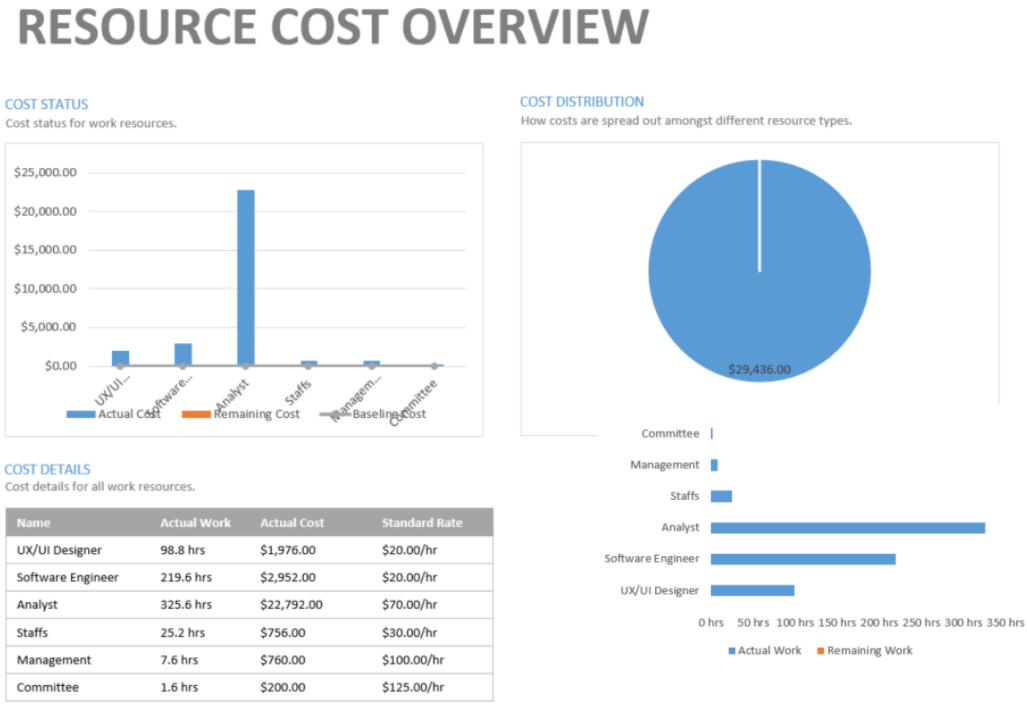


Figure 37: Resources Statistic Report (continue)

5.1.5 Risk Management

Project development and project execution always have risks, more or less. Risk management is one of the critical success factors to achieve the project objective. The Advanced Performance Management System also has many risks that shall be managed effectively.

Based on the 15 main tasks in the project schedule, nine risks are categorised per six groups of activities. Risk management started by identifying risks and risk consequences. Secondly, the risks were analysed by calculating the impact and probability to prioritise the risks and the risk response strategies and plans.

With an effective risk response plan, the project has a mitigation plan and counterplan for identified risks. Three risks shall be closely monitored and effectively managed, including; the delay in work process design and specification development, the quality failure of suppliers, and the delay in user-interface design, respectively.

Table 18: Risk Management Matrix (Roger, 2019)

Risk Identification			Risk Analysis (1-5)			Risk Response Strategy	Risk Response Planning
Task No.	Risk Description	Risk Consequence	Impact (I)	Prob. (P)	IxP		
Project Development and Execution Risks							
4	Unclear of role & responsibility for individual task	Delay in project execution and may require additional resources to complete the project	4	3	12	Mitigate	Closely communicate and monitor individual task and resource.
Cost & Schedule Risk							
9 to 14	Delay in project execution	Delay in announcing the Digital Platform for Performance System	5	2	10	Mitigate	Additional Analyst, Software Engineers, UX/UI Designer
7	Resource cost is higher than expectation.	Project cost overrun	4	1	4	Mitigate	Recheck resource cost with suppiler and HR department
Procurement Risk							
6	Quality Failure of Supplier	Delay in developing of database, collaboration platform, and KPI dashboard	5	3	15	Mitigate	Additional Software Engineers, UX/UI designer to re-developing.
Design Risk							
8	Delay in work process design and develop specification document	Delay in developing of database, collaboration platform, KPI dashboard, and testing	5	4	20	Mitigate	Additional Analyst, Software Engineers
9 -13	Delay in user-interface design	Delay in developing of database, collaboration platform, KPI dashboard, and testing	5	3	15	Mitigate	Additional UX/UI Designers
8 -13	Scope change during project execution	Delay in developing of database, collaboration platform, KPI dashboard, and testing	4	1	4	Mitigate	Additional Software Engineers, UX/UI designer
Testing Risk							
14	Quality Failure during User Accpetance Test	Delay in announcing the Digital Platform for Performance System	5	2	10	Mitigate	Additional Software Engineers, UX/UI designer
Operation Risks							
15	Platform and Dashboard are too slow for daily operation by users	Users would not use the Platform and Dashboard	5	1	5	Mitigate	Continuous Testing of system speed

5.1.6 Quality Control Plan

The quality control plan was prepared by utilising the prototype testing process in the design thinking workshop as the first stage gate for user approval before developing the full-scale systems. The second stage gate was the specification used to identify the scope and requirement for suppliers in detail. An organisation must approve the specification before starting the full-scale development. The last stage-gate was the user acceptance test conducted with all users after the full-scale completion.

Figure 38: Quality Control Plan

5.1.7 Implementation Strategy

The last stage of project planning and management is preparing the implementation strategy, which is the strategy to implement the developed Digital Platform for Performance Management System into the organisation effectively. The Implementation strategies include the communication plan, the performance measurement method, and the continuous improvement plan.

The communication strategies and plans were developed for communicating throughout the organisation at both management and staff levels. The performance measurement method was prepared to measure the project's success in both qualitative and quantitative benefits. Lastly, the continuous improvement plan was prepared for future enhancement after implementing the project for a while.

5.2 Solution Development

From the analysis result and potential solution described above, the practical solution will be developed using the Design Thinking approach as a guideline by empathising with users, defining users' actual needs, ideating possible solutions from the user perspective, and developing a prototype for testing with users.

Users from various departments will assess the potential solutions in the Analysis stage (chapter 4) and develop the prototype for testing. The user-interface design ensures that the developed Digital Platform for Performance Management will be effective, user-friendly, and effectively solve users' pain points.

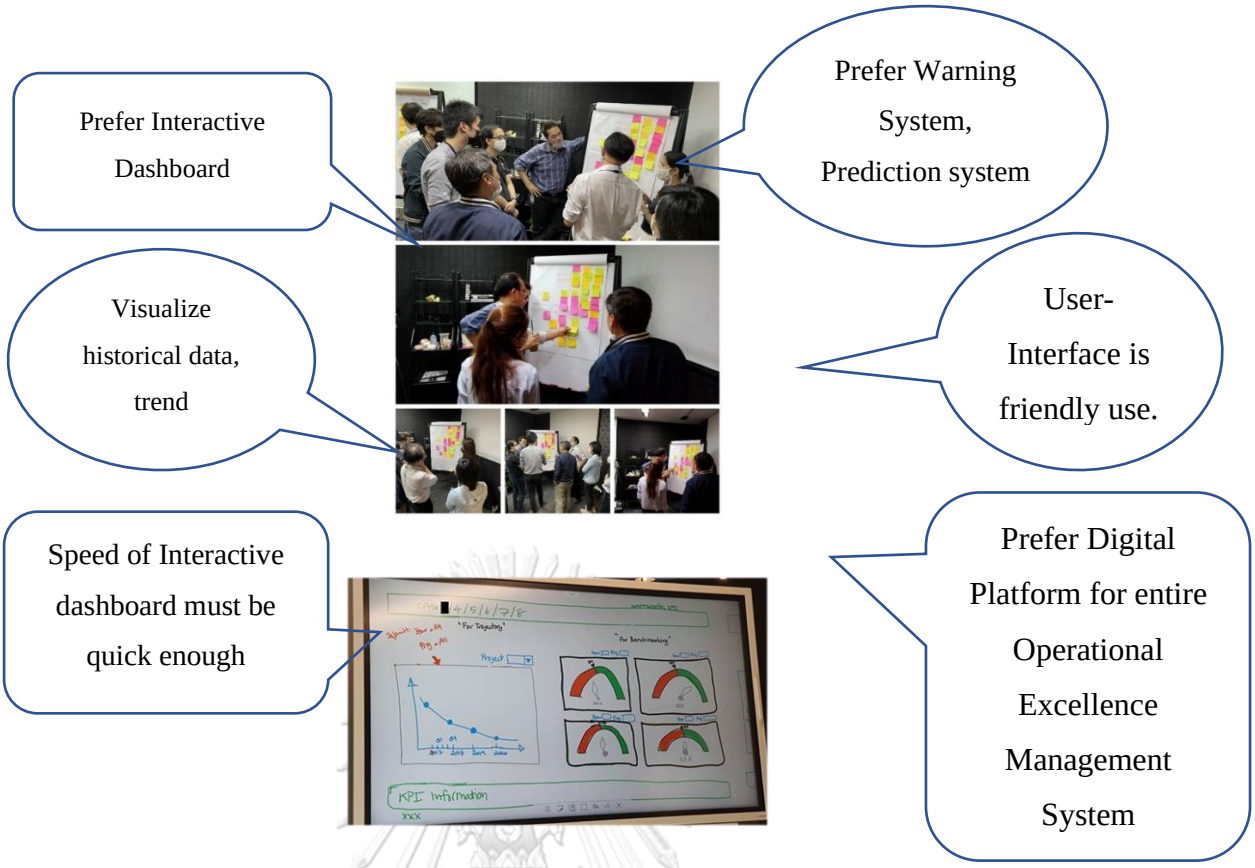


Figure 39: Examples of photos and users' feedbacks in Design Thinking Workshop

The project development will be executed to capture all users' feedback as reasonably practicable according to the project schedule and Thesis schedule.

