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Integrated Data Management and Digital System in Well Intervention Program Business Process. An Implementation Case Study from Mahakam Indonesia

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Abstract. In order to maintain the production rate in Mahakam, every year more than 4000 well intervention workloads are carried out as outlined in the Well Intervention Program. This work program goes through several stages starting from request, costing, workload determination, making program details up to approval from the engineering, operation, and economic value to ensure the work is carried out safely, efficiently and profitably. This process involves multiple entities and also multi-layer approval. This paper will explain the utilization of data management applications and digital systems in the Mahakam Well Intervention Business process and the various benefits provided.
A system was developed to assist the process of creating, implementing, recording and reporting well intervention workload using a web based application. This application is proven to provide enormous benefits in well intervention activities in Mahakam. Shorten the program creation time so that the entire process, which initially took 3 days, can be completed in less than 1 day. Increase the speed and accuracy of statistical operation calculations, more objective and measurable HSE Performance assessment to help provide early warnings of potential incidents, facilitate control and monitoring of budgets and contract expenditures as the basis of calculation cost efficiency, and facilitate the creation of external reports with valid data.

Keyword(s): Digitalization, Well Intervention Program, Optimization, Reporting

1 Introduction

Natural decline in Mahakam is quite high at 50% every year, to withstand the rate of production decline, it needs massive new well drilling and aggressive well intervention activities. This results in a high well intervention workload every year which is more than 4000 workloads.

On the other hand, the company also conducts a cost cutting program to reduce expenditure and maintain profitability operations in Mahakam. This requires efficiency in well intervention operations ranging from cost expenditure, job duration, manpower setting and lean organization. This raises some problems including:

1. Cost and duration job statistics are still not available, so it still does not have a fixed baseline in determining optimization.
2. There is still a lot of work done manually, so it requires manpower and a greater duration of work.
3. Reduction in the number of personnel that is not followed by a reduction in the number of jobs, causing an increase in job load in available personnel.
4. There is no integrated method for viewing the entire operation performance.
5. Data sources are scattered and involve a variety of functions, causing high probability of differences and data inconsistency.

These problems encourage the acceleration of digitalization development to solve problems that arise. The development of digitalization is carried out to be able to monitor performance and control the achievements of KPIs in Well Intervention in terms of workload, cost, safety and others.

2 Application Clustering

In order to support operating needs, various digital applications are developed inhouse by internal developers on the Drilling and Well Intervention team. The application has been developed since 2006 and is grouped in several large application clusters as shown in Figure 1. This paper only focused on the discussion of applications on two main clusters: (1) cluster operation, engineering & planning and (2) cluster monitoring & reporting.

Figure 1. Application Clusters

In cluster operation, engineering & planning consist of several sub-applications such as the applications to organize the creation of well intervention programs from requests to approval processes, then application for job planning, and well intervention work activity reporting applications. While in the monitoring and reporting section there is a daily report application, well chronology & well diagram, barge performance report and well intervention dashboard.

Figure 2. Simplified Application Workflow

3 Digitization Initiatives

In the early stage, the well intervention business process started from the job request from the subsurface team in the form of paper based request, then the request was reviewed by the team well performance to be further forwarded with the costing process and the creation of a well intervention program by well intervention engineers. Furthermore, the program was reviewed by the Head of Engineering, Head of Operation and Head of Asset. The process was done manually, and paper based, so that in the initial initiation process, it takes approximately 3-5 days in the creation of the program.

The Well Intervention Program is sent to the field by fax and then the paper program sent to each barge by seatruck. After the work is done, the job report of the work is sent back to the site base and then to Balikpapan (headquarter). Many efforts are needed to produce one complete report per barge per day, it requires transportation from well site to barge by sea truck as main transportation means in Delta. In this configuration, there are several inefficiencies observed,

1. Transportation costs needed to deliver programs and reports every day,
2. Data is stored in hardcopy form, so it is very difficult to do digital integration with reporting, and not easily accessible to all parties.
3. Data cannot be used in real time by concerned parties

