Supply Chain Collaboration for Sustainability in Thailand's Dairy Industry

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ความร่วมมือในโซ่อุปทานเพื่อความยั่งยืนในอุตสาหกรรมโคนมประเทศไทย

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การศึกษานี้รวบรวมตัวแปรที่เป็นไปได้ 95 ตัวแปรจากการทบทวนวรรณกรรม ผ่านกระบวนการทบทวนโดยผู้เชี่ยวชาญเหล่านี้ถูกกลั่นกรองออกเป็นตัวแปรวิกฤต 49 ตัวแปร นอกจากนี้การศึกษานำร่องโดยการมีส่วนร่วมของสหกรณ์และเกษตรกรแต่ละรายมีวัตถุประสงค์เพื่อพัฒนากรอบแนวคิดใน 6 ด้าน ได้แก่ ประสิทธิภาพและความมุ่งมั่นความร่วมมือภายในและภายนอกการวัดและประเมินผลการดำเนินการร่วมการแบ่งปันและนวัตกรรมและการเจรจาต่อรอง นอกจากนี้ยังระบุถึง 26 ปัจจัยอย่างชัดเจนโดยการวิเคราะห์โรงงานเชิงสำรวจ นอกจากนี้การศึกษาหลักได้ดำเนินการผ่านแบบสอบถามแบบกระดาษโดยมีผู้เข้าร่วม 1,224 คนทั่วประเทศ สมมติฐาน 11 ข้อที่เสนอซึ่งพยายามระบุความสัมพันธ์เชิงโครงสร้างระหว่างโครงสร้างในแบบจำลอง

ผลการศึกษายืนยันกรอบแนวคิดที่ได้นำเสนอจากการวิเคราะห์องค์ประกอบเชิงสำรวจ (EFA) และแบบจำลองที่ได้รับจากการวิเคราะห์องค์ประกอบเชิงยืนยัน (CFA) และการสร้างแบบจำลองโดยการวิเคราะห์โมเดลสมการโครงสร้าง (Structural Equation Modeling) ทำให้เข้าใจปัจจัยและโครงสร้างที่นำไปสู่ความสำเร็จของการทำงานร่วมกันของโซ่อุปทานในอุตสาหกรรมโคนมของประเทศไทย จากผลการทดสอบสมมติฐานแสดงให้เห็นว่าในปัจจุบันมีการร่วมมือแบบ coordinated collaboration และความสำเร็จของการทำงานร่วมกันในซัพพลายเชนได้รับผลกระทบจากการทำงานร่วมกันในโซ่อุปทาน 26 รายการ ยิ่งไปกว่านั้นการทำงานร่วมกันในโซ่อุปทานที่ส่งผลต่อความยั่งยืนของอุตสาหกรรมโคนมของประเทศไทย การดำเนินความร่วมมือด้านโซ่อุปทานในอุตสาหกรรมโคนมของไทยส่งผลดีต่อความยั่งยืนของอุตสาหกรรมโคนมของประเทศไทย นอกจากนี้ยังถือได้ว่าเป็นการนำไปใช้เพื่อความสำเร็จในอุตสาหกรรม

สาขาวิชา	การจัดการโลจิสติกส์และโซ่อุปทาน	ลายมือชื่อนิสิต .....
ปีการศึกษา	2563	ลายมือชื่อ อ.ที่ปรึกษาหลัก .....
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Virayos Vajirabhoga : Supply Chain Collaboration for Sustainability in Thailand's Dairy Industry. Advisor: Prof. KAMONCHANOK SUTHIWARTNARUEPUT, Ph.D. Co-advisor: Assoc. Prof. PONGSA PORNCHAIWISESKUL, Ph.D.

This study gathered potential 95 variables from a literature review. Through the process of expert review, these were refined into 49 critical variables. Moreover, pilot study, with participation from co-operatives and farmers, aims to develop conceptual frameworks in six areas: performance and commitment, internal and external collaboration, measurement and evaluation, joint operation, sharing and innovation, and negotiation. Furthermore, 26 factors were identified clearly by exploratory factory analysis. The main study was conducted via a paper-based questionnaire with 1,224 respondents nationwide. The proposed 11 hypotheses attempted to identify the structural relationships among the constructs in the model. The result confirmed the proposed framework from EFA, and a verified model, by CFA and Structure Equation Modelling, gives a clearer understanding of the factors and constructs leading to the sustainability in Thai dairy industry. The result of testing, it presented that coordinated collaboration is existing type of collaboration, success of supply chain collaboration impacted by 26 items. Moreover, supply chain collaboration impacted to sustainability of Thailand’s dairy industry. Finally, supply chain collaboration in Thai dairy industry had a positive impact to the sustainability of the dairy industry of Thailand. Thus, it can be considered to implement for the success of dairy industry.

