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Using integration definition for function modeling to define operational obstacles in cold chain farm-to-consumer delivery during the COVID-19 pandemic: A case study in Thailand

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ABSTRACT

This study responds to the urgent need of how community enterprise logistics service providers in Thailand would cope with pandemic challenges in cold chain farm-to-consumer (F2C) delivery. This case study aimed to reveal the underlying logistical problems, within the unique consumption context of Thailand, during the COVID-19 pandemic. Thailand is experiencing growth in e-commerce and social media-based shopping, especially during the pandemic. To capitalize on this trend, logistical service providers are looking for ways to expand the direct distribution of items like chilled and frozen food. Therefore, there is extraordinary growth of the door-to-door service business, especially F2C delivery. The in-depth interviews and observations of staff performance were conducted with a temperature-controlled logistics agent. Then, business processes were analyzed with a swimlane diagram and an integration definition for function modeling to identify the activities of key stakeholders and the problems of the agent. Next, the causes of poor service levels were analyzed by a causal loop diagram. To enhance productivity and service levels, the agent should establish supply and demand data collection, implement the proper forecasting and inventory management, design a standardized packing program for chilled and frozen products, and optimize the pickup and delivery routes.

Keywords: temperature controlled products; integration definition for function modeling; logistics service provider; causal loop diagram; COVID-19

1. INTRODUCTION

The coronavirus outbreak situation is a catalyst for a dramatic, digitally-focused change in consumer behavior (Bhatti et al., 2020). Consumers are demanding shopping through online platforms. As a result, both Thai and international entrepreneurs faced high competition in terms of price, service quality, and speed of delivery (Sasirin, 2020).

Before the pandemic, few researchers were addressing the challenges in last mile delivery, but research within temperature-controlled food categories is still rare. In addition, studies in developing countries and/or with limited logistics infrastructure barely exist. Facing this challenging pandemic environment without contingency plans or guidance from existing research, local Community enterprises (CEs) struggled to meet the unitarian and economical needs of their lockdown customers when the pandemic started.

Due to limited resources from federal and local governments, the research scarcity in this region provides an opportunity to fill the localization aspect of current distribution theories. The theory gap exists due to previous related research in this area failing to directly address this problem within the unique challenges of this region. This study responds to the strong need for practitioner-level theory validation, which is widely discussed among supply chain researchers (Toffel, 2016; Garver, 2019; Zinn and Goldsby, 2017). Theory validation in this specific context (e.g. nature of products, working environment, culture, industry) helps practitioners understand how the concepts work in real life (Garver, 2019; Zinn and Goldsby, 2017). As important as theory generalization, the application of theory in specific contexts helps to bridge the gap between practice and concept, and eventually strengthens theoretical concepts in the field (Garver, 2019). Theory dissemination/adoption is another gap to be addressed with a case study approach. It is important to note that local business is risk-averse and needs to see a well-proven example that already works in similar situations (Toffel, 2016; Garver, 2019). Therefore, testing the integration definition for function modeling (IDEF0) concept in Chanthaburi, Thailand is important for practitioners to gain confidence with ultimately adopting this concept. The use of a case study approach would help fill the dissemination gap in previous research. In this case study, the step-by-step procedures were analyzed and presented to practitioners, including providing the case background, the practical use of IDEF0 applications, and recommended solutions.

Thailand provides an interesting business logistics landscape with culture and economic background that could challenge well-established theoretical distribution concepts. Before the pandemic, Thai consumers, in all major cities, were well-equipped with online shopping tools and electronic payments. However, local businesses such as farmers still supplied and distributed their products through traditional channels, utilizing middlemen and wholesalers. During the COVID-19 curfew, the fresh market lockdown interrupted normal fresh food distribution, and the farm-to-consumer (F2C) business become a major alternative food supply channel for many households. More local producers started their online business through social media platforms, such as Facebook and Line. Many small parcel services mushroomed up to satisfy this growing demand of physical distribution, however, temperature-controlled delivery services are still limited to just a few service providers. Furthermore, in general, the shipper is responsible for packing, not the courier. Unfortunately, many local farmers are not capable of packing their products (i.e., seafood or fresh fruit) for long distance delivery. The community enterprise logistics agent emerged to help local farmers grasp the F2C e-commerce opportunity.

The research question of "How can IDEF0 help a consumer enterprise logistics service provider improve F2C distribution of temperature controlled/time-sensitive products?" needs to be addressed because many small farmers worldwide are struggling with this same ongoing distribution problem. The case study approach aims to promote quick dissemination and eventually easier adoption among practitioners. Within this specific case, the challenge of the F2C seafood and fresh fruit delivery is explored and the recommendations are provided.

