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Business process analysis and improvement for a raw milk collection centre in Thailand

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Abstract

The Royal Thai government promoted a school milk project in 1992 due to the low milk consumption rate in the Thai population. It encourages primary school students to drink milk. Hence, domestic farmers, collectors and milk plants have served milk to schools and through other channels for decades. This research studied a pasteurised milk supply chain, which is a medium-sized collection centre in central Thailand. Our objectives were to explore the current supply chain of pasteurised milk in Thailand, analyse the business process of the collector and propose improvements for efficiency. Next, we implemented Integration Definition for Function Modelling to present the business process of the collector; the activities are planning, sourcing, making, delivering and returning. After analysis, we identified ways and proposed how to improve efficiency in the planning, sourcing, production and delivery processes. In summary, our guidelines for the raw milk collector could be applied to other milk collectors to improve upstream supply chain efficiency.

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Keywords: Business Process Analysis; IDEF0; Pasteurised Milk; Supply Chain Management

1. Introduction

The Royal Thai government has promoted the domestic milk industry since 1977 according to the National Economic and Social Development Plan No. 4 (1977–1981) and the current National Economic and Social Development Plan No. 11 (2012–2016). The goal is to enhance milk consumption and to support the cow milk farmers to serve domestic demand (Food Intelligence Center, 2014). Due to the low milk consumption rate of the Thai people, the Royal Thai government established a school milk project in 1992 to encourage kindergarten and primary school students to drink milk to reduce malnutrition in children. In addition, the milk project has supported

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the domestic milk supply chain, which has lower competitiveness than among imported dairy producers (School Milk Programs, 1992). In general, 40% of domestic raw milk production is allocated to schools in the form of either UHT or pasteurised milk. Therefore, the domestic milk stakeholders have sufficient domestic demand to support raw milk production. The demand for raw milk is divided into school milk and commercial market milk. Although, the demand for school milk is quite stable, the demand for commercial market milk is likely to increase (Office of Agricultural Economics, 2013). Raw milk has a short shelf life and deteriorates over time; hence, it must be temperature controlled and delivered within a short time frame. Hence, a cold chain is required from upstream to downstream in the dairy supply chain. However, the upstream activities, which are related to farmers and collectors in some regions of Thailand, could not implement the cold chain due to the high cost and need for expensive equipment.

This research is part of the large project 'Food Cold Chain and Proper Packaging' funded by the Department of Primary Industries and Mines and the Ministry of Industry. We previously studied the dairy supply chain in the central region and implemented the cold chain and proper packaging measures to reduce waste through the handling, collecting, production, packaging and distribution in the supply chain. However, in this report, we explore a case study of a medium-sized pasteurised milk collecting centre located in central Thailand and its supply chain. Our objectives were to analyse the current activities and propose guidelines to increase the productivity of supply chain activities. We hope that our guidelines are of benefit to other milk collectors and provide a good representation for other agricultural supply chain stakeholders in Thailand.

2. Methodology

We performed in-depth interviews with the milk supply chain stakeholders – i.e., farmers, third-party logistics (3PLs), collecting centres, milk plants, retailers and consumers – so that we could model the milk supply chain. Then, we focussed on analysing the business process of a medium-sized collector based on Integration Definition for Function Modeling (IDEF0) (Colquhoun et al., 1993; Ongkunaruk and Kessuvan, 2013). IDEF0 represents the flow of activities in the form of square boxes such as planning, sourcing, making, delivering and returning. There are four types of arrows which identify the input, output, control and mechanism of activities. First, the input consists of the factors that drive the activities, shown by a left arrow directed into an activity box. Second, the output is the result of doing the activities, shown by a right arrow directed out of an activity box. Third, the control is the standard or requirement of the activity, shown by an arrow above an activity box. Finally, the mechanism includes the resources such as staff, equipment and machines used to accomplish the activity, shown by an arrow below the activity box. The code located in the right corner of each activity box designates the rank of the activity (for example A1, A2, … , A5). A solid line represents current activities. Next, we proposed implementation best practices to increase their efficiency as shown by the dashed line in Fig. 1.

