

RESERVES AND RESOURCES APPLICATION IN WELCOMING INDUSTRY 4.0 CHALLENGE

(Aplikasi Pelaporan Cadangan dan Sumber Daya Minyak dan Gas Bumi dalam Menyambut Tantangan Industri 4.0)

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ABSTRAK

Dalam era industri 4.0, digitalisasi adalah tahapan yang sangat penting bagi sebuah perusahaan. Setiap industri besar di dunia, termasuk industri minyak dan gas bumi (migas), perlu mengadaptasi digitalisasi ini di dalam proses bisnisnya. Pelaporan cadangan dan sumber daya migas perusahaan menggambarkan neraca keuangan, kesehatan keekonomian, performa, dan pertumbuhan perusahaan tersebut. Oleh karena itu, pembuatan laporan cadangan dan sumber daya ini memerlukan perhatian serius. Agar sejalan dengan tuntutan di era industri 4.0 dan memudahkan proses pelaporan cadangan dan sumber daya migas, perlu dibangun database dan aplikasi berbasis jaringan untuk mengelola laporan ini. Hal pertama yang harus dikerjakan dalam pembangunan database adalah membuat dan meng-input master data. Aset-aset perusahaan diklasifikasikan menjadi empat kategori: aset, area (field), struktur, dan layer (lapisan). Setiap lapisan mengandung tipe fluida tertentu dan atribut-atribut migas yang melekat pada reservoir dan fluida tersebut. Setelah master data selesai dibangun, tahapan selanjutnya adalah membuat sebuah aplikasi berbasis jaringan untuk mengelola transaksi data dan pembuatan laporan. Tipe pengguna yang dapat mengakses aplikasi ini dibagi menjadi empat kategori: data entry user, data approval user, administrator, dan manajemen. Setiap kategori ini mempunyai privilege masing-masing, sebagai contoh, data entry user dapat membuat, meng-edit, dan melihat data di dalam aplikasi, sementara manajemen hanya mendapat privilege untuk melihat data saja. Pekerja selain empat kategori pengguna tadi dapat mengakses aplikasi ini dan melihat datanya berdasarkan persetujuan manajemen dan direstriksi hanya untuk data lokasi asetnya masing-masing. Hal ini diterapkan untuk menjaga keamanan dan integritas data di dalam aplikasi. Implementasi aplikasi ini dalam proses bisnis perusahaan migas memberikan beberapa keuntungan: meminimalkan human error, membangun sumber data tunggal, dan mengoptimalkan waktu dalam pembuatan laporan. Aplikasi ini adalah sebuah solusi dalam pembuatan dan pengelolaan laporan cadangan dan sumber daya migas, serta penampilan data dalam bentuk grafik yang berguna bagi manajemen dalam pengambilan keputusan penting bagi perusahaan.

Kata Kunci: *Industri 4.0, laporan cadangan, sumber daya, minyak dan gas, Migas, aplikasi, jaringan*

ABSTRACT

In the era of industry 4.0, digitalization is a very significant step to adopt in a company. Every world-renowned industry, oil and gas included, needs to assimilate this term into its business process. Reserves and resources report depicts an oil and gas company's future cash flow, wealth, performance, as well as growth. Therefore, creating and managing this report need meticulous attention. In order to comply with demand in industry 4.0 and simplify reserves and resources reporting process, reserves and resources database and web-based application need to be developed. First task to carry in establishing database is to create and input master data. Companies' asset is classified into four common entities: asset, area, structure, and layer - as the smallest entity. Layer contains fluid type and oil and gas specific attributes. After master data is established, a web-based application to handle data transaction and reporting is developed. In order to maintain data security, access to this application is restricted into four roles: data entry user, data approval user, administrator, and management. Every role has its own privilege, for example data entry user can create, edit, and view data, while

management can only view it. Other employees that need to access this application are based on management approval and restricted into view privilege under their asset location. This application has already been tested in two reserves and resources reporting window, and underwent bug-fixing and improvement process. Implementing this application in oil and gas company's business process gives several benefits: minimizing human error, establishing a single data source, and cutting time consumption in creating reserves and resources report. This application is the solution in creating and managing the report, as well as displaying data in graphical view to help management makes corporate decision.

Keywords: Industry 4.0, reserves, resources, digitalization, application, web-based

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I. INTRODUCTIONS

Nowadays, the term "industry 4.0" appears in many journals, papers, and news. It is associated with sophisticated automation, digital technology, and internet of things. Recently, Indonesia's Ministry of Industry has designed 'Making Indonesia 4.0' as an integrated roadmap to implement a number of strategies to enter the Industry 4.0 era (<https://www.investindonesia.go.id/en/why-invest/indonesia-economic-update/making-indonesia-4.0-indonesias-strategy-to-enter-the-4th-generation-of-ind>). So, what is industry 4.0? In order to explain this, a brief history of industrial revolution explanation is needed. The first industrial revolution, also known as industry 1.0, was marked by the implementation of steam power and engines that led to mass mechanization. The surge of electricity powered mass production to mark the second generation of industrial revolution or industry 2.0. Early automation was the sign of the third generation of industrial revolution (industry 3.0). In this era, people were used to computers and robotics so that many things started to become digital and automatic. Then it comes to today where everything is connected through internet (industry 4.0). Machines are starting to support humans to make decisions and do work in areas too hazardous for people to go, or with tasks too complex (<https://www.ibm.com/blogs/internet-of-things/industry-4-0-industrial-framework/>). The industrial revolution of course affects development in oil and gas industry. Since the Drake Well, the first commercial oil well in the world, oil and gas industry also gets significant "revolution". There are automatic oil rigs today replacing traditional oil rigs and no more drawing contour map and decline curve manually since software such as PETREL® and OFM® established. There is also a term that is called "digital oil field" for a system that gathers data, analyzes them, and recommends probable solutions for problems faced

in daily basis. Reserves and resources report plays a very significant role in oil and gas industry (Alfajri, et al., 2018). Creating and managing these reports requires persistent and meticulous efforts from the personnel in charge (PIC) in order to have credible results. Before industry 4.0 era, these reports started with tables and numbers that were written manually. Daily production reports were compiled monthly and ultimately at the end of the year to create reserves and resources reports. Life became a little bit easier when Lotus® and Excel® come into equation, especially the latest one. However, the process could still be considered manual. Every oil and gas company commonly divides its assets into several regions and every region has its own reserves and resources report. These reports are created in each asset PIC personal computer, and then collected by the head office PIC to be reviewed. All process was done using email and Excel® and at the end of every year. Since industry 4.0 offers so many opportunities to make life easier, it would be foolish not to cultivate those opportunities to make this process digital, automatic, and interconnected (web-based). Cultivating these opportunities by developing a web-based database and application is a solution that not only help users in reserves and resources reporting process, but also offers other significant benefits. These benefits are:

- Become a single source data that can guarantee data integrity.
- Guard data security by applying user roles, identification and restrictions.
- Open an opportunity to develop one big application that can accommodate data integration among subsurface, surface, production, finance, etc.

