The analysis of a chilled beef supply chain for developing strategic improvement

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Abstract. The growth of population and economics are factors that affect the increasing demand for livestock products in Indonesia. Beef and chicken are the most consumed meat in Indonesia with an average meat consumption of 2.72 kg per capita per year and there is an increasing trend. Currently, the domestic production of beef is only about 45% percent of the demand, the rest of the demand will be fulfilled by importing live cattle and frozen meat, mainly from Australia. The beef supply chain is quite complex and long. The available infrastructures still need to be improved in order to deliver the beef quickly and handled under appropriate cold chain. Our objectives are to identify the business process of the abattoir in the chilled beef product cold chain, to analyze the problem, and to propose some recommendations for their strategic improvement. The observation and in-depth interviews are conducted. Then, the result is analyzed by using Integration Definition for Function Modelling (IDEF0) to figure out the current situation and the activities in the abattoir. Based on the result, it is found that inventory management and temperature controlling are the major issues in the chilled beef cold chain that need to be monitored and controlled. This suggestion would be able to improve the efficiency of a chilled beef cold chain in Indonesia.

1. Introduction

The growth of population and economics are the factors that affect the increasing demand for livestock products in Indonesia. The most consumed meat in Indonesia is beef and chicken with an average meat consumption of 2.72 kg per capita per year and there is an increasing trend [1]. Currently, the domestic production of beef is only about 45% of the demand, the rest of the demand will be fulfilled by importing live cattle and frozen meat, mainly from Australia [2]. The beef supply chain is quite complex and long. Currently, the high demand for fresh beef in Indonesia is hot carcass, the beef that is not stored in the chiller. Indonesian consumer considers the hot carcass as the fresh meat. The butchers were just put the carcass exposed to the air in the stall. This handling may lead to temperature abuse since the ideal temperature for storing fresh meat is range between 1°C to 3°C. The temperature abuse will affect the beef quality during distribution and may cause defects before the use-by date is reached, leading to food waste and economic losses. The increasing consumer awareness towards food safety in Indonesia also affects the demand for the high quality of beef. However, the available infrastructures still need to be improved in order to deliver the beef quickly and handled under the appropriate cold chain to maintain the beef quality. Other than that, there are restrictions due to the limitation of knowledge of the workers about the cold chain system [3]. Therefore, cold chain management is very important and becomes a challenge to maintain the freshness and the quality of the beef until it reaches the final consumer [4].
This study is focused on the implementation of the cold chain from the abattoir to the final consumer. The objectives of this research are to identify the business process and risks of the chilled beef supply chain in Indonesia. A recommendation can thus be developed to improve the efficiency of chilled beef product cold chain in Indonesia.

2. Methodology
The in-depth interview is conducted with the abattoir manager in Bogor, West Java, Indonesia by using a questionnaire to figure out the structures and the activities of a chilled beef cold chain. Then, the business process is analyzed by using Integration Definition for Function Modelling (IDEF0). An IDEF0 model contains information about how an organization running the business process activities [5]. IDEF0 is a modeling technique that combines graphics and texts into a systematic way to give the understanding, support the analysis, specify the requirements, or support system-level design and integration activities [6]. The model is constructed from two main things, the function box that represents activities, processes, and transformations also the arrows that represent data and objects related to the functions. There are four types of arrow including input, output, control, and mechanism [7]. The input is an arrow that entering the left side of the box represents the inputs that are transformed by the function for producing outputs. Second, the output is the arrow that leaving the box on the righthand side, it represents the outputs produced by the function. Third, control is the arrow that entering the box on the top represents controls that specify the required condition for a function to produce correct outputs. Last, a mechanism is the arrow that is connected to the bottom of the box, it represents the resource that is needed to perform the function [8]. Moreover, there is a solid line that represents the current activities and dashed line that shows the improvement that is suggested for improving the efficiency of chilled beef product cold chain in Indonesia.

3. Results and Discussion

3.1. Background of an abattoir
A case study company is a service provider specialized in cattle slaughter and beef production. The goal of the company is to produce a final product in the form of chilled beef from the high quality of cattle and meet the national standard of Indonesia. This company is one of the modern slaughterhouses in Indonesia that produces chilled beef, frozen beef, and portioning product based on the demand from the customer. Meanwhile, the side products such as meat offal, fat, tail, skin, and the bone will be distributed to some local business enterprises. The cattle that will be slaughtered are imported Australian cattle and have been fattened in Lampung Province for 100 days. There are about 150-180 cattle slaughtered a week on average. Then, the product will be shipped to Java and Bali Island. The company serves Indonesian markets including high-end restaurants, hotels, and supermarkets across the country since 2005. Previously, the company is owned under the supervision of Australian Company, but since August 2018 the Indonesian government proposed acquisition for this company. In order to distribute the products, the company has a refrigerated container for serving the local customer and rent the refrigerated truck from the third-party logistics provider in order to support its distribution.

3.2. A generic Indonesian chilled beef cold chain
The business process in the organizational level involved in the chilled beef product cold chain in Indonesia from upstream to downstream is analyzed by using IDEF0 level 0. In Figure 1, it is shown that the feedlot imported cattle from Australia according to the trader order. The feedlot is in Lampung Province, the cattle will be fattened within 100 days. When the cattle are ready to be slaughtered, they are transported by a truck with a capacity of 16 cattle per shipment (8 tons). The shipment takes 24 hours until it reaches the abattoir in Bogor, West Java. In the abattoir, the cattle are kept at the crib for a night. In the morning before the slaughtering, the cattle are being cleaned and inspected by a veterinarian (antemortem). After that, the hot carcass will be kept at the chiller for about 24 h. Then, the chilled carcass temperature will be checked on the next day. If it is under 20°C, the carcass is ready to be boned.
After the boning process, the carcass will be packed and stored in the chiller. The trader plays a role in getting the order from a customer, integrate it in their own system, and send it to the feedlot and abattoir as the customer demand. From the abattoir, the product is transported to the warehouse and kept until there is an order. The logistics service provider will pick up the packed chilled beef in an abattoir or in the warehouse and deliver to the retailers such as supermarkets, hotels, restaurants and caterers and end customers. The retailers are in Jakarta, West Java, Central Java, Yogyakarta, and Bali.

