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Optimizing Project Management Software to Manage Well Planning: a Case Study of Deepwater Exploration Drilling Campaign in Indonesia

Andrean Firnanto*[1], Daniel Adityatama[2], Ronny Siregar[1], Zakariya[1], Erwindo Tanjung[1], Farhan Muhammad[2], Dorman Purba[2]

[1]Premier Oil Indonesia

[2]Rigsis Energi Indonesia

* Email: AFirnanto.Contractor@premier-oil.com

Abstract.

Project management software such as Microsoft Project or Oracle Primavera is commonly used in civil or Engineering, Procurement, and Construction (EPC) project. However, it is not that common to find the project management software to be fully utilized for a drilling project. This paper describes the common features of project management software, how it may help to improve a drilling campaign planning process, challenges in utilizing the software, how to perform tracking time specifically for the critical path, and the reason some of these features are not commonly used for drilling project.

A literature review of project management in general and drilling project management, in particular, was conducted to fully understand the nature of the well planning and drilling execution (drilling project) and how it may differ from other EPC or construction projects. A deepwater exploration drilling campaign in Indonesia was used as a case study to demonstrate the usability of project management software in aiding drilling project planning.

The result of the literature reviews and the case study shows that the deepwater exploration drilling project is different from typical EPC projects due to it has to deal with subsurface conditions and oil price fluctuation that might incur some uncertainties till the drilling commences. The nature of drilling projects also means that adding more personnel does not necessarily mean increased productivity.

However, the case study shows that the project management software can be a great help in planning, mapping the tasks, tracking time and progress control, and also monitoring and forecasting the project completion. In addition, it can be perceived how the critical path might affect the whole drilling project, both in terms of schedule and cost-efficiency. The project management software certainly leverages the effectiveness of the integrated work of drilling project. Those things are proven difficult to achieve if using a conventional spreadsheet for creating project planning and control.

This study also found that there are some alternatives to the conventional waterfall project management approach that can be used for exploration drilling planning. One of these approaches is the agile project management commonly used for software development or a project that has a continuously changing requirements or condition, a typical situation faced in an exploration drilling campaign. A further study is required to assess the suitability of this agile project management approach in planning an exploration drilling project.

Keyword: Exploration, Drilling, Deepwater, Indonesia, Well Planning, Project Management, Microsoft Project

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1 Introduction

1.1 Background

Project management software such as Microsoft Project or Oracle Primavera is a tool to aid in planning, organizing, and managing resource in a project. Prior to the advent of those software, it was difficult to map the tasks and detailed work breakdown, especially if the project has hundreds of interconnected tasks. With project management software, it is possible to feed the work breakdown details into the software to generate network diagrams and schedules in various forms (Badiru & Osisanya, 2016). This can help in comparing the actual with planned progress for a more efficient project schedule monitoring.

Utilizing Microsoft Project or Oracle Primavera is quite common in civil or other Engineering, Procurement, and Construction (EPC) projects, but it is relatively uncommon to be fully utilized for managing drilling planning in Indonesia. It is often found that people use the project management software with manual scheduling just to generate Gantt chart, something that can be done in Excel (Lewis & Ambriz Avelar, 2009). A similar condition was also observed by one of the authors throughout his career, where the project management software was only used to create a timeline. This certainly nullifies the advantages of the software and making progress tracking more difficult. Other than seemingly complex nature of the software, it is often thought that the drilling project is different than typical EPC project, thus making project management software unusable.

However, as drilling planning and operation involves many departments and stakeholders and tasks with complex dependencies, a detailed schedule developed around Work Breakdown Structure (WBS) is required (de Wardt, 2010). Such a detailed schedule and/or task is difficult to develop or maintain without a dedicated project management software. Therefore, it is important to understand the typical project management software features. That way, one can fully utilize the software in order to optimize the drilling planning process.

1.2 Objectives and Methodology

The purpose of this paper is as follow:

- Describe the common features of project management software and how it may be used to improve the drilling planning process.

- Discuss the nature of drilling project and how it may differ from typical civil or EPC project.
- Discuss the challenges of utilizing project management software for planning a drilling campaign.
- Briefly compare the process of managing drilling project with project management software and conventional spreadsheet.
- Present a case study for project management software utilization for drilling campaign planning, progress tracking, and project completion forecasting.

A literature review of project management in general and drilling projects, in particular, was conducted to fully understand the nature of the well planning and drilling execution. A deepwater exploration drilling campaign in Indonesia was used as a case study to demonstrate the usability of project management software in aiding drilling project planning. The case study discussion focused on developing and control/monitoring project plan, schedule, and progress. The detailed project expense/cost was not the main focus of this case study.

2 Project Management Software

2.1 Definition

Project management software is designed to aid in planning, organizing, and managing resource of a project. PMBOK® stated that project management software is one of the project management information system (PMIS). The PMIS can ensure that stakeholders easily retrieve the information they require in a timely manner.

2.2 Example and Common Features

The capability of the project management software may vary depending on their sophistication level and target user, but generally, it comprises of scheduling (with the most widely known Gantt Chart), manage estimation, cost and budget management, resource allocation, communication and collaboration, and even decision-making and quality management tools. In particular, PMBOK® specifies that project management software may assist the project manager in sequencing the tasks, generate project schedule network diagram, and communicating the project.

The most widely known project management software is Microsoft Project and Oracle Primavera, both started as on-premises software solution. However, the rise of online work collaboration makes a path for cloud-based project management software such as Wrike, Team Gantt, etc., mainly targeted for startup or small/medium enterprise company. This trend is quickly followed by Microsoft and Oracle as well, with even the relatively "traditional" Microsoft Project adopts agile methodology in their Microsoft Project software suite (Microsoft, 2020).

3 Drilling Project

3.1 Characteristics of Oil and Gas Drilling Project

Projects in the petroleum industry are often typified by large investments (capital-intensive), multi-disciplines with a lot of interfaces, and very complex engineering work (Badiru & Osisanya, 2016). Another important characteristic, especially in upstream, is a remarkably high risk associated with the project, as it is challenging to be sure of what the developer might find (or not find) during the campaign.

Upstream (exploration and production / E&P) oil and gas projects such as drilling involve locating the hydrocarbon beneath the earth's surface, drilling, producing into the surface, and transporting it for further processing (Partowidagdo, 2009). As the subsurface condition cannot be 100% correctly predicted, especially during exploration, there are a lot of unknown factors that should be considered. This high degree of subsurface uncertainties poses other unique yet significant geological risk in an upstream E&P project (Figure 1).

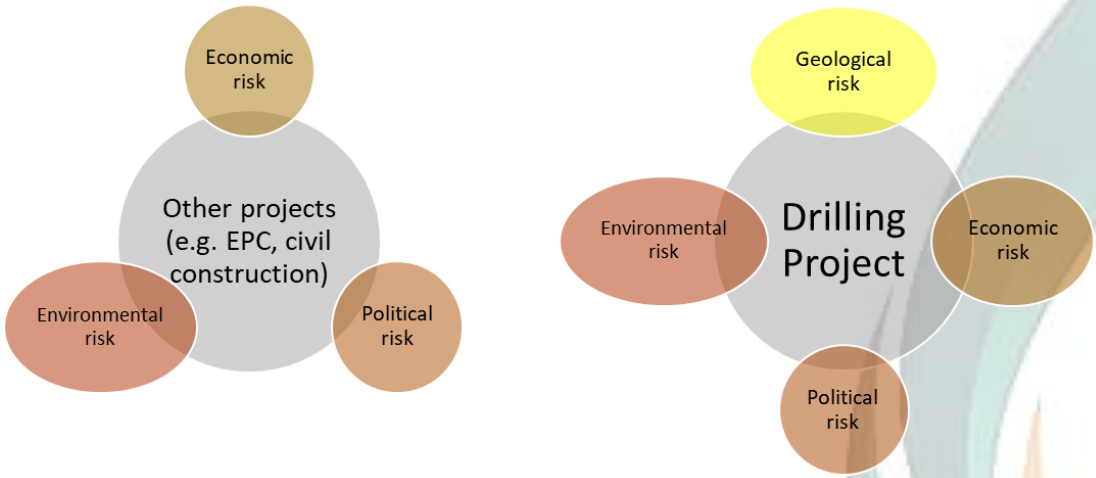


Figure 1. Typical risks associated with any projects and the ones in drilling. Note that E&P projects such as drilling has geological risk due to the subsurface uncertainty (modified from EKT Interactive, 2020).

Upstream oil and gas activities are started with the exploration phase. If the hydrocarbon reserve is discovered, it will then continue to development and production phase. Block concession contract period in Indonesia is typically ranging from 25 to 30 years, which is divided into the 1st period of 5 to 6 years for the exploration phase and the rest for development and production phases (Lubiantara, 2012). The drilling project itself is happening in both phases.