Field of Study:	Logistics and Supply Chain Management	Student's Signature .....
Academic Year:	2020	Advisor's Signature .....
		Co-advisor's Signature .....

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Virayos Vajirabhoga

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1.1 Background and Motivation

Story of milk and dairy products

Milk, and others dairy commodities are enriched of nutrient foods, it is supplying energy, proteins, amino acids, minerals, and other micronutrients.

FAO (Muehlhoff, Bennett, & McMahon, 2013) also showed that the basics function of milk is to feed the newborns of human and animals. The consumption of animal milk it happened about 10,000 years ago.

Milk is a major source of required nutrient which provides magnesium, selenium, calcium, riboflavin, pantothenic acid, and vitamin B12. Food origin from animal, including red meat, milk and dairy products, play an important role as providing zinc and vitamin B12 in children that facing risk or problem of micronutrient deficiencies (Muehlhoff et al., 2013).

Cow milk, it is acting an important role as a source of vitamin B12, which is a nutrient commonly lack in human that consume low amounts of animal source foods and it (Muehlhoff et al., 2013) can thus help to improve nutritional status of children. Moreover, milk also can act as a fortification carrier for micronutrients.

Muehlhoff et al., (2013) showed in FAO publication that the highly rise in proteins consumption such as meat and milk is impacted by growing incomes of

millions of people. It is moving from basic plant-based foods into containing high amounts of animal source foods. These changing trends are continuing by external pressures, moreover, in developing areas are remaining huge needs of animal proteins diets, the demands are moving increasing.

Increasing demands of milk, dairy, meat, and other livestock products is leading awareness of nutrition benefits in developing countries, even though many people in developing countries still cannot afford for better or high-quality foods due to the cost. It also gives opportunities for small farms and medium farms in dairy industries (Muehlhoff et al., 2013)

Milk contains many nutrients and it makes an important for the human body needs of vitamin and trace elements such as vitamin B5, vitamin B12, selenium, magnesium, calcium, and riboflavin. However, milk contains low level of iron and folate while the demands of growing newborn is higher, and this is a reason that animal milk products are not recommended to use as a main source of diet for infants less than 1 year. (Muehlhoff et al., 2013)

Animal proteins such as milk, dairy, meat, chicken and other food producing animals products have a high earning-elasticity of need, notably at medium to low earning segments (Gerosa & Skoet, 2013). Gerosa and Skoet (2013) also said that It means that a limited increase earnings or income effect to proteins consumptions in a higher percentage. Specific to milk and dairy products, there have earnings elasticities of need more than most other food commodities, including meat, shrimp, lamb, pork,

and fish. On the other hand, once earnings grow, it will lead consumption or purchasing on milk and dairy products increase faster than other animal source food.

Cow milk

Typically, majority of cattle species that are using as dairy cattle, both species, Bos taurus (hump less cattle) and Bos indicus (zebu cattle), almost 35 percent of cows on hand as milking cow (about 70 million heads) are to the Holstein-Friesian. This breed is more suitable by reason of, it gives high milk yield in average and it has high feed conversion ratio (FCR), it means one kilogram of feed, can produce protein more than other breed. (Wijesinha-Bettoni & Burlingame, 2013)

Cow milk is sharing about 83 percent of world-wide milk sources in 2010. Cow milk is acting as a source of nutrients and mineral that more important for life such as calcium and phosphorus, than human milk (Table 1). For example, in cow milk, the protein is of good quality, having a good combination the essential amino acids, such as lysine. Large numbers of human foods are lack of certain essential amino acids. In conclusion, milk together with other dairy diet can be used to improve food or diets quality in overall (Wijesinha-Bettoni & Burlingame, 2013).

