Utilization of Low Code Framework Tool for Knowledge Management in Well Service

Ramadhan Prasetya Utama[*1], Ragil Sudira Wardana[2]

[1,2]PERTAMINA HULU ROKAN

* Email: ramadhan.utama@pertamina.com ragil.wardana@pertamina.com

Abstract. Well service activities hold important role in maintaining production sustainability from subsurface to surface. This makes conducting well service jobs safely, efficiently, and effectively has become focus for many oil & gas companies. But in the execution phase in the field, knowledge gap among personnel often creates challenge in well service activities. Fast personnel turn over, and generation gap among personnel creates the need for strong knowledge management to ensure every personnel assigned to conduct well service execution has fully understood of the standard procedures and the best practices. This full comprehension will ensure every condition in the field will be handled with the most optimal way. Previously there is not any system available to easily access company specific (operation/area) knowledge from the field by every personnel both experienced and young green company man/ woman.

To develop a strong knowledge management in the field execution, well service team deployed a well service handbook in the form of mobile application. This handbook consists of guideline for job execution as well as tool to calculate various parameter based on proprietary formula defined by subject matter expert experience. By using a mobile application, every field personnel easily access the standard guideline wherever they are in the field. This will ensure all personnel execute the job optimally regardless their years of experience. The mobile well service handbook app is developed using PowerApps low code framework. By leveraging low code application development, team can meet the urgent need of rapid deployment to field operation. Low code framework also enables team to be more agile in adjusting the application immediately based on feedback from the field.

Implementation of this initiative could minimize human error related to well service job execution. Especially on sub-optimum suspended jobs, working team could assure that the optimum effort had been conducted optimally as well as suspending job safely before next well intervention job will be assigned.

Keyword(s): well Service, knowledge management, mobile application, low code framework

1 Introduction

Well service is one of the most common job executed in oil and gas field. This type of job is essential to ensure well produces optimally by reconditioning production tubing, sucker rod, pump, or basically any other parts degrade over lifetime of the well. Well service itself, can also be described intervention as well, has objective to make well produces sustainable all the time, which is unfortunately most likely not possible. Therefore, well service job is essential for energy company to maintain stable and certain revenue from hydrocarbon sales meanwhile profit generated could be used to fund investment in new well.

PT Pertamina Hulu Rokan conducted well service jobs more than 3000/ years handled by Rig Hub team, a sub team under Drilling & Completion (D&C)/ Drilling Well service & Intervention PT Pertamina Hulu Rokan, making it one of the busiest team within the company. Due to significant number of executions, it will be highly rewarding if well service executions could be performed safely, efficiently and effectively, not only for one well service execution but also for all well service jobs conducted.

Oil and gas related activities had been severely reduced during the year 2014 – 2016 because of the oil price crash[1] disrupting oil and gas company to become more efficient in terms of cost spending. The reduced price of oil started showing many of oil and gas companies, as well as supporting services companies, downsizing, and streamlining their respective man powers, resulting many of oil and gas professionals seek for another career opportunity.

During the oil price crash, all of companies were disrupted and had no other options better than efficiently maximize all resources available to attain, at least, the same amount of revenue by increasing more productions and reducing lifting cost to stay profitable. Reducing cost and optimizing production remained many companies focus during the period since many projects or investments were put a halt.
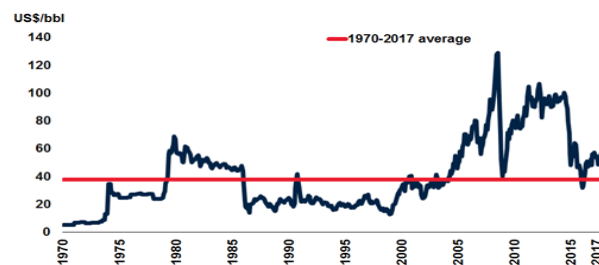

Figure 1. Real oil prices, last observed in November 2017 (The World Bank, 2018)

Well service job, as the name implies, is always about servicing the well to be able produce again, creating positive cashflow, as quick as possible. Beyond the efficient execution, well service jobs are also expected to be effective, which is translated to a higher mean time between failure (MTBF) therefore reducing company spending to conduct unnecessary well service. On top of that, safety is always on priority to establish a strong mindset and commitment for protecting people and environment.

To support operational excellence, knowledge transfer holds important role within any organization to stay competitive by making certain any know-how or know-why during business activity is conducted perfectly or at least not repeating previous mistakes. Experienced employees are one of the assets who can support companies to enable high levels of performance, however, turnover is one thing that companies cannot always control, be it is because of personal preference, benefit, or natural attrition etc. Responding to that problem, PT Pertamina Hulu Rokan should have a good knowledge management system to pertain any best practices, lesson learned, and tacit knowledge from experienced employees which will be beneficial to company.

