PROCEEDINGS
JOINT CONVENTION BANDUNG (JCB) 2021
November 23rd – 25th 2021

Development of an Integrated Operation Center (IOC): Streamlining Upstream Oil and Gas Production Monitoring in Indonesia

*(M. Fauzan Amir, Alfandra I, Amalia KD, Vitrisia K, Widi K.P, M. Ridlo Rosyid, Bong Anthony, Yogi A, Panca D. N, Mildo N, Bambang P, Ngatijan)**
**) SKK Migas*

Abstract
As appointed to represent Indonesia government for managing the entire business and operational aspects of upstream oil and gas in Indonesia, Special Task Force For Upstream Oil and Gas Business Republic of Indonesia or known as SKK Migas have established a vision to integrate operation monitoring of all oil and gas blocks in Indonesia, by means of an Integrated Operation Center (IOC) that transform the previous conventional approach in to an unified online monitoring system. It has been motivated by digital transformation trend in oil and gas industry which bring a new wave of opportunities in order to raise effectivity and efficiency in terms of monitoring and supervision.

Motivated by the fact that the old vision of the integration that never come true—due to the complicated proposed solutions at that time, therefore, a simpler method is required. Supported by the better infrastructure condition and more developed web-based technology, finally the system has been successfully built. By combining in time and real-time connections based on web-based application, the IOC is able to provide more than 2500 derived monitoring dashboards covering oil and gas production operation and plant information management system (PIMS) in Indonesia. The system is used to monitor the daily production data of around 670,000 barrels oil per day and close to 7,000 millions standard cubic feet per day gas and, from the whole PSC companies in Indonesia, where 80% of them are in real time monitoring.

The dashboards are available in two platforms, i.e. desktop and mobile application which gives flexibility in terms of connection and access as long as internet connection available. During the pandemic COVID-19 which restricts inspection activities going to the fields, the system is proven effective in monitoring point of view, without losing the essence of direct supervision over the operational assets which usually locates on the stranded and limited areas.

In conclusion, the contribution of the presented work is the digital transformation in oil and gas sector in Indonesia, which successfully creates collaborative working environment in managing the oil and gas production operation. It changes the interaction approach between the regulator and PSC operators in terms of process monitoring as well as underlying the foundation of the data management toward the preliminary development of data analytics as path forward of the oil gas operation management in Indonesia

Introduction

Since 2019, SKK Migas has launched an upstream oil and gas transformation program that carries a big vision to return to oil production of 1 million barrels of oil per day and gas production of 12,000 MMSCFD. This vision is realistically achievable if there are giant discoveries that are supported by improvements in upstream oil and gas governance. Furthermore, the transformation pillars underlying the process improvement are translated into programs like organizational and human resource management towards a center of excellence, simplification of permit process through a one door service policy, acceleration of commercial potential and last but not least digitalization programs.

The digitalization in oil and gas sector is actually not new, as in fact that has been developed for quite a long time, in accordance with the characteristics of the oil and gas industry that requires high technology. The digital application has obviously played an important role in the upstream industry, including in Indonesia, generally placing the technology development at the forefront compared to other industrial sectors. However, in the integrated management point of view in Indonesia, the digitalization just plays the partial role, where the production sharing contracts were formerly managed in individual systems, without the support of an integrated system which supposes to help process monitoring more effective and efficient.

The old ideas to build such system have been actually discussed formerly, but they were too complicated and hard to be implemented considering high costs, large resources and long project time duration. In addition to that, the information technology infrastructures between BPMigas/SKK Migas and PSC operators at that time was not pretty good and still in early development phase of integration, so that raising the complexity of the implementation.