However, human milk contains more lactose than dairy products. Human milk does not have β-lactoglobulin, it is a major protein that associated to allergy of cow milk in human. In cow milk also contain nearly 80% of caseins while in human milk contain just 40%. As curds in the stomach can lead to deadly problem in newborn, casein is one of the reasons, moreover, it is not easy to digest as well. For the casein

level in milk, as the result of analysis, it proved that different breed of cow gives different level of casein. Furthermore, high casein milk is more select by cheese makers (Wijesinha-Bettoni & Burlingame, 2013).

Classification of Milk

Fat content in milk is using as a classification tools for the milk, it can be classified to be whole milk, skimmed milk, semi-skimmed milk, low-fat milk, and standardized milk. Moreover, production processing can be used classify milk category, for example, as UHT milk (ultra-high-temperature-treated milk), sterilized milk, pasteurized milk, and extended shelf-life (ESL) milk and, others.

Table 1 Milk Composition and dairy diets (per 100 g of food)

(Wijesinha-Bettoni & Burlingame, 2013).

Description	Water (g)	Energy (kcal)	Energy (kJ)	Protein (g)	Total fat (g)	Lactose (g)
Cow milk, whole, fresh	88.1	61	256	3.2	3.3	5.1
Cream, fresh	73.8	195	818	2.7	19.3	0.1
Butter of cow milk	15.9	717	2999	0.9	81.1	0.1
Ghee (from cow milk)	0.2	876	3664	0.3	99.5	0.0
Skim milk of cows	90.8	34	142	3.4	0.1	5.1
Whole milk, condensed	27.2	321	1343	7.9	8.7	54.4

Yoghurt	87.9	61	257	3.5	3.3	4.7
Whole milk, evaporated	74.0	135	567	6.8	7.6	10.0
Skim milk, evaporated	79.4	78	326	7.6	0.2	11.4
Dry whole cow milk	2.5	496	2075	26.3	26.7	38.4
Dry skim cow milk	3.2	362	1516	36.2	0.8	52.0
Dry whey	3.4	346	1448	12.3	0.8	74.0
Whey, fresh	93.3	26	107	0.8	0.2	5.1

Thailand's Dairy industry

Thailand's dairy industry, in 1960, it has been founded after some dairy were gave to Thailand by the King of Denmark during the visit of the King of Thailand. As a result of the visit, the Dairy Farming Promotion Organization of Thailand was established by the King, while Department of Livestock Development established the insemination station. Moreover, in 1971, native cows were breed with Holstein Friesian to develop the dairy cows that suitable for Thailand climate.

Nowadays, Thailand can produce raw milk per day about 2.8 thousand metric-tons, or about 1 million metric-tons a year in 2015. Approximately 40% of milk production are using for a project called "school milk project" and the rests for commercial market (Thongnoi, 2015).

Thailand's Dairy production

In the past, milk and dairy products were not a major supply of protein in Thailand, milk was more important role in Thailand around 1950 onward. However, around year 2000, animal milk is increasing in term of production and consumption about more than 1.5 times (Phi, 2017)

Dang Xuan Phi (2017) said about the source of dairy in Thailand, it comes from 2 major sources. the co-operatives and milk-collecting centers are providing raw milk. The co-operatives, set up by small dairy farmers who have the lactating cow on average about 15 to 20 cows per farms, then supply the daily milk requirements to the co-operatives that they are committed, and in some co-operatives are doing as manufacturers of milk products.

Dairy Farming Promotion Organization (DPO), a government own organization, has a clear objective to promote, support, develop the growth of the industry, not only manages dairy co-operatives, but also regulates private milk-collecting centers as stand alone. Some co-operatives and milk-collecting centers are producing milk for consumption directly, on the other hand, some are doing the dairy products more than direct consumption milk, for example, yogurt, ready to drink yogurt, flavored milk, and cheeses.

Thailand's dairy products market

The number of dairy commodities in Thailand is increasing at the same time, dairy commodities in this region are, for instance Australia, New Zealand, South Korea, and China, as well as increasing. Additionally, dairy products from these major countries are be able to entry Thailand milk market effortlessly. As result, in 2015, total imported dairy commodities to Thailand was 583 million dollars.

Moreover, the free trade agreement and AEC have impact to Thailand dairy farmers, this agreement enhance competitive advantages for China and Vietnam producers, while Thai producers are on risk of losing market share. Thai industry has a low performance and higher production cost when compare with others in the ASEAN. This industry has a risk to be taken over by other ASEAN countries when compare in term of performance and cost.