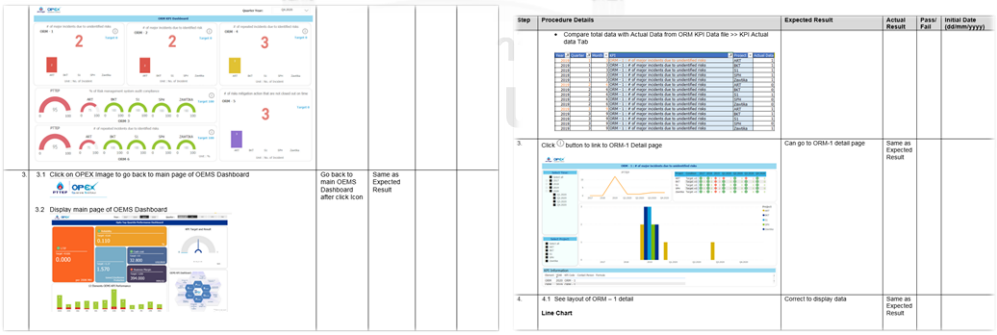


Figure 40: Examples of Prototype Acceptance Test

5.3 Supplier Selection

From potential solutions and prototypes, the technology selection will be conducted to select the appropriate technologies compatible with business strategy and organisation context.

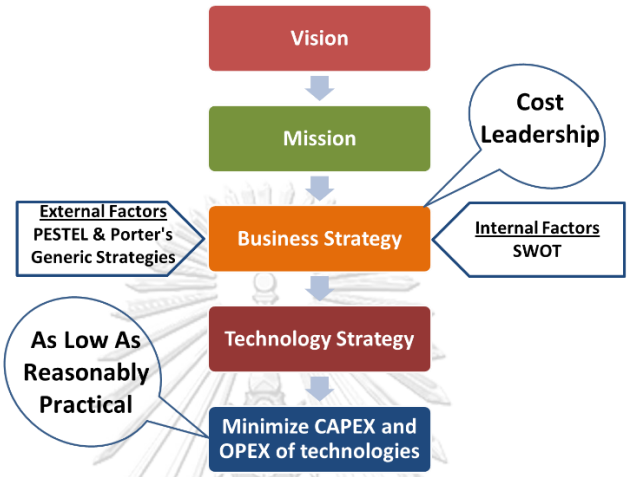


Figure 41: Technologies Strategy Framework (modified from Angela, 2020)

The Oil and Gas Exploration and Production business are in the commodity section, which the organisation cannot control the selling price. The cost leadership strategy is the proper strategy that the organisation shall focus on (Porter, 1985). Therefore, the selected supplier and selected technologies for the Advanced Performance Management System shall have CAPEX and OPEX as low as reasonably practical.

The following will describe the supplier and technology evaluations before developing the actual Digital Platform for Performance Management systems.

In terms of technical evaluation, all outsource suppliers can develop and supply the off-the-shelf Performance Management System, including the project management and redesign of the work process. On the contrary, the in-house development by the subsidiary company cannot analyse the existing performance Management system, identify the potential solutions, manage the project, and redesign of work process because they did not have experience in developing the performance Management

system. However, they had technical competency and experience in developing database and visualisation dashboards for other applications.

Table 19: Technical Evaluation Summary

Technical Requirement	Pass-Fail Criteria	Suppliers			
		Supplier#1	Supplier#2	Supplier#3	In-house Development (PTT Digital)
Project Scope	Included Database system Integration with legacy system Collaboration Platform Performance Monitoring Dashboard Automated KPI Calculation / Automated KPI Report	PASS	PASS	PASS	PASS
Resouces (Software Engineer, UX/UI Designer)	Included 2 software engineers / 2 UX/UI designers	PASS	PASS	PASS	PASS
Design Specification	Included 13 design specification separated per department	PASS	PASS	PASS	PASS
Inspection and Test	Included: User Acceptance Test	PASS	PASS	PASS	PASS
Conclusion		**PASS**	**PASS**	**PASS**	**PASS**

The commercial evaluation presents that the in-house development would have the lowest cost for developing the Performance Management System. Although outsourced suppliers could provide full-service, including project management and work process design, in-house development was still the most competitive option because the additional resources were acceptable and competitive compared to other options.

Table 20: Commercial Evaluation Summary

Tasks / Functions	**Commercial Evaluation (CAPEX + OPEX)** (score 1-5)			
	Supplier#1	Supplier#2	Supplier#3	In-house Development (PTT Digital)
Database System	4	4	5	1
Integration with legacy system	3	3	5	1
Collaboration Platform	5	5	5	5
Performance Monitoring Dashboard	3	3	3	3
Automated KPI Calculation System / Automated KPI report	3	3	3	3
Summary	**18**	**18**	**21**	**13**

Another reason for utilising the in-house development rather than purchasing the off-the-shelf software from an outsourcing supplier is that the organisation already had the cloud database and the visualisation software called Power BI from MICROSOFT.

Therefore, the in-house development of a digital platform for a performance management system is practical and reasonable. The in-house development could solve the users' problems effectively through design thinking workshops and provide flexibility to the organisation for any modification in future.

Mainly, the organisation could commercialise the developed Digital Platform for Performance Management to other companies because a performance management system is a routine activity for most organisations.

5.4 Product Development

5.4.1 Database Development

The architecture of the Digital Platform for Performance Management System could be presented below. The digital platform development includes developing a new work process, centralised database, collaboration platform, visualisation dashboard, automation system, and integration with legacy systems.

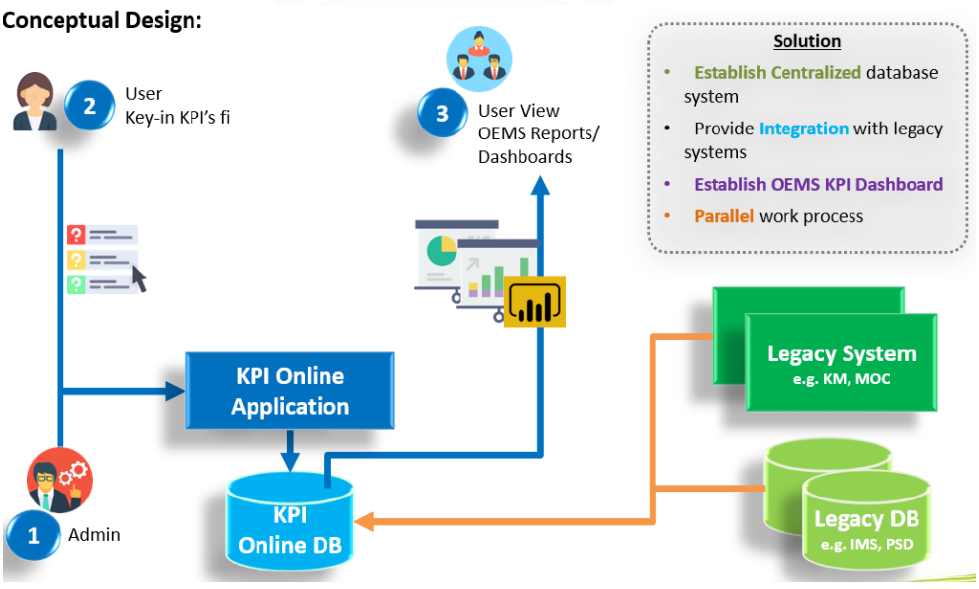


Figure 42: Digital Platform for Performance Management System Architecture

The centralised database is developed using MICROSOFT cloud service to provide access to all users for data recording. The legacy database and system are integrated into the online database to utilise the readiness data without repeating work.

5.4.2 New Work Process

According to the digital platform architecture for a performance management system, the process that consumes the workforce in reporting KPI is reduced from thirteen (13) processes to two (2) processes, including; staffs input data and Analyst verify KPI per green box.

The rest processes were eliminated through redesign of the work process according to the analysis result (section 4), supported by service support technologies such as database system, collaboration platform, interactive dashboard, and automation system. Besides, the raw data in the legacy systems were integrated into the KPI database, calculated, and reported to KPI Dashboard automatically.

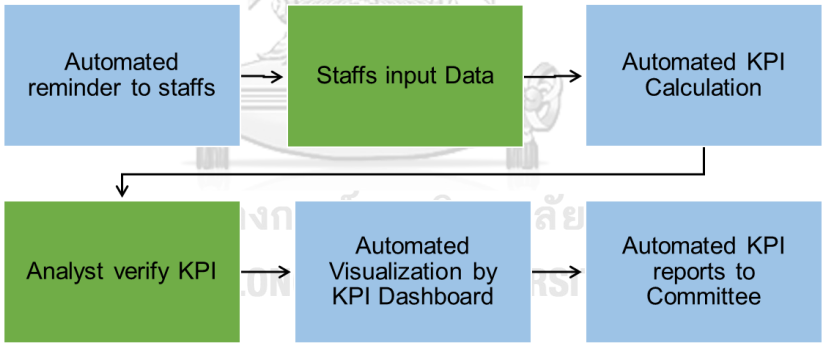


Figure 43: New Work Process of Digital Platform for Performance Management System

5.4.3 Digital Platform for Performance Management System

The Digital Platform for Performance Management System will be presented through the Customer Journey that helps illustrate the entire processes for Performance Management System and reflect the customer satisfaction through Customer Journey Mapping (CJM).