2. MATERIALS AND METHODS

2.1 Data collection

Nowadays logistics service providers have adopted various combinations of assessment techniques; both qualitative and quantitative, to embrace the broader scope of customer expectations and perceptions of service quality performance (Mathong et al., 2020; Sureeyatanapas et al., 2018; Sureeyatanapas and Tawwan, 2018). Therefore, in-depth focus group interviews were adopted to collect qualitative data for analysis.

First, based upon the criteria proposed by Ying and Dayong (2005), the two focal stakeholders were identified as shippers (who demand delivery services) and local logistics agents (who collect products from shippers for a third party service provider). Next, an in-depth interview with a focus group was conducted to collect the data from both shippers and local logistics agents. The logistics agent group consisted of the agent manager and three staff members who operated in the receiving, packing and data input. The shipper group consisted of three shippers, who shipped seafood, fruit desserts, and dairy products via premium transportation service to a consumer. The semi-structured interview, adopted from Degirmenci et al. (2017), was used to address the following five topics; (1) company background, (2) business processes, (3) service performance of the local logistics agent, (4) activities and operating during the lead time from the agent to customers, and (5) problems and risks from cold chain management and customer service. As recommended by Umar et al. (2018), the interactions between agent staff and shippers were observed at the agent service center site and included in the analysis.

2.2 Data analysis

First, a swimlane diagram was drawn to present the sequences, time intervals between activities, and relationships of the activities with other functions in a company or with stakeholders such as a supplier and customer. The activities are presented in a square box with a number, and the length of the box indicates the time interval between activities. The box is located in a row, which indicates the response functions of a stakeholder of that activity. The arrow identifies the direction of the relationship from one function/stakeholder to another function/stakeholder. It was used to analyze food supply chains as raw milk blending for a collecting center (Chueprasert et al., 2016).

Next, as recommended by previous research, the IDEF0 was used to analyze the data and establish the business model (Chueprasert et al., 2016; Neisyafitri and Ongkunaruk, 2020; Ongkunaruk and Kessuvan, 2013; Poochinya and Ongkunaruk, 2020; Pradita and

Ongkunaruk, 2019; Prasertwattanakul and Ongkunaruk, 2018; Srilarp and Ongkunaruk, 2020; Tangkham and Ongkunaruk, 2019). IDEF0 is a tool for visualizing, analyzing, and improving business processes. It presents the details of the organization processes linked between the first to the last process (Waissi et al., 2015). There are several levels of IDEF0 starting from level 0 or the organization level which presents the relationship between stakeholders in the supply chain. Levels 1, 2, and 3 are internal processes levels. Specifically, the higher level contains more details of minor activities. The IDEF0 also consists of boxes and arrows. The function boxes present activities, processes, or systems. The four types of arrows are (1) a left arrow of the activity box, which represents input factors like raw materials or data sent to activities, (2) a right arrow of the activity box represents productivity after completing an activity, (3) an arrow at the top of the activity box represents a guideline used to control the activity, and (4) arrow at the bottom of the activity box represents a driver or mechanism of each activity that keeps the activity running. Additionally, the solid line indicates the current operation, and the dashed line indicates our proposed improvements. Then, the IDEF0 was used to identify and prioritize problems in the areas of planning, sourcing, production, delivery, and returns. Next, solutions were suggested by analyzing root causes of the selected problem (customer service), using the causal loop diagram (Kim, 2011; Rattanawong and Ongkunaruk, 2017; Chaitangjit and Ongkunaruk, 2019). Finally, suggestions for process improvement were proposed.

3. RESULTS AND DISCUSSION

3.1 Stakeholders in the express delivery business and their functions

There are five stakeholders involved in the express delivery business as shown in Table 1 and a swimlane diagram is presented in Figure 1.