The dairy sector of Thailand is both a local market and an export markets, for the export markets, Thailand's dairy commodities are exporting to neighbor countries such as Cambodia, Laos, Myanmar, and other countries. In 2015, Thailand exported dairy commodities 192 million dollar.

In term of balance in value of dairy products, raw milk is currently not enough supply for domestic consumption. This forces, Thailand imports milk and dairy products from others. Importers need to pay tax which is a system that help to protect our domestic industry. However, in reality, powdered milk is charged only 5% Tax, but the condition is, milk manufacturers must use local dairy products first, then can use

the imported products. Furthermore, beneficial to develop competitive advantage of Thailand's stakeholder in this business, some issues are needed to solve. for instance, performance enchantment, cost reduction and quality products are key areas that Thailand needs to improve.

Industry problems

Department of Livestock Development, Thailand demonstrated that the issues and problems in the dairy products values chain in Table 2.

Table 2 Thai Dairy industry's problems

Problems	Comments
1. Genetic Improvement	Low milk yield production from the non-improvement genetics
2. Research and extension of livestock	Some technology is not suitable for them due to highly investment
3. Farmers	Limited capital for investment Limited knowledge and go to market model
4. Feed management	Not enough area to grow the proper grasses and other rough feed

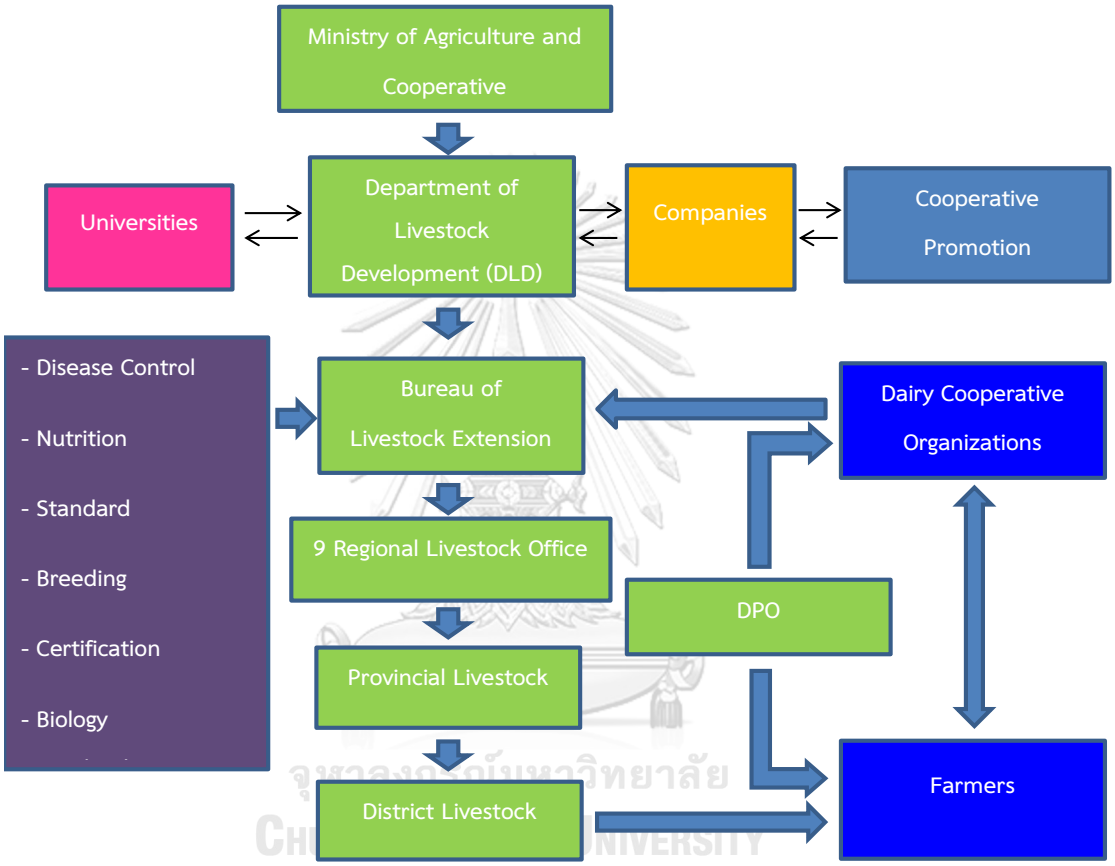
5. Reproductive or farm performance	Poor reproductive performance leads to economics issue in single farms level, co-operative level, and national level
6. Health and hygiene management	20 – 25 % of dairy cows are culled due to health-related problems
7. By-products utilization problems	Waste from water and cattle feces need to manage. This is one of 3 pillars for sustainability
8. Quality control of dairy products	Quality of milk is concerned by the consumers
9. Processing of dairy products	Limited products innovation
10. Marketing of dairy products	Limited go to market channel by farmers