II. METHODOLOGY

The life of reserves and resources report process in PT. Pertamina EP (PEP) before this application launched can be summarized in Figure 1. The approach

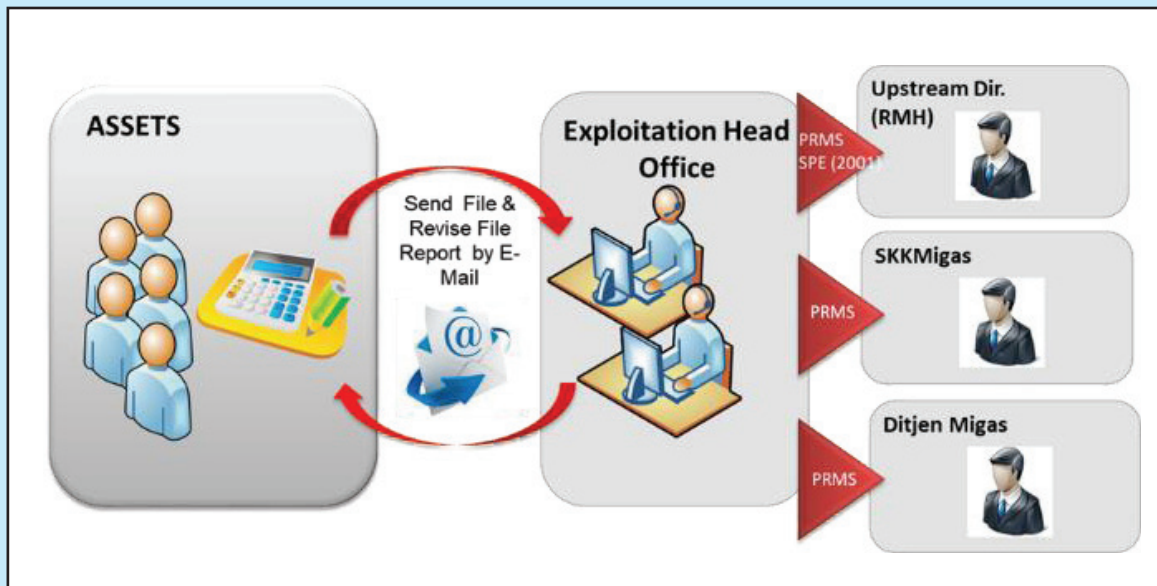


Figure 1
Reserves and resources report process before implementation of the web-based database and application.

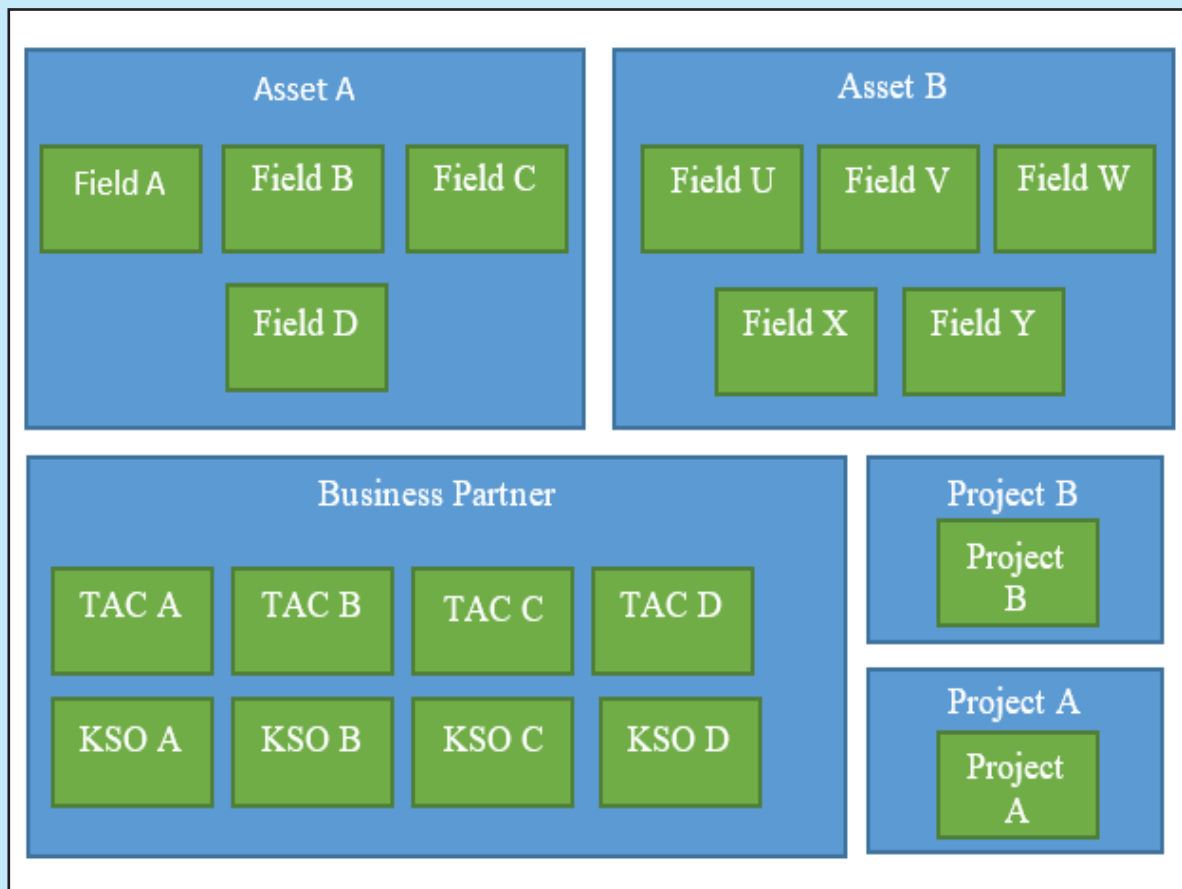


Figure 2
PEP Data model from reserves point of view.