1. Automated Reminder to Staffs

One week before the due date, the system will automatically remind staff to report data into the collaboration platform via email. The system would keep reminding staff every day until staff input the data in the system. Staff could access the collaboration platform via the provided link in the email.

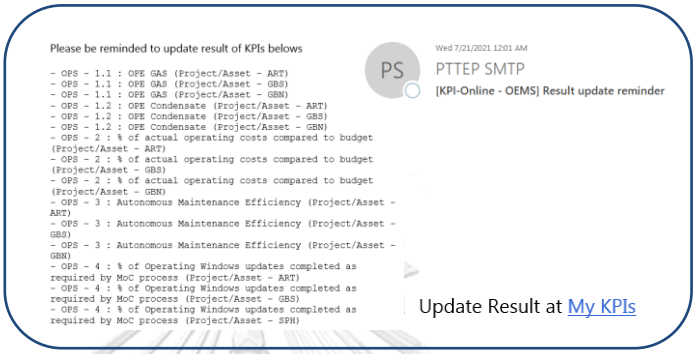
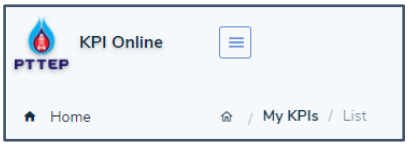


Figure 44: Example of Automated Reminder

2. Staffs record data

When staff enter the collaboration platform, they see their responsible KPIs by selecting "My KPIs". Staff could record data in the system quickly.



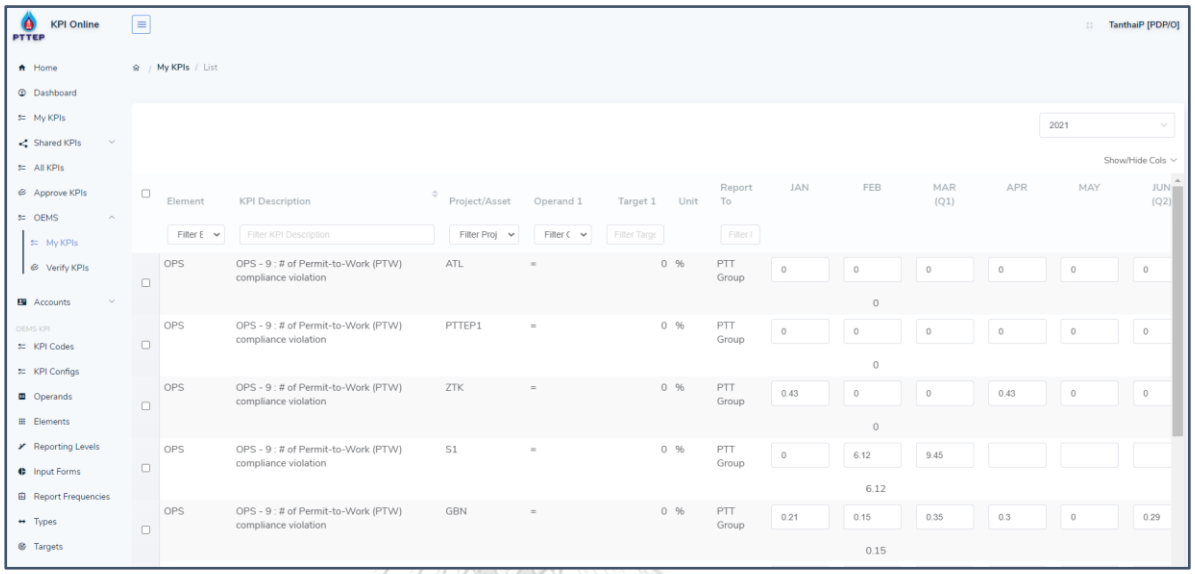


Figure 45: Collaboration Platform Homepage

3. Analyst verify KPIs

When staff recorded data, the system would automatically calculate and email the KPI to the Analyst for KPIs verification. An analyst could access the collaboration dashboard and verify KPIs.

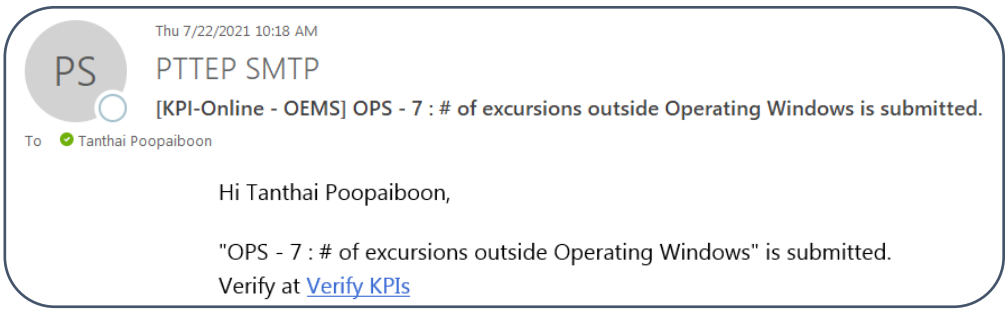


Figure 46: Automated email to request Analyst for KPIs verification

4. Automated Visualization by KPI Dashboard

When the Analyst verified KPIs, the system would automatically email the KPI results to all stakeholders. All authorised users, including Staff, Analysts, Management, and Committee, could access the interactive visualisation dashboard via the provided link in the email.

The dashboard is designed to visualise the organisation performance throughout 111 Key Performance Indicators (KPIs) separated per department. Users also could access their department KPI by selecting their department.

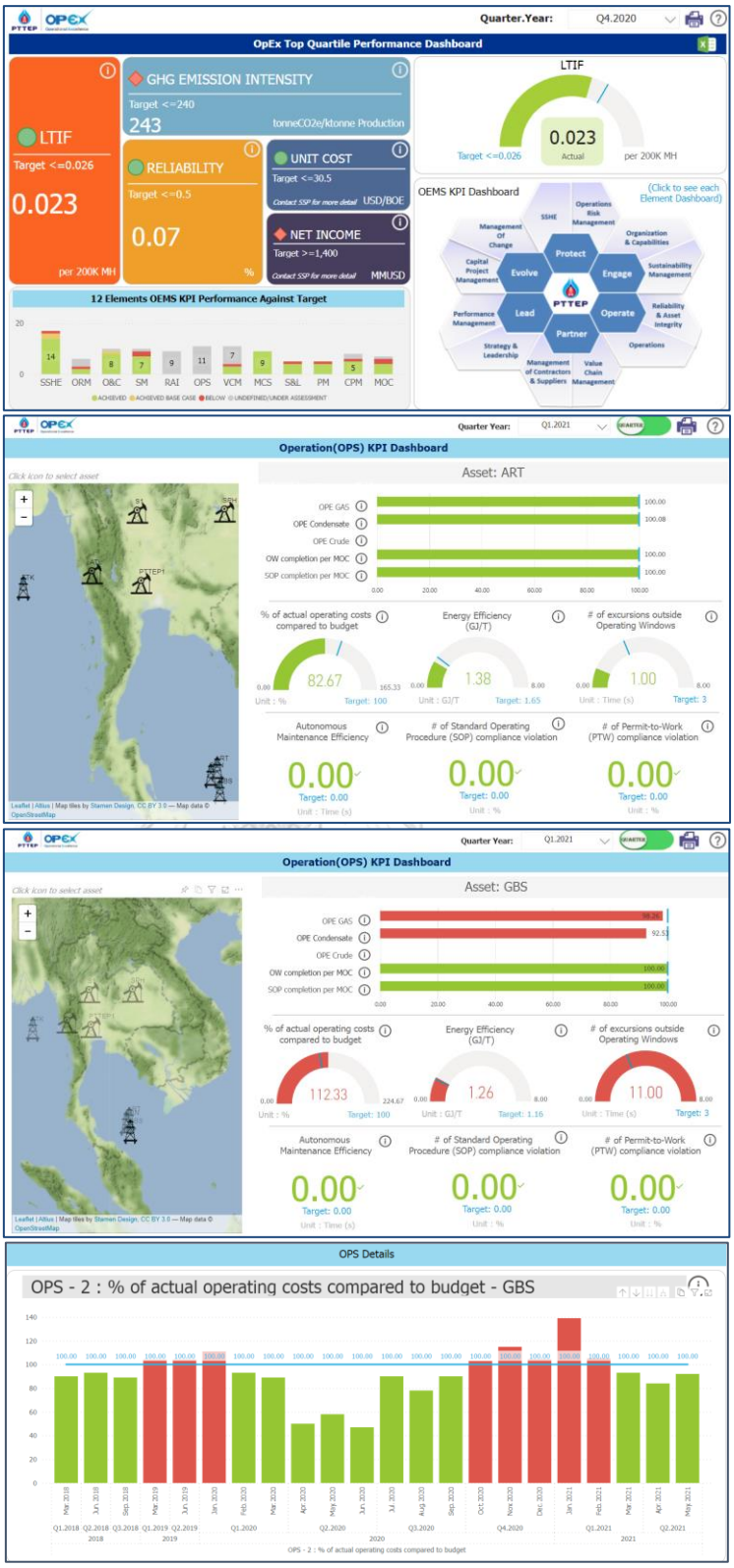


Figure 47: Examples of Performance Management Dashboard

Users could select the plant in the left map to access the KPI result at the individual plant. Users also could select either monthly report, quarterly report or yearly report. The red colour in the dashboard presents the KPI, which missed the KPI target. So, all stakeholders could monitor all 111 KPIs in real-time and prepare the action plan to improve the failed KPI easier than in previous practice.