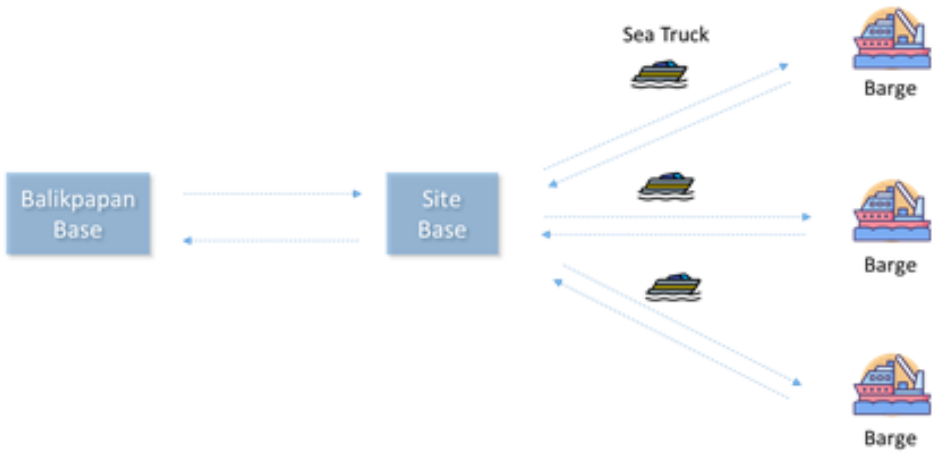

Figure 3. Initial reporting process illustration

The digitization process in the Well Intervention Business process began to be developed to increase efficiency, control in performance and overcome some of the problems encountered in the previous system. Development process is starting from Operation, HSSE, Performance, Contractual, and finally Dashboard and Reporting.

In terms of operation, development starts from the creation of a digital system for well intervention request, well intervention program, offline daily report, and data storage system well diagram and well chronology (a collection of operation reports of work done on the well). In general, the process is divided into the following:

1. Well Intervention Request creation and approval
2. Well Intervention Program creation and approval
3. Offline Daily Report
4. Well Diagram and Well Chronology Report
5. Reporting
6. Job History and Statistics
7. Other Apps