In contrast with other oil and gas projects such as EPC of production facilities or refineries where the requirement or scope is typically firm (e.g., capacity of the plant, etc.), the drilling engineering design and planning is subjected to subsurface data and requirement that still might change along the course of the project (especially in the exploration phase). This makes the project requirement and scope for drilling may not as firm as other projects that have no geological risk. This factor should be taken into account during the drilling planning process to ensure that the project can be progressing but still accommodating the subsurface requirement.

Even though other risks are not necessarily unique to oil and gas E&P projects, but they should be considered as they may greatly alter the project schedule. For example, economic risk for E&P projects might comprise the oil and gas supply and demand condition which may affect the oil price. The change in oil price can affect the project schedule as the projects may be rescheduled due to the changing project economics. A similar situation may also occur due to the environmental and political aspects such as changing regulations or fiscal regime in a country.

3.1.1 Drilling Project Cycle

To ensure the drilling project is able to deliver its intended value for the consumer (either external or internal), it is common for an oil and gas company to apply Well Delivery Process or WDP (de Wardt, 2010). De Wardt described WDP as a process that defines the best practices through the whole life cycle, from the concepting phase to the final delivery of the product for exploration or development drilling.

The drilling Project Cycle (DPC) is reflected in the WDP, which defines a set of activities along time line to plan, execute, and close out a well (de Wardt, 2010). Each E&P company have their own WDP which might have some detail differences with each other but are generally similar in essence. The length of well planning process is generally more complex than it may seem in the company's policy or Standard Operating Procedure (SOP). Table 1 shows the contributing factors that might affect the duration of the well planning (Minton & Thorogood, 1998; Costamte, Siswanto, Mustafa, & Durachman, 2015; Luckanakul & Chuemthaisong, 2016). The typical well planning process might take from as short as 1 year to up to 10 years.

Table 1. Some Factors that may affect the Drilling Project Cycle.

Contributing Factors	**Remarks**
Fiscal regime and regulations	Each country might have different regulations and fiscal regimes with their own specific complexities to deal with (e.g.: Service Contract, Production Sharing Contract, and Concession).
Oil price	The changing oil price might affect project economics, which may lead to whether the project is approved to start or to be postponed.
Project size and complexities	The project size can be determined from the initial or remaining volume of the resources beneath the earth. This will determine the number of wells to be drilled to drain it. Furthermore, the complexities also depend on the characteristics of each location (e.g., onshore, offshore, artic area, dessert, etc.), the maturity of the field or block, and many more.
Company policy regarding the WDP	The seamless and straightforward WDP process might reduce the duration, but this does not guarantee better results. Big company usually has a more complex WDP process compared to medium and small ones.
Personnel/organization capability	The numbers and experiences level of personnel within the organization might affect well planning duration. Company needs to figure-out the optimum composition of those two aspects.

Generally, stages for WDP can be defined as shown in Figure 2:

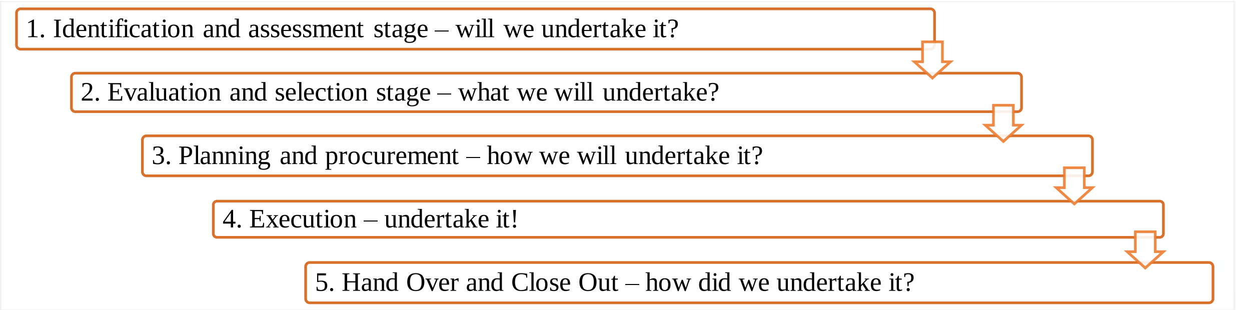


Figure 2. Stages of WDP (modified from de Wardt, 2010).

Each stage will have stage gate which requires management approval to proceed to the next stage. The stage is a review point that will decide whether the project should go to the next stage or needs to stop, hold, or recycle (re-work) to the previous stage (de Wardt, 2010).

The first stage will identify and assess the opportunity, populate the rough cost estimate (typically -30% to +50%), and the associated risks and uncertainties. These aspects are then evaluated and compared to other opportunities.

The evaluation and selection stage start the detailed design for the drilling (concept lock), including narrowing the options for the critical aspects such as hole or casing diameters, trajectory, and completion which will affect the next decisions. The long lead items (LLI) requirement is identified at this stage.

The third stage further details the well design and planning. The design should be locked at this stage and the drilling program is developed to manage the uncertainty level. Normally, this stage would be the most prolonged period among other stages since many factors to be considered prior to the Final Investment Decision (FID) such as LLI, market condition, government/JV/headquarter approvals, etc. The success of a well planning will be reflected during the execution (fourth stage) and all of the WDP will be reviewed during close-out stage.

Figure 1 shows that the planning and procurement process might consume around 60% of the cycle time period of drilling project, as described in Figure 3. Even though first and second stages are shorter in terms of time period, but the influence on the cost estimation and possible actual cost during execution are higher (Figure 4). As the WDP is progressing through its stages, the risk and uncertainty level is decreasing.

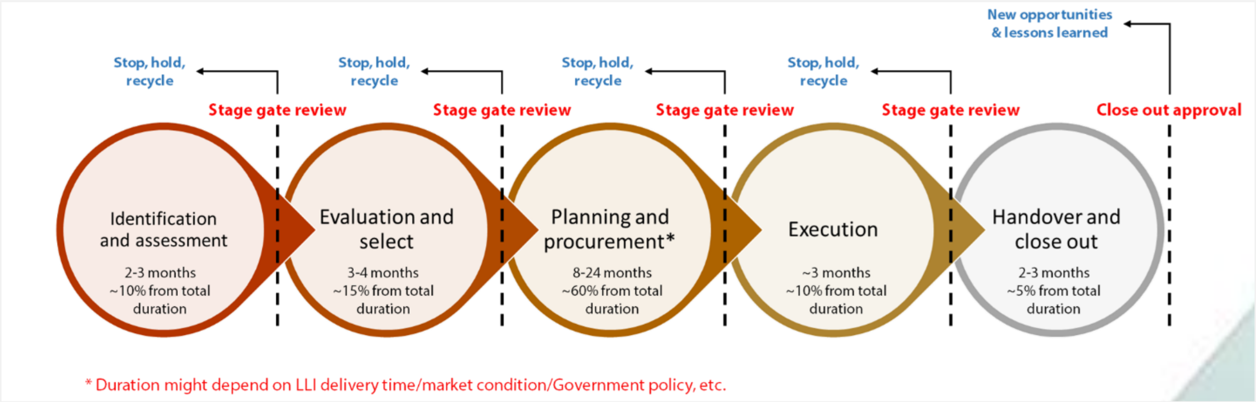


Figure 3. Typical Well Delivery Process for a single well.

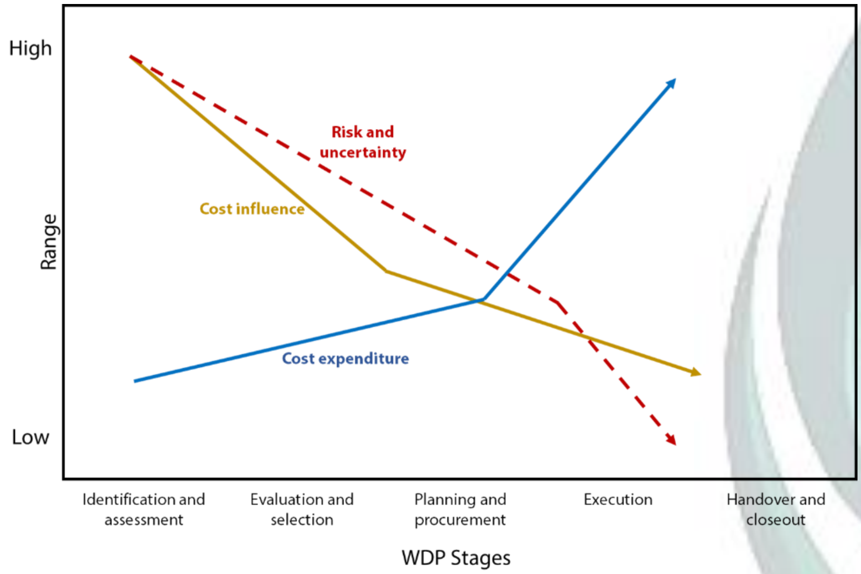


Figure 4. Risk and cost profile throughout the course of the project (de Wardt, 2010). Please note that the graph is only showing the typical risk and cost profile trend throughout the drilling project phases.