Table 1. Role of a related person in the supply chain

Stakeholders	Logistics activity
1. Shipper	Farmers, groups of farmers, community enterprises, and SMEs who produce and sell products, and middlemen who sell products via social media and online marketplace channels. If the shippers deliver regularly, they can request the local logistics agent to pick up the products at their site. The samples are community enterprises and SMEs who produce and sell seafood and fruit desserts and dairy products.
2. Local logistics agent	A community enterprise logistics agent serves as a collector of local areas throughout Thailand. The main service is to collect products at the center by picking up or establishing the drop-off office. Additional services include: consulting on how to pack specific products, packing the product, pick-up products from shippers, temperature-controlled storage, delivery status tracking, and relaying delivery information to shippers.
3. Regional distribution center of logistics service providers (RDC)	The regional distribution centers of a logistics service provider are located throughout Thailand as a network, including Bangkok, Central, Northern, Northeastern, and Southern Thailand. There are four functions: 1) cross-docking is the sorting process between products to be distributed to customers in their area or to transported to nationwide distribution centers to distribute 2) packing service according to the company's standards, procedures, and standard packing equipment, namely: cool bag, temperature-control box, styrofoam boxes and repacking service if problems occurred 3) cold storage service 4) distribution of products to customers in responsible areas and pick up products from the local logistics agent to perform the cross-docking process. This study only focused on the Eastern region.
4. Nationwide distribution center (NDC)	The nationwide distribution center performs four functions: 1) cross-docking center which is the hub for sorting and distributing goods to customers in different regions 2) storing products in ambient and temperature-controlled warehouses 3) fulfillment service composed of storage services, order-based picks, and delivery directly to customers. The direct delivery is suitable for e-commerce or large businesses who would like to reduce transportation costs and increase customer service level 4) cold chain management service is the center for providing information, education services, and standardization to regional distribution and local logistics agents.
5. Customer	The customers who buy products from shippers are divided into two groups: 1) consumers sectors (B2C) 2) business sectors (B2B) such as restaurants. If customers cannot receive the products on the delivery date, the delivery can be postponed to the next day or products will be delivered to the local logistics agent located near customers.