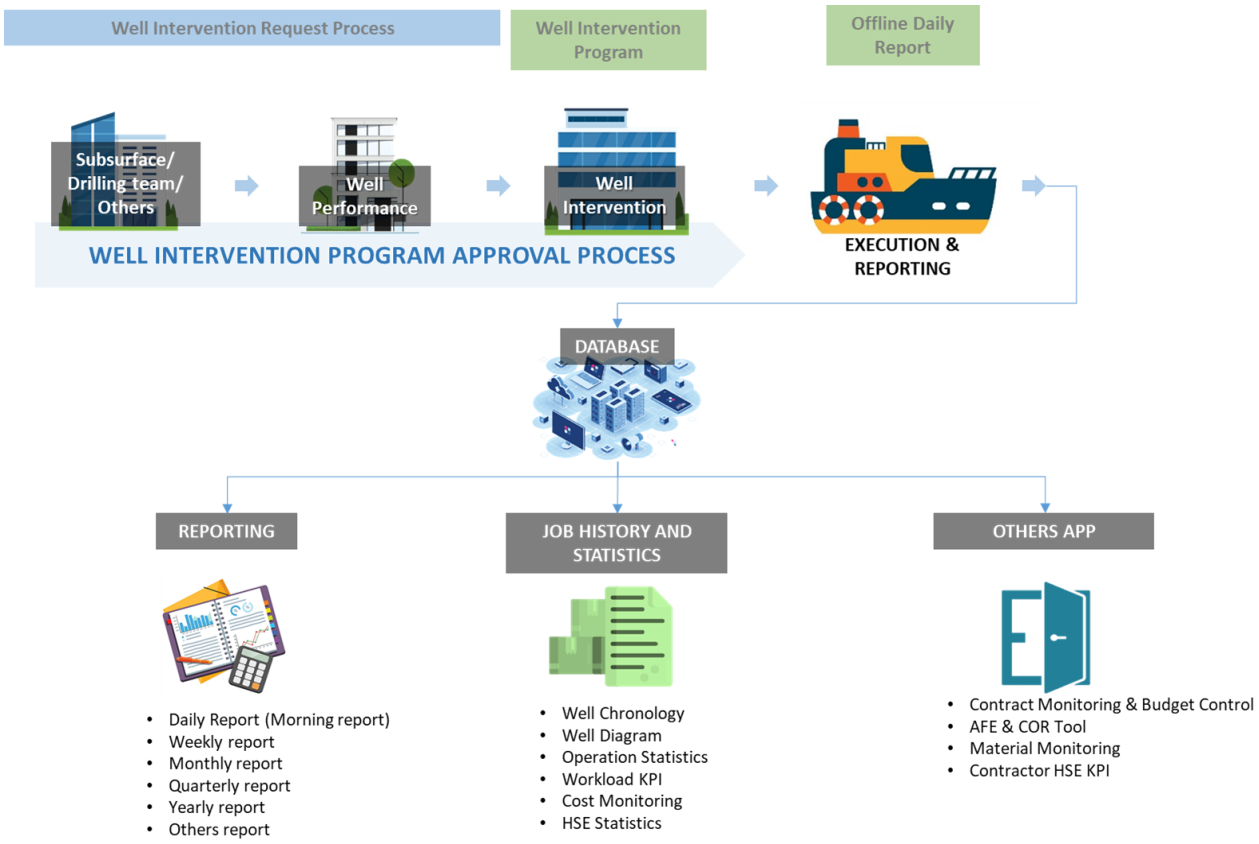

Figure 4. Well Intervention Program Business Process

4 Well Intervention Request

Well Intervention Request is a formal request from a particular function to the Well Intervention team to perform certain Well Intervention work. Well Intervention Requests can be issued by subsurface teams, drilling teams, well integrity teams or other teams that require well intervention work. This request is made through the web based application. The view of the well intervention request is shown in Figure 5. Some of the main data in the well intervention request are as follows:

1. Present Status: describes the current well condition
2. Intervention Main line: an overview of desired intervention needs
3. Reservoir Data
4. Type of operation budget and workload
5. Success ratio
6. Expected gain and estimated stakes
7. Cost and Duration Estimation
8. Review surface data and specific concern from Well Performance Team
9. Attachment: Completion log, Cement Log, another related data

Well intervention request is also connected with the well integrity application to see the well integrity status of the well and determine whether it is safe to do intervention activities or not. In the example below, the green Well Color indicates that the integrity well status is in good condition.