In this study, we are focusing in supply chain activities that impact the dairy industry. It means the research is focus in farmers, feed management, by-products utilization, quality of animal products, processing, and marketing of dairy products.

To make understanding of stake holders of Thai dairy business, as per below figure, farmers and co-operatives are the important stake holders in the chain, due to, only the part of productions. The rests are the government officers and regulators, or technical people. However, this chart showing about the information flow and the

knowledge flow together with line of regulator (Figure 1). We are going to discuss the supply chain and value chain in the different chart.

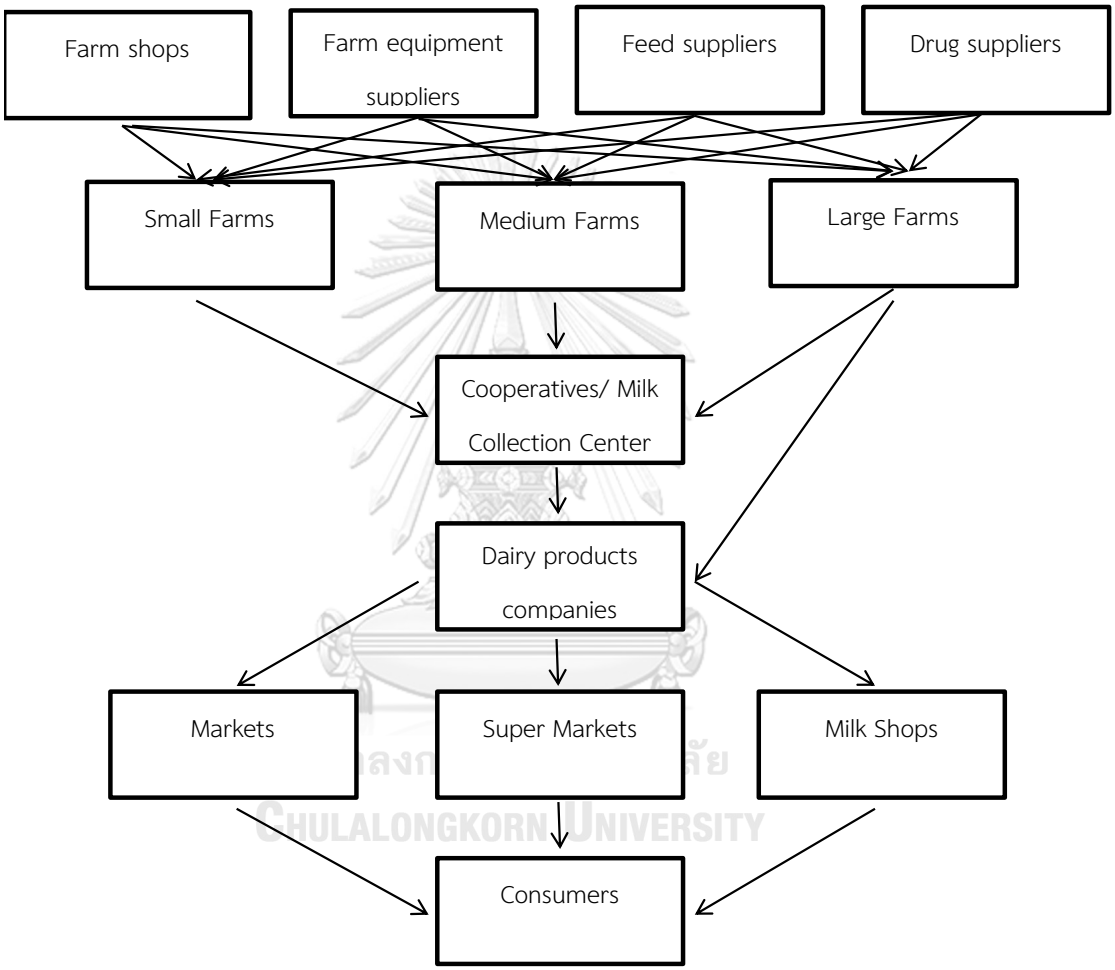
Figure 1 Stakeholders in Thai dairy products and relations (DLD and DPO information)