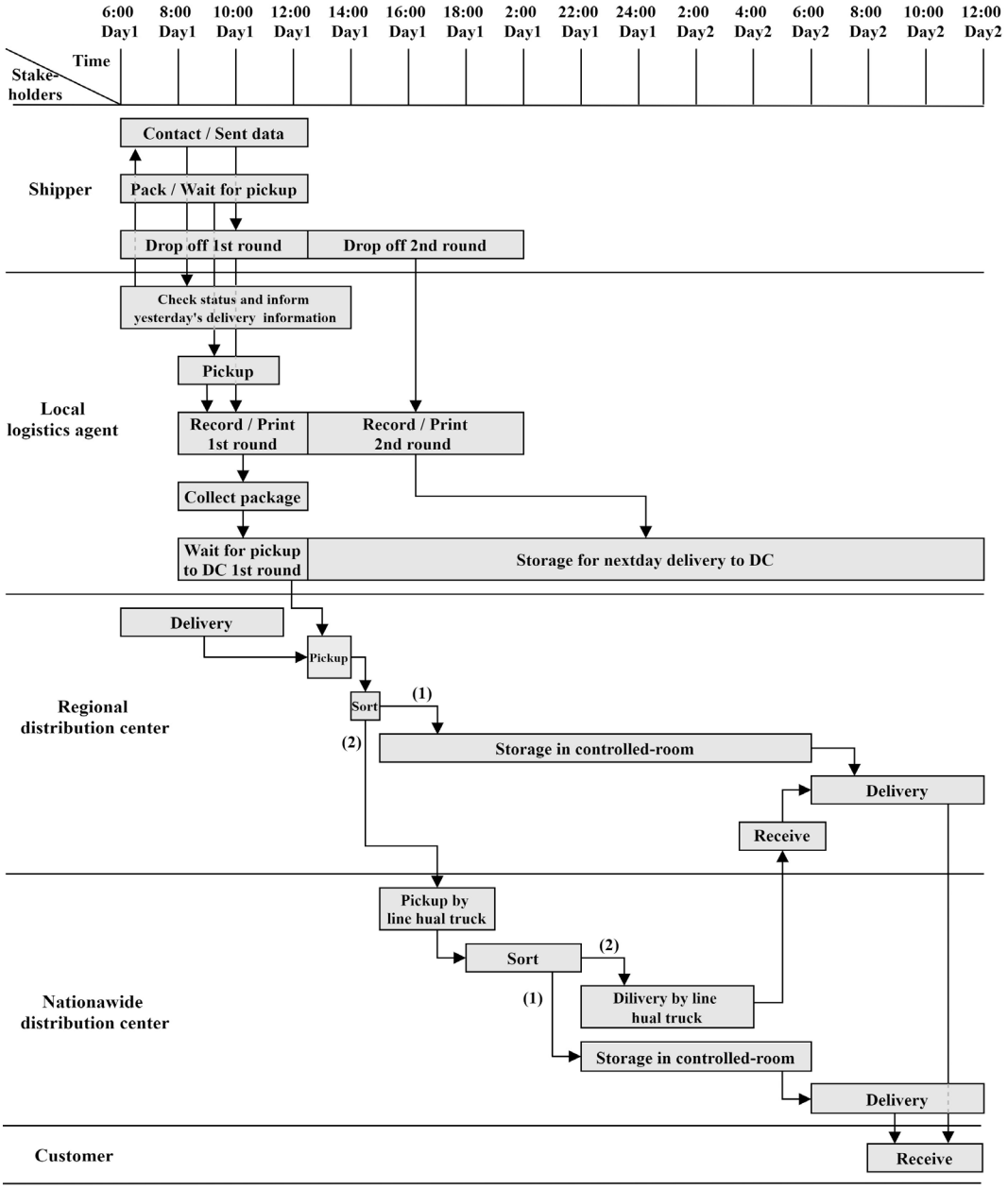

Figure 1. A swimlane diagram of the express delivery processes

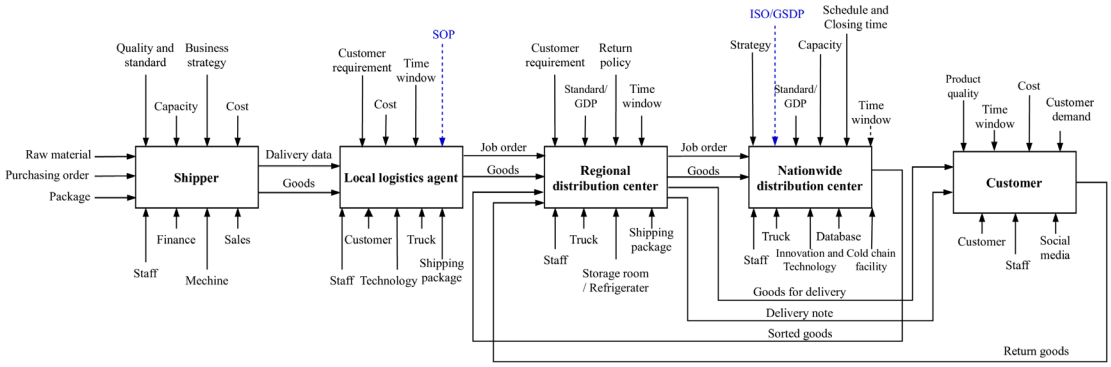

Figure 2. Business processes of the express delivery business (IDEF0 level 0)
Note: The black is the As-Is business process, and the blue is the To-Be business process.

In a swimlane diagram, initially starting from shippers' activities that are shippers contact a local logistics agent, inform shipping requirements and the product condition such as type, weight, size, and packaging needs to the local logistics agent. After that, the agent confirms the order. The shippers can choose to either wait for the agent to pick up the products at their places or deliver the packed products to the agent's center. If the shippers need the pickup service, they can contact the agent any time until 8 a.m. which is the daily cut-off time for pickup service. In the morning, the officer at the agent center checks the status of the products received yesterday and informs shippers of the current status. When the products arrive at the agent's center, customer service staff record the delivery information, fill the information into a database and print the documents tag to attach to the box and wait for the temperature-controlled truck from the regional distribution center to pick up the products in the first round. The cut-off time for the delivery is scheduled at 12:30 p.m. The products that arrive at the center after the cut-off time will be stored and scheduled for the next day delivery.

The activities of the regional distribution center (RDC) are to deliver products to customers from 6-12 a.m. and pick up the products at the local logistics agent at 12:30 p.m. and return them to the regional distribution center by 2 p.m. When the products reach the regional distribution center, they are divided into two groups based on their destination: (1) the destination within the region, and (2) the destination in the other regions. The first group of products are stored in temperature-controlled rooms based on item types and will be delivered to customers at 6 a.m. the next day. On the other hand, the product's destination to the other regions will depart to the NDC at 3 p.m. The activities of the NDC start with a temperature-controlled truck picking up products from the RDC and sorting products into two groups according to the receiver's address: (1) customers based in Bangkok and metropolitan whose products will be stored in the temperature-control room and wait for delivery the next day, and (2) customers in other regions whose products will be transported by express controlled-temperature trucks to the RDC for sorting and delivery at 6 a.m. The customers receive products from the RDC between 8 a.m. to 12 a.m. as presented in Figure 1.

3.2 Business process analysis of the temperature-controlled express delivery business

The focal case provided a comprehensive logistical business process to study since this agent was the largest branch in the province and registers commercially as a sole proprietorship. There was one branch manager and seven employees. The agent offered three types of transportation conditions including 1) frozen products such as ice cream, cooked food, prepared food, and seafood, 2) chilled products such as yogurt and peeled fruit, and 3) ambient products such as fresh fruit like durian, mangosteen, salacca and processed dried fruit, etc. The agent also provided services in other logistics activities such as receiving goods from shippers, temporary storage of products, and packing consulting. However, shippers and local logistics agents lacked a real understanding of cold chain management. This deficiency leaded to products arriving in an inappropriate state or deteriorating during transportation. Therefore, if the operators improved cold chain management through the in-depth study, it would directly affect the opportunity to increase reliability in the quality of products. This study was a good model for those involved in the development of cold chain systems.