2   Basic Theory

2.1 Knowledge Management

Based on paper by Tidd and Bessant[2] there are 5 critical tasks of knowledge management:

1. Generating and acquiring new knowledge.

   This task is how a company could acquire new knowledge, either by learning from the existing experienced employees, conducting business improvement project, or even outsourcing employees with technical expertise whose skillset is required.

2. Identifying and codifying existing knowledge.

   Generally, there are two types of knowledge, explicit and implicit/tacit knowledge which are easy and hard, respectively, to communicate. Eventually, it is expected that tacit knowledge could be converted to explicit knowledge, in which Nonaka and Takeuchi[3] argue that the conversion is connected between individual and organizational knowledge. This individual knowledge could be converted to organizational knowledge through 4 cycles: *socialization* [tacit to tacit] – *externalization* [tacit to explicit] – *combination* [explicit to explicit] – *internalization* [explicit – tacit].

3. Storing and retrieving knowledge.

   After acquiring and codifying knowledge, storage and retrieval will be a company's next focus since it will decide whether the valuable knowledge is sustainable, not diminished over time, and also is easily accessible for others.

4. Sharing and distributing knowledge across the organization.

   This task is required to enable sharing and distributing existing knowledge within a company to every employee. Often employees don't realize that such knowledge does exist in their company because of the large organizational scale.

5. Exploiting and embedding knowledge in process, products, and services.

   The final task of knowledge management is making use of available knowledge existing in the company. Good company is expected to be capable of contextualizing and applying the knowledge into its organizational day to day activity. Even better if the company could evaluate, support, and re-innovate knowledge to pertain knowledge sustainability as well as knowledge relevance regarding the dynamic condition of a competitive business environment.

2.2 Low Code Development Platform (LCDP)

As people are more dependent in mobility device, the demand for mobile and web applications rapidly increased in industry especially with the global trend in digital transformation (OutSystems, 2019[4]). This trend has increased industry demand for programmers and application developers (Metrolho et al, 2019[5]). In perspective anticipated by Gartner, this application demand in the corporation will grow five times faster than the ability of IT department to fulfill the demand (Chang & Ko, 2017[6], Hyun, 2019[7]). In the trial to fulfill this high demand, relying solely on traditional application development approach seems not adequate. In the traditional application development approach, an application is developed by writing an enormous amount of code based on the user's requirement, often written from scratch by the programmers, implying a lot of costs in terms of time, money, and effort (Sanchis et al, 2020[8]). The total lines of codes written by programmers has a linear relationship with the increase of code testing process and the probability of having a bug/error in the application. In other words, the more code written by programmer, the more time and

resource spent for testing and bug fixing. Furthermore, what causes the time increase is also steep learning curve for programmer to learn the specific programming language in which the code is written.

With the nature of time and resource intensive of traditional application development approach, Low-Code Development Platform (LCDP) rises to solve this challenge. Compared to a traditional approach, LCDP can deliver a rapid application delivery to end users (Vikebo & SydvoID, 2019[9]). This is achieved by eliminating the need to write huge number of code and by providing a simpler programming platform thus eliminating a steep learning curve to programmers.

LCDP grew from the merging concept of fourth-generation programming (4GL) with the Rapid Application Development (RAD). Programmer is expected to not code from scratch, but rather using a graphical user interface with very minimum to no code needed in the process. The low code platform technology will automatically translate the interface into codes to be compiled and run by the system, making programmers can focus only to: User Interface, Databases, and Business Process.

3   Methodology

In the D&C Rig Hub operation in the field, every condition needs to be response with the most optimal response based on knowledge from best practices and experiences. And these responses need to be provided in timely manner to ensure there is no disruption or nonproductive time (NPT) during operation. With the high personnel turn over in the D&C Rig Hub team of PT Pertamina Hulu Rokan due to retirement and promotion in current year, ensuring every action follows the standard and best practices can be a challenge. There is an immediate need to strengthen Knowledge Management in D&C Rig Hub team to address the knowledge gap in the relatively new personnel. One of the strategies is by strengthening the 5th task of Knowledge Management: Exploiting and embedding knowledge in process, products, and services.

The approach for this Knowledge Management task is by providing an application which serves as a guideline in every process in D&C Rig Hub during operation phase. The objective of the application is to encode standards, formula, and best practices for Rig Hub activities in the application, thus every D&C Rig Hub personnel can refer to the application to calculate various parameters during well service process. This helps to flatten the learning curve for new personnel in comprehensively remembering all the standards and best practices.