The historical data of KPI in the last five (5) years also displays in the dashboard. So, users could access and analyse the historical performance while the previous practice did not have this information. Besides, the causes of failed KPI was recorded in the system; so, users could analyse that failed KPI for the performance improvement program.

The confidential information such as financial performance would not be displayed to unauthorised persons while the authorised persons could see the financial performance automatically.

5. Automated KPI Report to Committee

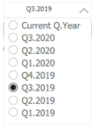
Although the Committee could access the performance Management dashboard, the system also provides the automated KPI report feature by clicking the printer icon at the top right of the dashboard.

Figure 48: Examples of Automated KPI Report to Committee

5.3.4 User Acceptance Test

Before public, the Performance Management System, the user acceptance test is the stage-gate to verify whether the system is acceptable. There are two documents that the user must approve before the public. Firstly, the requirement specification that includes the conceptual design, project scope, and authorisation matrix. Secondly, the user acceptance test report includes the customer journey and the comparison of users' expectations and actual results. Users could test the individual process per customer journey mapping concept and specify testing results for an individual process.

Table 2: Test Report Contents, Layout & Data

Step	Procedure Details	Expected Result	Actual Result	Pass/ Fail	Initial Date (dd/mm/yyyy)
Check Report Content, Layout and Data					
1.	1.1. Click on drop down Quarter Year and select on Q3.2019  1.2. Dashboard data will change to be based on Q3.2019  	Correct Result on Dashboard based on logic of calculation	Same as Expected Result		

Document Signoff

The cover page identifies all management authorities who have successively approved the present issue of this document.

<Start BAPM2019090015 – OEMS KPI Dashboard (Modification)>

No.	Reviewer	Date	Signoff	Comments
1	Pongsak Metheethara	12/07/21		NA
2	Wattana Ratchatamongkolchol		Wattana Digitally signed by Wattana Ratchatamongkolchol DN: cn=Wattana Ratchatamongkolchol,	

Figure 49: Examples of User Acceptance Test Report

5.5 Implementation

The last stage in the project development framework is implementing the developed Digital Platform for Performance Management System into the organisation. The Implementation strategies include the communication plan, the performance measurement method, and the continuous improvement plan.

The communication strategies and plans were developed for communicating throughout the organisation at both management and staff levels. The Digital Platform for Performance Management System was communicated throughout the organisation by email. Also, the performance Management dashboard was presented in department monthly meetings and quarterly meetings. With effective communication, all relevant

employees throughout the organisation used the Digital Platform for Performance Management System, especially department Managers, Analysts, and top Management.

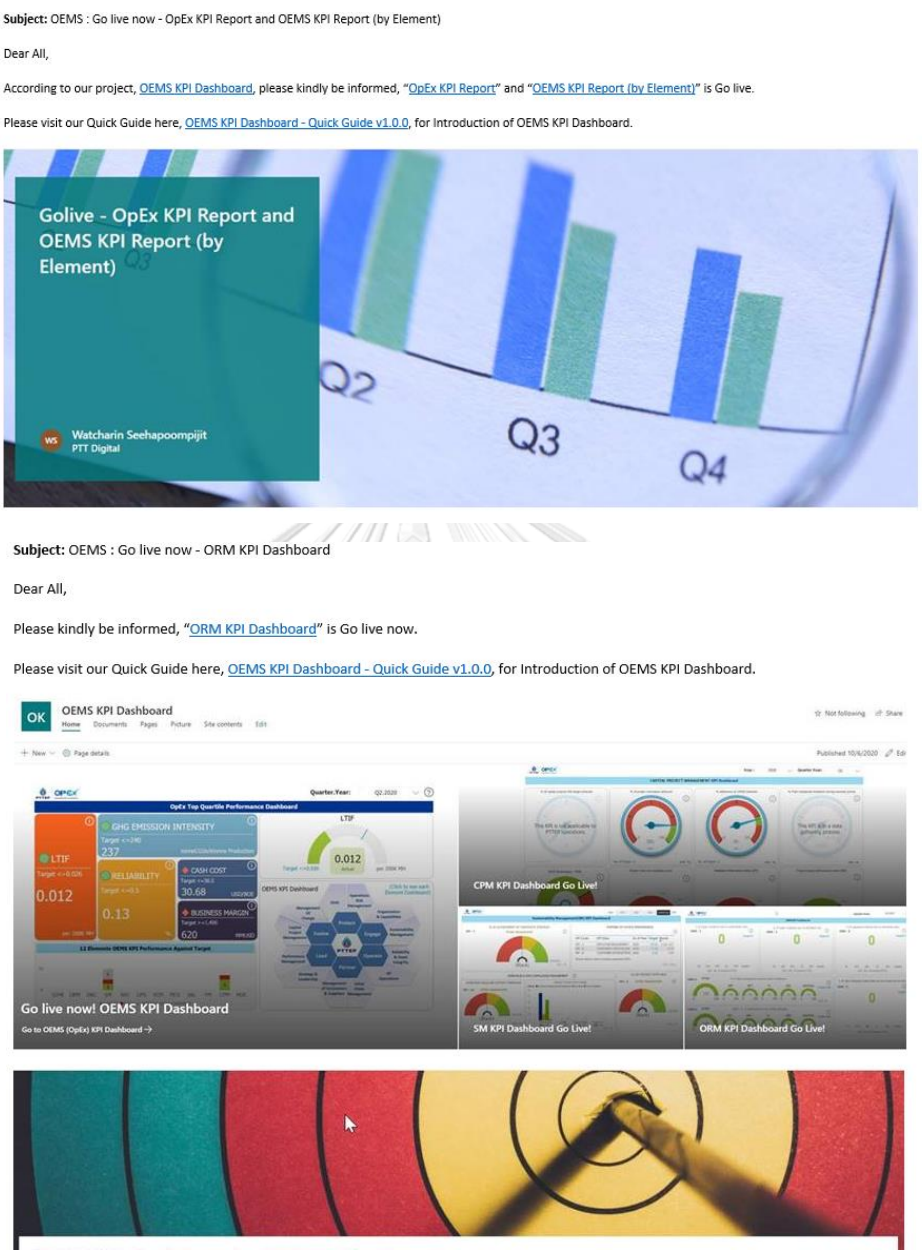


Figure 50: Examples of Communication of New KPI Platform

After implementing the Digital Performance Management System for a while, the implementation results are captured by measuring both qualitative and quantitative benefits.

In order to present the qualitative benefits, the Customer Journey Mapping (CJM) will be used to present customer satisfaction and compare customer needs and customer perspectives to identify the different expectations.

For quantitative benefits, the man-hour reduction resulting from the Digital Platform will be calculated as the quantitative benefit. The reduction of man-hours allowed the organisation to allocate and train the valuable resources for more beneficial activities that require higher skills and directly contribute to organisational performance.

Eventually, the PDCS (Plan-Do-Check-Act) approach is applied as a continuous improvement framework by identifying and evaluating the improvement opportunities after implementation to sustain and improve the effectiveness and efficiency. The customer feedback survey will be used to collect the customer satisfaction level quarterly. The customer feedback will be analysed and identify the improvement opportunities.

Chapter 6 Results

After implementing the Advanced Performance Management System powered by digital technologies throughout the organisation, the implementation results are captured by measuring qualitative and quantitative benefits.

Overall, the Advanced Performance Management System enhanced the effectiveness and efficiency of the Performance Management system in the organisation through the following methodologies and technologies.

- LEAN work process
- Database system
- Integration with legacy system
- Collaboration Platform
- Interactive KPI Dashboard
- Automation system
- Warning System

The project was developed with well understanding of problems and causes of problems through multiple analysis techniques. The potential solutions were assessed and brainstormed through a Design Thinking workshop to ensure that the developed system solves the users' problems and is user-friendly.

Eventually, the processes that consume the workforce were reduced from thirteen (13) processes to two (2) processes. The remaining processes include Staff record data and Analyst verifies KPI, which were classified as necessary activities. The rest processes were eliminated through redesign of the work process, digitalisation, and automation system.

6.1 Qualitative Benefit

In order to present the improvements in terms of qualitative benefits, the Customer Journey Mapping (CJM) will be used to present the customer satisfaction and compare customer needs and customer perspectives to identify the different expectations. Some

users' feedbacks in the Design Thinking Workshop which were not implemented in this project phase, also were considered in CJM analysis and included in the different expectations for future improvement.