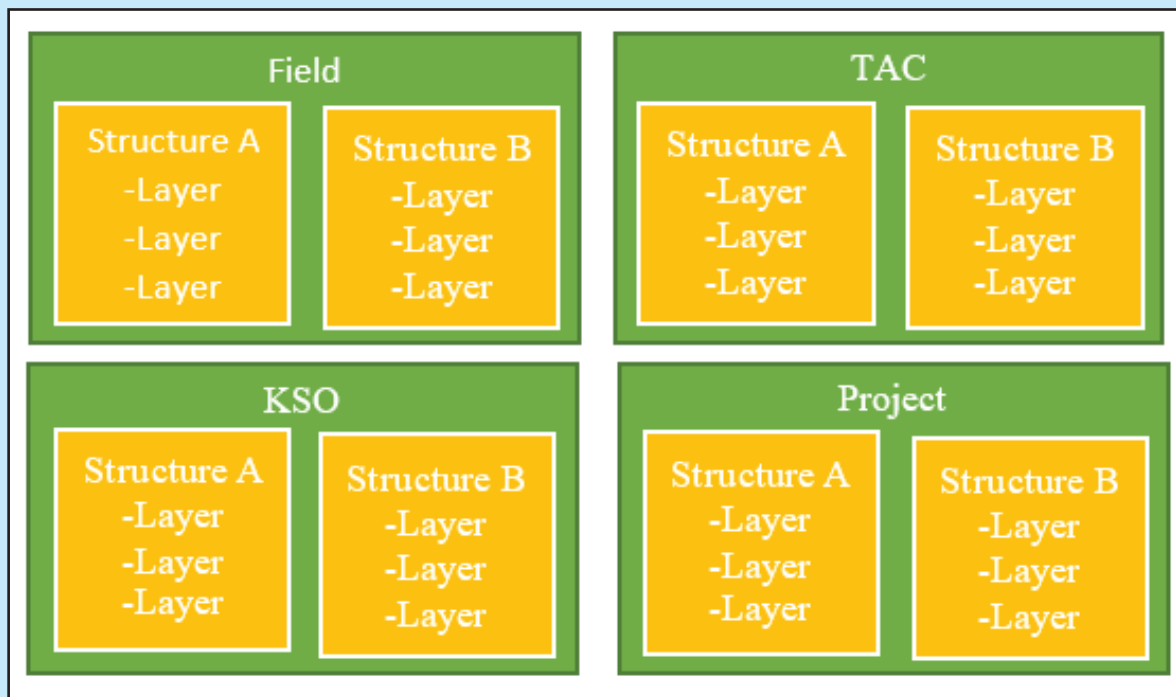


Figure 3
PEP Data model from reserves point of view.

that is used to develop a web-based database and application can be categorized into three big steps: modelling data, managing reporting period, and classifying users' role in application's workflow. Every asset PIC created reserves and resources report manually and separately in their own PCs. They sent those report files to head office PICs to be reviewed. If there were mistakes in those reports, head office PICs would discuss it with asset PICs and send them back to be corrected. Asset PICs would send the corrected version back to Head office by email. This process would go back and forth until there were allegedly no more mistakes in the file. After reports from assets were compiled and approved by management, head office PICs would send the files to the stakeholders (RMH, SKKMigas, and Ditjen Migas).

Generalization method was used in modelling data. Generalization method is the process of extracting shared characteristics from two or more classes, and combining them into a generalized superclass (<https://sourcemaking.com/uml/modeling-it-systems/structural-view/generalization-specialization-and-inheritance>). Figure 2 and 3 shows the result of PEP data model from reserves point of view and its hierarchy using this method. The model started from Asset to area to structure, and in the end to the smallest entity that is layer. Layer carries all oil

reserves specific attributes, which contains initial in place, ultimate recoverable reserves, remaining reserves, production, and cumulative production. Each layer produces one or more fluid types (oil, gas, or condensate). Figure 4 summarize pseudo entity relationship in the application.

In PEP there are three classes that act as the biggest entity: Asset, Business Partner, and Project.

Layer is the smallest entity after structure under Field/TAC/KSO. However this hierarchy is smaller inside project.

Reserves and resources report is performed annually. Each layer has an initial reserves value and a cumulative production which is the total production from the beginning to the first reporting period. The real process begins from initial period, where the opening value is the initial reserves minus initial cumulative production. Next, the opening value is the balance that is brought forward from the end of one reporting period to the beginning of a new reporting period. This provide data integrity and continuity in the application lifetime. Figure 5 shows illustration of this process.

Reporting period will be opened at the beginning of the year and will be closed after reserves annual meeting was held (estimated at the end of the year or at the beginning of next year).