3.1.2 Drilling Project Cycle and WDP Implication to the Project Planning

WDP ensures that sufficient work has been conducted during the planning phase to meet the level of manageable risk and uncertainty in the execution phase. Even though WDP guides the works to be done during every stage of the project, but it is not necessarily dictating the detailed timeline and/or defining detail tasks or work breakdown structure (WBS). Therefore, it is important for the project team to develop a detailed project schedule with the project management tools available for the company.

The stage gates review process and approval illustrated in Figure 3 should be incorporated into the project schedule. The approval process and the possibilities of a loopback in case of the stage gate is not approved by the management has to be considered in the timeline, otherwise the project schedule will be overly optimistic.

3.1.3 Differences with other projects (e.g., EPC, civil construction, etc.)

As discussed in Figure 1, the oil and gas projects are exposed to geologic risk in the form of subsurface uncertainties. This uncertainty affects the project not only in the execution phase (drilling operation) but also during the planning phase. The requirement or data from subsurface might be updated during the course of the project if there is additional information received. This subsurface uncertainty differs from typical EPC or construction project, where the scope and requirement are relatively firmer and less likely to change.

During the execution phase, drilling project has a significant difference from typical EPC or construction project. The drilling operation has sequential activities, with little to no option to conduct activities in parallel. Adding personnel or equipment will not accelerate the project, e.g., one well can only be drilled with one rig; adding more rig will not cut the drilling time into half. This differs from the EPC projects where adding more resources may speed up the project, e.g., adding welder groups may increase the productivity in the pipeline construction project. Therefore, most of the time crashing the project by adding more resources during drilling operation is impossible. Table 2 summarizes the typical differences between drilling and EPC project in terms of project management approach.

Table 2. Differences summary between drilling project and EPC/construction project.

	Drilling project	EPC or construction project
Project scope and requirement	Subjected to subsurface uncertainty, as more information is acquired, the subsurface data/requirement might change. For example, during planning phase, the pore pressure data might still change but should be locked prior to LLI procurement. However, if the pore pressure is higher than anticipated and the company is running out of kick tolerance, the consequence is that the drilling activity might not be able to drill to the planned target depth. During the execution phase where the actual subsurface condition is revealed, any significant difference from the prediction will affect the drilling operation. Any changes during this stage should be well documented in the form of Management of Change (MOC).	Even though change order is common, especially on large projects, the project requirements for EPC projects are considered to be relatively firmer than the drilling project as it is not dealing with geologic uncertainty. The typical causes for change order are: • Incorrect estimation of project work (bill of quantity). • Project team incapable of completing their required deliverables within budget, and additional money, time, or resources must be added to the project. • Additional features or options are requested during the course of the project.
Execution phase	The drilling operation is sequential, with almost no room for parallel activities to speed up the project.	Some tasks/activities can be made parallel. Thus, adding more resources might be able to accelerate the project

	Drilling project	EPC or construction project
		completion.
Crashing project	Crashing project by adding resources is possible during planning phase but may not be possible once the operation commences (Execution Phase).	Crashing project by adding resource is possible during planning phase and in the operation/construction.

3.1.4 Project management software utilization for managing drilling planning

Even though having several differences with other projects such as construction project, but project management software such as Microsoft Project can still be an excellent tool for developing project timelines and managing projects. Several prominent features of the software are as follow:

- Schedule development – the software can significantly aid in developing a schedule with numerous interconnected tasks (which are the case in deepwater drilling project) that are challenging to be done manually. It can also be used to easily generate tasks network diagram and Gantt chart for better visualization and understanding of the project schedule.
- Resource assignment to tasks – the resource assignment (whether it is personnel, department, or material) can be quickly done in typical project management software such as Microsoft Project or Primavera.
- Progress tracking – one of the most useful features of the software, the progress tracking feature can significantly assist the engineer or project control to monitor the progress and incorporate it into the original plan. The progress of the project can also be easily used to forecast the new project completion date to check whether the project will be late or ahead of schedule. This can greatly help especially as the drilling project should follow the WDP cycle, where there is a possibility of a stage loopback as shown in Figure 3.
- Budget management – if used, the budget management features can track the total project spending along the course of the project. The budget tracking is one way to monitor the project progress, e.g., using S-curve to track project spending vs. tasks completed.
- Workload analysis – this feature can help identify whether the assigned resource (e.g., personnel or department) has too many tasks to be completed at one time, indicating a work overload. An overloaded resource might not be working efficiently and can lead to project delay.

Those features are very powerful tools if used properly and will help the project manager to run the project. However, the author's experience in previous drilling projects has shown that software such as Microsoft Project was only used to generate a Gantt chart without a proper WBS/tasks development (manual scheduling). This was a waste of a powerful tool and left much room for improvement for future drilling project planning.

4 Case Study: Deepwater Exploration Drilling in Indonesia

A planning process for an ongoing deepwater exploration project in Indonesia was used as a case study to demonstrate the application of project management software to manage a drilling project. The software being used in the planning is Microsoft Project. The advantages and challenges of utilizing it were identified, and the further future potential utilization of the software's feature was also discussed.

A deepwater drilling project is considered to be more complex than other offshore projects. A deepwater exploration or appraisal could take several years for a single well, and in the case of a discovered resource, the development phase might last for 25-30 years (Aird, 2019). However, in the case of Indonesia where the concession contract period is generally ranging from 25-30 years, the long exploration period can make the project unattractive. Therefore, usually an extension agreement of concession period for the field becomes one of the critical deliverables prior to the FID for developing the field (Aird, 2019).

The complexity of deepwater drilling also makes it notoriously known to be far more expensive than other offshore drilling, with the total deepwater drilling cost alone might contribute to 50-60% of the total project cost spending for the field development (Aird, 2019). This is due to the project is involving a highly technical, demanding, and challenging safe-operating environment requirement. Thus, it is crucial that the project should not be managed and operated in a "business as usual" manner.

Those aforementioned aspects make some E&P companies classify the deepwater drilling project as a "complex project" in their WDP. This would mean that the company might introduce an additional stage gate process for more screening or review process. For example, the planning stage can be split into two separate stages, such as "Planning-1 stage" and "Planning-2 stage" (Aird, 2019; Premier Oil, 2020).

4.1 Brief Project Background

The deepwater well is classified as a wildcat exploration well. Company leadership involves the multi-function personnel in this drilling campaign during well planning and execution stage. For the first exploration well, the company requires well-prepared project planning for both technical and non-technical matters to undertake the campaign of the safety and success of drilling project delivery. Therefore, proper utilization of project management is crucial in creating and tracking a plan, also monitoring the project readiness.

4.2 Developing Project Plan

The complexity of deepwater drilling project requires careful planning and a good coordination from various departments. As the project is a deepwater exploration drilling, the level of uncertainty is relatively high. Therefore, utilizing a project management software that can accommodate those potential changes along the course of the project can be a great help in achieving an efficient and effective project planning. The well planning can always be dynamically updated according to the latest information. The software is also used to communicate any changes or updates on the project to other team member to elevate the effectiveness in managing the project.

4.2.1 Workflow

The sequential flow of a whole planning process is useful to make the project plan easy to understand. This important since it helps to identify the missing link along with the planning and monitor process. Premier Oil has its WDP named Well Engineering Management System (WEMS). All project phases and delivery processes are mandatory to meet the WEMS standard.

Drilling project characteristics which alluded to earlier on section 3.1, might cause uncertainty anytime during the project is running. Project movement can be a return to the previous phase again if those uncertainties force to reset the current grand timeline because of significant change. Even until the project is finished, it might be much change. Therefore, developing a project plan in real-time from the start to completion date is necessary.

The workflow for this case study is depicted below:

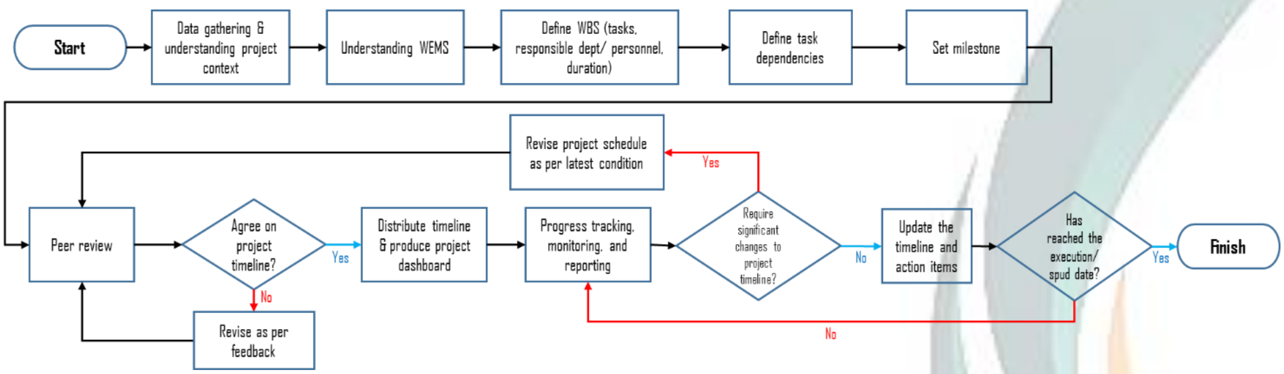


Figure 5. Flowchart for Developing Deepwater Project Plan

1. **Data gathering and understanding project context**
   The first step is to obtain all available spreadsheets that consist of a schedule or timeline from all departments involved. Understanding the project context of deepwater exploration drilling in Indonesia needs to be performed.