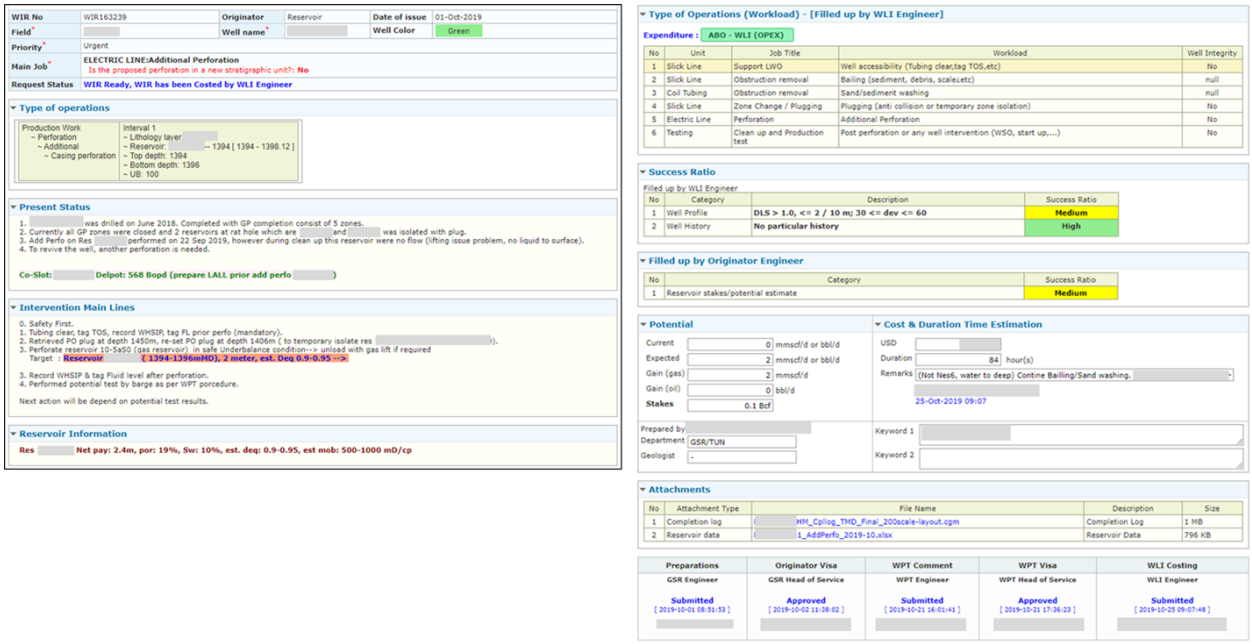

Figure 5. Well Intervention Request

The process continued with a review by the Well Performance Team. The team will assess the risk of short fall, overall impact on production performance, sand issue, or specific surface facilities issue. After going through a review from the team, well performance then well intervention request will go through the initial review process in terms of cost, engineering, and operation by well intervention engineer. In this step, the well intervention engineer will determine the details of the operation step, determine the budget and job duration estimates, look at the feasibility operation from the engineering side, and see job readiness from the operation side (barge allocation, material availability, platform accessibility etc.). In this stage we will be able to determine whether this work is economical and feasible to do or not. If it is not economical and not feasible, then the well intervention request will be delayed or even canceled, but if the work can be done, it will be continued with the next step, which is the creation of the Well Intervention Program.

5 Well Intervention Program

In this stage, the well intervention engineer will make details of the well intervention program including the following:

1) **Program introduction,**
   - The objective tab contains an objective of well intervention program, general well intervention sequence, estimated stakes, expected Gain.
   - The Introduction tab contains an overview of well conditions consisting of Well status, Highlight well history related to well accessibility, Current well production, Reservoir category, and some important job-related data that need to be considered by the team in the field.
2) **Workload and budget type,**
   - This tab contains the details of the workload used and budget allocation. These data will be used in the calculation of job realization statistics and also cost expenditure.
   - Type expenditure is divided into Opex (operational expenditure), Capex (capital expenditure), and Capex new well (capital expenditure which includes the cost of a new well job).
3) **Program detail including workload, estimated duration and estimated cost.**
   - This section contains details of step well intervention operation, the work unit used, workload related to the step, as well as the estimated duration and budget of each step.
4) **Well Information**
   - Well information contains maximum depth of operation, well deviation, maximum bottom hole temperature, well status, current production and expected production after well intervention. These data provide an initial picture of the limitations of well intervention activities as well as the economic value of well intervention work to be done.
5) **Attachment**
   - Some data related to well intervention programs is included to make it easier for the field team to get important data related to operations while ensuring that it has the same reference in the implementation of the program. One of them is the GBUC (Gun Blown Up Calculation) document which calculates the maximum safe underbalance in perforation activities

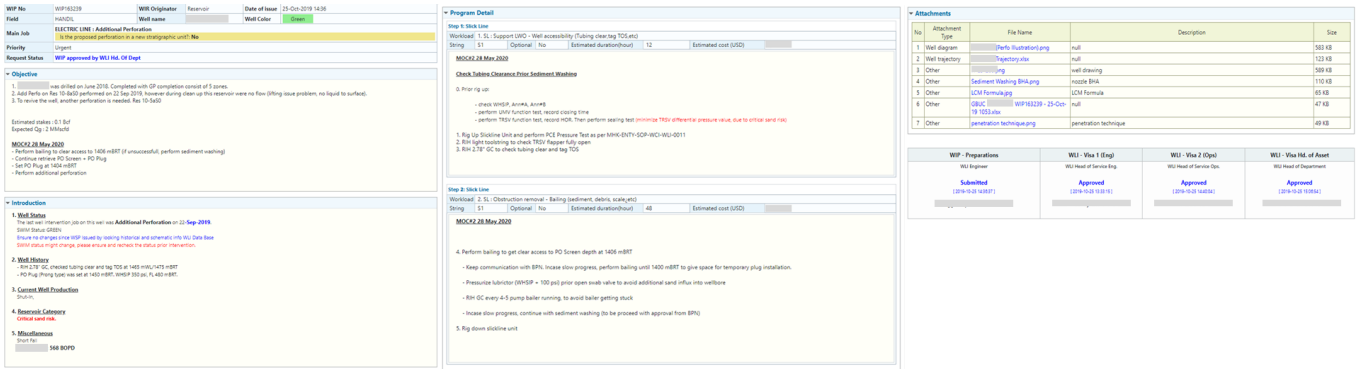

Figure 6. Well Intervention Program

6 **Offline Daily Report**

Once the program gets full approval, then the work can be done in the field. Operation team in the barge can create reports through the offline daily report application. This allows all teams to be able to create reports even though it is not connected to the company's intranet network due to signal limitation caused by geographical location and tide.