The unavailability of the integrated system leaves some concern of the operation supervision of oil and gas production facilities, as follows [1]:

1. Limited available information
   The availability of operation information was generally limited, usually manual or offline and unidirectional (without comparison). With other words, the human dependency plays important role in providing the data or information, not based on a system-driven
2. Monitoring system
   The unavailability of a real-time monitoring system made it difficult in terms of the immediate need of monitoring PSC operational disruptions or in some cases for which requires direct approval or close monitoring of the regulatory body
3. Transparency and data openness
   Due to the absence of the online monitoring system, the data submitted by PSC operators is sometimes not transparent, un-comparable and relying only on the one-way information
4. Effectiveness of supervision
   Monitoring of operational activities requiring hands-on supervision is sometimes ineffective because the personnel mobilization for the field visit requires time and administrative processes, while the availability of information is needed right away

The development of Integrated Operation Center in SKK Migas is therefore intended to overcome the problems mentioned above. It is motivated by efforts to carry out the transformation pillar for the upstream oil and gas operation which improves the good governance of oil and gas industry in Indonesia.

This paper presents the contribution of the development of integrated operation center (IOC) in SKK Migas in the context of oil and gas production operation. Introduced system in first section by some issues of the unavailability of the integrated and the justification of the IOC development, the next one describes the data and method used in building the integrated operation system. The emphasis is placed on the technology selection, step-by-step approaches of the engineering implementation and proposed system architecture as well. The next section explains the dashboard design and examples of the real time monitoring system and its associated results, while the last one presents the conclusion of the presented work and the way forward for next development.

Building System of Production IOC

The use of digital technology in the oil and gas world has grown rapidly. Driven by a high level of competition in creating added value for companies [2,3], innovation in the digital sector is exponentially growing in various fields leading to the development of data integration, modern visualization processes as well as increasingly sophisticated analytical data management systems.

Many international oil and gas companies have succeeded in developing data integration centers and analytics systems to integrate the operating systems of oil and gas production facilities that are scattered everywhere. As shown in Figure 1, an oil and gas company in UAE (ADNOC), for example, has developed an Integrated Operation Center (IOC) which unites its subsidiaries from upstream to downstream. The modern management of the oil and gas industry not only provides efficiency values in terms of monitoring oil and gas production operations, but also provides a positive reputation in terms of modernizing oil and gas management, thus indirectly becoming an effective marketing strategy.

Figure 1. ADNOC – Panorama [4]

Driven by the success of the companies, SKK Migas has benchmarked several typical companies and invited some PSC operators to share their experiences and to formulate the idea to realize the development of the IOC. Brain storming, discussions and exploring some options were conducted to determine the best option which is appropriate to the limited budget and the time given. By empowering internal resources in designing the system supported by the local technology provider, the IOC was finally launched and inaugurated by the Minister of Energy and Mineral Resources Republic of Indonesia by the end of 2019, as shown in Figure 2.

Figure 2. The IOC Soft Launching in SKK Migas

Basically, the Integrated Operation Center (IOC) of SKK Migas consists of some dashboard modules, namely production, drilling, project, maintenance and HSE, which combine in time and real time data. Here, in this paper, the concentration is only focused on the development of the production module due to the large scope of operation, which covers:

1. The daily production dashboard of all PSC operators in Indonesia
2. Plant Information Management System (abbr. PIMS) enabling the live monitoring of production operation of in Indonesia

The both items above adequately provides a representative picture of the production operation conditions of the upstream oil and gas in Indonesia. The users are given by various national data and displays of oil and gas production, lifting, stock, gas balance, gas utilization and reconciliation including thousands of the derived sub-dashboards, which are useful for monitoring operation condition all at once evaluating the operation performance.

Having the system like the IOC obviously offers some advantages. First, the production data including the derived one can be stored permanently. The data can be easily accessed, traceable, kept safely, instead of using the conventional storage devices like hard disks that prone to damage. Second, the data can be displayed systematically, integrated in structured visualizations, so that providing the transparent data, open, in an attractive modern design. Third, the information is quickly available to meet the demand. Live access featured in the plant information management system provides even the instant information on what's going on in the plant in real time. By doing so, the interaction approach in terms of monitoring is changing significantly which is creating new values in supervision and monitoring of upstream oil and gas operation in Indonesia.