As the Rig Hub activities take place in the field, it demands a mobility feature so Rig Hub personnel can easily access the application anywhere from the field. With this condition, an application for this knowledge management task needs to be a mobile application. This mobile application will serve as a digital handbook for D&C Rig Hub personnel in the field.

Based on the Forster study (Rymer & Appian, 2017[10]), utilization of traditional programming application development in corporation faced the following challenges: *1. Meeting business requirements on time, 2. Need long time to update the apps, 3. Costly, 4. Low quality, 5. Unsatisfied customers*. Based on the study, leveraging Low-Code Development Platform helps to eliminate those challenges. Referring to that study, PT Pertamina Hulu Rokan leverage LCDP to develop mobile application called D&C Rig Hub Handbook as digital guidance for field personnel.

In the development phase, Power Apps, a LCDP technology from Microsoft, is used. In the Power Apps, several features are implemented in this study: *1. User access management, 2. Data structures, 3. GUI designer, 4. Workflow modeling and 5. Corporate application store.* User access management feature handle authentication and authorization process for the user. In the authentication, Single Sign On (SSO) is implemented for easy accessibility as well as security. Data structures feature serve as data model designer to contain every data required related to field operation. GUI designer feature provides components to develop a user-defined UI forms with a drag and drop method instead of code from scratch. The GUI designer will interact with the data and the business logic of the application. It also serves as the translation to enable the application to be rendered in different system environments (e.g., smartphones, tablets, and web browsers). Workflow modeling feature provides components to define component interaction, screen transition, as well as business logic in the application. The Corporate application store serves as a deployment platform. It serves as a private portal for downloading company's in-house application just like an Android PlayStore or Apple AppStore in smartphones. This makes every personnel in the organization with the right access can easily search for the application and install it in their smartphones.
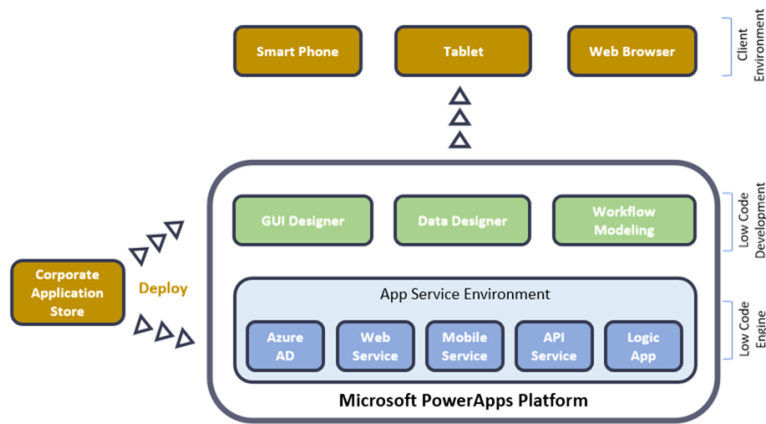

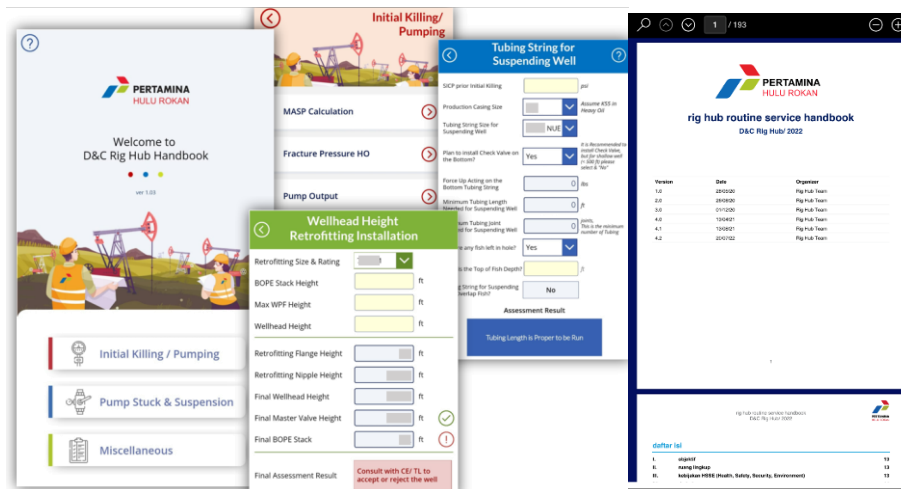Figure 2. Low code development platform architecture

Figure 3. D&C Rig Hub Handbook mobile application

After field personnel has D&C Rig Hub Handbook in their mobile, field personnel can easily access the procedure in responding to field condition. For example, on the worst case of well service job to be suspended, this mobile application also provides calculation of range of optimal overpull, targeted tension of back-off, safe number of tubing length, etc. The suspension job guideline is required to make certain that suspended job should be followed up by more complex job as well as bigger rig and avoiding paradigm that Rig Hub team conducted sub-optimum job execution.