2. **Understanding Well Engineering Management System (WEMS) specifically for Deepwater Exploration Well**
   It is critical to comprehend the context of Well Delivery Process as dictated on the WEMS. In developing project plan, WEMS is the primary point that mandatory to be complied.

3. **Define Work Breakdown Structure (WBS)**
   To determine the scope and hierarchy of the project, the WBS is needs to be determined. WBS represents the components of detail line items associated with the project.

4. **Define Task Dependencies**
   Each task might have its relation to other tasks. Task dependencies show which task needs to be performed first before other tasks can start. It is crucial to determine the task dependencies accurately, otherwise the project plan software might incorrectly estimate either the critical path or the project completion date.

5. **Set Milestone**
   A milestone represents the important task of the project that is supposed to achieve a certain date. This is a standard tool used in project management to mark a specific point along the whole course of the project.

6. **Peer Review**
   Conduct a discussion with the team in order to get feedback and input. Ensuring all personnel on the team are agree with the timeline. Therefore, the project plan is ready to distribute.

7. **Distribute Timeline and Produce Project Dashboard**
   The agreed original timeline is distributed to all elements on the team. A project dashboard is generated to display project status for the management level.

8. **Progress Tracking, Monitoring, and Reporting**
   Project tracking and monitoring are routinely conducted during the well planning, the report will be distributed to the management. There is a condition where a significant change of the project is occurred and need to revisit peer review for the new schedule version.

9. **Update the Timeline and Action Items**
   Monitoring output should be known by everyone in the team and ensure all members get the project information updated. The project planner helps to create action list and capture ongoing progress, so the target deliverable date remains as it is with no delay/risk. Monitoring/updating the project is recurrence until the timeline has reached the execution date.

4.2.2 Scheduling

Project management software has its feature to create the grand timeline or schedule comprehensively. As Microsoft Project is chosen in handing this case, some of its features are utilized to build up the project plan. The deepwater exploration drilling project is categorized as complex well. The total task is 407 items with the much-interconnected task from one to each other is the real challenge to manage. Microsoft Project is expected to aid in constructing the grand project schedule.

1. Defining Task and Hierarchy and Assigning Responsible Department/Personnel
   Timeline that obtained from all department involved is then included in the project plan as WBS. The high-level grand timeline example can be seen below.

ID	Task Name	Duration	Start	Finish
0	DEEPWATER PROJECT TIMELINE	27.68 mon	July 30, 2019	November 26, 2021
1	MILESTONES	20.18 mons	October 14, 2019	June 26, 2021
2	Pre-identify Stage Approval	0 mons	October 14, 2019	October 14, 2019
3	Exploration SOR Document	0 mons	February 7, 2020	February 7, 2020
4	Identify Stage Gate Approval	0 mons	March 18, 2020	March 18, 2020
5	AFE Approval (Stakeholder Decision)	0 days	April 16, 2020	April 16, 2020
6	Select Stage Gate Approval	0 mons	April 29, 2020	April 29, 2020
7	Define 1 Stage Gate Approval	0 mons	September 30, 2020	September 30, 2020
8	Define 2 Stage Gate Approval	0 mons	April 28, 2021	April 28, 2021
9	SPUD DATE	0 edays	June 26, 2021	June 26, 2021
10	DRILLING OPERATIONS	6.9 mons	March 4, 2021	October 1, 2021
11	Rig Inspection and Function Test	2.45 mons	March 4, 2021	May 18, 2021
16	Mob, Prep and Acceptance	20 edays	June 3, 2021	June 23, 2021
17	MIGAS and SKKMigas Inspection	3 edays	June 23, 2021	June 26, 2021
22	DRILLING ENGINEERING	27.68 mons	July 30, 2019	November 26, 2021
90	EXPLORATION / SUBSURFACE	13.93 mons	July 30, 2019	September 30, 2020
96	Full Scale PSTM	0.48 mons	March 16, 2020	March 30, 2020
98	Full Scale PSDM	6 mons	March 30, 2020	September 30, 2020
101	PROCUREMENT	16.05 mons	January 27, 2020	June 3, 2021
102	PROCUREMENT (LLI)	13.77 mons	February 28, 2020	April 27, 2021
123	PROCUREMENT (SERVICES)	16.05 mons	January 27, 2020	June 3, 2021
277	FORMALITIES	8.45 mons	September 17, 2020	June 3, 2021
278	Explosive Formalities	7.64 mons	September 17, 2020	May 26, 2021
304	LLI Formalities	6.63 mons	October 6, 2020	April 27, 2021
323	LOGISTICS	18.86 mons	September 2, 2019	April 2, 2021
351	GA / Security	6 mons	February 3, 2020	August 4, 2020
352	Social & Stakeholder Mapping Study	6 mons	February 3, 2020	August 4, 2020
353	ENVIRONMENT/HSES	19.05 mons	August 1, 2019	March 9, 2021
354	EBA	7 mons	August 1, 2019	March 3, 2020
355	UKL / UPL	6.82 mons	March 4, 2020	September 30, 2020
356	Dumping Cutting Permit	12.5 mons	February 19, 2020	March 9, 2021

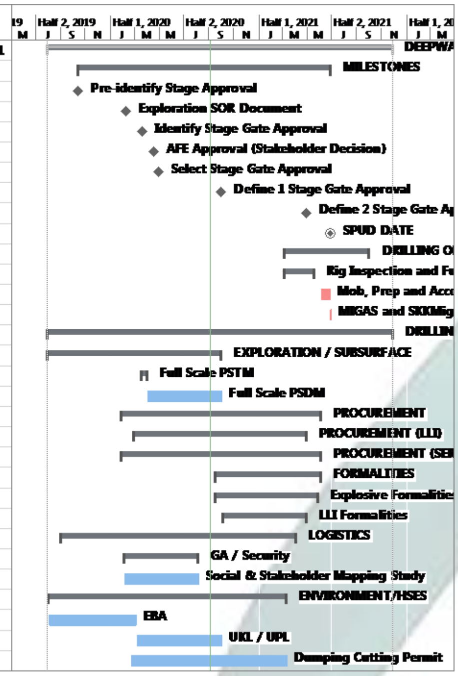


Figure 6. Example of WBS for Deepwater Exploration Drilling Project

2. Defining Task Dependencies and Duration

   Defining accurate task dependencies and duration is not simple. A thorough discussion among the expert of each department is needed to minimize missing links of one task and another. The inaccurate result of linking these dependencies will directly affect the critical path and project forecasting. See below for the example.

ID	Task Name	Duration	Start	Finish
0	DEEPWATER PROJECT TIMELINE	27.68 mon	July 30, 2019	November 26, 2021
1	MILESTONES	20.18 mons	October 14, 2019	June 26, 2021
5	AFE Approval (Stakeholder Decision)	0 days	April 16, 2020	April 16, 2020
90	EXPLORATION / SUBSURFACE	13.93 mons	July 30, 2019	September 30, 2020
93	TCM for LLI approval from JV	1.1 mons	February 26, 2020	March 31, 2020
101	PROCUREMENT	16.05 mons	January 27, 2020	June 3, 2021
102	PROCUREMENT (LLI)	13.77 mons	February 28, 2020	April 27, 2021
103	Subsea Wellhead	13.77 mons	February 28, 2020	April 27, 2021
104	SOW Preparation - SSWH	1.78 wks	February 28, 2020	March 11, 2020
105	Procurement process - SSWH	6 wks	March 11, 2020	April 22, 2020
106	PO Issuance - SSWH	0 mons	April 22, 2020	April 22, 2020
107	Delivery Lead Time - SSWH	12 mons	April 22, 2020	April 27, 2021
108	Big Casing	10.05 mons	April 30, 2020	March 4, 2021
109	SOW Preparation - OCTG big	3 wks	April 30, 2020	May 20, 2020
110	Procurement process - OCTG big	6 wks	May 21, 2020	July 1, 2020
111	PO Issuance - OCTG big	0 mons	July 1, 2020	July 1, 2020
112	Delivery Lead Time – OCTG big	8 mons	July 2, 2020	March 4, 2021

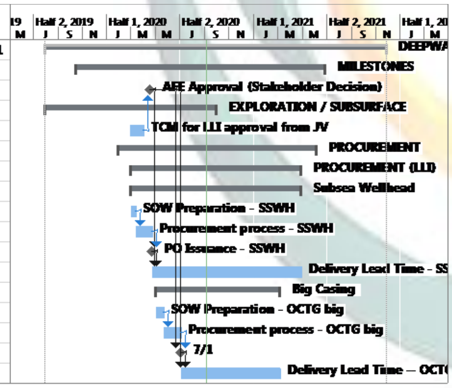


Figure 7. Example of Task Dependencies for Deepwater Exploration Drilling Project

3. Determining Milestones

   Milestone is a project management tool to evaluate where the project is in terms of schedule quickly. Premier Oil determine the milestone referring to the WEMS stage gate. Besides, remarkable events are also displayed as a milestone to facilitate assessing the course of the project. The display of the project milestone is shown below.