In this section, IDEF0 was used to analyze the relationship among stakeholders of the temperature-controlled express delivery business (Level 0) as shown in Figure 2. Starting with shippers received orders from customers. Then, the shippers purchased raw materials for production and controled the quality, standard, and cost to align with the current capacity and their business strategies. The local logistics agent operated under customer requirements, time windows, and cost control. The agent provided shipping packages and pickup services. The improvement could be the establishment of standard operating practices.

The RDC operated under good distribution practice (GDP) standards, operators knew how to pack specific products according to the temperature characteristics, time windows, return policies, and customer requirements. They used styrofoam boxes, cool bags, temperature-control cartons, cooling equipment, ice packs, gel, and a controlled temperature room. The temperature in trucks was set to eight degrees celsius. The sorted products were separated based on the recipients' addresses. The NDC operated under GDP, time window, capacity, and strategy. Its cold storage operated under ISO 9001 and good storage and distribution practices (GSDP). There were innovative technology and database systems to enhance operations in the NDC.

3.3 Case selection and case background

During the COVID-19 pandemic, the adoption of F2C delivery has been accelerated by several factors, especially with the government stimulus spending program and restrictions placed on in-restaurant dining. Fruit farmers and local fishermen in Chanthaburi saw the F2C business opportunity but faced an immense challenge finding a temperature-controlled courier who understands the local shipper's needs. Based on our focus group, temperature-controlled couriers in this area were limited, and common couriers struggled to help small farmers to prepare and pack their products for long distance shipping. The focus group also emphasized that local farmers did not have much experience in F2C delivery. In our case, the focal company was one of very few pioneer community enterprises in Chanthaburi, who specialized in home delivery of fresh fruit and seafood to locations across Thailand. The scarcity of the CE logistics service providered limits the chance for a qualitative approach in such a case study. In addition, the sole entrepreneurship nature of this full-service provider also provided a comprehensive business process to the study.

This local logistics agent, the first in the province, was founded in 2017. It was one of ninety representatives of the temperature-controlled logistics provider. Eighty percent of products were temperature-controlled products using styrofoam boxes such as frozen products packed with dry ice, seafood packed with ice and salt, chilled products such as milk products, yogurt, and fruit in syrup packed with ice, and peeled fresh fruits packed without ice. Twenty percent of products were ambient products such as fresh fruit, and other goods packed with corrugated boxes. However, during the fruit season from March to July, this proportion would be reversed to eighty percent of ambient products. Some shippers are sold freshly peeled fruits in styrofoam boxes. There were four ambient pickup trucks to serve shippers and customers in Chanthaburi. The agent communicated with the shipper via the Line application.

3.4 Business process analysis of the local logistics agent

The local logistics agent was selected to analyze the process because the agent had different operating standards based on experience and the type of products distributed in each region. The quality of service would affect the agent's reputation and the trust of the shippers. Four main activities of the local logistics agent are shown by IDEF0 level 1 in Figure 3.

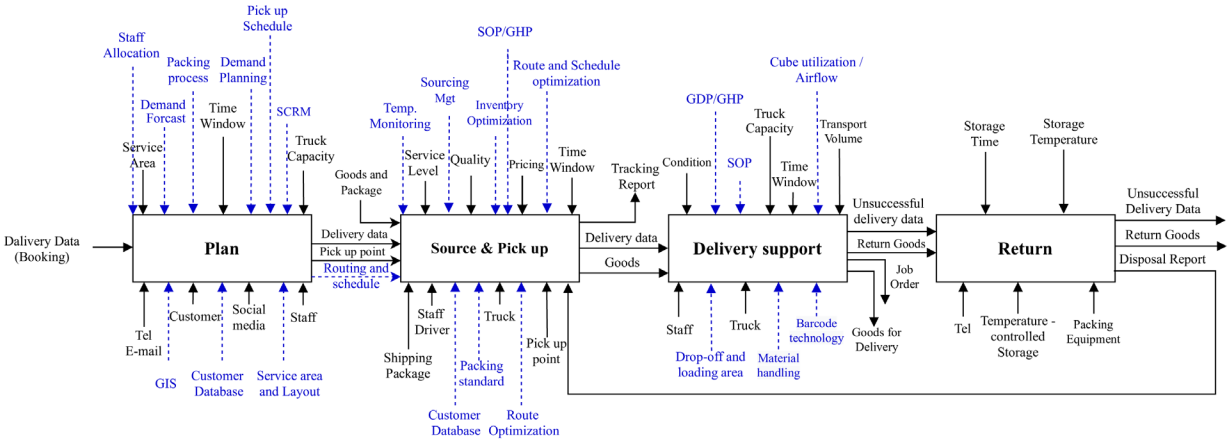

Figure 3. Business processes of the local logistics agent (IDEF0 level1)
Note: The black is the As-Is business process, and the blue is the To-Be business process.