4   Result and Discussion

High turnover in D&C Rig Hub team due to personnel retirement and promotion creates knowledge gap in new personnel. To fulfill the knowledge gap, a mobile application is developed as one of knowledge management critical task to embed knowledge in the field operation activities. With the growing number of works over activities, this mobile application needs to be delivered immediately. To answer this challenge, a Low Code Development Platform (LCDP) is leveraged in the mobile application development process to develop D&C Rig Hub Handbook as personnel digital guidance.

By leveraging LCDP, it delivers several advantages:
- Rapid application delivery
  By eliminating code writing from scratch, team can develop applications much faster by using out of the box components in LCDP. This helps in meeting team deadlines to deploy the application in an immediate manner. Using LCDP, minor changes in the application can be done by D&C Rig Hub personel independently, compared to previous practice where every changes in application can only be done by IT team.
- Faster application life cycle
  By utilizing corporate application store, update version of the application can easily be published to the server. Automatic push notification will be received by the user to update the application. This feature makes every update iteration can be immediately accessible by all users.
- Security and maintainability improvement
  In the security aspect, LCDP reduces the complexity of programmer or security analyst to do security test of the whole system. Security analyst only needs to test the workflow of the application while the components and the platform security already handled by LCDP technology provider. Having less code written in LCDP also reduces complexity of maintaining application stability since application is consisted of small number of building blocks instead of huge lines of codes.

These advantages prove that LCDP is suitable to answer the rapid need for application development from oil and gas operation. Having the D&C Rig Hub handbook delivered in timely manner, enable newer personnel to easily be guided during all phases and conditions in the field during well services activities. This helps PT Pertamina Hulu Rokan in sustaining operational excellence during massive well service campaign despite of heavy personnel turns over.

D&C Rig Hub handbook mobile application is embedded in daily operation activity of well service as a guideline for operation team to handle common problem with existing best practice. Change of mind set

from I Think to I Know could also be accelerated by delivering handbook on hand of operation team personnel since best practices in D&C Rig Hub handbook are completed with background explanation. Previously in 2021, there were 39 cases of follow-up work over job for well service suspended jobs related to tubing hanger/ tubing string stuck. It was observed that 16 out of 39 cases (41%) could be completed without conducting complicated fishing (e.g., requiring back off tubing/ jarring job/ washing over). It was implied that Rig Hub team did not deliver optimal execution. By implementing standardized calculations of optimal overpull required, the sub-optimal jobs can be eliminated completely in 2022 and reducing unnecessary complex work over job due to sub-optimal well service execution.

In future study, the utilization of mobile application to develop other tasks of Knowledge Management can be studied. For example, a study of developing a mobile application using LCDP in creating a knowledge base application in company. This application can capture and store every new knowledge from field operation and will serve as knowledge bank for reference in facing operation cases or issues in the future.

References

[1] World Bank. 2018. Global Economic Prospects: Broad-Based Upturn, but for How Long?. Washington DC: The World Bank.

[2] Tidd, Joe and Bessant, Joe. 2009. Managing Innovation: Integrating Technological, Market and Organizational Change – Fourth Edition. West Sussex : John Wiley and Sons.

[3] Nonaka, I. and Takeuchi, H. 1995. The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. New York : Oxford University Press.

[4] OutSystems. 2019. The State of Application Development. Is IT Ready for Disruption? OutSystems. Retrieved from Boston, MA, USA

[5] Metrôlho, J., Araújo, R., Ribeiro, F. & Castela, N. 2019. An approach using a low-code platform for retraining professionals to ICT. Paper presented at the 11th International Conference on Education and New Learning Technologies.

[6] Chang, Y.-H. & Ko, C.-B. 2017. A Study on the Design of Low-Code and No Code Platform for Mobile Application Development. International journal of advanced smart convergence, 6(4), 50-55.

[7] Hyun, C. Y. 2019. Design and Implementation of a Low-Code/No-Code System. International journal of advanced smart convergence, 8(4), 188-193.

[8] Sanchis, R., García-Perales, Ó., Fraile, F. & Poler, R. 2020. Low-Code as Enabler of Digital Transformation in Manufacturing Industry. Applied Sciences, 10(1), 12.

[9] Vikebø, E. & Sydvold, L. B. 2019. An inquiry into low-code solutions in institutions for higher education: a case study of low-code implementation at the Admissions Office at the Norwegian School of Economics.

[10] Rymer, J. R., & Appian, K. 2017. The Forrester Wave™: Low-Code Development Platforms For AD&D Pros, Q4 2017. Cambridge, MA: Forrester Research.