Table 21: Customer Journey Mapping (CJM) for Digital Platform for Performance Management System

High Level Process	Automated reminder to Staffs	Staffs input data	Automated KPI Calculation	Analyst verify KPI	Automated Visualization by KPI Dashboard	Automated KPI reports to Committee
Customer Need	- Early receive the request with enough time for data preparation - Cleary defind the due date.	- If some data was available in database, thesystem automatically extract data from database. - Automate calculation after input raw data. - Staffs could record data easily.	- Automated KPI calculation after input raw data.	- Analyst could verify and revise KPI report easily. - Prefer data analytic and prediction system for KPI.	- Easily prepare KPI report. - Automately email KPI Report to Stakeholders. - KPI report is well visualized and easy understanding. - Require historical data and trend	- Automately generate KPI Report. - Committee prefer Digital Platform for entire Operational Excellence Management System.
Moments of Truth	😀	😀	😀	😀	😀	😀
Customer Experience (Positive)	●	●	●	●	●	●
Customer Experience (Negative)						
Customer Perspective	- Staffs received the automated reminder one week before due date. - Staffs have enough time for data preparation. - The system would keep reminding Staffs every day.	- Data existed in legacy system was integrated into the Digital Platform automatrically. - Staffs could record data easily by only two clicks.	- Automated KPI calculation are provided.	- Analyst could verify KPI by only two clicks. - After KPI verification, the KPIs are automatically upload to the KPI dashboard	- After KPI verification, all stakeholder recevied the automated KPI results and the access link to KPI Dashboard. - The KPI dashboard provided the real-time KPI results to all stakeholder automatically. - The Interactive KPI dashboard is well visulized and easy understanding. - Historical data and trend were visuailized in dashboard. - The causes of failed KPI were presented in dashboard.	- Committee could access the KPI Dashboard anytime. - In case Committee requested the KPI Report as PDF file, Analyst could print in the system with the standard report format.

After assessing the Advanced Performance Management System powered by digital transformation, the followings are the different expectations between customer needs and customer perspective. Most touchpoints are positive, while only two touchpoints are below customer expectations which are recorded and will be improved in the future project section.

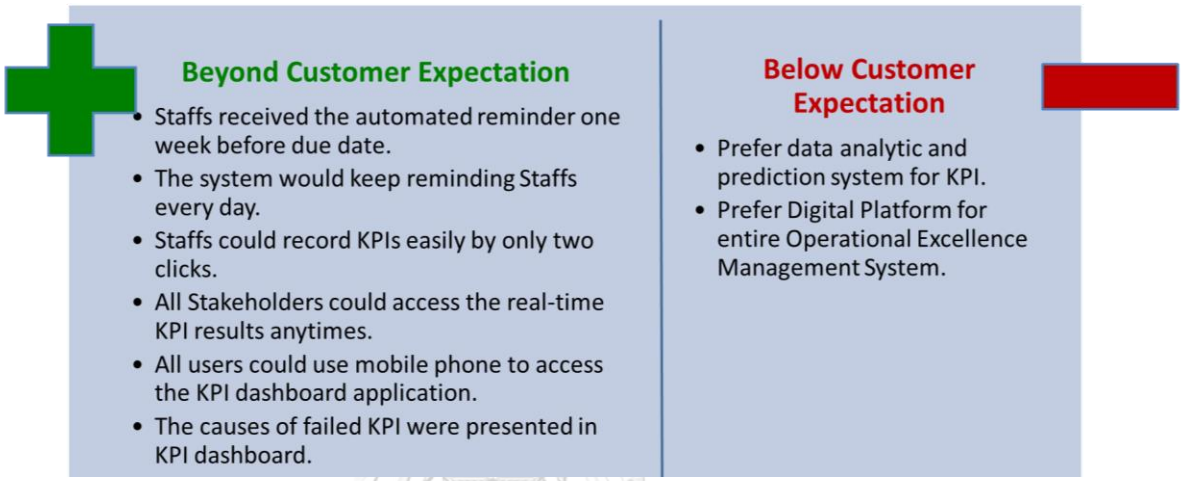


Figure 51: Different Expectations between Customer Needs and Customer Perspective for Digital Platform for Performance Management System

As the above different expectations between customer needs and customer perspective, the touchpoints could be described as following.

- Beyond Customer Expectation:
- Staff received the automated reminder one week before the due date

Staff would receive the automated reminder via email monthly or quarterly according to the due date of individual KPI. This automation system help Staffs report KPI on time. This automation system helps Analysts focus on more critical tasks than writing emails to request information.

- The System would keep reminding staff every day

In case staff did not record the KPI after receiving the first reminder, the system would remind staff every day until the KPIs would be recorded. This automated reminder

reduces the Analyst's effort in following up information. Also, staffs have an assistant to remind them.

- Staff could record data easily with only two clicks

When staff accessed the collaboration platform to record data, staff could complete the data submission with only two clicks, including; select KPI to record data and submit data for the automated KPI calculation.

- All Stakeholders could access the real-time KPI results anytime

Stakeholders, including staff, Analysts, Management, and committee, could access the real-time KPI results through the interactive KPI dashboard. This comprehensive KPI report presents all 111 KPI separated according to the department. Users could access the KPI dashboard anytime. The information in the dashboard would be automatically updated every day when staff recorded data in the database.

- All users could use a mobile phone to access the KPI dashboard application

Users also could access the KPI dashboard through a mobile phone application called the Power BI application. The mobile phone application provides flexibility to users to access information anywhere and anytime. The application enables employees to work anywhere according to the new operating model of the organisation.

- The causes of failed KPI were presented in the KPI dashboard

All causes of failed KPI were recorded in a database and presented in the KPI dashboard to allow users to investigate the sources of problems, prepare mitigation plans, and prepare improvement plans. This causes and effect analysis could be conducted through this information. Besides, this information would be the crucial input for data analysis and prediction models in the future.

- Below Customer Expectations:
- Prefer data analytic and prediction system for KPI

Currently, the Digital Platform for Performance Management System excludes data analysis and prediction model functions. Users could review KPI results, historical KPI, and trends; then, users should analyse the information manually. However, the established database and historical data will be the crucial input for data analysis and prediction model in the future phase.

- Prefer Digital Platform for entire Operational Excellence Management System.

Committees and Management suggested developing the comprehensive Digital Platform for the entire Operational Excellence Management System. Currently, the Digital Platform covers the Performance Management Section while excludes Procedure, Deployment, and Conformance section. However, this suggestion will be developed in the future project section.

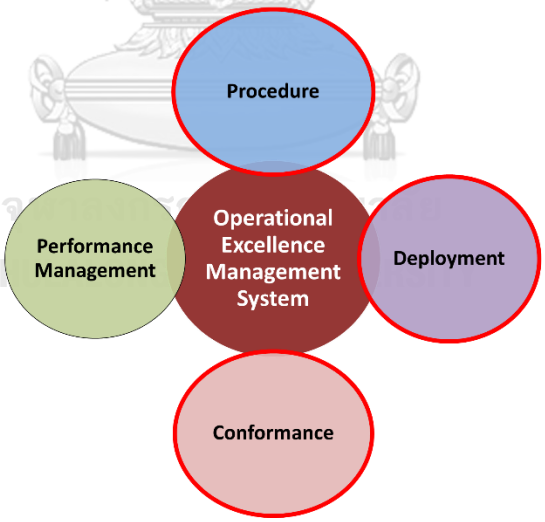


Figure 52: Operational Excellence Management System Framework

6.2 Quantitative Benefit

For quantitative benefits, the non-valued added activities eliminated by LEAN methodology supported by digital technologies will be calculated as the quantitative

benefit resulting from man-hour reduction. The reduction of non-valued added activities allowed the organisation to allocate and train the valuable resources for other beneficial activities that require higher skills and directly contribute to organisational performance. This project's practice could also be shared with other functions and could be applied for other applications throughout the organisation, providing extra benefits to the organisation.

Table 22: LEAN Methodology Analysis of Advanced Performance Management System powered by Digital Transformation

High Level Work Process (5 processes)	Activity (8 items)	Man-Hours		Activities Classification		
		Hour	Minute	Value-Added (VA)	Non-Value-Added (NVA)	Business-Value-Added (BVA)
Automated reminder to Staffs	Staffs receive the automation email	-	-		YES	
Staffs record KPI	Staffs search data from the operators or stakeholders	16	-	YES		
	Stafff access the Collaboration Platform	-	1	YES		
Analyst verify KPI	Waiting time for receiving KPI from 12 departments	8	-		YES	
	Analyst verify KPI	1	-		YES	
Automated Visualization by KPI Dashboard	All stakeholder including staffs, analyst, management, committee access the KPI dashboard	-	1	YES		
Automated KPI reports to Committee, if required	Analyst click printer icon in KPI dashboard	-	1		YES	
	System automatically email to Committee	-	-			YES

After implementing the Digital Platform for Performance Management System, overall, **the total process time** required to complete the entire work process (intermittent) **was reduced from 1,626 hours to 300 hours (yearly) or an 83% reduction**. However, some Non-Value-Added Activities (NVA) still exist in the work process. Besides, **the total man-hour** required to complete the entire work process **was reduced from 1,034 man-hours to 205 man-hours (yearly) or an 80% reduction**.

Table 23: Total Process Time and Man-Hour

Total Process Time / Man-Hour	Hours	Minutes	Approx. Total Hours
Total process time required for reporting KPI to Management per month	25	2	25.0
Total process time required for reporting KPI to Committee per quarter	0	2	2 minutes
Total Process Time required for Performance Monitoring System (Yearly-hour, intermitent)	**300**		
Total manhour used for reporting KPI to Management (monthly) Exclude waiting time	17	3	17
Total man-hour used for reporting KPI for reporting KPI to Committee (quarterly)	0	3	3 minutes
Total Man-Hour used for Performance Monitoring System (Yearly-man-hour):	**205**		

When analysing the detailed activities, there are three or 33.33% of total activities: the value-added activities (VA). On the contrary, the non-value-added activities (NVA) that do not add value to the KPI report were reduced from seventeen (17) activities or 73.91% in previous practice to four or 44.44% of total activities.

