Conceptual Model of Supply Chain Structure Mapping - A Case of Subsidized LPG Commodity in Yogyakarta

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Abstract. — In 2007, the government launched a conversion program of kerosene to LPG by issuing a Presidential Regulation No. 104/2007 on Supply, Distribution and Pricing LPG 3 Kg. Article 2 on the regulation says that setting the supply, distribution, and pricing of LPG 3 Kg include planning an annual sales volume of enterprises, the reference price and the retail price and conditions of export and import of LPG 3 Kg in order to reduce subsidies Kerosene especially to divert the use of kerosene according to government policy. In principle, the purpose of this policy is to reduce energy subsidies on commodities, especially Kerosene. Although the government claimed the conversion program is success, there are few problems arising from conversion program. In 2014, many scarcity and high price of LPG 3 Kg were reported. In this case, Pertamina was given full authority to manage all supply chain and distribution. Because the root of the problem of scarcity that occurred in the supply chain system has not been explained, the proposed solutions will also be partial and not comprehensive. Thus, this research will build a structural map of the causes of supply chain system LPG 3 Kg, as well as providing a comprehensive picture of system dynamics of LPG 3 Kg supply chain system which applied in Indonesia. And the result is expected as in form of Causal Loop Diagram of supply chain system.

1. Introduction
Demand for natural gas or liquefied petroleum gas (LPG) has increased significantly since the conversion program from kerosene to gas fuel in 2007. The conversion program refers to Presidential Regulation No. 104/2007 on Supply, Distribution and Pricing for LPG 3 Kg. Second article on Presidential Regulation says that the supply, distribution, and pricing for LPG 3 Kg include Enterprise annual sales volume, benchmark price and retail price as well as export and import of LPG 3 Kg in order to reduce subsidies on oil fuel particularly to divert the use of kerosene is rendering to government policy. Principally, the purpose of this policy is to reduce energy subsidies, especially in petroleum commodities. In 2006, kerosene subsidy is up to IDR 41.7 trillion. With the conversion of kerosene to LPG, the government is targeting to save IDR 15 trillion per year. After 8 years, the government can save 144.5 trillion in 2007-2014 [1]. PT Pertamina states can resolve the conversion program target of kerosene to LPG 3 Kg to 58 million household by the end of 2014. In this case, Pertamina was given full authority to manage all supply chain and distribution systems [2].
Recently, the reformation spirit of Indonesian government for energy subsidy is very high. In 2015, Indonesian Proposed Budget agreed by DPR is allocated around IDR 275 Trillion for oil fuel subsidy. This subsidy includes premium for IDR 108,3 Trillion, diesel for IDR 80,2 Trillion, kerosene for IDR 6,1 trillion, LPG 3 Kg for IDR 55,11 trillion and electricity for IDR 68,7 trillion [3]. Figure 1 shows the behavior of subsidies for LPG 3 Kg by the government. Thus, the original purpose of energy conversion program to reduce energy subsidies, currently just shows the opposite direction.

Even though the government claimed success, there are problems arising from the conversion program. In 2014, scarcity and high price of LPG is widely reported. Early 2014, scarcity has reported in Tondano [4]. Followed by scarcity in Majalengka [5] and Batam in Mei [6] as well as Riau Provinsi in September [7] has been reported. Scarcity is also reported in 2008, causes by technical problem in Cilacap and Indramayu refuelling point [8]. Gas conversion policy in its development has been changing people’s habits. Because the price is cheaper, people who previously using LPG 12 Kg switch to LPG 3 Kg [9]. In previous years, Pertamina has conducted market operation to overcome scarcity of LPG 3 Kg [10]. In addition, the distribution arrangement was also made to overcome the same problem [11]. In fact, agents and resellers are suspected of adding the complexity of distribution problem [12].

The cause of scarcity was allegedly from the mixing activity of transferring LPG 3 Kg to 12 Kg. This activity is one of criminal act with profit motif of price disparity between subsidies LPG 3 Kg with non-subsidies LPG 12 Kg [13]. Otherwise, besides Pertamina, the role of National Entrepreneur Accusation of Oil and Gas needs to be strengthened, as well as police controlling, prosecutors, legislators, and local government [14]. In addition, the increasing price of LPG 12Kg causes a lot of people switch to use LPG 3 Kg, it effects to high demand of LPG 3 Kg. These data shows that the root problem of scarcity has not well explained, this research will analyse the structural map of supply chain system of LPG 3 Kg as well as providing comprehensive picture of it system based on descriptive analysis method by utilizing Causal Loop Diagram.

2. Research Methodology
This research will use descriptive qualitative method. It is aim to gathering, enclose, and data interpreting which will then be processed to determine in detail the decision process making and distribution process on LPG 3 Kg distribution system. Gathered data will be used to develop Value Stream Map (VSM) and Causal Loop Diagram. VSM used to de-fine the whole distribution activity, whether they have value added or not, in delivering the product from Depot up to customers. While Causal Loop Diagram used as a tools to help researcher to mapping the system structure of LPG 3 Kg distribution. Both VSM and CLD used to help modeller to analyse the distribution system which focus on LPG 3 Kg distribution in Sleman regency, Daerah Istimewa Yogyakarta. The required data type for
this research is primary data collected by observation and interview. In this research, primary data will be collected from the Pertamina Yogyakarta, SPBE, agent, and station about the decision making process and order fulfilment order. Research methodology will adopted from the methodology offered by [15]. In general, model development will be done iteratively using following scheme.