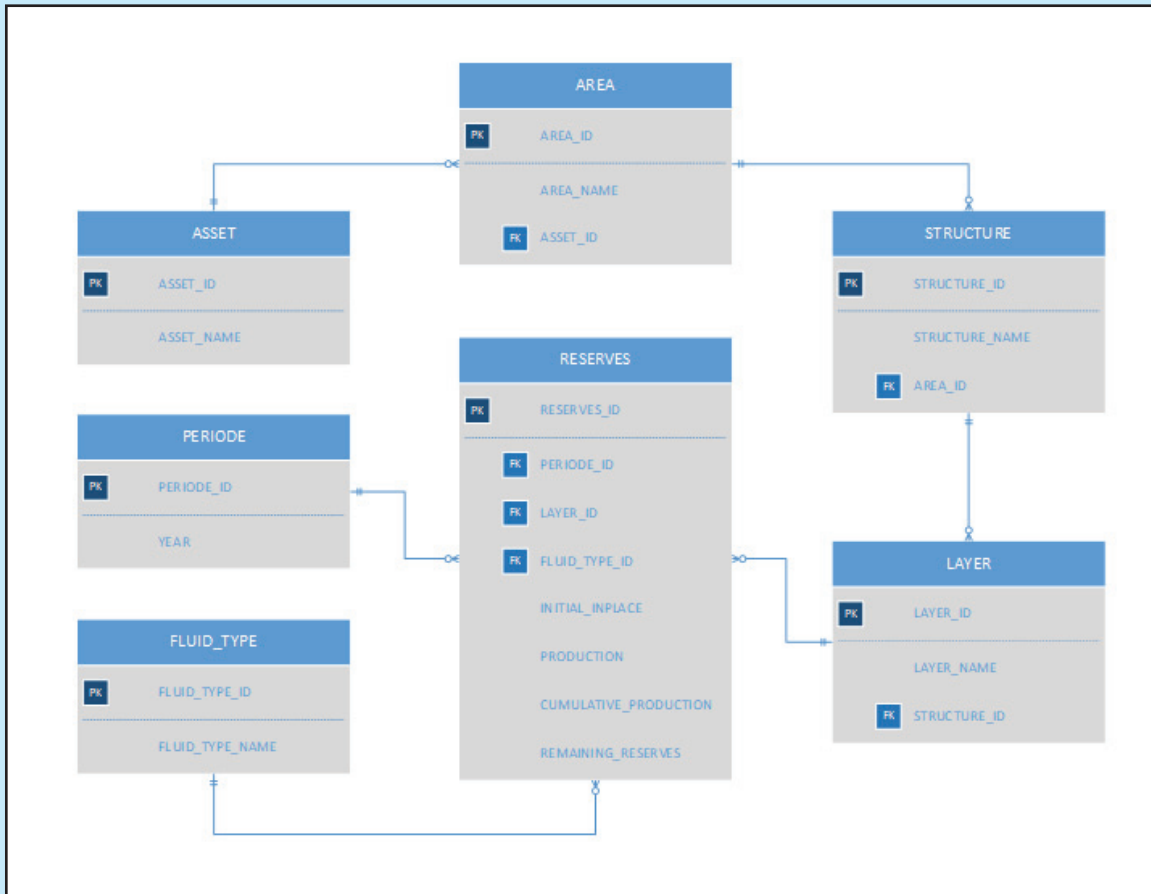


Figure 4
PEP Data model from reserves point of view.

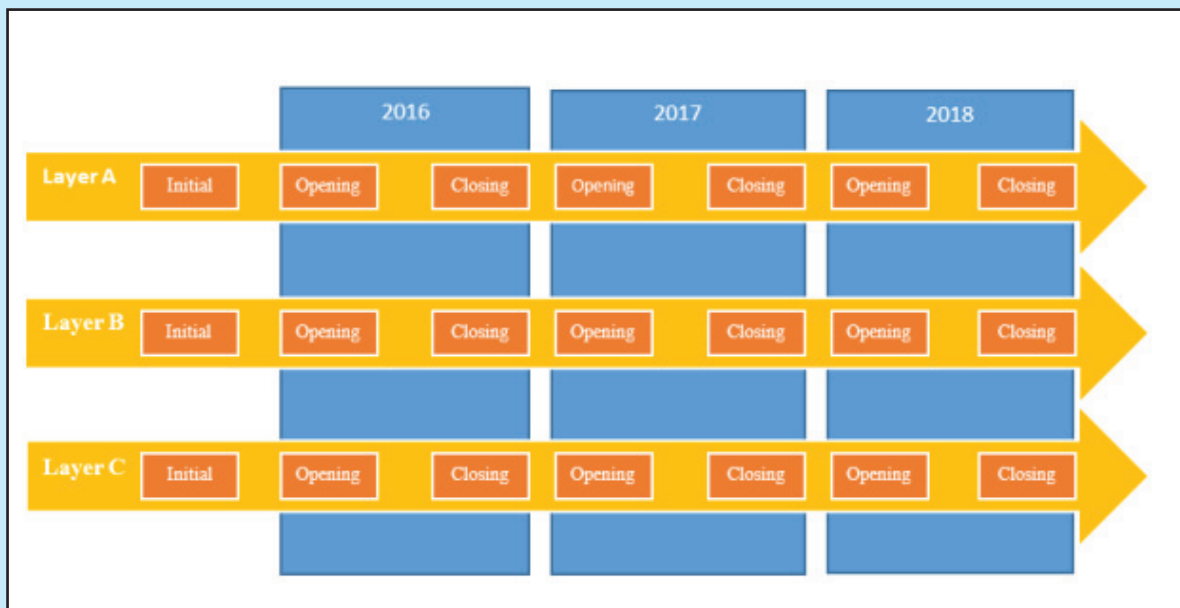


Figure 5
Illustration of PEP reserves and resources reporting process.