3. Results

3.1. A pasteurised milk supply chain

From the survey, we could graphically represent the pasteurised milk supply chain, as shown in Fig. 1. The solid line indicates the flow of materials among stakeholders while the dashed line indicates the control activities. For example, the milk board will control the farmers, collectors and milk plants. Note that the existing supply chain may include other channels as well. The major stakeholders of the pasteurised milk supply chain are:

- Dairy farmers: the milk cow farmer has to get milk, keep it in an appropriate container and quickly transport it to the nearest collecting centre. Some farmers who do not have their own truck will outsource to 3PLs teams to deliver for them. Some farmers will transport milk using their own vehicles, such as motorcycles, trolleys and four-wheel drive trucks.
- Local 3PLs providers: the local logistics service providers who pick up raw milk from farms using four-wheel drive trucks and deliver it to the nearest collecting points.
- Milk collection centres: a collection centre is located within 20 km from farms which gather raw milk from farmers or 3PLs providers. Their activities include quality checking, reducing temperature, storage and

delivery to customers. They have a contract according to the milk board agreement.

- Milk plants: the manufacturers which process milk using methods such as pasteurisation or UHT processing.
- Retailers: the merchants who sell milk directly to consumers.
- 3PLs: the logistics service providers who pick up pasteurised milk from the milk plants using motorcycles or trucks and deliver milk to schools or households in their zones.
- Schools: the students in private and public kindergartens and primary schools under the school milk project are the target consumers. During their break, the students are provided with UHT milk instead of pasteurised milk.
- Consumers: some consumers buy milk directly from the plant while some buy from retailers or 3PLs providers.
- Milk board: the board was established according to a milk act which was composed by agricultural experts and scientists from stakeholders in the dairy supply chain and governors. The board has a role to support and control the quality, quantity and price of raw milk for domestic consumption. An annual Memorandum of understanding (MoU) is established under an agreement among farmers, collectors and milk plants.