ID	Task Name	Duration	Start	Finish
0	DEEPWATER PROJECT TIMELINE	27.68 mon:	July 30, 2019	November 26, 2021
1	MILESTONES	20.18 mons	October 14, 2019	June 26, 2021
2	Pre-identify Stage Approval	0 mons	October 14, 2019	October 14, 2019
3	Exploration SOR Document	0 mons	February 7, 2020	February 7, 2020
4	Identify Stage Gate Approval	0 mons	March 18, 2020	March 18, 2020
5	AFE Approval (Stakeholder Decision)	0 days	April 16, 2020	April 16, 2020
6	Select Stage Gate Approval	0 mons	April 29, 2020	April 29, 2020
7	Define 1 Stage Gate Approval	0 mons	September 30, 2020	September 30, 2020
8	Define 2 Stage Gate Approval	0 mons	April 28, 2021	April 28, 2021
9	SPUD DATE	0 edays	June 26, 2021	June 26, 2021
22	DRILLING ENGINEERING	27.68 mons	July 30, 2019	November 26, 2021
23	Pre-identify Stage	2.5 mons	July 30, 2019	October 14, 2019
25	Stage 1 Gate - Identify	6.5 mons	September 2, 2019	March 18, 2020
42	Stage 2 Gate - Select	1.36 mons	March 19, 2020	April 29, 2020
57	Stage 3 Gate - Define 1	5 mons	April 30, 2020	September 30, 2020
59	Stage 4 Gate - Define 2	6.77 mons	October 1, 2020	April 28, 2021
75	Stage 5 Gate - Execution	3.27 mons	June 23, 2021	October 1, 2021
84	Stage 6 Gate - Review	1.82 mons	October 1, 2021	November 26, 2021

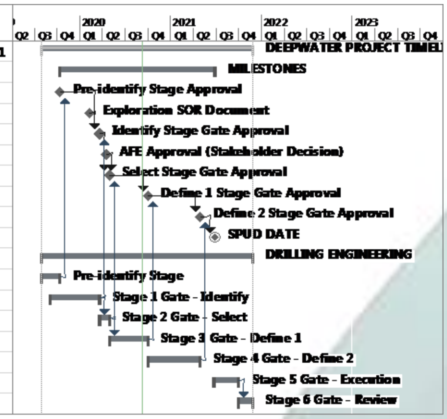


Figure 8. Example for Incorporating Milestones as per WEMS Deepwater Exploration Drilling Project

4. Identifying the Critical Task
   This is one of the important parts of the project to see which tasks need to be intensely monitored. The detail of critical path will be explained in section 4.2.3.

5. Project Completion Estimation
   Project manager will be able to predict the completion date once all the scheduling steps are completed. The impact of delayed tasks will also be seen easily. This will be very helpful for controlling and monitoring processes.

4.2.3 Critical Path

After the planning process, tracking the project is essential to detect the actual progress compared to the planned schedule. The Gantt chart shows the bar charts that usable to see the tracking of the project. However, how to classify the most impactful bar chart among all scheduling activities? The critical path is the answer to identify the longest path through the project. Generally, it is the sequence of the task which determines the duration of the complete project. Critical path has no flexible room in the schedule to slip on. All tasks on the critical path are said to be "critical task." The identified critical tasks must be taken carefully since those will directly affect the project finish date. Because of the long timeline on the Oil and Gas project, understanding the critical path are an excellent way to lessen the risk of project delay.

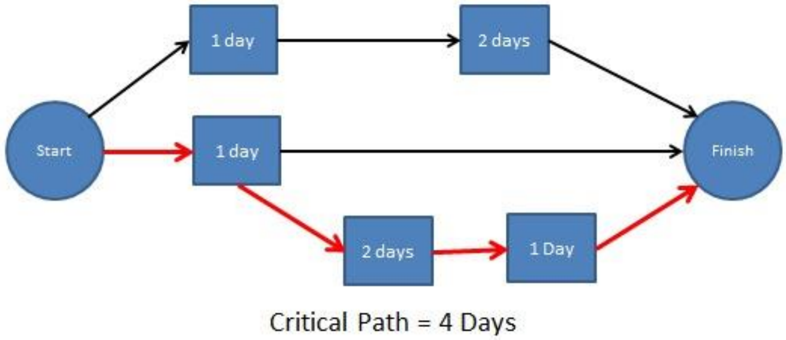
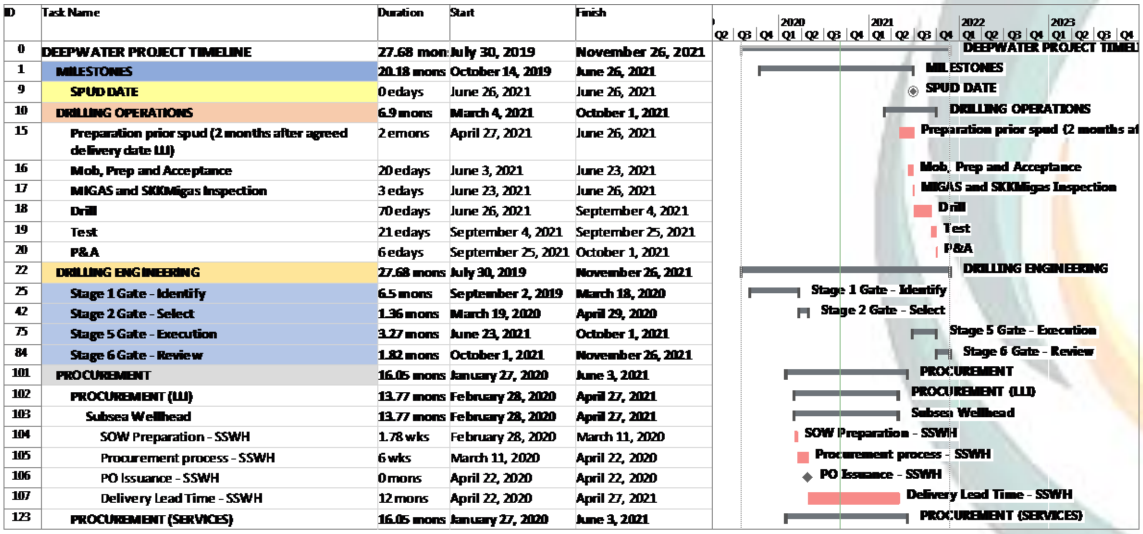


Figure 9. Critical Path Illustration

In Microsoft Project practical, it is essential to revisit WBS and task dependencies to get the perfect activity network that will result in a critical path. The incomplete activity network will defect the critical path determination as well, the impact one task to other tasks become inaccurate. This significantly affects the project completion estimation. Looking at the Gantt chart, critical path is easy to detect by visual. It is indicated by red bars on the Gantt chart. If the bar has zero slack time, it is supposedly determined as critical. Slack time itself is defined as the amount of flexibility of a task. The example of a critical path on the deepwater drilling project is displayed below.



ID	Task Name	Duration	Start	Finish
0	DEEPWATER PROJECT TIMELINE	27.68 mon	July 30, 2019	November 26, 2021
1	MILESTONES	20.18 mons	October 14, 2019	June 26, 2021
9	SPUD DATE	0 edays	June 26, 2021	June 26, 2021
10	DRILLING OPERATIONS	6.9 mons	March 4, 2021	October 1, 2021
15	Preparation prior spud (2 months after agreed delivery date LLI)	2 emons	April 27, 2021	June 26, 2021
16	Mob, Prep and Acceptance	20 edays	June 3, 2021	June 23, 2021
17	MIGAS and SKKMigas Inspection	3 edays	June 23, 2021	June 26, 2021
18	Drill	70 edays	June 26, 2021	September 4, 2021
19	Test	21 edays	September 4, 2021	September 25, 2021
20	P&A	6 edays	September 25, 2021	October 1, 2021
22	DRILLING ENGINEERING	27.68 mons	July 30, 2019	November 26, 2021
25	Stage 1 Gate - Identify	6.5 mons	September 2, 2019	March 18, 2020
42	Stage 2 Gate - Select	1.36 mons	March 19, 2020	April 29, 2020
75	Stage 5 Gate - Execution	3.27 mons	June 23, 2021	October 1, 2021
84	Stage 6 Gate - Review	1.82 mons	October 1, 2021	November 26, 2021
101	PROCUREMENT	16.05 mons	January 27, 2020	June 3, 2021
102	PROCUREMENT (LLI)	13.77 mons	February 28, 2020	April 27, 2021
103	Subsea Wellhead	13.77 mons	February 28, 2020	April 27, 2021
104	SOW Preparation - SSWH	1.78 wks	February 28, 2020	March 11, 2020
105	Procurement process - SSWH	6 wks	March 11, 2020	April 22, 2020
106	PO Issuance - SSWH	0 mons	April 22, 2020	April 22, 2020
107	Delivery Lead Time - SSWH	12 mons	April 22, 2020	April 27, 2021
123	PROCUREMENT (SERVICES)	16.05 mons	January 27, 2020	June 3, 2021

Figure 10. Example of Critical Path for Deepwater Exploration Drilling Project

Apart from the powerful critical path method, it has several cons of its usage that need to be aware. Nevertheless, there is a way to mitigate it so the disadvantage can be minimized.