The processing time used for NVA was reduced from 1,242 hours to 108 hours (yearly, intermittent). The processing time used for NVA was reduced from 76.39% to 36% of the total process time.

Also, the total man-hours used for NVA was reduced from 650 man-hours to 12 man-hours per year. The proportion of man-hour required for NVA also was reduced from 62.88% to 5.88% of the total man-hour required to complete the entire work process. This information presents the success of developing and implementing the Digital Platform for Performance Management System that contributes to cost optimisation for the organisation.

Table 24: Summary Activities Analysis (before implementation)

Summary of Activities Analysis	Activities		Total Process Time (yearly-hour, intermittent)		Total Man-Hour (yearly-man-hour)	
	No. of Activity	Percentage	Process Time (Hour)	Percentage of total	Man-Hour	Percentage of total
Value-Added Activities (VA)	5	21.74%	384	23.61%	384	37.12%
Non-Value-Added Activities (VA)	17	73.91%	1242.4	76.39%	650.4	62.88%
Business-Value-Added (BVA)	1	4.35%	5 minutes	< 0.01%	5 minutes	< 0.01%

Table 25: Summary Activities Analysis (after implementation)

Summary of Activities Analysis	Activities		Total Process Time (yearly-hour, intermittent)		Total Man-Hour (yearly-man-hour)	
	No. of Activity	Percentage	Process Time (Hour)	Percentage of total	Man-Hour	Percentage of total
Value-Added Activities (VA)	3	33.33%	192	64.00%	192	94.12%
Non-Value-Added Activities (NVA)	4	44.44%	108.0	36.00%	12.0	5.88%
Business-Value-Added (BVA)	1	11.11%	o	0.00%	0	0.00%

Eventually, developing a Performance Management System could benefit the organisation in both qualitative and quantitative benefits. The quantitative benefit could be calculated to project cost based on workforce cost as follow.

Table 26: Summary Man-Power Cost Reduction (after implementation)

Practice	Man-hour Required per Report						Total Man-PowerCost (Yearly-USD)	
	Staff		Analyst		Management			
	Man-hour	Unit Cost	Man-hour	Unit Cost	Man-hour	Unit Cost	Man-hour	Total Cost
Previous Practice	65	30	21	70	1	100	1,034	42,240
New Practice	16	30	1	70	0	100	205	5,830
Man-Power Cost Redcution (Yearly-USD)							**829**	**36,410**

When the yearly-man-power reduction (36,410 USD) is compared with the investment cost (29,436 USD), the benefit ratio is 123.7%, and the investment cost could be recovered not over one year while the digital performance management platform can be used every year. The project result presents that the project development achieved the project objective and benefited the organisation.

The Advanced Performance Management System can be applied to the oil and gas exploration and production organisations. The digital platform can also be modified and applied for other businesses that use the key performance indicator (KPI) as the representative of the organisation performance.

6.3 Key Performance Indicator (KPI) Improvement

Refer to the KPI analysis, the recommendation is to suddenly eliminate the duplicated KPIs (25 KPIs). Therefore, **the 111 KPIs were reduced to 86 KPIs (22.5% reduction)**, enabling the organisation to focus on the necessary KPIs and provide additional workforce reduction throughout Performance Management System due to fewer KPI numbers than previous practice.

Table 27: The KPI Improvement Result

KPI Category		
	Environment (4 items)	3 Lagging KPIs
		1 Data Monitoring
	Maintenance (10 items)	5 Leading KPIs
		4 Lagging KPIs
		1 Data Monitoring
	Operations (27 items)	12 Leadinig KPIs
		7 Lagging KPIs
		8 Data Monitoring
	Reputation (10 items)	6 Lagging KPIs
		4 Data Monitoring
	Resources (8 items)	4 Leading KPIs
		2 Lagging KPIs
		2 Data Monitoring
	Safety (27 items)	13 Leading KPIs
		7 Lagging KPIs
		7 Data Monitoring

Besides, the KPI analysis recommends deleting the unnecessary 24 KPIs and change from KPI reporting to data monitoring. Therefore, the number of KPIs could be reduced to 62 items in the future.

With the readiness of the database and the automated KPI calculation module, another recommendation is to group all KPIs into six (6) categories and report to Committee only six (6) KPIs that could also represent the effectiveness and efficiency of the organisation in all dimensions. The calculation formula for each KPI category could be

the summary of total KPIs in that category based on individual KPI weight. The KPI Optimisation would be considered as the proposal for the committee in the incoming years.

Chapter 7 Discussion and Conclusion

According to chapter 6, the project result consists of three (3) main results; the qualitative benefit presented by customer satisfaction level, the quantitative benefit presented by the number of process reduction and workforce reduction, and the recommendation for KPI optimisation.

However, there are two (2) below customer expectation items according to the Customer Journal Mapping (CJM) analysis result. Firstly, customers preferred the data analytic and prediction system for KPI. Secondly, customers prefer the enhancement of the Digital Platform to cover the entire Operational Excellence Management System.

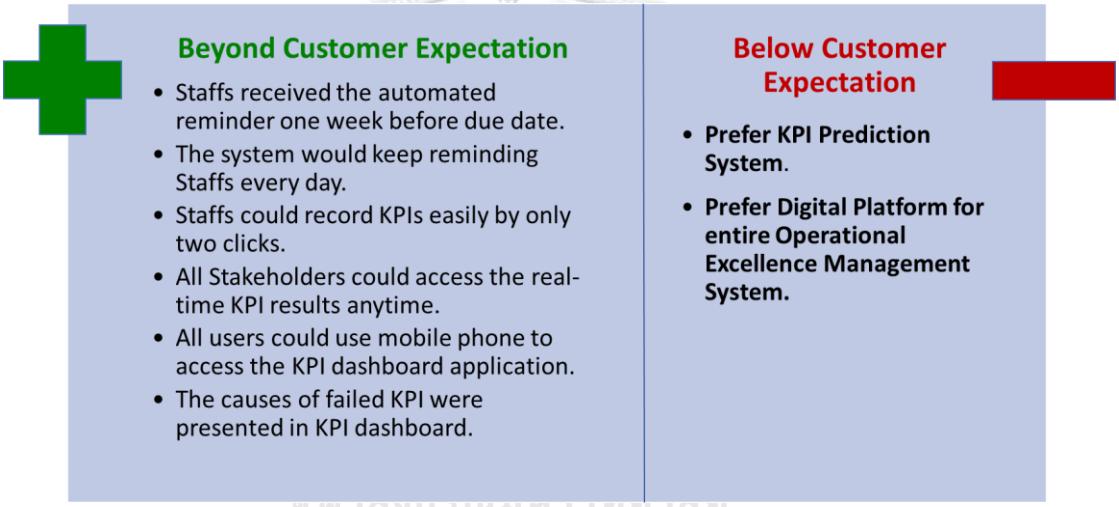


Figure 53: Different Expectations between Customer Needs and Customer Perspective

7.1 KPI Prediction System

The first future development will be developing a data analytic and KPI prediction model supported by the readiness of database, the readiness of digital KPI platform, and the KPI improvement. The calculation formula and KPI weight will be provided to the prediction model of six (6) KPI categories. The machine learning technology will be used by input the historical KPI results and KPI mapping resulted from KPI leading-lagging analysis in Section 4 and Section 6 to predict the future KPIs of the organisation. Therefore, the organisation could advance prepare the action plan and

mitigation plan. Also, the organisation could resolve the potential problems before the problem occurred.

Besides, the KPIs that should be reported to Committee and Top Management could be optimised to six (6) main KPI categories calculated according to the weight of leading and lagging KPI. The proposed KPI hierarchy could be presented as follow.

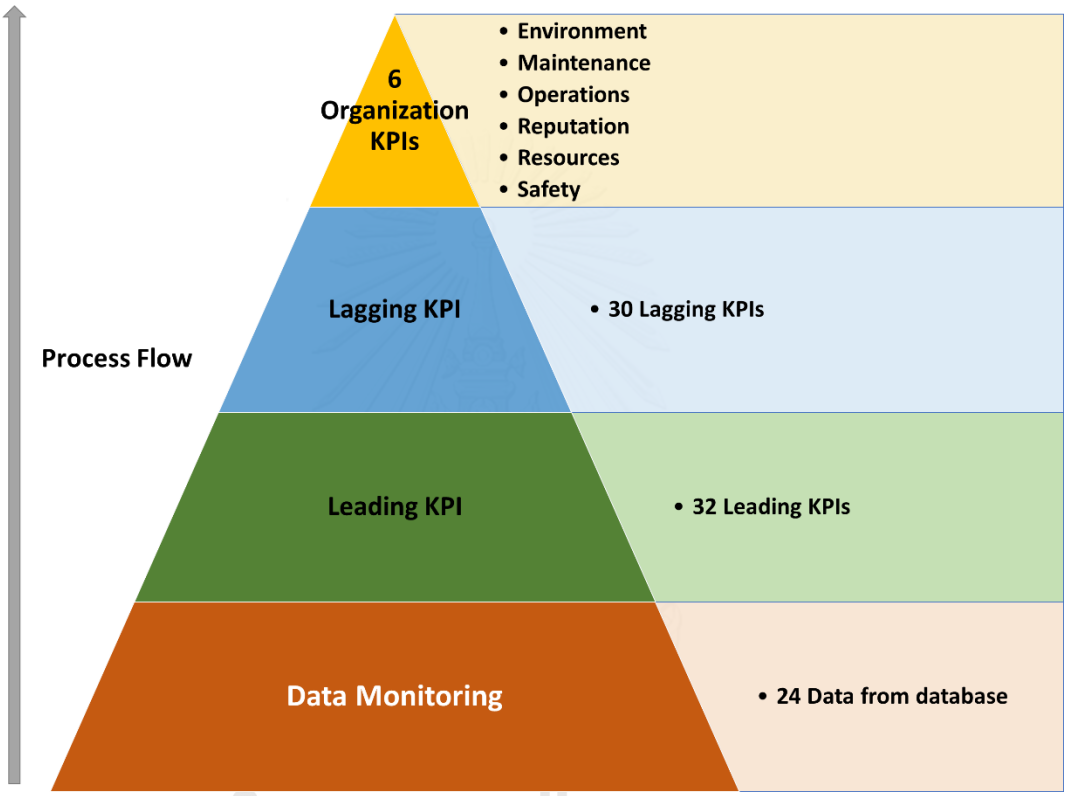


Figure 54: The recommended KPI hierarchy

7.2 Enhancement of Digital Platform Scope

Refer to the customer feedback, Committees and Management suggested developing the comprehensive Digital Platform for the entire Operational Excellence Management System. Currently, the Digital Platform covers only the Performance Management Section (green colour) while excludes Procedure, Deployment, and Conformance section. Therefore, the suggestion would be developed in the incoming years supported by the readiness of Performance Management Platform, database system, and automation system.