Using the same reference by [1], there are some criterion used to build the production modules. First, the financial aspect, where it is expected to be as low as possible without sacrificing quality. The second one is the project duration, which is challenged that must be completed in

relatively short time. Third, the data can be transmitted in online in a combination of daily data and real time one with a configuration of 1 minute or less of the refreshment time. Fourth, the system must be designed securely and protected, so that minimizing the cyber threat risk. Fifth, the system should have good reliability in terms of connection, so that it is operable for a long time. The last one is flexibility. The system should be accessible anytime and anywhere, without limited by time and location.

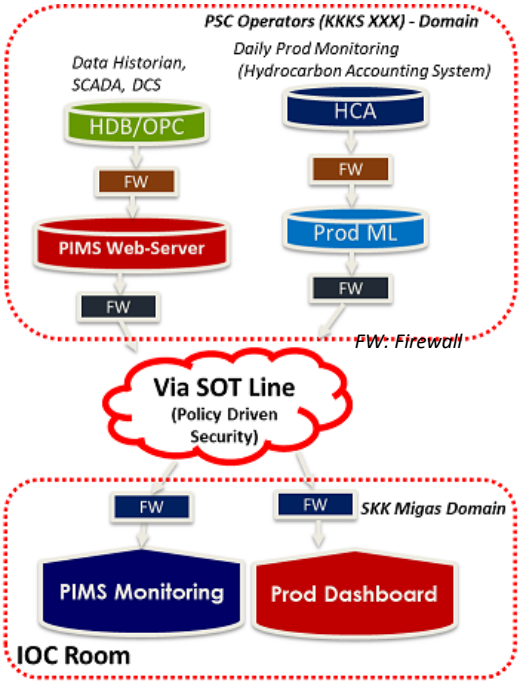

Figure 3. The Simplified System Architecture

The simplified system architecture is shown in Figure 3. The real time data from SCADA systems or automation systems is consolidated in the historian database or connected through the open platform communication or well knows as OPC. The data is then sent to the PIMS server for further translation to the SKK Migas network via the SOT line. Through a layered security system, the PIMS application can be accessed safely at SKK Migas. On the other side, the daily data like production, lifting and stock sourced from hydrocarbon accounting system of the associated PSC is translated into a prod ML format and sent to the SOT server in SKK Migas. The SOT data is afterward visualized into production dashboards including their derivatives.

In general, the production dashboards contain main production information as follows:

- Management dashboard that informs the production and lifting key performance indicators
- Oil and gas production including the details of daily & historical production data, activity contribution, well performance and data reconciliation
- Oil and gas lifting including oil stock and operational reconciliation data
- Gas balance composing gas lifting, fuel, flare, impurities and discrepancy
- Gas utilization displaying gas buyers, associated industry classification and comparison contract versus actual sales
- Plant Information Management System (PIMS) providing real time plant data from well summary to custody points

The next section describes in more details the displays available on the IOC, including the associated features.

Production Dashboards

This module basically represents the national scope of the production monitoring reflected by 15 main production displays with more than 2500 sub-dashboards of the operational data across all PSC operators including oil and gas production, oil and gas lifting, oil and condensate stocks, gas balance and gas utilization.

Desktop Dashboards

Once the application is launched, the viewers are brought to the front page which provides general information about oil and gas operation. As seen in Figure 4, the today oil and gas production, the oil and gas lifting, the national oil stock, the drilling progress information and the planned maintenance monitoring are the presented data based on the last report status updated regularly by associated functions in SKK Migas.

Figure 4. The IOC landing page

Moving on the next menu, the user is presented the drop down features that can select the desired dashboard, for example, operation management as pictured in Figure 5. This page is intended to the management level to see the helicopter view of the major parameters in operation, among others production operation, drilling operation, project management, maintenance and operation support.