![Figure 2. Scheme of Research Methodology](image)

### 3. Result and Analysis

#### 3.1. Identification of Supply Chain System LPG 3Kg

3 Kg LPG distribution channels in general is Depot → SPBE → Agent → Base → Customer. Physical flow of 3 Kg LPG distribution starting from Depot heading SPBE (Charging Station and Freight Bulk LPG), there are 2 different depots locations at Cilacap and Semarang. Delivery from Depot to SPBE done every Monday to Saturday. Furthermore, after the truck arrived at SPBE, the unloading process is carried then performed the process of updating inventory levels. After that, trucks from agent are going to SPBE to fill the bulk LPG. When the trucks from agents comes to SPBE, they will be checked for the administration and LO (Loading Order), after fulfilling all the administrative requirements then they will go to the bulk filling area if there is no queue then it will go directly to the truck unloading process that is loading the empty LPG to be filled. Then the empty bulk will go to the filling to the bulk process. The next process is the LPG which are already filled will be closed and given a protective plastic whose name matches the name of the agent in the Sealing process. After that is the quality control by dipping the LPG into the water to check for leaks tube. Then LPG directly inserted into the truck (truck loading). After the truck has finished loading, the next is the administrative process for issuing the street. Then LPG will be taken to the warehouse agent and will be distributed to Base Agent owned. Then the customer will come to the base to purchase LPG 3 Kg.

LPG distribution information flow is starting from Pertamina Yogyakarta which makes forecasting for daily quota Agent. Then the results of the daily quota Agents commonly called Kitir was proposed to Pertamina Regional IV, after the evaluation and approved then the Kitir published in the system information in Pertamina which can be accessed by the Agent and SPBE. SPBE will confirm to Pertamina Regional IV on the number of tons of LPG to be transported which later Pertamina Regional IV will confirm to the Depot. In the agency, after receiving Kitir containing daily quota Agent, the agent paid the amount of the quota to be able to fill up to SPBE. Once it paid, a letter of Pertamina for charging to SPBE would be issued.
3.2. Causal Loop Diagram

Figure 4 shows the causal loop diagram of LPG 3 Kg distribution system. Causal loop diagram is consist of system elements which constitute the LPG 3 Kg distribution system. These elements have feedback relationship among others. The feedback could be positive or negative relationship. Positive relationship occurs when the value of an element increased, it led to an increase in other element value, or if the value of an element is decreased, it led to the decline of other element value. Otherwise, negative relationship among elements occurred if the increase of certain element value would cause other certain element value is decrease or contrarily.

The amount of LPG 3 Kg subsidy distribution is depend on the ability of each region subsidy budget. This budget will also affecting the price of LPG 3 Kg in certain region. The subsidy budget set by Sleman region government will then be distributed to LPG 3 Kg agent in form of quotas which done by Pertamina Yogyakarta. The quota become agent authority to take it in form of agent distribution based on quota. This quota is use to filling agent LPG bulk in SPBE which means decreasing SPBE stock. As the agent take the LPG quota, SPBE may supply the LPG from the Depot based on supply planning and considering safety stock and SPBE storage capacity. Once the agent take their quota, it means that the agent is adding their stock. These stock should delivered to the station subsidiary by the agent. Distribution quota for each station is depends on quota set by Pertamina, the number of station subsidiary by the agent, and the station capability to sell LPG 3 Kg bulk. It means that each of station may have different quota and delivery time. The station is responsible to sell the LPG 3 Kg bulk to the end customers. Quota given to station often create Gap between stock and demand, where the demand of LPG 3 Kg is more than the station stock. Subsidy which should delivered to micro business and middle and lower income people is adding with the others element which causes the unfulfilled demand. This unfulfilled demand may encountered by adding subsidy quota if the subsidy budget still sufficient enough. Otherwise, if there is no left subsidy budget, then there will be no additional subsidy quota.
4. Discussion

In the beginning of conversion program, there are many step in conversion program which not proper with the regulation [16]. So, the conversion program target is not achieved as the purpose of LPG 3 Kg subsidy is originally targeting the micro business and middle and lower income. However, any parties exclude these parties can still buy LPG 3 Kg. As the growth of population, another problem occurred relates with the amount of subsidy. In this condition, a new facilities to support LPG 3 Kg distribution has to be built. Analysis to define new facilities has been done using P-Median method [17]. Optimization of supply chain configuration also has been studied previously using goal programming [18] as well as transportation route selection [19].

Many research about LPG 3 Kg has been previously done by researchers. However, there is no research done by utilizes CLD as a key to analyse the root cause of scarcity yet. As we know that causal loop diagram (CLD) or even called influence diagram is use to help modeller to understanding the system and to give the general image through cause and effect relationship in existing system.

Figure 4. Causal loop diagram of LPG 3 Kg distribution
From the causal loop diagram, the station stock is causes by the distribution quota from agent to station. This condition means that station can determine their stock in order to meet customers demand. While the distribution quo-ta from agent to station is depend on the proper delivery or distribution planning which determine by Pertamina Yogyakarta. So, in order to fulfilled customer demand Pertamina Yogyakarta should increase the distribution quota. The ideal condition is LPG 3Kg can fulfil the demand in proper condition. But in this case, increasing quota of subsidy is not easy since it deal with government subsidy budget. A closed distribution system may become alternative solution for the government to distribute LPG 3Kg. An agent based model for closed distribution has been developed [21]. Simulation to compare open and closed distribution system also has been developed [22]. These research shows that closed loop distribution is more effective and efficient.

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