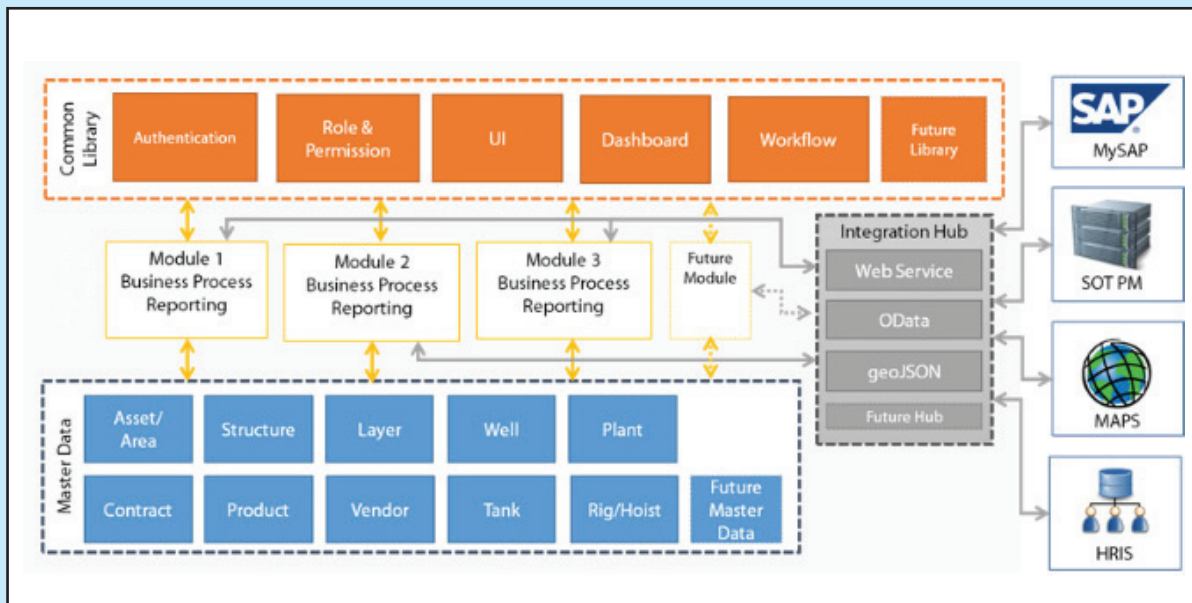


Figure 6
ODR Architecture.

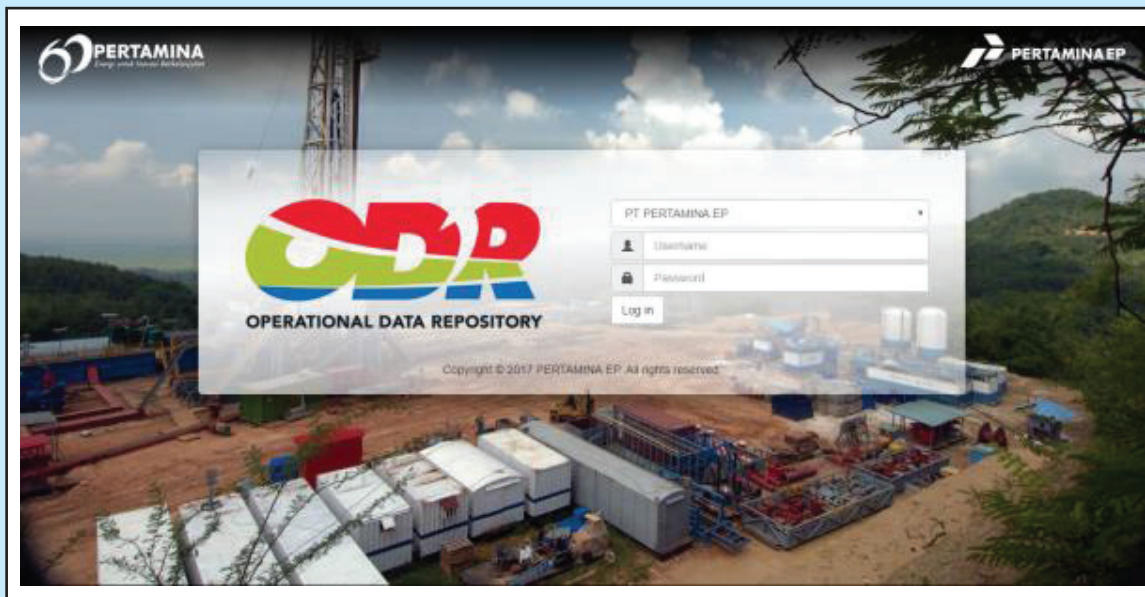


Figure 7
ODR Home Page.

In order to maintain data integrity and security, users are classified into different roles. Each role has privilege that is attach to their account.

There are four roles in this application:

- Master Data Administrator This account has every privilege there is in the application, and it should be from IT department.
- Head Office PIC Reserves and resources report PIC in the head office opens and closes reporting period, as well as approving data that is submitted by area PIC.
- Area PIC This account only has privilege to view and edit for data under its area. It creates report to be reviewed by head office PIC.

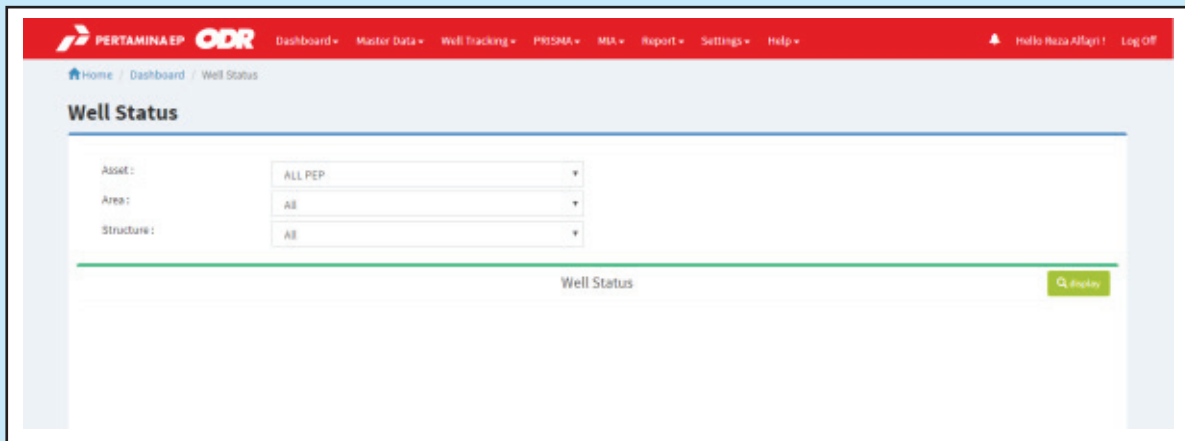


Figure 8
ODR dashboard after logging in.