- For the complex and large project, there will be hundreds of tasks and dependency relationships. It can be mighty tricky managing the large project unless using a software. If the planned schedule changes significantly in the middle of the project, all of task dependencies should be reviewed. Microsoft Project might ease the work, but still, routine check and review are supposed to be done to assure the dependency relationship is still aligned to the project.

- Sometimes non-critical task that pending or delayed surprisingly becomes the critical task. Once the slack of the task down to zero, then it is defined as "critical". In the large project, those unidentified critical tasks should be avoided. Microsoft Project can mitigate this issue by changing the slack condition critical path. It will add a safe margin to the project. For example, tasks are critical if slack is less than or equal to 7 days instead of zero days.

4.3 Controlling and Managing Project

The progress of drilling project planning is monitored and tracked in this phase. The primary goal is to identify the scope that necessitate a change from the initial plan then analyzes the strategy in order to keep the project remain at no risk. It helps to measure the actual performance of the drilling project, thereby identifying how it deviates compared to the original plan. Hence, recommended action and forecasts turn out to be the outcome of managing projects.

4.3.1 Progress tracking and control

Tracking and controlling are performed to monitor the progress of the ongoing project. Project Planner commonly utilizes Microsoft Project in obtaining real-time information. In this case, Premier Oil also uses a weekly project summary template as a monitoring tool besides the Microsoft Project. Both tools are suitable for performing project monitoring as follows:

- Project Overview Dashboard
  Microsoft project can easily generate various type of dashboards for monitoring and tracking purpose. The team agreed for utilizing some features to display the project status. Ms. Project Timeline is used to show the schedule overview of designated task summaries. Figure 11 shows the time planner. The project planner is able to customize the displayed timeline depends on the purposes.

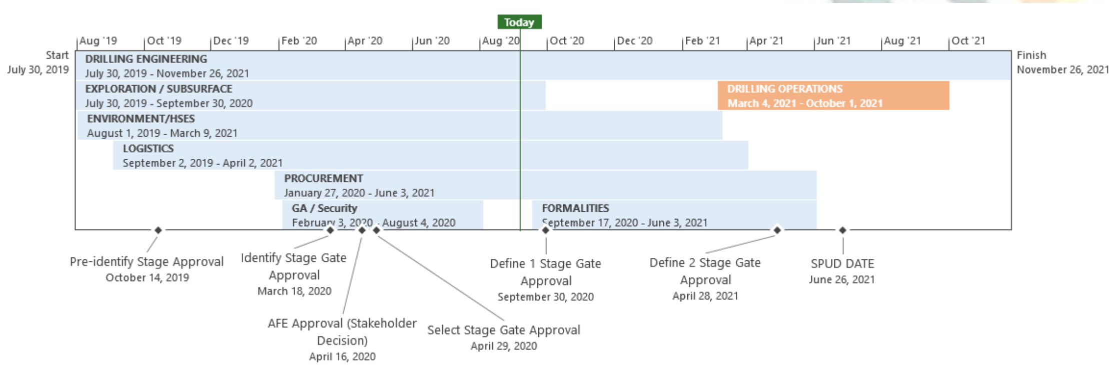


Figure 11. Example of Timeline for Deepwater Exploration Drilling Project

For the **Top Management** level, it is crucial to keep them aware regarding the high-level scope of the project that occurs. They need a simple and effective summary to track the progress and understand how the project is running. The burndown chart, or commonly named as S-curve, represents a one-time graph that displays the project status, whether it is on-track on not. Therefore, it is effortless for the management to comprehend if things are on the planned state or they need to make a backup strategy so the project can meet the goal on time.

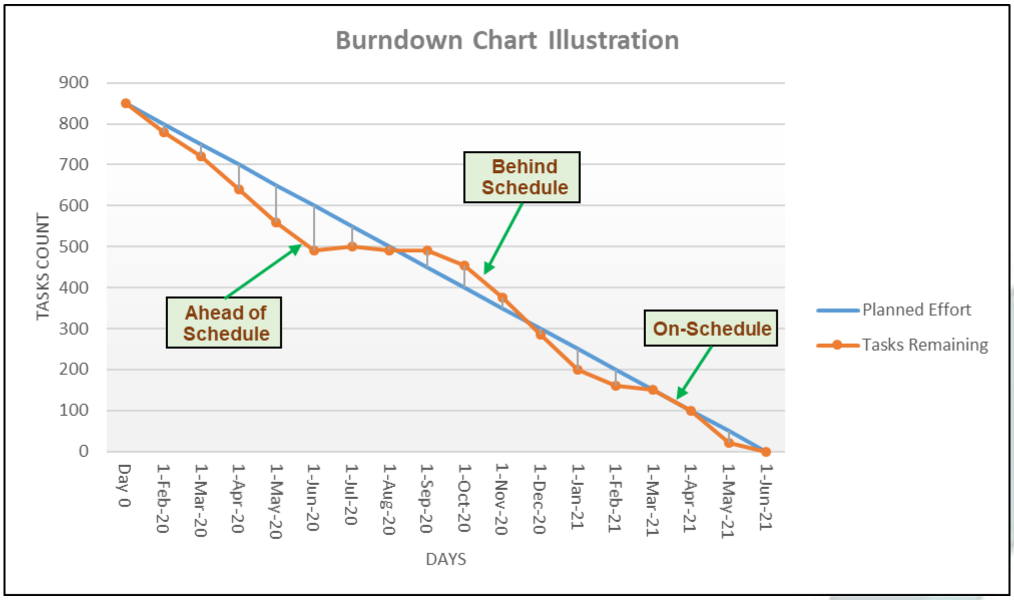


Figure 12. Burndown Chart Illustration

The report of whole project overview is also available in Microsoft Project. The *Project Overview Report* shows the estimation percentage of project, completion of each level of WBS, milestones due, and late task. The report that showed can also be modified as well (by adding critical task information, etc.) or formatting the display. Besides the burndown chart, project overview report can be provided to the top management for the more detail information.

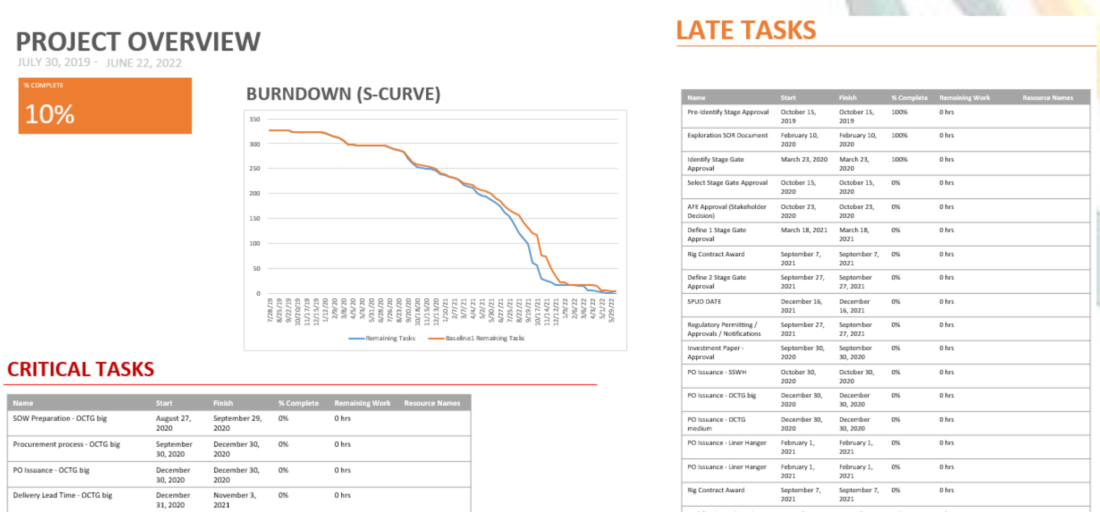


Figure 13. Example of Project Overview Dashboard for Deepwater Exploration Drilling Project

- Premier Oil Weekly Monitoring Report (Weekly Project Summary)
  Burndown chart and project overview are fairly easy to understand. However, the team frequently struggle to interpret the full meaning behind. For the manager level and working team, the detailed status of each task is necessary. They need to know which specific tasks are having an issue. By monitoring each task, any project risks can be mitigated. Hence, Premier Oil released the project update summary by weekly.
  Project planner summarizes the ongoing and upcoming tasks based on the planner from Microsoft Project, then reported on a one-page overview. Different colors highlight each task depends on their weekly status. The highlight report allows the manager to confirm and point out any foreseeable problems of the project. The example of the weekly report is shown in Figure 14.