In Thai dairy business, on top of the knowledge and information flow, this figure also shows the supply chain flow. From supply of raw materials, such as feed, farm supplies, health care products are not only supplying to the farms directly but also supply to the co-operatives. Moreover, co-operatives are doing as the supplier to farms not only the supplies, but also for the financial supply as well as farm management

knowledge. Farmers are the suppliers to the co-operatives and milk collector in term of the raw milk, then farmers, co-operatives, and milk collectors are acting as the suppliers to the dairy manufacture and companies. Then last chain are consumers

Figure 2 Dairy products supply chain in Thailand



However, in this study we are focusing only for farmers and co-operatives level due to this portion are the most important of the chain.

Motivation of the research

Researcher has a background in animal health industry, veterinarian science, and agriculture in Thailand and nearby countries. Moreover, unlike industrialized products such as automobile industry, electronics industry, etc., agriculture industry is semi control for the production and performance. It is not only for the controllable factor from the factory. For the agriculture industry, it might be impacted by many external uncontrollable factors for example, climate change might impact in many aspects – less of water from the rain can lead to many problems, or high volume of water, also lead to the flooding. These are the reasons for the agricultural needs more study. Moreover, the production performances are related to external factors, if we can do more collaboration among the chain, it leads to reduce the gap in the industry.

Second, Agriculture businesses are fundamental of Thai businesses. We have rice, corn, fishery, fruits, and dairy industry. Dairy farming profession was initiated by His Majesty King Bhumibol, as per the quote of the speech below.

"...Dairy farming is an appropriate profession for Thai people. With proper knowledge, we can grow and earn decent income..."

His Majesty King Bhumibol's royal speech given to the delegates of Agricultural Co-operatives, Estate Co-operatives, Fishery Co-operatives, Juvenile Agriculturalists, and milk collecting co-operatives. Then, researcher sees that this industry is a fundamental of Thai people. If we can provide them the right direction and right framework, it would be help them in a sustainable way.

Third, dairy products are sources of protein for the consumers, once we can improve the industry and businesses in the sustainable way, we also can help Thai people to get the better sources of protein. For example, the School milk program, this is one of the topics that need to be solved.

All in all, researcher expected to enhance supply chain collaboration of dairy business, this is not only for the business sector; however, this will be impacted to the backyard farmers from the left hand side, they will get the benefits from the suitable supply chain model, on the other side of chain, consumers will also get the benefits from the right supply chain and farmers can deliver the right products to the right people.

1.2 Research Questions

The research objectives are to explore and understand the existing collaboration model in dairy products supply chain. This research examines the research questions as following:

(1) What is type of an existing supply chain collaboration of dairy industry?

(2) What is the level of adoption of supply chain collaboration in Thai dairy industry?

(3) What are main factors of supply chain collaboration that can create the dairy business competitive advantages?

(4) What is the proper model of supply chain collaboration of Thailand's dairy industry in? And how can we develop the model?

1.3 Research gaps

Since now, there are not many studies on supply chain collaboration in dairy industry. The related study that found, it studied about improving raw milk logistics system. However, for the study, it was from one cooperative in North-eastern area of Thailand.

Moreover, some study in Greek showed that (Ghadge, Kaklamanou, Choudhary, & Bourlakis, 2017) the Greek dairy supply chain stakeholders need to seriously develop key sustainability performance indicators immediately. In this case, stakeholders are breeders, manufacturers, wholesalers, retailers, and catering companies. They also demonstrate that the main driver for the implementation of key initiatives in the industry are the large dairy production plant.

In addition, Australian dairy industry had the framework for the sustainability dairy industry since 2010 and now implement for the long-term plan for 2030. However, for this sustainability, it is not link to the supply chain collaboration

Furthermore, another evidence on the supply chain collaboration about dairy industry was in Indonesia, mainly on dairy farms. Therefore, this study has the expectation to frame a framework of supply chain collaboration for Thailand's dairy products industry and their other benefits.