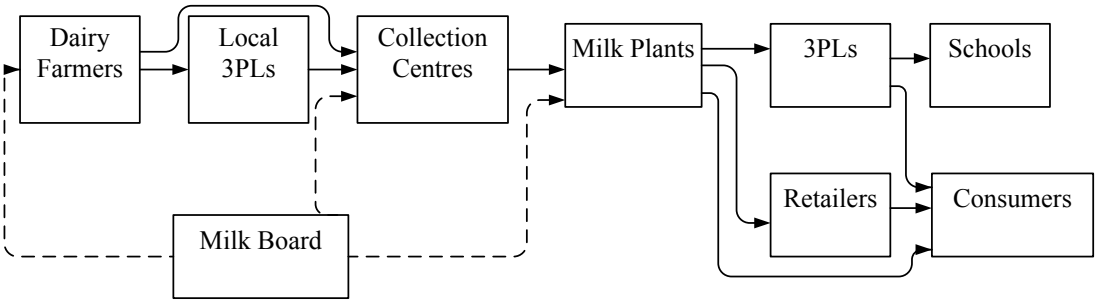

Fig. 1. A pasteurised milk supply chain in Thailand

3.2. Business process analysis of a collector

Our analysis focused on a pasteurised milk supply chain and a business process analysis of a collection centre using IDEF0. The business process analysis of a pasteurised milk supply chain at level 0 or the organisation level showed the relationship of stakeholders in the supply chain, as seen in Fig. 2. The milk board has the important role of controlling farmers, collectors and milk plants via an annual meeting and a MoU which determines the quantity and price of raw milk. The other requirements are time and temperature which ensure that the quality of raw milk is maintained. The milk act states the responsibilities of the dairy supply chain stakeholders. Dairy farmers feed milk cows according to Good Agricultural Practices (GAP) and the MoU stipulations. After milking, raw milk must be delivered to the nearest collection centre as soon as possible. Then, the collectors will check the raw milk quality and composition and pay the farmer in cash according to the quality and nutrient composition. Veterinary doctors assist farmers in treating sick cows on farms and make suggestions on how to raise milk cows efficiently. The collection centres hire the veterinary doctors as consultants and inspectors at local farms biannually. Good Manufacturing Practices (GMP) are the required standard practices for collection centres and milk plants (Thai agricultural standard TAS 6401-2005, 2005).

After interviewing the top management of the collection centre and related staff, we could draw the current activities, as shown in Fig. 3. The solid lines represent the current activities with input, output, control and mechanism, while the dashed lines represent the improvements that we suggested. Currently, the collector has an annual plan and a short-term plans which are aligned with the MoU. Hence, long-term planning, such as supply and demand planning, should be created so that the top management is able to make the decision to establish a new collection centre to serve additional supply and demand. In addition, the existing vendor development program should be extended through collaboration with academic institution to determine the optimal feed for milk cows so that the raw milk has the highest nutrient levels within an acceptable cost frame. Dairy farmers and 3PLs providers

will deliver raw milk to their nearest collecting points. In the receiving area, either an alcohol test or a somatic cell count will be performed to ensure that raw milk is not colostrum or mastitic. However, temperature measurement and traceability at farm level have not been reached yet. It is difficult to separate the raw milk within a large-sized storage tank. Thus, this is an issue of concern as the nutrient compositions of raw milk from different farms vary.

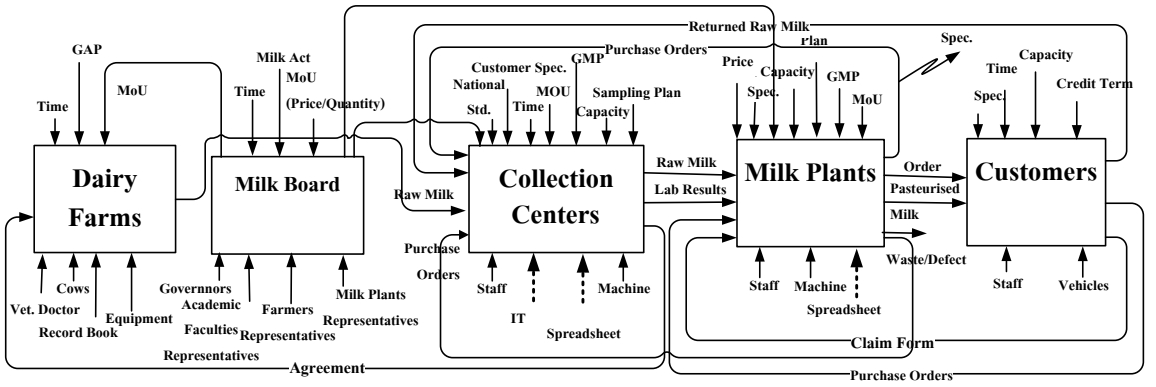

Fig. 2. The business process of a pasteurised milk supply chain (IDEF0 level 0)

