

Development of Closed Distribution Monitoring System, Case Study: 3-kg LPQ Distribution in Malang, Indonesia

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Abstract

Since a few years ago, supply, distribution, and price regulation of 3-kg Liquefied Petroleum Gas (LPG) has been fully handled by the Indonesian government. Distribution of the LPG has been monitored by a system named 3-kg LPG Distribution Monitoring System (SIMOL3K). It was developed in a closed distribution model from suppliers to consumers through registered agents and distributors. However, the SIMOL3K has been prepared only to control the distribution by the control card up to distributors. It does not have the capability to arrange area of distribution for agents and distributors. Hence, in practice there exist overlapping area of distribution and extension of distribution chain. Consequently, the price in distributors and sub-distributors cannot be controlled properly. Considering those problems, this study is aimed to develop a new closed distribution monitoring system to set the controlled distribution by the control card up to distributors with clear area of distribution. The new system is built by involving SPPBE's, agents, distributors, and consumers in Malang-Indonesia based on mapping location and area of distribution. Results of the study shows that the system can successfully cover the distribution from LPG Filling and Bulk Carrier Station (SPPBE) to distributors by including mapping of location and area of distribution.

Keywords: monitoring system, closed distribution, control card, location mapping, distribution area

1. Introduction

The government has set and categorized 3-kg LPG as subsidized product. In 2009, government started to apply a closed distribution system for 3-kg LPQ to ensure the effective distribution and keeping the quota until the end of the year. In the closed distribution system, the consumer of 3-kg LPG are households with low income and micro businesses which are registered in Kartu Kendali (Control Card). The supply chain or distribution network for 3-kg LPG consist four levels. SPPBE are the facilities in the first level where each one of them has the limited filling capacity for 3-kg LPG. Agent is the facility in the second level with limited storage capacity. Agent can be supplied by more than one SPPBE. Next is the distributor in third level which will distribute the 3-kg LPG to consumers, as the fourth level, in specific area. Each distributor will be served only by their one agent in the second level.

Malang is one of the area in Indonesia selected as a test case for implementation of closed distribution system of 3-kg LPG in 2009-2010. Implementation of the closed distribution system for 3-kg LPG in Malang can reduce the number of stockout and inventory of 3 kg-LPG at the agents, cylinder that circulates in the whole system and the number of purchases of new cylinder (Nariswari and Pujawan, 2010). The closed distribution system has shortcomings such as the risk of supply shortages higher. On the other side, the closed distribution also has the advantages with a higher quality of administration, higher data traceability, and more predictable demand (Widad and Pujawan, 2010).

In order to monitor closed distribution system, PT. Pertamina as LPG commercial license holders have established their efforts to ensure a fair distribution within a specified price by launching the 3-kg LPG Distribution Monitoring System (SIMOL3K). However, the monitoring system which is implemented by SIMOL3K covers the distribution process only up to the agent level. Whereas at the distributor level, the LPG circulation is controlled manually through a log book. The SIMOL3K also do not deal with the arrangement of location of 3-kg LPG distribution of SPPBE's to the agents, the agents to distributors. Therefore, the solutions offered in this study is the development of a new closed distribution monitoring system that allows the controlled distribution process up to distributors with clear area of distribution for both agents and distributors. By developing this new system, distribution of 3 kg-LPG in Malang-Indonesia can be distributed to suitable locations and reach the consumers within a specified price.

2. Literature Review

Supply chain has become an important focus of competitive advantage for organization business. It is the set of values adding activities connecting the enterprise's suppliers and its customers with principles activity of receiving input from firm's suppliers, add value, and deliver to customers (Harrison et al., 2006). A supply chain considers all the stakeholders that are involved, directly or indirectly, in

meeting customer demand. Effective supply chain management is important to build and sustain competitive advantage in product and services of the companies.

Gunasekaran and Ngai (2004) stated that the performance of supply chain was influenced by managing and integrating key element of information into their supply chain. To achieve effective supply chain integration, the companies need to implement information technology (Handfield and Nichols,1999); Qrunfleh (2010). Brandyberry et al. (1999) suggested that by using information technology, the company could manage the flow and impact of numerous supply chains dimension, such as quality, cost, flexibility, delivery, and profit. Byrd and Davidson (2003) demonstrated that information technology impacts the supply chain effectiveness. Vickery et al. (2003) showed that supply chain coordination and integration is facilitated by using integrated information technology, which directly impacts a financial performance of the companies.

One of previous research about information system in LPG supply chain is conducted by Hossain et al. (2015). Quick and effective information system helps a manager to understand the customer response, their demand, inventory in stock, amount to be produced, time frame and location of delivery because LPG is a necessary commodity. Flow of information has become a crucial function for taking right decision regarding supply chain of LPG throughout the whole country by linking the supplier, manufacturer, distributor, dealer/retailer and customer to achieve optimum productivity, overall satisfaction and joyful relationship at competitive costing.