Figure 55: Digital Transformation for Operational Excellence Management System

The Digital Transformation for Operational Excellence Management System would consist of entire four sections, including; Procedure, Deployment, Conformance, and Performance Management System in the single platform. The consolidated database or the linkage to the legacy system would be developed to support this platform for seamless operation.

The procedure section would be the development of a centralised database of procedures for the entire organisation. Users could search for any procedures on this platform. The readiness of the procedure platform would support Management in communicating the procedure to staffs easier. Also, staff could search documents easily.

Secondly, the deployment section would develop the visualisation dashboard to track the training and communicate status. All staff could access the deployment platform anytime to learn and study the training material recorded in the system. The platform would be developed by developing the linkage to the Human Resource (HR) platform used for HR training management.

Lastly, the conformance section would be developing a digital assessment system (Audit Platform) that would be used for auditing staff at the operation level whether they comply with the procedures. The audit was executed manually per previous practice. However, the digital transformation could reduce the workforce for audit as a

result of effective audit management and automation systems such as the automated audit score calculation and automated audit report.

7.3 Conclusion

The paper provides a comprehensive case study to enhance the Performance Management System of an organisation. Although the system was designed for the Oil and Gas Exploration and Production industry, the paper could be applied effectively for other industries because the modern organisation mainly utilised the Key Performance Indicator (KPI) to reflect its performance. So, the Advanced Performance Management System could be applied to a modern organisation with minor modifications.

The Advanced Performance Management System is developed systematically according to the research methodology framework starting from researching the relevant literature, analysing the current practice to identify the potential improvement areas, and developing solutions.

The Advanced Performance Management System provides significant benefits to the organisation by reducing the manpower by 80% and allowing the organisation to reskill and allocate resources to other essential tasks that could generate more value. Besides, the recommendation for Key Performance Indicator (KPI) hierarchy and the KPI category are provided for the oil and gas industry.

Eventually, the paper provides the recommendations for a future project to cover all areas of the Operational Excellence Management System, which could sustain the organisation performance although the talents relocated to other departments or retired from the organisation.

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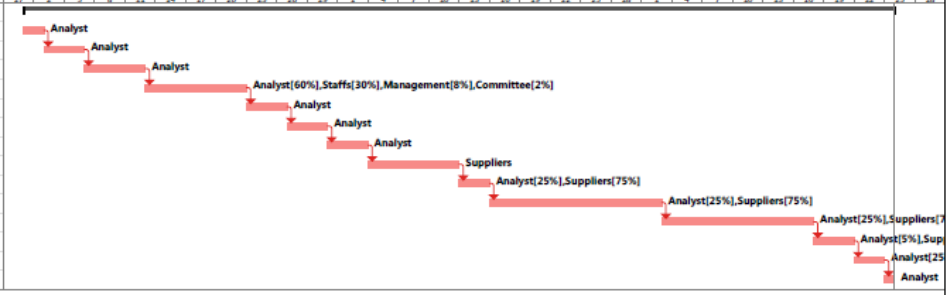
APPENDIX

Appendix A Project Schedule

APPENDIX-A: Project Schedule

ID	Task Mod	Task Name	Duration	Start	Finish
1		**Project Schedule**	**86 days**	**Mon 3/1/21**	**Tue 5/25/21**
2		Review the analysis result	2 days	Mon 3/1/21	Tue 3/2/21
3		Assess the Potential Solutions	4 days	Wed 3/3/21	Sat 3/6/21
4		Project Planning and Management	6 days	Sun 3/7/21	Fri 3/12/21
5		Solution Development through Design Thinking Workshop	10 days	Sat 3/13/21	Mon 3/22/21
6		Technical Evaluation	4 days	Tue 3/23/21	Fri 3/26/21
7		Commercial Evaluation	4 days	Sat 3/27/21	Tue 3/30/21
8		Design Work Process	4 days	Wed 3/31/21	Sat 4/3/21
9		Develop Database System	9 days	Sun 4/4/21	Mon 4/12/21
10		Develop Integration with legacy system	3 days	Tue 4/13/21	Thu 4/15/21
11		Develop Collaboration Platform	17 days	Fri 4/16/21	Sun 5/2/21
12		Develop Performance Monitoring (KPI) Dashboard	15 days	Mon 5/3/21	Mon 5/17/21
13		Develop Automated KPI Calculation System	4 days	Tue 5/18/21	Fri 5/21/21
14		User Acceptance Test	3 days	Sat 5/22/21	Mon 5/24/21
15		Go LIVE the Digital Platform for Performance Monitoring System	1 day	Tue 5/25/21	Tue 5/25/21



Appendix B Key Performance Indicators (KPIs) Analysis

Element	KPI Code	KPI Description	Leading	Lagging	Duplicate	Data Monitoring	Rational for Unnecessary KPI	Group
OEMS	OEMS-1	Reliability		Lagging				Maintenance
OEMS	OEMS-2	GHG Emission Intensity		Lagging				Environment
OEMS	OEMS-3	Loss Time Injury Frequency (LTIF)		Lagging				Safety
OEMS	OEMS-4	Unit Cost		Lagging				Operations
OEMS	OEMS-5	Net Income		Lagging				Operations
SSHE	SSHE-1	# of work related fatalities		Lagging		YES	Never happen	Safety
SSHE	SSHE-2	Total recordable injury Rate (TRIR)		Lagging				Safety
SSHE	SSHE-3	Total Recordable Occupational Illness Rate		Lagging				Safety
SSHE	SSHE-4	Loss Time Injury Frequency (LTIF)		Lagging	YES			Safety
SSHE	SSHE-5	Number of Process Safety Event		Lagging	YES			Safety
SSHE	SSHE-6	Percentage of major and catastrophic incident reported that has been investigated and closed-out on time		Lagging				Safety
SSHE	SSHE-7	Percentage of significant security incidents investigated and closed-out on time	Leading			YES	Always on time. KPI shall be challenge.	Safety
SSHE	SSHE-8	Percentage of near miss and substandard cases related to security issues that have been reported, taken a preventive action and closed-out on time	Leading			YES	Company Regulation	Safety
SSHE	SSHE-9	Percentage of Emergency Response Exercise Level 2 or higher completed as planned	Leading			YES	Company Regulation	Safety
SSHE	SSHE-10	Percentage of recommendation from validated Emergency Response Exercise Level 2 that has been closed-out on time	Leading			YES	Always on time. KPI shall be challenge.	Safety
SSHE	SSHE-11	Greenhouse Gas Emission Index		Lagging	YES			Environment
SSHE	SSHE-12	Number of spill incidents		Lagging				Environment
SSHE	SSHE-13	Total water withdrawal		Lagging		YES	Very less water withdrawal due to gas field	Environment
SSHE	SSHE-14	Percentage of total hazardous waste (routine) disposed at landfill		Lagging				Environment
SSHE	SSHE-15	Number of SSHE regulatory non-compliance	Leading					Safety
ORM	ORM - 1	# of major incidents due to unidentified risks		Lagging				Safety
ORM	ORM - 2	# of major incidents due to identified risks		Lagging		YES	Never happen	Safety
ORM	ORM - 3	% of Risk management system audit compliance	Leading					Safety
ORM	ORM - 4	# of repeated incidents due to identified risks	Leading			YES	Never happen	Safety
ORM	ORM - 5	# of risks mitigation action that are not closed out on time	Leading					Safety
ORM	ORM - 6	% adherence to risk review schedule	Leading					Safety
O&C	OC - 1	% attrition rate		Lagging		YES	Not significant. Recommend to monitor data.	Resources
O&C	OC - 2	% competency Development Achievement		Lagging				Resources
O&C	OC - 3	Benefit Value from applied Utilization		Lagging	YES			Resources
O&C	OC - 4	Organization effectiveness and efficiency survey score	Leading		YES			Resources
O&C	OC - 5	Average talent recruitment lead time	Leading					Resources
O&C	OC - 6	% increase of Best Practice/Shared Practice/Lesson Learned	Leading					Resources
O&C	OC - 7	% of mission critical positions filled by high-potential talents	Leading					Resources
O&C	OC - 8	% of successful talent recruits vs. planned	Leading					Resources
O&C	OC - 9	% of relevant employee pass OEMS Training	Leading			YES	Not significant. Recommend to monitor data.	Resources
SM	SM - 1	% of achievement of corporate strategy		Lagging				Reputation
SM	SM - 2	# of grievances or cases related to human rights violations where the organization is at fault		Lagging				Reputation
SM	SM - 3	Employee Engagement Score		Lagging				Resources
SM	SM - 4	# of grievances and legal cases resulting from non-compliance with SSHE laws or regulations		Lagging				Reputation
SM	SM - 5	# of grievances or cases, where it has been proven that the organization was at fault, that resulted from violations of the Code of Business Conduct and Anti-corruption policy		Lagging				Reputation
SM	SM - 6	% of community development projects that have been assessed for returns on investment		Lagging		YES	Not significant. Recommend to monitor data.	Reputation
SM	SM - 7	# of violations of the PTT Sustainable Suppliers Code of Conduct and supplier environmental, social, and governance (ESG) requirements		Lagging		YES	Company Regulation	Reputation
SM	SM - 8	Customer Satisfaction Score		Lagging	YES			Reputation
SM	SM - 9	Annual Corporate Reputation Score		Lagging				Reputation
SM	SM - 10	% of grievances resolved within the designated timeframe		Lagging				Reputation
RAI	RAI - 1	% of unplanned shutdown time		Lagging	YES			Maintenance
RAI	RAI - 2	% of actual turnaround duration compared to planned		Lagging		YES	Use other KPI to measure turnaround	Maintenance
RAI	RAI - 3	SSHE critical Equipment PM plan compliance	Leading					Maintenance
RAI	RAI - 4	Mean Time To Repair of critical equipment (MTTR)	Leading					Maintenance
RAI	RAI - 5	Mean Time Between Failure (MTBF)	Leading					Maintenance
RAI	RAI - 6	Plant Availability		Lagging				Maintenance
RAI	RAI - 7	Ready Backlog	Leading					Maintenance
RAI	RAI - 8	PM / RM ratio	Leading					Maintenance
RAI	RAI - 9	Maintenance Cost Index		Lagging				Maintenance
OPS	OPS - 1	Overall Plant Efficiency		Lagging				Operations
OPS	OPS - 2	% of actual operating costs compared to budget		Lagging				Operations
OPS	OPS - 3	Autonomous Maintenance Efficiency		Lagging				Maintenance