The report creation process starts by downloading the OCF (ODR Config list. File) which contains programs that have completed the approval process. So that reporting can only be done on approved programs, and avoid the execution of operations on programs that are still in the approval process, or still not validated. Furthermore, the field team selects the corresponding program and workload and then fills out the details of the job report based on the specific order of time and work code. The selection of work codes becomes something critical because it is related to statistical calculations.

In ODR, in addition to data time-log operation, the field team also fills in barge summary data, well summary, and POB data. After completing all the data, then the data is uploaded in the system and will be stored in data reporting and well chronology.

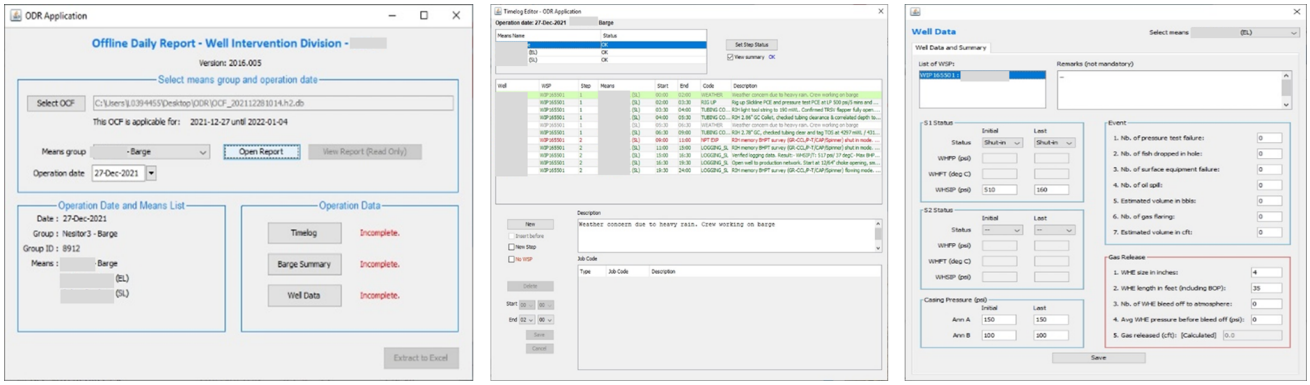

Figure 7. Offline Daily Report

7 Barge Planning

Setting and scheduling the implementation of work by barge is set by WLI Planner in Balikpapan and in the field using a planner application created by the DWI digitization team. In this application, not only being able to schedule barge job sequence, but can also monitor some data, as follows:

- Well Intervention Program status: this status as indication of WIP step
  - Job in progress: the work has been going on
  - WIP ready: Well Intervention Program is ready but work is not started yet
  - WIR ready: Well Intervention Request has been validated but not reviewed yet by well intervention engineer
  - WIR commenting: WIR awaits review process from subsurface team
- Jobs sequence from this series of jobs
- Expected gain
- Estimated duration of work

In view, views can be selected based on the area of operation and filters of 5 or 10 nearby jobs. This application is accessed by the planner team in Balikpapan, wellsite planner and also barge team. In addition, this application can also be accessed by the Well Performance team and subsurface team as subjects in determining work priorities.

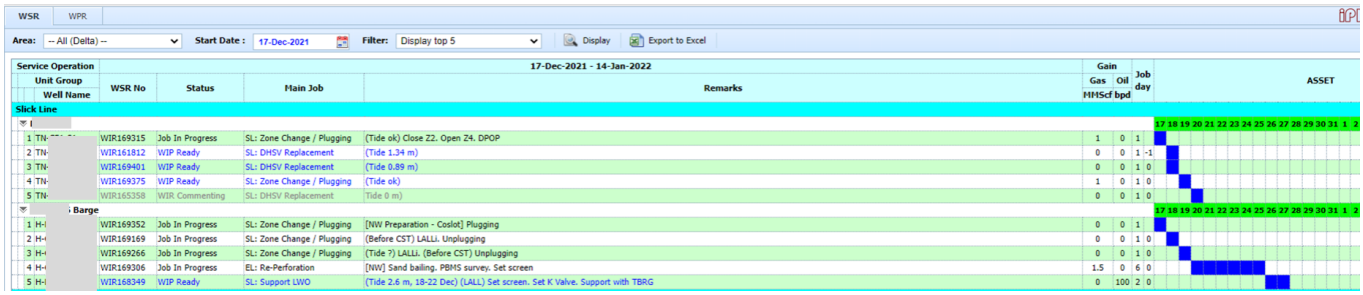

Figure 8. I-Plan, planner application

8 Well Chronology and Well Diagram

Well chronology contains a collection of reports of all work done in the well since initial intervention job until abandonment. Well chronology is a series of time logs of work taken from the daily report. The well diagram is visual data related to the condition of the latest well after the well intervention activity. Data well chronology and well diagrams are essential for designing the next intervention activity.