3.4.1 Plan: there was a delivery plan based on customer requirements and orders from shippers in four districts of Chanthaburi. After receiving information including product type, dimension, weight, storage temperature, shipping location, and product box image, this information was used to create delivery data and shipping documents. Then, the staff printed labels to attach to the packaging. Before the truck picked up the products in the morning, the manager informed drivers to plan for the pickup schedule. Currently, there was no demand forecasting, which results in poor customer service due to long waiting time, especially during the fruit season with high demand from shippers. Besides, the service area was not properly designed for high demand in fruit season and the staff allocation was inappropriate. In recent years, the local logistics agent has faced the service level problem from the extremely high demand for transportation that requires line haul trucks to run directly from the nationwide distribution center to pick up products. Moreover, the agent has lacked a contingency plan for the risks in the supply chain such as accidents, shipping on wrong vehicles, and loss of products during storage.

3.4.2 Source and pick up: there were two types of incoming products: 1) shipper-delivered products in both packed and unpacked products delivered to the agent center, and 2) agent-pickup packed products and labeling them at the agent center. After the products arrived at the center, the counter service staff labeled items and take photos of the labeled items and sent the invoice to the shippers. The local logistics agent lacked pickup route schedule optimization to achieve low costs and high service levels. The main concern of shippers was service quality due to a lack of standard operation procedures (SOPs) and key performance indicators (KPIs) to evaluate the performance of counter service staff and drivers. The suggestions to improve customer service included setting proper SOPs and KPIs, and monthly training to increase service skills and service mindset. At present, the local logistics agent does not implement the proper inventory policy to determine the reorder point and order quantities for items like packaging and equipment such as corrugated boxes, styrofoam boxes, and adhesive tapes. Hence, the agent should implement the inventory policy in terms of procurement method, quantity, quality, and standards. In general, the agent buys packaging from online vendors without quality evaluation and long-term contracts while during high season, the agent purchases the corrugated paper from a manufacturer in a full truckload. In summary, the main problem was no standard practices in warehouse and inventory management. Some products were damaged during storage due to a lack of good hygiene practice (GHP) and good distribution practice (GDP), and not using packing standards. Hence, the agent was recommended to apply the warehouse management standard, partition the storage space, and exercise proper inventory policy. Furthermore, the agent should establish the manual for shippers to properly pack products using ice, salt, dry ice, and foam boxes according to the requirement of the products.

3.4.3 Delivery support: the local logistics agent was not responsible for shipping and distributing products, but collected, inspected, and loaded the products onto the trucks. The local logistics agent problems were the drop-off and the loading area, and lack of temperature-controlled trucks, lack of material handling and equipment to lift and move products, lack of parking space for trucks from the regional distribution center and nationwide distribution center, no proper loading/unloading area, lack of operational standards in the receiving and loading process, human error in sorting, and lack of inspection solution and technology for the receiving process. To reduce human error in the receiving and sorting process, the agent should use barcode technology.

3.4.4 Return: the local logistics agent did not have operations directly related to return activity. It was the RDC's responsibility if the customers were unable to receive the products. The products were stored in the temperature-controlled rooms until the next day delivery or the RDC informed customers to pick them up at the RDC, or deposited them at the local logistics agent. If there were no recipients, the driver contacted the shippers to return the products and re-pack if the package was damaged.

3.5 The causal loop diagram for service level improvement

The analysis resulted from the causal loop diagram as shown in Figure 4 revealed the possible causes of subpar service levels. The service level improvement concept in this causal loop diagram was based upon the supply chain operation reference model or SCOR model (APICS, 2017). There were five main key performance indicators in service levels as follows.

3.5.1 Reliability: reliability involved the following issues: (1) poor product quality caused by improper cold chain management in packing products, distribution, and no implementation of GHP and GDP standards (2) the return of the products due to staff input wrong shippers and customers information (3) wrong information from shippers such as wrong booking information and wrong pick-up locations (4) delayed delivery schedule from the agent, and (5) shortage of packaging materials and packing equipment.

3.5.2 Responsiveness: responsiveness involved the delivery cycle time. To improve responsiveness, the agent should reduce the operating time per customer using route optimization and set a standard operating procedure for packing and related services.