In Pakistan, Zia Ullah Muhammad et al. (2014) demonstrated that disruption of supply chain management has become serious topic, the three critical problems or

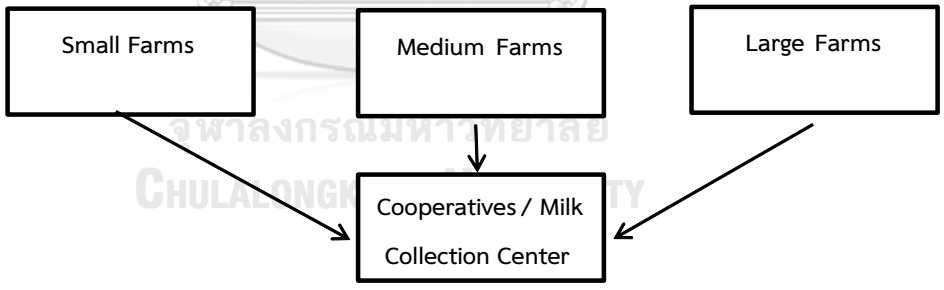
discussion points are informal channel, bargaining power and information barriers (Muhammad, Akhter, & Ullah, 2014)

In summary, Supply chain collaboration in dairy industry has limited reports or studies, especially in Thailand, and this gap is important for Thai farmers to develop their self, and it was expected to support the industry.

1.4 Scope of the study

An exploratory research will focus on Thailand's dairy industry in general. Many operations will be covered in this study. Moreover, it will cover in different levels from large scale to small and medium scales, and from different geography.

Figure 3 Area of the study



1.5 Research methodology

This study separated into 3 parts

1. Expert interviews
2. Pilot study
3. Survey

Expert interviews

A total 11 experts from Thailand's dairy industry were interviewed by researcher from October to November 2020

The interview sessions with them in 4 regions of Thailand: North-eastern, Eastern, Central and Western. There were 11 interviews with industry experts, as shown in table 3.

Table 3 Experts interviewed in each region

Region	No. of experts interviewed
North-eastern	2
Eastern	5
Central	3
Western	1
Total	11

Pilot study

A paper-based pilot group survey was conducted with managers of the Dairy Farming Promotion Organization of Thailand (D.P.O.); academics such as a Dean of Veterinary Science, Walailuck University and Dean of Veterinary Science, Mahasarakarn University; officers of the Department of Livestock development; managers of large farms in the central region; and members of dairy co-operative communities from 4 regions: North-eastern, Eastern, Central and Western. The survey was conducted in Nakorn Ratchasima, Chantha Buri, Prajeub Kirikun and Saraburi provinces in October-December 2020, using the Likert-scale from one to nine score (one is strongly disagree, and nine is strongly agree).

Moreover, the pilot survey was conducted with participants as dairy farmer from Northern, Central and North-eastern areas of Thailand. Finally, total, the pilot study had a sample size of 158.

Survey

A total of 186 co-operatives and milk-collecting centers (one center is not active as a center) surveys were conducted by mail. A paper-based questionnaire was starting in January 2021. Total of questionnaire was 6,702 printed copied. For non-respondents, they were contacted by email during February to March 2021

1.6 Research expected contributions

1. To identify type of supply chain collaboration in Thai dairy industry
2. To demonstrate the level of supply chain collaboration in Thai dairy industry
3. To show the key success factors that lead to success of Thailand's dairy business
4. To address the factors that all stake holders need to improve
5. To prioritize the important factors that can enhance supply chain collaboration for the industry
6. To develop the proper supply chain collaboration model of supply chain for dairy industry in Thailand

1.7 Terminology and definition

Dairy Farming Promotion Organization of Thailand (D.P.O.) is a government-owned organization under control of Ministry of Agriculture and Co-operatives. It was established in Thailand since 16 January 1962, with missions to support and establish Thailand's dairy industry. Dairy Farming Promotion Organization of Thailand is not only supporting technical knowledge about cattle farming, managing dairy co-operatives that under their supervision, but also acting as milk producer such as ready to drink dairy products under Thai-Denmark brand name.

Department of Livestock Development (DLD) is a government organization that has main duty to control animal related activities such as animal health controlling, prevention, treatment, regulation the law. DLD has center office, reginal office, and provincial office in the local areas.