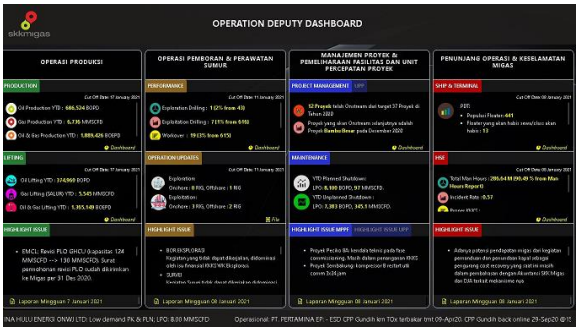

Figure 5. Operation Management Dashboard

The main production page as available on the Figure 6 shows the data of today oil and gas production rate,

monthly average, yearly average, top oil and gas producers, and historical data all at once the production notes appointed to the production curve and running text updated regularly.

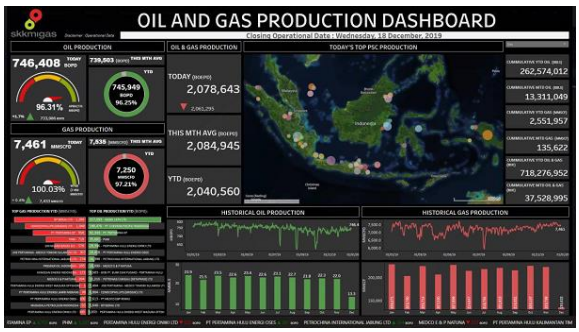

Figure 6. The oil and gas production page

Like the production page, the lifting dashboard is designed similarly as presented in Figure 6. The lifting operation displays shows the oil and gas lifting data from today, monthly, yearly average and the lifting distribution of the all PSC operators. Furthermore, the associated data can be filtered in national or PSC operator category including its accumulation as well as top lifting PSC operators today in Indonesia. The oil stock complementing the lifting reports is then available from the major terminals in Indonesia. Then, the LPG lifting volume is also presented in the same display including monthly and its related yearly average.

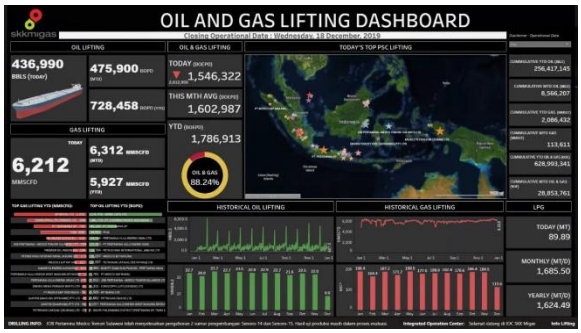

Figure 7. The oil and gas lifting page

In addition to that, there are also available on the advanced dashboard analysis related to the performance of oil and gas wells, the production contribution from drilling, work overs and well services activities, the top 10 rankings of oil and gas development wells, to the comparison of the number of on stream wells with respect to the monthly plan. The gas balance user interface describing the flare data, gas consumption, impurities, discrepancy and gas lifting are also available on the other window equipped by the filter to select national or individual data of PSC operator, as desired. We also develop a gas utilization dashboard, displaying a helicopter view of the gas distribution to the all buyers as well as related industries in Indonesia. Once can see the data of the main gas buyers including the daily contract quantity (DCQ) compared to the actual sale volume to see the gas lifting performance.