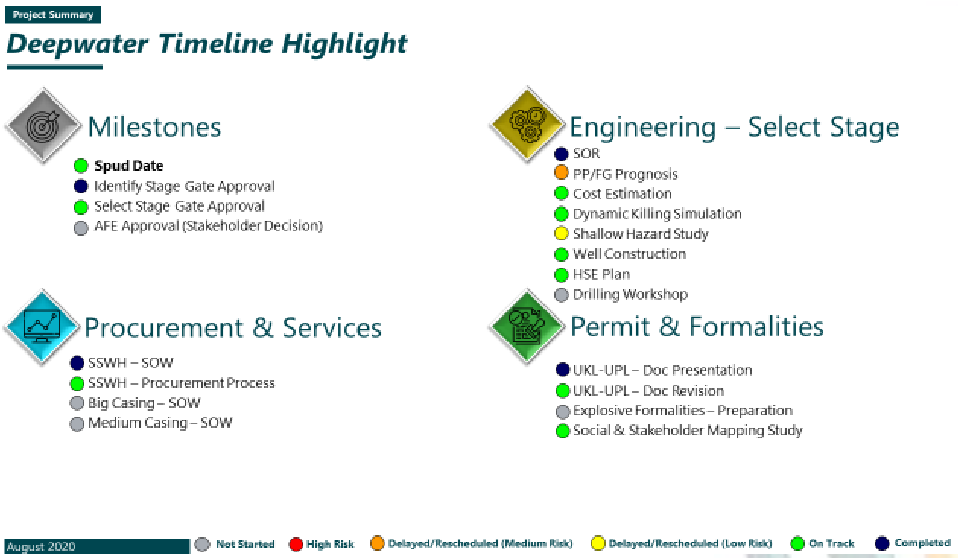


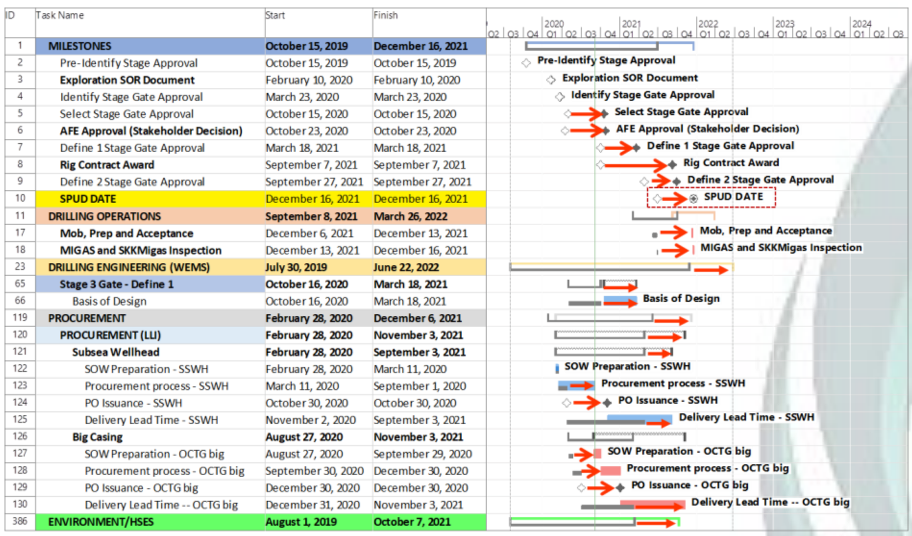
Figure 14. Example of Weekly Summary Template of Premier Oil

4.3.2 Project Completion Forecasting

Once the planning steps are done, then proceed to the forecasting process. It is fast and easy to estimate the future condition if there is a significant update during ongoing well planning. The actual information is able to predict the timeline implication of the whole project. In this deepwater exploration case, the subsurface condition contributes most timeline change. One of the engineering lines items, namely Pore Pressure/Fracture Gradient (PP/FG) Prognosis is an example of unique uncertainty on this project. PP/FG prognosis oftentimes drives the whole schedule since there are many factors to be considered, then it necessary to be updated if any information is added. The project planner should notice and make sure that the target timeline still accommodates the change. Figure 18 below shows implication to the other tasks due to dynamic update affected by PP/FG prognosis.

Figure 15. PP/FG Prognosis Predecessor Workflow

This case study also faces the challenge of the oil price slump during drilling project planning. It stimulates corporate decision to defer the deepwater drilling project since the project economics are affected. All remaining WEMS stages and original schedules need to be significantly revised. Ms. Project feature is compelling to generate a new schedule in a short time. Besides, it is easily compared with the previous schedule, which this feature cannot be found on a conventional spreadsheet. See below for the example of changed project schedule due to the oil price slump.

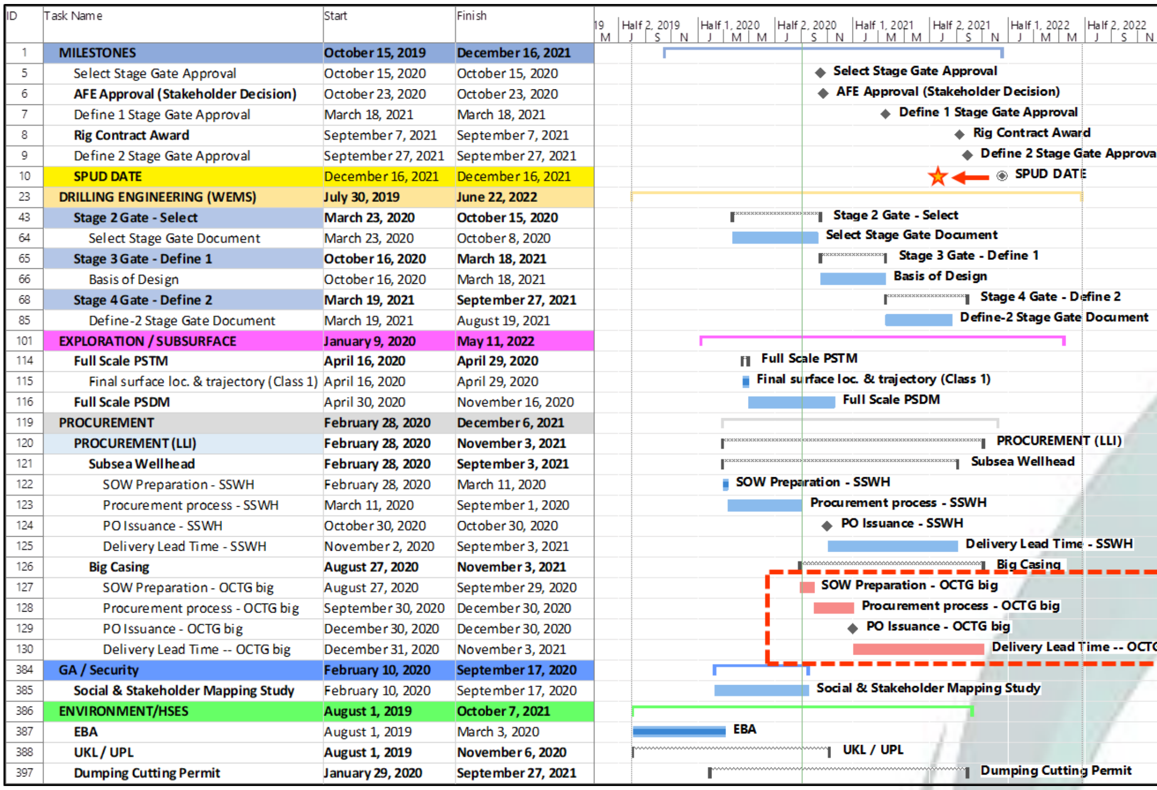


ID	Task Name	Start	Finish
1	MILESTONES	October 15, 2019	December 16, 2021
2	Pre-Identify Stage Approval	October 15, 2019	October 15, 2019
3	Exploration SOR Document	February 10, 2020	February 10, 2020
4	Identify Stage Gate Approval	March 23, 2020	March 23, 2020
5	Select Stage Gate Approval	October 15, 2020	October 15, 2020
6	AFE Approval (Stakeholder Decision)	October 23, 2020	October 23, 2020
7	Define 1 Stage Gate Approval	March 18, 2021	March 18, 2021
8	Rig Contract Award	September 7, 2021	September 7, 2021
9	Define 2 Stage Gate Approval	September 27, 2021	September 27, 2021
10	SPUD DATE	December 16, 2021	December 16, 2021
11	DRILLING OPERATIONS	September 8, 2021	March 26, 2022
17	Mob, Prep and Acceptance	December 6, 2021	December 13, 2021
18	MIGAS and SKKMigas Inspection	December 13, 2021	December 16, 2021
23	DRILLING ENGINEERING (WEMS)	July 30, 2019	June 22, 2022
65	Stage 3 Gate - Define 1	October 16, 2020	March 18, 2021
66	Basis of Design	October 16, 2020	March 18, 2021
119	PROCUREMENT	February 28, 2020	December 6, 2021
120	PROCUREMENT (LLI)	February 28, 2020	November 3, 2021
121	Subsea Wellhead	February 28, 2020	September 3, 2021
122	SOW Preparation - SSWH	February 28, 2020	March 11, 2020
123	Procurement process - SSWH	March 11, 2020	September 1, 2020
124	PO Issuance - SSWH	October 30, 2020	October 30, 2020
125	Delivery Lead Time - SSWH	November 2, 2020	September 3, 2021
126	Big Casing	August 27, 2020	November 3, 2021
127	SOW Preparation - OCTG big	August 27, 2020	September 29, 2020
128	Procurement process - OCTG big	September 30, 2020	December 30, 2020
129	PO Issuance - OCTG big	December 30, 2020	December 30, 2020
130	Delivery Lead Time -- OCTG big	December 31, 2020	November 3, 2021
386	ENVIRONMENT/HSES	August 1, 2019	October 7, 2021