3. Research Method

The development of the closed distribution monitoring information system for 3-kg LPG is adopting the Rapid Application Development (RAD) which covers:

Step-1: The characteristic of RAD approach is the focus of capture user requirement. In order to ensure the correct process flow according to the closed distribution rules, literature reviews has been performed related to model, mechanism, and implementation of the closed distribution specifically to 3-kg LPG distribution.

Step-2: Business modelling identification refers to 3-kg LPG distribution activities from up to downstream, and formulated into functional and non-functional which was derived from interviews with PT. Pertamina, one SPPBE, one agent and two selected distributors.

Step-3: Data modelling from business modelling analysis result to determine the data relationship design. This research uses Entity Relational model.

Step-4: Process modelling to implement the defined business model flow using data model. This research uses Unified Modelling Language.

Step-5: System prototyping by implementation of the closed distribution monitoring system of 3-kg LPG and transactional system.

Step-6: System trial was performed in development environment by using automated testing tool and field implementation at agent and distributor level.

3.1. Proposed Business Modeling

Business model of 3-kg LPG distribution consist of LPG canister filling, distribution, and selling. LPG canisters are filled at SPPBE while the distribution and selling is done by agent and distributor with different selling capacity. Functional requirement of closed distribution monitoring information system at agent level are among others: 1) Distributor data management, 2) Distributor location management, 3) Distributor transaction management, 4) Customer transaction monitoring at each distributor. Functional requirement at distributor level covers: 1) Customer data management, 2) Customer location management, 3) Customer transaction management. Functional requirement at admin level covers: 1) Distribution distance management, 2) Distributor-customer transaction monitoring, 3) SPPBE-Agent realization monitoring, 4) Agent-distributor realization monitoring.

In order to encourage the implementation of closed distribution system at consumer level, we offer a cashless payment and transaction control using control card. Additionally, there is also non-functional requirement of the closed distribution monitoring system for 3-kg LPG which is based-location information.

3.2. Proposed Process Modelling

The use case of the closed distribution monitoring system of 3-kg LPG of consist of 4 stakeholders: SPPBE (Pertamina), agent, distributor, and consumer. Detailed diagram of the use case is depicted in Fig.1 below.

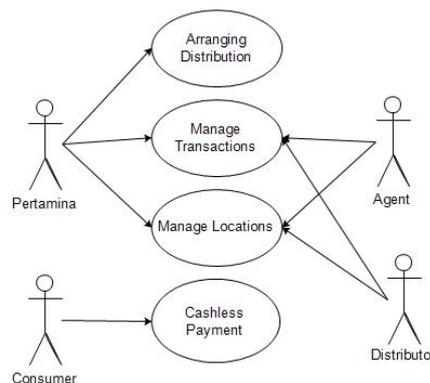


Fig.1: Use case diagram

Distribution arrangement of the use case in Fig. 1 governs the distance arrangement between SPPBE (Pertamina) to agent with constraint not beyond 15 km. We used haversine functions to compute distance between two SPPBE and agent given their longitudes and latitudes. The Haversine ('half-versed-sine') formula was published by R.W. Sinnott in 1984. Using longitude-latitude coordinates and the great circle (spherical trigonometry) distance formula can guarantee reliable result and avoid mapping distortions (Ballou, 2004). Use case of transaction and location management is provided for every user. The closed distribution monitoring system of 3-kg LPQ architecture consist of web application at SPPBE and agent and mobile application for distributor and consumer, as shown in Fig.2. Code structure of 3-kg LPG closed distribution monitoring system consist of feature modules, as shown in Fig.3.

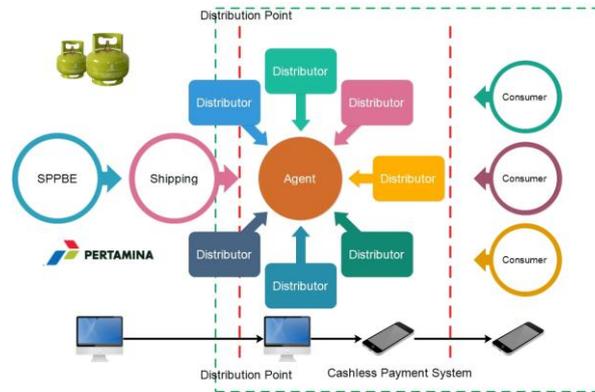


Fig.2: Monitoring system architecture

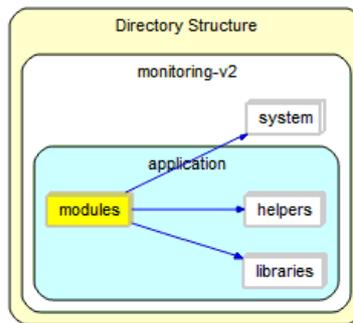


Fig.3: Code structure

4. Implementation and Results

Implementation of the closed distribution monitoring system of 3-kg LPQ was performed in Malang. Trial location for agent was at PT. Ilham Berkah Jaya and for distributor was at the two selected distributors. One of the features built on the monitoring system was visualization of SPPBE coverage area in Malang Raya. Referring to research result at Garside et al. (2015), the ideal distance from SPPBE to distributors is around 15 km.