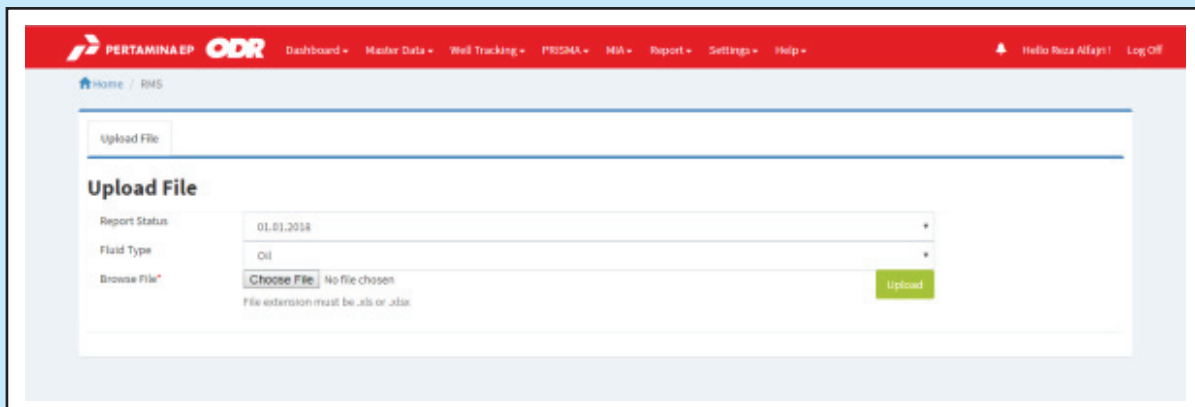


Figure 9
ODR Architecture.

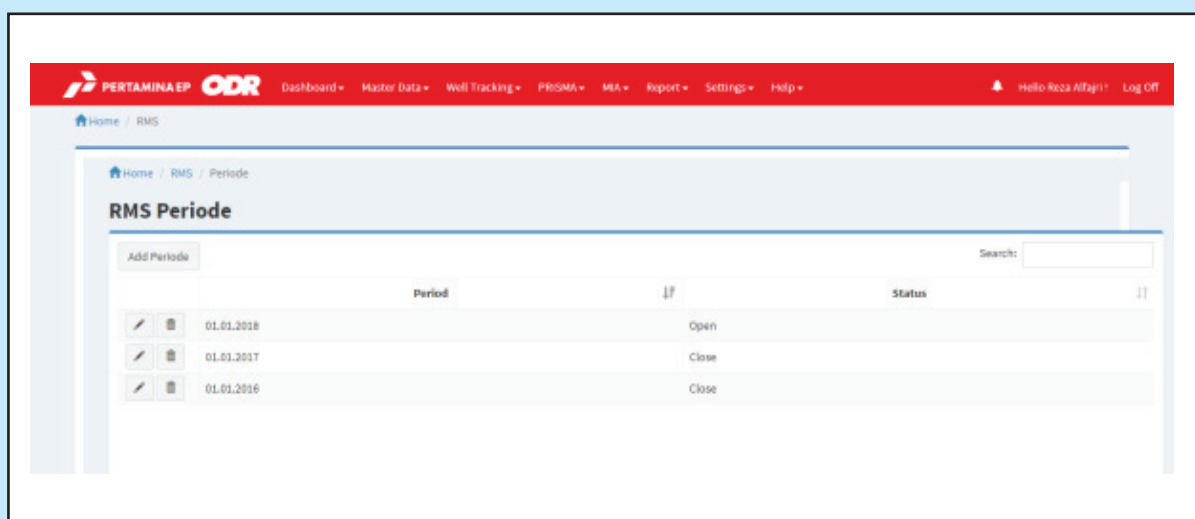


Figure 10
Setting period page.

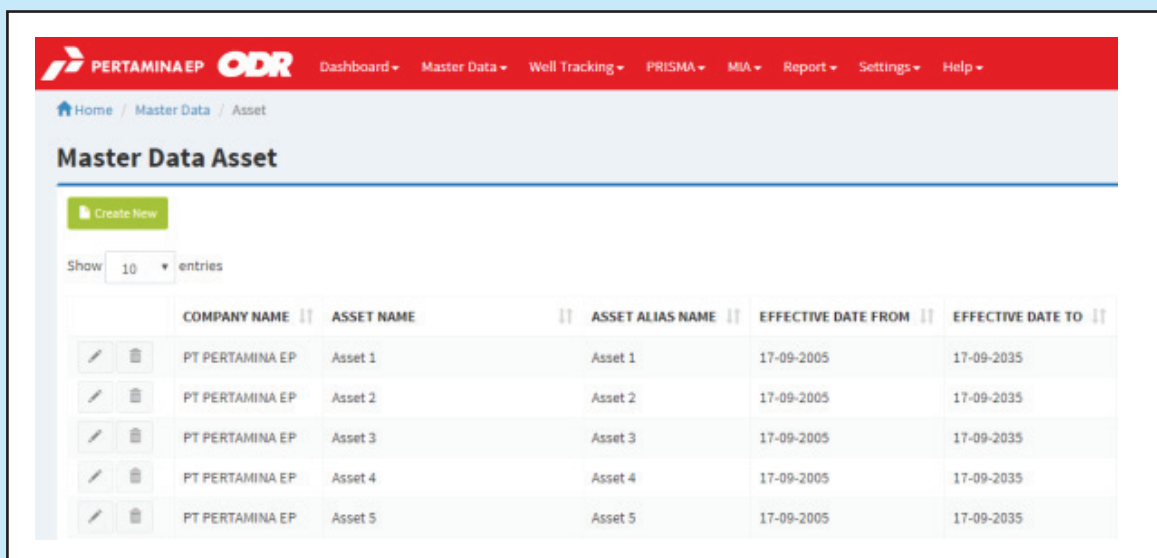


Figure 11
Form for master data.