3.5.3 Agility: agility means the competency of the agent to quickly adapt its operations and tactics to cope with a sudden situation without notice in advance, especially during a pandemic situation like COVID-19. There were four factors to enhance the agility of the agent as follows: (1) improve customer service policy by expanding the customer service space for social distancing and reducing contamination (2) implement supplier relationship management to ensure a sufficient quantity of packaging (3) implement outsourcing policy to increase service capabilities, and (4) schedule resource personnel based on demand and set up a regular training program for staff.

3.5.4 Cost: the cost elements consisted of planning cost, sourcing cost, and pickup costs. The sourcing cost could be reduced by using the appropriate procurement method, selection, and bargaining with suppliers. In addition, the cost of the pickup should be analyzed to determine the appropriate service area and vehicle type.

3.5.5 Asset management efficiency: this term refers to the management of working capital to invest in equipment, packaging, and materials and to maintain the inventory levels to serve the demand. Cash to cash cycle time was the KPI to measure the efficiency of inventory management of packaging and materials.

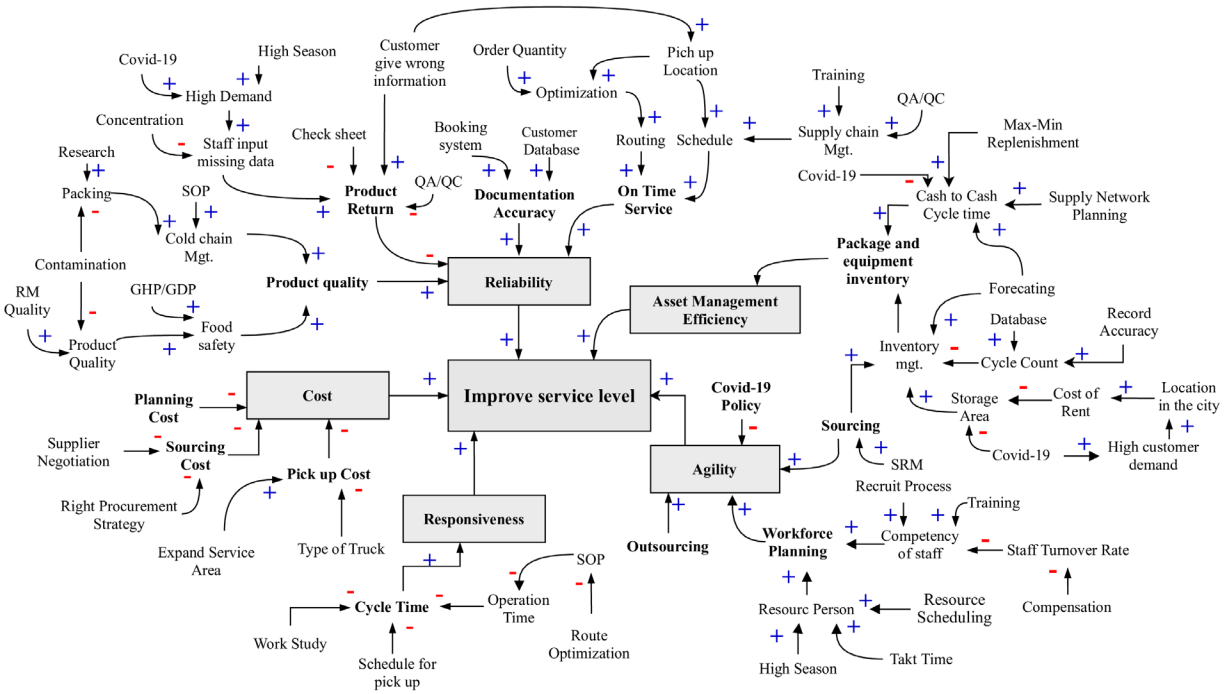

Figure 4. A causal loop diagram of how to improve the service level of the local logistics agent
Note: The plus sign (+) indicates a positive relationship where an increase in the causal variable leads to increase in the effect variable and the negative sign (-) indicates a negative relationship where an increase in the causal variable leads to decrease in the effect variable.

3.6 Suggestions for process improvement

Improvement guidelines were analyzed according to three major activities as follows.

3.6.1 Planning improvements

3.6.1.1 Pickup planning improvement: the local logistics agent should utilize a geographical information system (GIS) to optimize the pickup planning and scheduling (Ongkunaruk and Ongcunaruk, 2015; Yao and He, 2019). The GIS would help minimize cost and distance and help customize selection criteria and outsourcing options. In addition, the agent should implement a feasibility study on the use of a joint replenishment system to design a pickup route in case the products had different temperatures (Ongarj and Ongkunaruk, 2013; Doungpattra, 2012; Chen et al., 2016; Ongkunaruk et al., 2016).