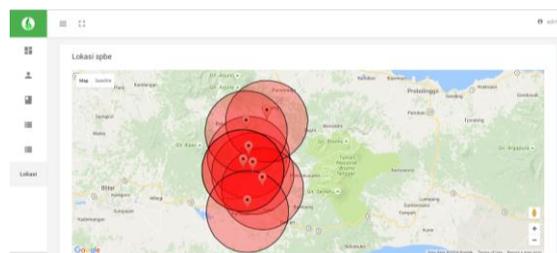


Fig.4: Coverage area of all SPPBE in Malang Raya

Fig. 4 illustrates coverage area of all SPPBE in Malang Raya. Location feature for SPPBE was also equipped with agents location which supplied by the SPPBE in Fig. 5. The SPPBE coverage area was visualized by red circle that shows the agents within 15 km radius from the SPPBE.

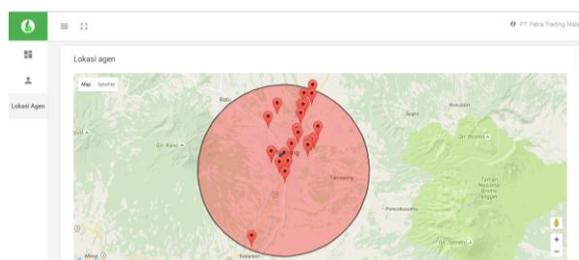


Fig. 5: Coverage area of a selected SPPBE

Feature in agent also provides mapping of distributors location of each agent. Fig. 6 shows that the system marks the 10 km coverage area of distribution of each agent. Mapping of consumer location in each distributor was marked within 10 km radius appears in Fig. 7 to visualize coverage area of distribution of each distributor.

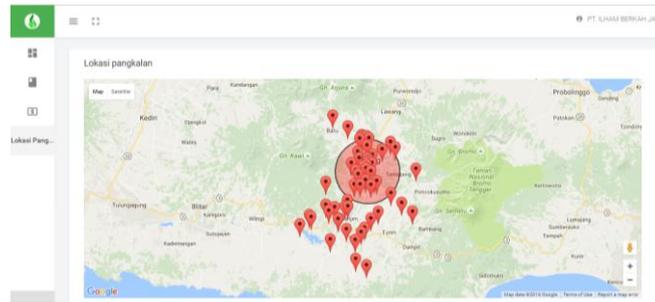


Fig. 6: Coverage area of agent

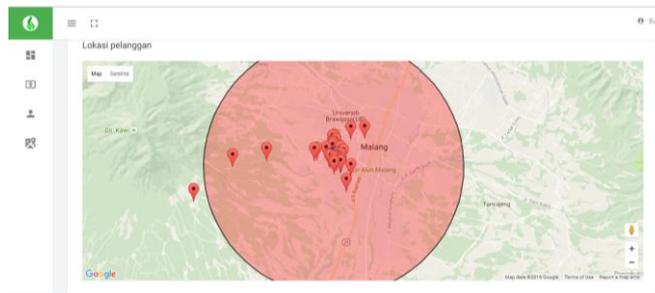


Fig. 7: Coverage area of distributor

The closed distribution monitoring system of 3-kg LPQ testing was performed using functionality tests to ensure all features are working. The tests were performed using automated error testing tools from www.testomato.com. From results of the Pertamina user functionality test, several features have demonstrated successful result, including admin dashboard, manage users, manage distance, manage consumer, manage agent, manage SPPBE, and consumer location. Otherwise, several features failed to respond due to massive load of data which took more time than the limit, including manage SPPBE-Agent, distributor transaction, agent transaction, SPPBE transaction, distributor location, agent location, and SPPBE location. However in general the feature still work. Agent functionality test in agent dashboard, distributor management, distributor transaction and distributor location have demonstrated successful result. Similarly, the functionality test in distributor level have demonstrated successful result

5. Conclusion

New closed distribution monitoring system for 3-kg LPQ has been successfully developed and implemented. From several trials on the closed distribution monitoring system of 3-kg LPQ at the selected agent and distributors, obtained that the proposed system was available to control the distribution until distributor level. Moreover, the system was capable to manage mapping location and coverage area of agents, distributors and consumers properly. Abnormal condition (mistakes) of distribution in each level of the distribution can be directly detected from visualization of distribution area of each users in the system feature. Functionality tests on all the features shows that overall features in agents and distributors were functioned very well, however big data load in Pertamina may influence the performance of its feature.

Acknowledgment

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