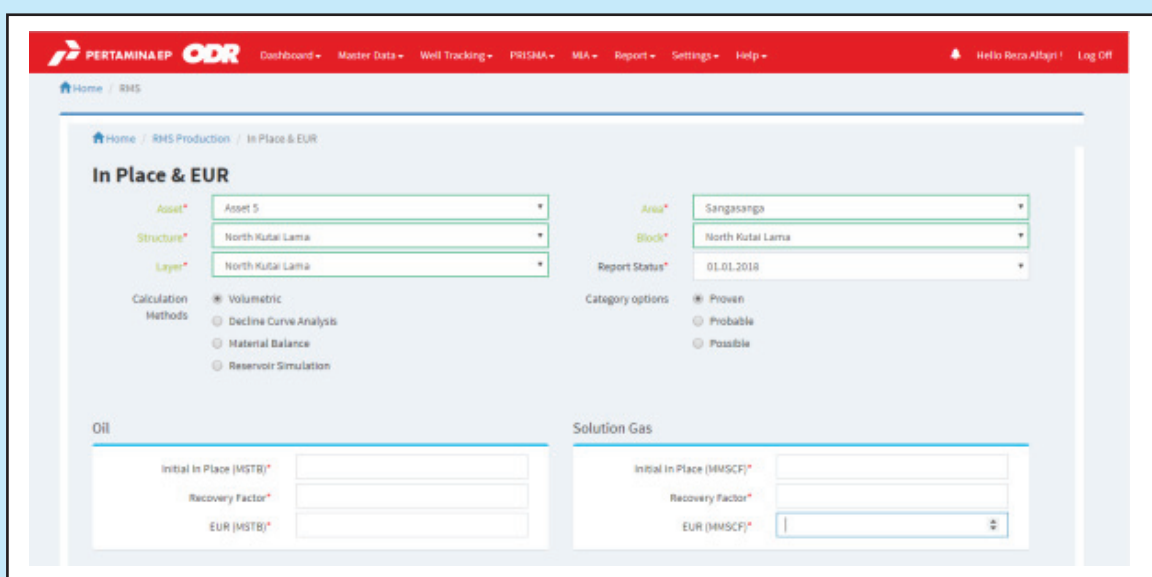


Figure 12
Form for content data (in place & EUR).

- Report Viewer This account can only view the report. These roles construct a workflow to make the application run smooth.

The workflow in this application is as follow:

- Master Data Administrator updates data
- Head Office PIC opens a new reporting period
- Area PIC update data
- Head Office PIC close the period

This application was built as a module under a big application n environment in PEP that is called Operational Data Repository (ODR). It is built upon a Model-View-Controller (MVC) pattern as shown in Figure 6. This architecture as shown enables separation between components, while shared core components keep reusable across modules (<http://best-practice-software-engineering.ifs.tuwien.ac.at/patterns/mvc.html>).

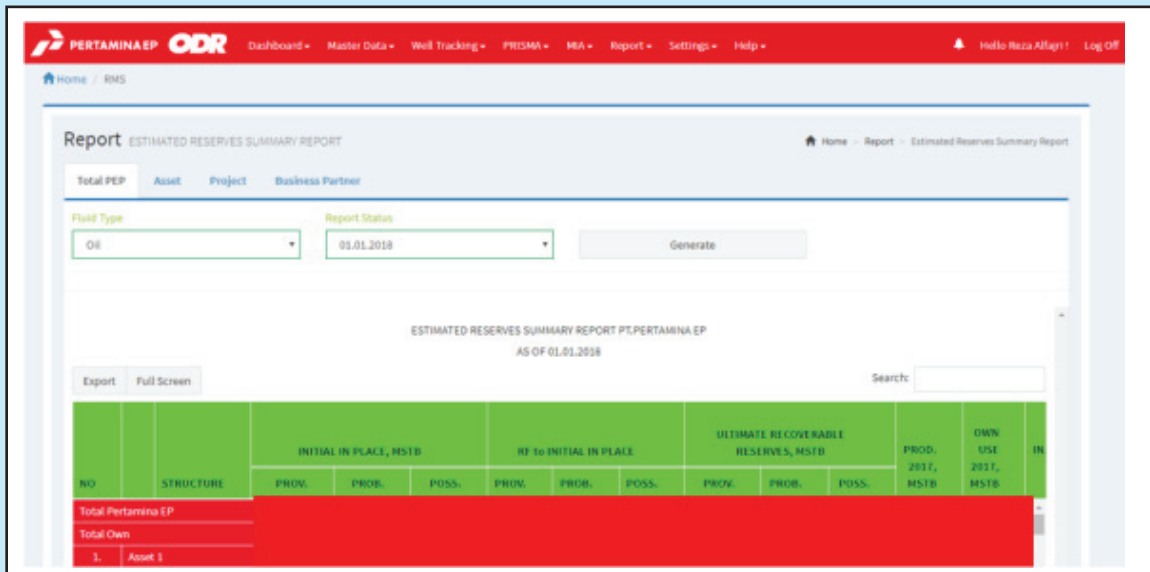


Figure 13
Part screenshot of reports in table form.

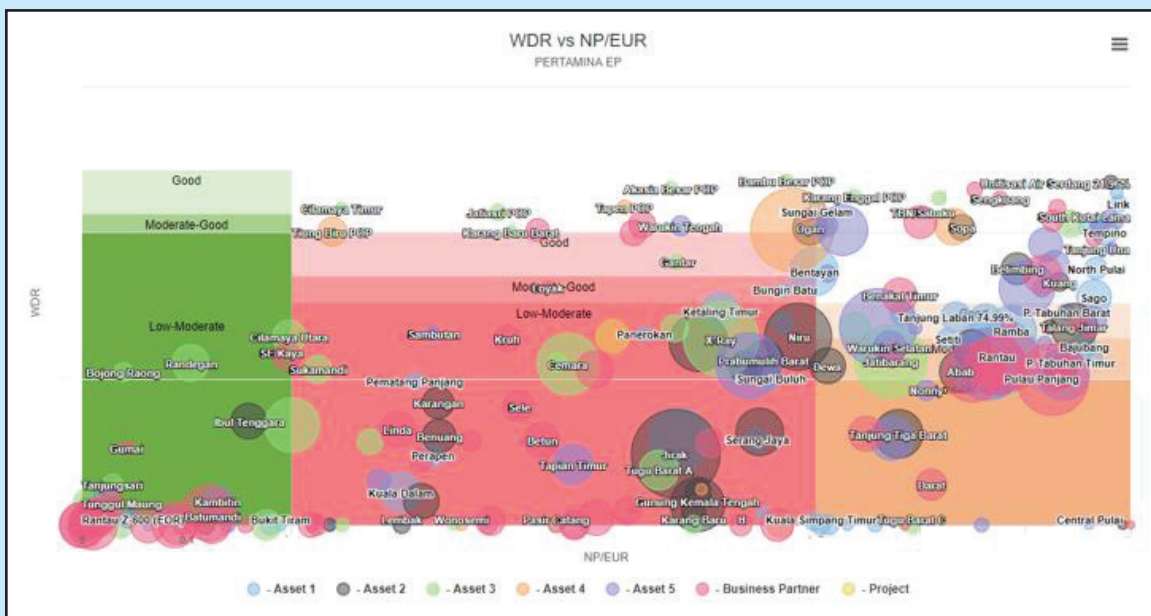


Figure 14
Chart report for reservoir maturity Figure.