![Figure 1. The business process of chilled beef product in Indonesia (IDEF0 Level 0)](image1)

3.3. Business process analysis of an abattoir

The business process analysis of an abattoir is visualized in Figure 2. It shows the activities including plan, source, make, deliver, and return. From the IDEF0 Level 1, the activities in the abattoir are analyzed in detail in order to identify the problem by doing the observation and in-depth interview within 1 month. The abattoir will get an order of a number of imported cattle a month in advance after an external monthly meeting with a trader. From the meeting, the slaughtering schedule is established. After the production process, the product will be stored in the warehouse. Some products are directly sent to the warehouse in Bekasi, West Java.

![Figure 2. The business process of an abattoir (IDEF0 Level 1)](image2)

Currently, the trader will calculate customer demand and order the number of cattle to be slaughtered. Sometimes, the trader cancels the order suddenly and resulting in rescheduling the slaughtering. Then, abattoir loses the chance to serve another trader. Hence, the abattoir should establish a due date to cancel the order to protect the reschedule and implement the demand planning with the trader. In the sourcing process, inventory accuracy is quite low due to human error. It results in mismatch order and lost sales. Thus, proper inventory management should be established to reduce human error. There is no recorded information about the cattle shipment, thus they should establish the database and real-time sharing information. In make process, the low responsibility of the workforce still becomes an issue because their absenteeism affects productivity. We suggest them to do the worker performance evaluation and implement reward and punishment. Moreover, the abattoir did not have any laboratory to examine the microbial content in the meat. Due to the product is sensitive towards the contamination and the external inspection took 2 weeks, we suggest they invest in the laboratory equipment in order to obtain the result quickly and able to respond with suitable corrective action as soon as possible. In the delivery activities, there is not sufficient temperature-controlled truck to deliver products. Hence, the company outsources a third-party logistics provider who establishes a real-time temperature record during delivery. However, there is no staff who is in charge to monitor the temperature data. Only when there is an accident or
rejected product during transportation, the abattoir will check the temperature data. Hence, preventive control should be implemented by real-time monitoring of the temperature. Finally, there are a lot of returned products from customers over the time frame specified by the abattoir, it is because there is no rule that controls the requirement before returning the product. Then, we suggest them to establish new agreements. The current problems and recommendations for improvement are summarized in Table 1.

Table 1. Summary of current problems and recommendations for improvement

| Activities | Problems | Improvement Guideline |
|------------|----------|-----------------------|
| Plan       | Order cancellation | Establish a due date for cancellation, demand planning with the trader |
|            | Low inventory accuracy | Implement an integrated inventory management |
|            | Lack of production plan | Establish the production planning |
| Source     | No database | Establish database and evaluate the supplier periodically |
|            | No real-time sharing information of cattle shipment | Establish a new system in order to track the cattle condition during shipping |
|            | No adequate livestock transportation | Evaluate the animal welfare standard of the livestock shipping provider |
| Make       | Low productivity | Lean/Line Balancing Implement a reward and punishment from the management policy |
|            | Lack of worker awareness towards food safety standard | Evaluate and train the worker periodically |
|            | Lack of laboratory inspection during production | Invest in laboratory equipment |
| Deliver    | Insufficient truck | Outsource to qualified 3PL providers |
|            | No monitor the temperature | Establish preventive control by monitor the temperature real-time |
| Return     | A high amount of returned goods | Set up a rule for customers to return on the delivery date only |

4. Conclusion
This research explored the chilled beef product cold chain by using IDEF0 Level 0 and 1 to analyze the business process of the abattoir in detail. Then, we identified the problems in the stakeholders activities and suggest recommendation for improvement such as implement demand and supply planning, implement an integrated inventory management, establish database and traceability system, evaluate the animal welfare standard of livestock shipping provider, evaluate the worker productivity, focus on quality inspection, hire some qualified 3PL providers, establish preventive control, and set-up a rule for customer to return the product. This research could be a guideline to help similar companies to improve their business.

5. References
[1] Agus A Budisatria IGS Ngadiyono N 2014 Road map of beef cattle industry in Indonesia (Yogyakarta: APFINDO and Faculty of Animal Science, Universitas Gadjah Mada)
[2] Agus A and Widi TSM 2018 Asian-Austr. J. Anim. Sci. 31 976–83
[3] Gery J Syari S P Hidayat R D R Maulana A and Darunanto D 2018 Proc. Advances in Transportation and Logistics Research 1 1233-1
[4] Nastasijevic I Lakicevic B and Petrovic Z 2017 IOP Conf. Ser.: Earth Environ. Sci. 85 012022
[5] Prasertwattanakul Y and Ongkunark P 2018 J. Inter. Food Research 25 481-6
[6] Bichou K Bell M and Evans A 2007 Risk Management in Port Operations, Logistics and Supply Chain Security (New York: CRC Press)
[7] Ongkunark P 2015 Agriculture and Agricultural Science Procedia 3 35-9
[8] S P Pradita and Ongkunark P 2019 IOP Conf. Ser.: Mater. Sci. and Eng. 526 012004