PIMS Dashboards

Completing the in-time data, the IOC also provides real-time features via PIMS application. The PIMS dashboards are designed to represent the live actual data of the PSC operators, from the well heads to the metering systems that constructs the surface production facilities. Usually, there are some requirement of process visualization, which present the oil and gas production operation in terms of simplified process diagrams, namely:

1. Well summary
2. Production rate
3. Major/critical equipment (corresponding to
4. production impact)
5. Gas flaring system
6. Fuel gas system
7. Power generation system
8. Metering system (custody)
9. Air pressure system
10. Oil inventory system

The samples of the PIMS dashboards are shown in Figure 8, which basically meets the main points above. Currently, the number of the PSC operators which are connected to the IOC PIMS covering around 80% of the oil and gas production all over Indonesia. So far, it is sufficient to describe the dynamics of major operations in the PSC fields, as the main objective of the real time monitoring.

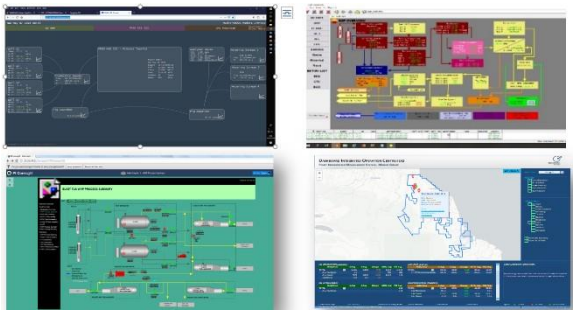

Figure 8. The examples of the PIMS application

All the critical equipment corresponding to the production impact is included in the PIMS. Thus, the process disruption occurring on the plants is easily known and checked without waiting the PSC operator response which usually take time. The users can easily monitor the shutdown execution and ensuring the process startup is on time as planned. If something happened, the historical data for the analysis purpose can be called easily. One can set the initial time and the interval duration, and then the historical trending is immediately available as expected. By these features, the users are helped, to improve the data evaluation quickly and overcome the slow response issue of the PSC operators, whenever the data anomaly is detected.

IOC Mobile Version

Besides being available in the desktop format, the IOC is made in a mobile version as well. As shown in Figure 9 above, the users can see the production operation data in the mobile version, following the technology trend recently. This application facilitates the data monitoring easier, quicker and more flexible in the context of the data access and transfer without necessarily opening the desktop application whenever requiring some data access instantly. The user can adequately check the data from the mobile dashboards, or screen-shoot and send it to the other user by means of the trending medias like whatsup, telegram or others.

Figure 9. The IOC Mobile Version

Conclusions

This paper presents an innovation of the development of an integrated operation center (IOC) to streamline the production operation in upstream oil and gas industry in Indonesia. The old vision finally comes true, so helping SKK Migas as an appointed government body to supervise and monitor the whole upstream production operation in Indonesia easily using the digital technology.

The development of new features in the IOC is still ongoing. By equipping early warning systems and automatic reporting, the process monitoring is expected easier and quicker so that resulting in the more effective approach in terms of supervision. Moreover, we also currently plan to develop a new approach in forecasting the oil production data for oil lifting management based on an analytical tool like machine learning or other advanced method. The result is expected to be more accurate and consistent so that further calculation such as based on the data become more precise to achieve the optimum oil lifting management.

References

[1] M.F. Amir, Yogi A, Rossupanji P, Bambang P, Ngatijan, “Proceedings IPA”, September 2021
[2] Alexander Clark, Henrik W. Larsen, Jan-Erik Nordtvedt, Bart T. Stafford, Kevin Stewart, Bård-Henning Tvedt, Ådne Tveit, ,” SPE Annual Technical Conference and Exhibition, 30 September - 2 October, Calgary, Alberta, Canada
[3] Claudio L, Osvaldo L. Gonçalves Quelhas, Gilson Brito Alves L, Rodrigo N. F. Value and approach in the oil industry” 2015
[4] https://www.smartindustry.com/articles/2019/adnoc-pioneering-oil-and-gas-4-0/

Acknowledgements

The authors gratefully acknowledge the support of SKK Migas, PSC operators, and other parties (who, unfortunately, could not be mentioned one by one) in finishing the projects and creation of this paper.