Some data that must be updated after doing well intervention activities include:

1. TOS (Top of Sediments): Last TOS depth conditions
2. Open Reservoir: especially after perforation activities
3. Changes in completion conditions: Installation of flow control equipment, SSD configuration, gas lift configuration, gas lift deepening installation, installation of bridge plug and casing patch, tubing leak
4. Cement interval: especially after annulus cementing
5. Fish: fish components, and their dimensions
6. Restrictions: if there is a reduction in diameter due to scale, tubing deformation, or even broken tubing

Visual data displayed in well diagrams and operating data recorded in well chronology will be used as a source of data in determining further well intervention activities to increase production, restore integrity, or other work.

9 Performance Reporting

Work implementation data will be processed further to produce statistical data used in performance measurements, produce reports to relevant parties, and display KPI Dashboards that provide overall visualization of achievements. Some of the performances measured and recorded in this reporting are:

1) HSE Performance

It shows the summary of HSE achievement during the year. HSE dashboard contains some data as follows:

- Overall HSE Performance
- Pie chart unsafe condition and situation filtered by Company live saving rules
- Hazard observation card quantity per contractors
- Hazard observation card filtered by detail activity
- Closure status of hazard observation card

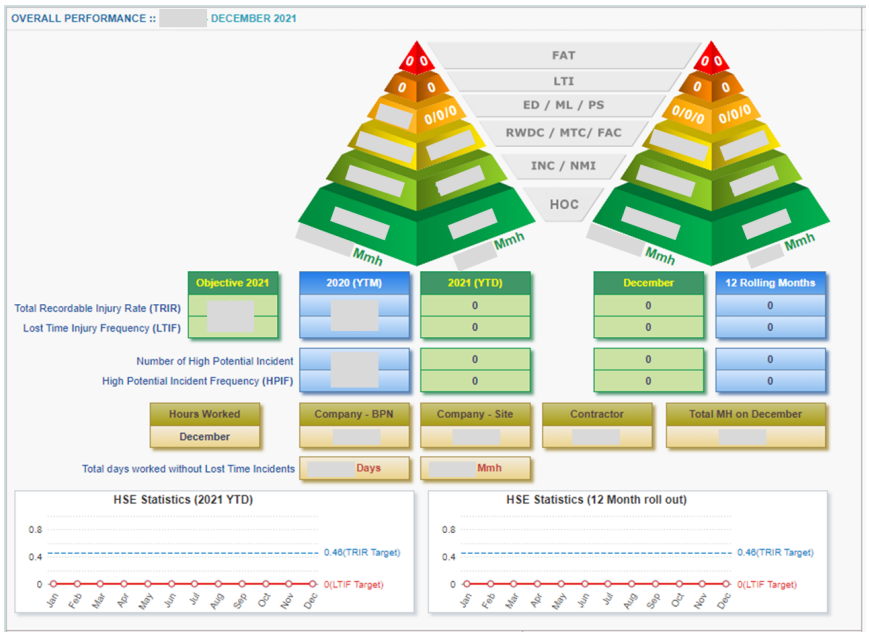

Figure 9. HSSE Dashboard

2) Operation Performance

Summary of operation performance is recorded and reported through the Well Intervention Dashboard. This data retrieved automatically from ODR, HSE report, and morning summary report. These data contain several information as follows:

- Summary
- Workload Realization
- Budget Expenditure
- NPT (Non Productive Time) Trend

- Instantaneous Gain
- Well Integrity

HSE Performance and Well Integrity Performance will be discussed in more detail in separate papers. Some papers related to HSE and Well Integrity applications can be found in attachments.