3.6.1.2 Demand planning improvement: the local logistics agent should analyze demand forecast (Pradita et al., 2020b) and integrated business planning to determine the number of service requirements and to establish operation plans such as renting additional service areas during high seasons and offering promotional activities during low season. In addition, ABC analysis to group shippers in specific services should prepared.

3.6.1.3 Resource planning improvement: the agent should design workforce allocation and supply chain risk management (SCRM) plans (Pradita et al., 2020a) to assess whether there were unexpected situations such as employees infected with COVID-19 and low reliability in using the service from shippers.

3.6.1.4 Space management improvement: the agent lacked a preparation area for shipment products to a regional distribution. Therefore, proper layout and design of the preparation area should be implemented to cope with the COVID-19 situation for social distancing among customers.

3.6.2 Source and pick up improvement

3.6.2.1 Customer service improvement: the counter staff lacked a service mindset. The agent should establish a training program and an online assessment system to ensure the quality of services. The assessment results could be used as an incentive for staff.

3.6.2.2 Inventory management improvement: there was no inventory management for packaging materials and equipment. Hence, the inventory optimization of packaging and stock counting duties should be studied to reduce the inventory cost.

3.6.2.3 Workflow improvement: inventory cost: there was no standard of operation in the pickup of goods from shippers. Therefore, shippers and the agent should cooperate with research institutions or universities to research packing standards for chilled and frozen products (Navaranjan et al., 2013; Burgess, 1999; Singh et al., 2008), including the introduction of GHP and GDP principles from the shipper's manufacturing process. In addition, the agent should study standard time and standard operating procedures (SOPs).

3.6.3 Delivery support improvement: the agent lacked standard practices in sorting and loading vehicles. The truck from the regional distribution center lacked the stacking method to control the product temperature. To mitigate this problem, shippers and local logistics agents should study and implement standard operating procedures (SOP), cold chain management, and GDP, determine standard loading cycle times and use the proper material handling equipment and boxes (Chaitanoo et al., 2020). The regional distribution center should analyze cube utilization and improve ventilation potential and temperature control in the truck to determine vehicle type and stacking characteristics in vehicles (Defraeye, et al., 2015a; Defraeye et al., 2015b).

The summary of the problem for each of the supply chain activities and improvement techniques is shown in Table 2.

Table 2. Summary of the current problem and improvement in all activities

Activity	Problem	Improvement
Plan	Lack of pickup plan	- Establish a geographical information system (GIS) for pickup planning and scheduling - Optimize the routing, transport between locations, and joint replenishment
	Lack of demand planning	- Demand forecast - ABC analysis of shippers - Integrate business planning
	Lack of resource planning	- Workforce allocation - Supply chain risk management (SCRM)
	Lack of preparation area	- Design layout of the preparation area - Rent or prepare working area
Source and pick up	Counter staff lack a service mindset	- Staff training - Define KPIs for incentive - Use service evaluation equipment
Source and pick up	Lack of inventory management for packaging materials and equipment.	- Inventory optimization - Increase inventory accuracy and stock counting
	No packing standard and pickup of goods from the shippers is inefficient	- Research on packing standards for perishable products - Implement GHP and GDP - Route optimization using a simple tool and zoning - Set transportation standard time and standard operating procedures (SOPs) - Consider outsourcing options
Delivery support	No standard practice in sorting, loading, and storing products.	- Establish SOPs and apply cold chain management and GDP - Determine standard delivery cycle time - Use proper material handling equipment and boxes - Cube utilization and checking airflow and temperature control in the truck.

4. CONCLUSION

This research examined the business process of a local logistics agent, who serves as the local collector, to facilitate delivery service throughout Thailand. The findings revealed logistical issues in three main areas: planning, sourcing, and delivery. The focal company in this case provides valuable insights into IDEF0. This insight has helped them gain competitive advantages by gaining strong trust and building an effective operational plan. The local agents and nationwide 3PL can benchmark whether they have similar kinds of problems. Then, they can choose to use the KPI and best practices that fit with their situations. It is important to note that sourcing complications and inefficient pickup from shippers became more serious issues during COVID-19, while the issue of common management is present despite the pandemic.

The COVID-19 pandemic affects staff operations and makes shipper procedures more difficult. Meanwhile, the demand for transportation increases. Therefore, the development of the project is important. However, the entrepreneur's attitude toward cold chain management is insignificant. Therefore, future research should be conducted in collaboration with the university research unit and the agent. The topics of interest include the development of a temperature-controlled packaging management system to maintain the product condition throughout the supply chain and optimization of collecting routes for cold chain logistics of controlling temperature products.

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