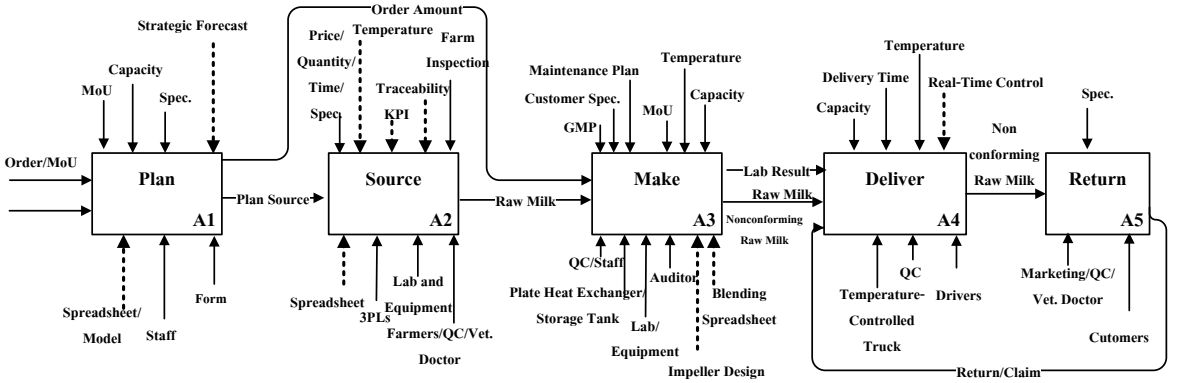

Fig. 3. The business process of a medium-sized raw milk collector (IDEF0 level 1)

Then, we suggested the appropriate criteria (Key Performance Indicators) to determine the price of raw milk which should depend on the quality of raw milk and its nutrient composition, such as fat and solid non-fat percentages. After being received, raw milk is cooled down to 4 °C using a plate heat exchanger and kept in a storage tank until the delivery time. Raw milk in each tank has a specific composition and the tank that stores the morning raw milk has less fat. Thus, raw milk from different tanks will be blended such that the composition of milk is aligned with customer requirements. The quality control (QC) staff will check the temperature, specific gravity and somatic cell count of raw milk in each tank on the truck and send the lab results promptly with the driver. In this process, we suggested that storage tanks should have an impeller design so that raw milk will be mixed thoroughly and provided a spreadsheet to determine the blending formula. Next, raw milk will be delivered to customers in a temperature-controlled truck. We found that the milk plant staff could not track the milk truck on a real-time basis. Then, coordination between two organisations should be established so that the staff are prepared to receive and produce accordingly. Finally, if the raw milk fails to meet the customer specification, then it will be rejected and sent back to the collector. We summarise the guidelines that the collection centre should implement to improve its efficiency in Table 1.

Table 1. Summary of current problems and suggestions for improvement

Activities	Problems	Improvement guidelines
Plan	Lack of strategic forecast	Long-term supply and demand forecast
		Data analysis from number of milk cows and productivity
		Determine the optimal location and numbers of collecting centres
Source	Lack of traceability at farm level	Implement database and traceability system
	Lack of raw milk price system considering nutrient composition	Nutrient composition checking at farm level
	Lack of consistency of raw milk quality	Cooperate with agricultural technician to increase the productivity and quality of raw milk
	Lack of temperature measurement at farm level	Vehicle routing with time windows
Make	High volume of water usage	Implement green technology and lean production
	Inefficient blending of raw milk	Design the optimal impellers for storage tank
	Lack of decisional support for blending of raw milk	Spreadsheet for decisional support for blending of raw milk
Deliver	Real-time tracking and coordination between driver and raw milk receiving staff	Real-time control and milk truck tracking system

4. Conclusion

The current pasteurised milk supply chain in Thailand was explored. The analysis of the business process of the raw milk collector in central Thailand, using IDEF0 at levels 0 and 1, was presented to illustrate current activities which are planning, sourcing, making, delivering and returning. Then, the problems were identified and guidelines for improvement were proposed, such as using a spreadsheet and mathematical model for the long-term planning process; establishing the measurement of the temperature and nutrient composition of raw milk from each farm so that the traceability is applicable; decisional support for blending optimisation; optimal impeller design; and truck tracking. In summary, we hope our guideline can be implemented at milk collection centres to increase the upstream supply chain efficiency. In the future, the logistics costs and cost structures of each of the stakeholders should be identified so that cost reduction measures can be implemented (Ongkunaruk and Piyakarn, 2011; Ongkunaruk and Usri, 2012).

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