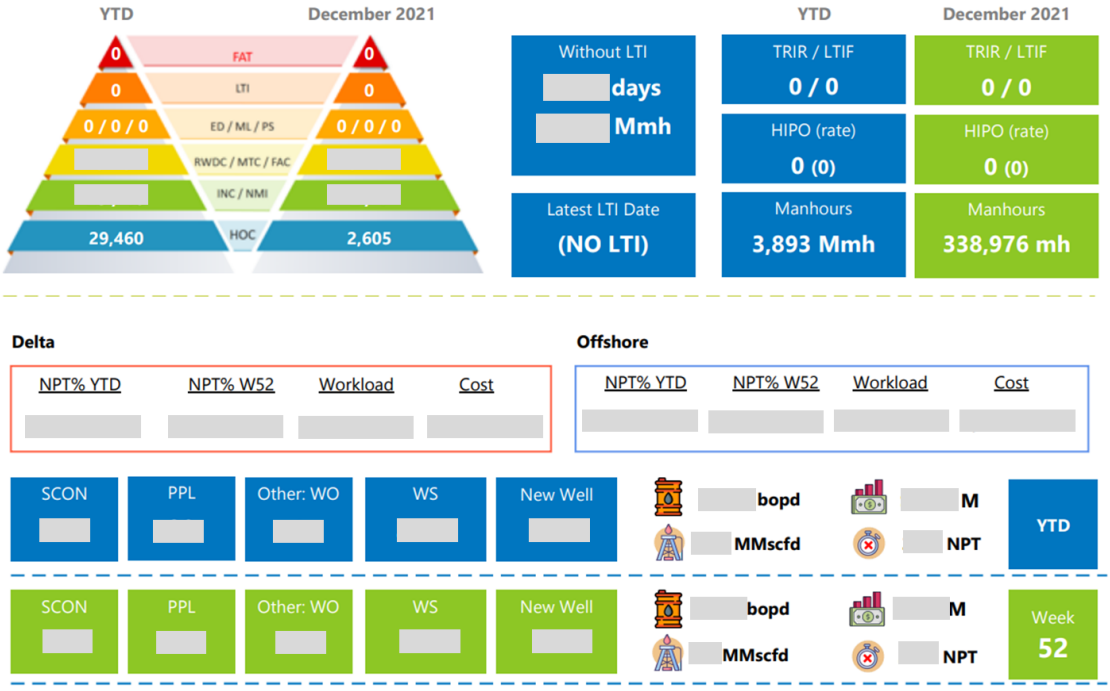

Figure 10. Operation Dashboard

10 Result

Digitalization in business process well intervention is proven to provide a variety of significant benefits, including:

1. Improve the efficiency of the creation of well intervention programs. Program creation can be completed in just a single day.
2. Optimization in reporting. Because to submit a report there is no need to use a sea truck in sending the report to the base, but simply by using ODR and uploading to the database system.
3. Data reports can be accessed in real time by concerned parties
4. Data is centralized and synchronized so as to prevent data errors and data versioning differences.
5. Means of collaboration of various functions and departments so as to avoid silos of knowledge and data
6. There is a monitoring system to see the achievement of KPIs and measure performance

7. Various conveniences in generating reports because of data that has been centralized and structured

These benefits encourage the improvement of overall well intervention performance ranging from safety, operation performance, budget and expenditure, and contractual aspects.

11 Conclusion

The Digital System developed in well intervention activities in Mahakam is a robust system in supporting operating activities and also monitoring performance achievements and reporting. Currently, digitalization development opportunities are in the utilization of machine learning and artificial intelligence to maximize support in operations, especially to help decision making process, as well as in maximizing the efficiency potential from the barge planning side by integrating weather factors, water tide, shortfall associations, moving time optimization and work areas.

The potential for digitalization development in well intervention activities is still wide open. It is hoped that these small steps can help maintain the sustainability of Mahakam production and provide support in the provision of national energy.

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Nomenclature

DWI	: Drilling and Well Intervention
WLI	: Well Intervention
ODR	: Offline Daily Report
OCF	: ODR Config. List File
AWB	: Accommodation Working Barge
HWU	: Hydraulic Workover Unit
WIP	: Well Intervention Program
WIR	: Well Intervention Request
AFE	: Authorization for Expenditure
COR	: Close Out Report
KPI	: Key Performance Indicators
POB	: Personnel On Board
SSD	: Sliding Side Door
GBUC	: Gun Blown Up Calculation