Figure 16. New Drilling Project Schedule affected by Oil Price Effect

4.3.3 Crashing the Project

Crashing is one of schedule compression technique that used to shorten or accelerate the schedule duration without reducing the project scope in order to meet project objectives. (Project Management Institute, 2017). In the drilling project, crashing the project is very common. The study is used in this study to crash the date accomplishment due to oil price fluctuation. The company dictates to mitigate project economics by re-planning the overall target delivery. When the target date is set earlier, sometimes the project planner has to determine which task to accelerate. The only point to speeding up is on a critical task. Since the critical task can be identified easily, the project planner should understand where to focus the work or assign more resources if necessary. Those all can be done using Microsoft Project. Below depicted the example of project crashing in drilling project. The *Big Casing* task should be optimized to compress the schedule.



ID	Task Name	Start	Finish
1	MILESTONES	October 15, 2019	December 16, 2021
5	Select Stage Gate Approval	October 15, 2020	October 15, 2020
6	AFE Approval (Stakeholder Decision)	October 23, 2020	October 23, 2020
7	Define 1 Stage Gate Approval	March 18, 2021	March 18, 2021
8	Rig Contract Award	September 7, 2021	September 7, 2021
9	Define 2 Stage Gate Approval	September 27, 2021	September 27, 2021
10	SPUD DATE	December 16, 2021	December 16, 2021
23	DRILLING ENGINEERING (WEMS)	July 30, 2019	June 22, 2022
43	Stage 2 Gate - Select	March 23, 2020	October 15, 2020
64	Select Stage Gate Document	March 23, 2020	October 8, 2020
65	Stage 3 Gate - Define 1	October 16, 2020	March 18, 2021
66	Basis of Design	October 16, 2020	March 18, 2021
68	Stage 4 Gate - Define 2	March 19, 2021	September 27, 2021
85	Define-2 Stage Gate Document	March 19, 2021	August 19, 2021
101	EXPLORATION / SUBSURFACE	January 9, 2020	May 11, 2022
114	Full Scale PSTM	April 16, 2020	April 29, 2020
115	Final surface loc. & trajectory (Class 1)	April 16, 2020	April 29, 2020
116	Full Scale PSDM	April 30, 2020	November 16, 2020
119	PROCUREMENT	February 28, 2020	December 6, 2021
120	PROCUREMENT (LLI)	February 28, 2020	November 3, 2021
121	Subsea Wellhead	February 28, 2020	September 3, 2021
122	SOW Preparation - SSWH	February 28, 2020	March 11, 2020
123	Procurement process - SSWH	March 11, 2020	September 1, 2020
124	PO Issuance - SSWH	October 30, 2020	October 30, 2020
125	Delivery Lead Time - SSWH	November 2, 2020	September 3, 2021
126	Big Casing	August 27, 2020	November 3, 2021
127	SOW Preparation - OCTG big	August 27, 2020	September 29, 2020
128	Procurement process - OCTG big	September 30, 2020	December 30, 2020
129	PO Issuance - OCTG big	December 30, 2020	December 30, 2020
130	Delivery Lead Time -- OCTG big	December 31, 2020	November 3, 2021
384	GA / Security	February 10, 2020	September 17, 2020
385	Social & Stakeholder Mapping Study	February 10, 2020	September 17, 2020
386	ENVIRONMENT/HSES	August 1, 2019	October 7, 2021
387	EBA	August 1, 2019	March 3, 2020
388	UKL / UPL	August 1, 2019	November 6, 2020
397	Dumping Cutting Permit	January 29, 2020	September 27, 2021

Figure 17. Example of Project Crashing for Deepwater Exploration Drilling

4.4 Advantages of Project Management Software

Microsoft Project has various features that offer several advantages. By utilizing its feature, the effectiveness and efficiency in developing project planning can be perceived. Drilling exploration drilling project as a case study has shown the ease of Microsoft Project use. It proves how powerful the project management software utilization and will help the team to run the project. The common spreadsheet becomes less preferable for being used. Table 3 summarizes project management software advantages in this study.

Table 3. Comparison Table between Project Management Software and Conventional Spreadsheet

Area of Comparison	Project Management Software	Conventional Spreadsheet
Define Task / WBS	Can easily be defined hierarchically	Manual entry
Network Diagram	Has feature to create the diagram	Cannot create the diagram
Scheduling	The schedule is calculated automatically as per input	Need to generate the formula to calculate the schedule duration manually
Track and control	Very efficient in tracking and controlling the project as well as able to identify a critical path	Time-consuming to control and update the project
Forecasting	Easy to estimate the new project	Manual calculation to forecast

	completion date if any change occurs	schedule
Reporting	Has a built-in dashboard and report template	Manual setup

4.5 Lesson Learned

- It is challenging to compile the separated timeline from all departments. Sometimes redundant each other
- Drilling operation/execution stage: Challenging to add resources in order to fasten the project (disparate compared to EPC project, which is able to speed up the project by adding many more resources). Example: cannot adding more drilling rig to accelerate the project
- A dedicated person should be assigned to maximize the project management work in real-time monitoring
- On the early phase of planning, in order to accelerate the development of the project planning in a lean organization, additional resource in the form of the project planning consultant was utilized to initiate the plan and schedule development in Ms. Project.

5 Summary and Conclusion

This study has discussed the project management software's common features for developing deepwater exploration drilling planning in Indonesia. The project management software can be used to aid in planning, organizing, and managing resource of a project. Project scheduling (WBS, task dependencies, critical path, etc.) and monitoring features (dashboard, timeline, burndown chart, weekly summary template, baseline) are the most predominantly used to elevate the effectiveness of the planning process.

Drilling project, with exploration, in particular, has to deal with subsurface uncertainty. This relatively fluid requirement is different from the EPC project, where the requirement is typically firmer. The dependencies to other external factors such as oil price fluctuations and changing regulations further complicate the drilling planning process. During the execution, drilling operation is a sequential process with little to no room for a parallel activity. Therefore, it is almost impossible to crash the project by adding resources when the drilling commences. This difference should be carefully considered during developing the project plan to ensure that the project controlling approach is suitable for the nature of the drilling project.

From the case study of the deepwater exploration drilling campaign in Indonesia, the following points are identified. First, in the early phase of planning, it is not easy to perform data gathering from all departments involved. In order to accelerate the development of the project planning in a lean organization, additional resource in the form of the project planning consultant was utilized to initiate the plan and schedule development in MS Project. Besides, a dedicated person should be assigned as a project planner to maximize the work in planning and real-time monitoring. Overall, from the literature review and the case study of deepwater drilling planning, utilizing MS Project for planning offers several advantages compared to using conventional spreadsheet software to develop the project schedule.

6 Path Forward

In project management, the phases associated with the development of the product, services, or results are called the development life cycle (Project Management Institute, 2017). This development life cycle can be predictive (plan-driven), adaptive (agile), iterative, incremental, or combination (Figure 18).

As shown in the literature review and case study results, the drilling project (exploration in particular) deals with subsurface uncertainty. These relatively fluid requirements are not suitable for a predictive project management approach and tend to be more suitable with the incremental or even agile approach. Further study is required to assess where the exploration drilling project fits in the project management approach.

Predictive **Iterative** **Incremental** **Agile**

Requirements are defined up-front before development begins	Requirements can be elaborated at periodic intervals during delivery	Requirements are elaborated frequently during delivery
Deliver plans for the eventual deliverable. Then deliver only a single final product at end of project timeline	Delivery can be divided into subsets of the overall product	Delivery occurs frequently with customer-valued subsets of the overall product
Change is constrained as much as possible	Change is incorporated at periodic intervals	Change is incorporated in real-time during delivery
Key stakeholders are involved at specific milestones	Key stakeholders are regularly involved	Key stakeholders are continuously involved
Risk and cost are controlled by detailed planning of mostly knowable considerations	Risk and cost are controlled by progressively elaborating the plans with new information	Risk and cost are controlled as requirements and constraints emerge

Figure 18. Types of project development life cycle (modified from PMI, 2017).

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