Element	KPI Code	KPI Description	Leading	Lagging	Duplicate	Data Monitoring	Rational for Unnecessary KPI	Group
OPS	OPS - 4	% of Operating Windows updates completed as required by MoC process	Leading					Safety
OPS	OPS - 5	% of SOP updates completed as required by MoC process	Leading					Safety
OPS	OPS - 6	Energy Efficiency (GJ/T)	Leading		YES			Environment
OPS	OPS - 7	# of excursions outside Operating Windows	Leading					Safety
OPS	OPS - 8	# of Standard Operating Procedure (SOP) compliance violation	Leading					Safety
OPS	OPS - 9	# of Permit-to-Work (PTW) compliance violation	Leading					Safety
VCM	VCM-1	% production target achieved		Lagging	YES			Operations
VCM	VCM-2	% of customer service level achieved (e.g. volume, lead time and quality)		Lagging	YES			Operations
VCM	VCM-3	% of average production unit cost compared to budget	Leading		YES			Operations
VCM	VCM-4	% of logistics cost deviated from budget	Leading					Operations
VCM	VCM-5	% of activity schedule adherence	Leading		YES			Operations
VCM	VCM-6	Total hours of operations interruptions due to resources conflict	Leading		YES			Operations
VCM	VCM-7	Supply / stock risk index compared to target	Leading					Operations
VCM	VCM-8	% of inventory level (quantity) discrepancy between system and physicals	Leading		YES			Operations
VCM	VCM-9	% On-time departure of supply vessel from PSB Songkhla	Leading					Operations
VCM	VCM-10	% of in-process quality compliance (e.g. BS&W, Calorific Heating Value)	Leading		YES			Operations
VCM	VCM-11	% of inventory stock-out	Leading		YES			Operations
VCM	VCM-12	Total hours of operations interruptions due to logistics	Leading		YES			Operations
MCS	MCS - 1	% of overall purchase price variance		Lagging				Operations
MCS	MCS - 2	% of contractors' KPIs achieved targets		Lagging		YES	Monitor projectprogress instead	Operations
MCS	MCS - 3	% of suppliers' KPIs achieved targets (On time delivery)		Lagging				Operations
MCS	MCS - 4	% of contracts deviation from standard provisions and master service agreement	Leading			YES	Company Regulation	Reputation
MCS	MCS - 5	Average purchase process lead time by category	Leading			YES	Use other KPI to measure lead time	Operations
MCS	MCS - 6	% of contract close-out report conducted on-time	Leading			YES	Not significant. Recommend to monitor data.	Operations
MCS	MCS - 7	Hours of interruption in operations due to procurement issues	Leading					Operations
MCS	MCS - 8	% of off-category spend	Leading			YES	Not significant. Recommend to monitor data.	Operations
MCS	MCS - 9	# of non-compliance procurement	Leading			YES	Company Regulation	Reputation
MCS	MCS - 10	% of off-contract spend	Leading		YES			Operations
MCS	MCS - 11	# of contractors / suppliers non-compliance to PTT MCS requirements (Terms and conditions, SSHE, SM, etc.)	Leading		YES	YES	Company Regulation	Reputation
MCS	MCS - 12	% of cost saving over procurement spending		Lagging		YES	Focus unit cost instead	Operations
S&L	SL - 1	Average score of company's PTT Group OpEx KPIs		Lagging	YES			Operations
S&L	SL - 2	% Productivity improvement target achievement		Lagging	YES			Operations
S&L	SL - 3	% Strategic initiatives completion	Leading					Operations
S&L	SL - 4	% of PTT Group OpEx KPI communication activities delivered by leaders against plan	Leading					Operations
S&L	SL - 5	% of leadership asset visits against plan	Leading					Operations
PM	PM - 1	% of company level performance target achieved		Lagging	YES			Operations
PM	PM - 2	% PTT Group OpEx KPIs which have KPI tree support		Lagging		YES	Not significant. Recommend to monitor data.	Operations
PM	PM - 3	# of assets without up to date benchmarking plan (includes internal and external)	Leading					Operations
PM	PM - 4	# of assets without up to date Top-Quartile plan	Leading					Operations
PM	PM - 5	% of internal or external performance management audit compliance	Leading					Operations
PM	PM - 6	% progress of key initiative to support PTT Group OpEx KPIs	Leading			YES	Use project progress for monitoring	Operations
CPM	CPM - 1	% of capital projects IRR target achieved		Lagging				Operations
CPM	CPM - 2	SSHE Performance		Lagging	YES			Safety
CPM	CPM - 3	Project close-out evaluation score		Lagging				Operations
CPM	CPM - 4	Schedule Performance Index (SPI)	Leading					Operations
CPM	CPM - 5	Project budget performance index (BPI)	Leading		YES			Operations
CPM	CPM - 6	% of project milestones achieved	Leading		YES			Operations
CPM	CPM - 7	% adherence to CAPEX schedule	Leading			YES	Recommend to measure overall CAPEX instead	Operations
MOC	MOC-1	# of incidents due to unidentified change		Lagging				Safety
MOC	MOC-2	% of unauthorized changes	Leading					Safety
MOC	MOC-3	% of MoC internal compliance audit as plan	Leading					Safety
MOC	MOC-4	% of accountable employees trained on MoC process	Leading					Safety
MOC	MOC-5	# of incidents caused by changes		Lagging				Safety
MOC	MOC-6	% of Temporary changes overdue	Leading					Safety
Total	**111**				**25**	**24**		

Appendix C Ethical Approval

จาก: <wmg-overseas@warwick.ac.uk>
Date: พฤ. 13 พ.ค. 2021 00:35
Subject: Ethical Approval not currently required
To: <Tanthai.Poopaiboon@warwick.ac.uk>
Cc: <cuse.chula@gmail.com>, <jeerapat.n@chula.ac.th>

Ethical Approval Not Required

Dear Mr Poopaiboon,

Warwick ID Number: 1841305

This is to confirm that your Supervisor's Delegated Approval form has been received by the WMG Overseas Programmes's Office, confirming that your project: Digital Platform Development for Oil and Gas Exploration and Production Performance Monitoring System **does NOT require ethical approval.** You are reminded that you must now adhere to the answers and detail given in the completed WMG SDA ethical approval form (and associated documentation) within your research project. If anything changes in your research such that any of your answers change, then you must contact us to check if you need to reapply for or update your ethical approval before you proceed. If your data collection strategy changes substantially prior to or during data collection (e.g. you decide to conduct any interviews, surveys, focus groups or anything similar involving human participants or their data), then you MUST stop data collection and reapply for ethical approval before your changes are implemented. When you submit your project please write N/A against the ethical approval field in the submission pro-forma and include a copy of this email in the appendices of your project."

Best Wishes

Mengjiao Han
WMG Overseas Programmes Office
wmg-overseas@warwick.ac.uk
warwick.ac.uk/fac/sci/wmg/overseas/

VITA

NAME	Mr.Tanthai Poopaiboon
DATE OF BIRTH	13 July 1986
PLACE OF BIRTH	Phuket, Thailand
INSTITUTIONS ATTENDED	Chulalongkorn University