This application for reserves and resources report uses the most common front-end technology in web today's, such as Bootstrap, jQuery and HTML5 which provide compatibility with popular browsers in desktop PC or mobile phone. To maintain compatibility with existing IT environment, Microsoft .NET platform is adopted with C# programming language and Oracle database for back end technology. For charting library, Highcharts component for .NET is used, which supports many types of chart and rich features

for intuitive presentation of information. In ODR there are several modules that support PEP business. These are:

- Well Tracking from Drilling and Workover division
- MyBasin from exploration division
- Application for Reserves and Resources Report from Exploitation division
- MIA from the Surface Facilities

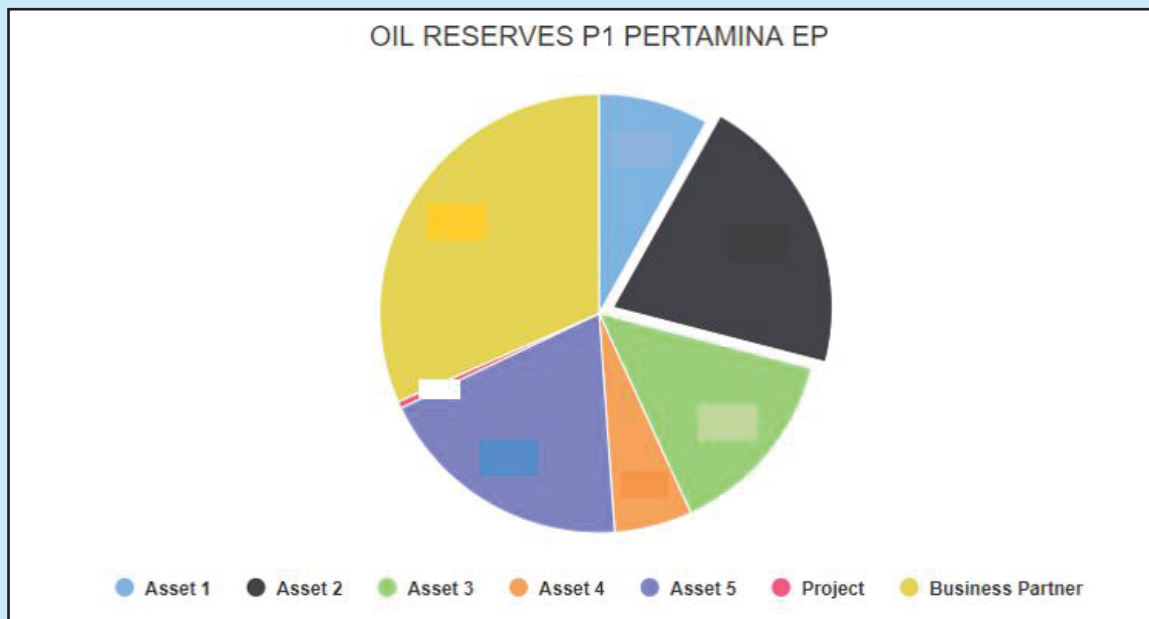


Figure 15
Chart report for oil reserves.

- HIRARC from HSSE division
- SIPERA & SOT FQR from Finance division
- Gas Sales Agreement from Commercial division
- Inventory from SCM division

The first goal for this application is to be able to be reliable as a standalone module, and ultimately will be interconnected to other modules in synergy to run PEP operational business.

III. RESULTS AND DISCUSSION

After being launched, this application has been used in three reporting period: 1.1.2017, 1.1.2018, and 1.1.2019. In reporting period 1.1.2017, information about bugs and opportunities for improvement were gathered and dealt with. In 1.1.2018 and 1.1.2019 the implementation was quite smooth, although, like all software, there were still room for improvement to handle. Figure 7 shows home page to enter ODR environment to access reserves and resources report module. This login ensure security of the page through roles that are assigned to every user. Figure 8 shows the page after logging in. Every user should have different modules on the tab that they can access based on their roles.

There are three important aspects to look at in the application. They are database, forms, and reports. The first step when a house is built is filling it with required furniture. In this case, establishing database is that first step. A template is created to input data

needed into the application. Reporting period was set first in order to put the data into the correct period. Figure 9 shows page to upload data into the application. Figure 10 shows setting period page. Modules that can be accessed by user can be seen on the tab, and it depends on user's role.

After data template is filled and saved, this file can be uploaded into the application through this page.

On this page a period can be created, opened, and closed.

Forms were created for master and content data. Master data can only be handled by data administrator while content data by report PICs. There are four types of forms for content data: in place and EUR, production, PRMS reserves, and additional reserves. Figure 11 and 12 show forms for master data and one of content data respectively. This form show list of master data, either it is asset, structure, or layer. On this page new master data can be created, edited, or deleted.

Content data can be uploaded by form or template. If there are only little amount of data to be inputted, forms can be used. If the data to be inputted is large, like production data, using template upload is better.

There are two types of report in this application: tables and charts. Figure 13 through 15 show some of

these reports. Due to data confidentiality, numbers in the Figures were covered. There are several reports in form of tables. Formats are adjusted to stakeholders' demands.

Like tables, there are also several charts type that can be used to analyze report's content. They can be reserves data, changes, maturity or parameters.

This application eases PICs works in reserves and resources reporting process. Once data is uploaded, the application will automatically calculate several parameters. This will minimize human error. The application also ensures data integrity and security because there is only one single data source that can be accessed through the internet using login that governed by roles assigned to each user. This is a suitable answer for challenges in creating and managing reserves and resources report in industry 4.0 era. Besides continuous improvement that needs to be considered, there are some opportunity to further enhance this application:

- Connected to SKKMigas application for reserves and resources report.
- This application can also be applied to Pertamina other sub-holdings by approval and help from upstream directorate.
- Integration to other applications in ODR

IV. CONCLUSIONS

The launch of this application in PEP marked company's readiness to enter industry 4.0 era in one of oil and gas industrial aspects. No more tedious excel filling activities that rather often than not led to human error. Data integrity and security are also empowered by assigning roles to each user. By eliminating all these handicaps will raise company's reserves and resources report, and in turns company's credibility itself.

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