Co-operatives is the organization that support the farmers that create the bargaining power in the supply chain. They also be able to provide farm equipment, animal health products, feed for the farms.

Milk-Collecting Center is a private organization to gathering milk from farmers and deliver to the manufactures. However, it also is acting like a co-operative.

Manufactures is a ready to drink milk producers.

Farm shops is a shop that provide the goods that farmers can reach in the remote area.

Farm equipment suppliers is a shop or company that provide the farm equipment such as milking machine, milk tank, liners, etc. that farmers can reach in the remote area.

Drug suppliers is a company that provides health care products to the farms, co-operatives, and farm shop. It can be a local or a multinational company.

Feed supplier is a company that provides feed for the farms. It can be local in region or national wide company.

Chapter 2
Literature review

2.1 Supply chain collaboration

Supply chain collaboration and management have been successfully implemented to many industries. For example, a study conducted a survey regarding to collaboration and management of supply chain by using a questionnaire in construction industry focused on top contractors' companies of in the United Kingdom. They found that in the construction industry in UK had some awareness of supply chain collaboration; however, it was not high (Akintoye, McIntosh, & Fitzgerald, 2000).

Moreover, another report presented concept of collaboration in supply chain was highly critical in agricultural and food businesses. They were showing some difficulty of implementation supply chain collaboration, because of the characteristics of products in the industry, moreover, the segment's structures were not support. Furthermore, limitation of operational and logistics-related activities were not favorable for collaboration in the supply chain (Matopoulos, Vlachopoulou, Manthou, & Manos, 2007).

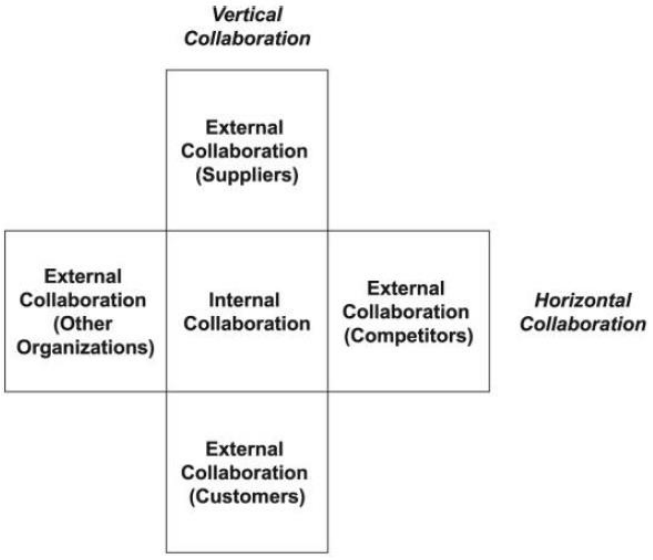
Supply chain collaboration shows a critical role impact the success of the business, Ramanathan and Gunasekaran (2014) studied an impact of long-term partnership in supply chain collaboration for garments and textile industry, and they

result of study showed that the success of supply chain management, and activities were affected by some collaboration factors. Moreover, collaborative in execution of supply chain plan also leads to collaboration in the future (U. Ramanathan & Gunasekaran, 2014).

Barratt (2004) said supply chain collaboration has known that it is difficult to implement but it still has a high potential to deliver significant improvement to the firm, organization, or industry performances. The study also demonstrated the scope of collaboration. There are two dimensions of collaboration, vertical and horizontal collaboration in supply chain. It shows in the Figure 4 (Barratt, 2004). In vertical, it shows the collaboration with suppliers and customers with the organization. While, the horizontal, it shows collaboration with competitors and other organization are keys. Moreover, internal collaboration is addressed in the scope as well.

Figure 4 The scope of supply chain collaboration

(Barratt, 2004)



Barratt (2004) also mentioned about the inter- and intra-organization integration. Within company, it has set up inter-organization collaboration. From the strategic level, it must have communication down to tactical level and cascades down to the operational level.

While inter-organization is setting up the collaboration in the company, intra-organization also important that needs to address. Same as, inter-organization integration, intra-organization needs to have strategic, tactical, and operational integration. Among the companies, the same level it needs to align the integration together with communication and other factors as shows in the Figures 5.

Figure 5 Level of inter-organization and intra-organization integration

(Barratt, 2004)

Figure 6 Strategic components for collaboration in supply chain

(Barratt, 2004)

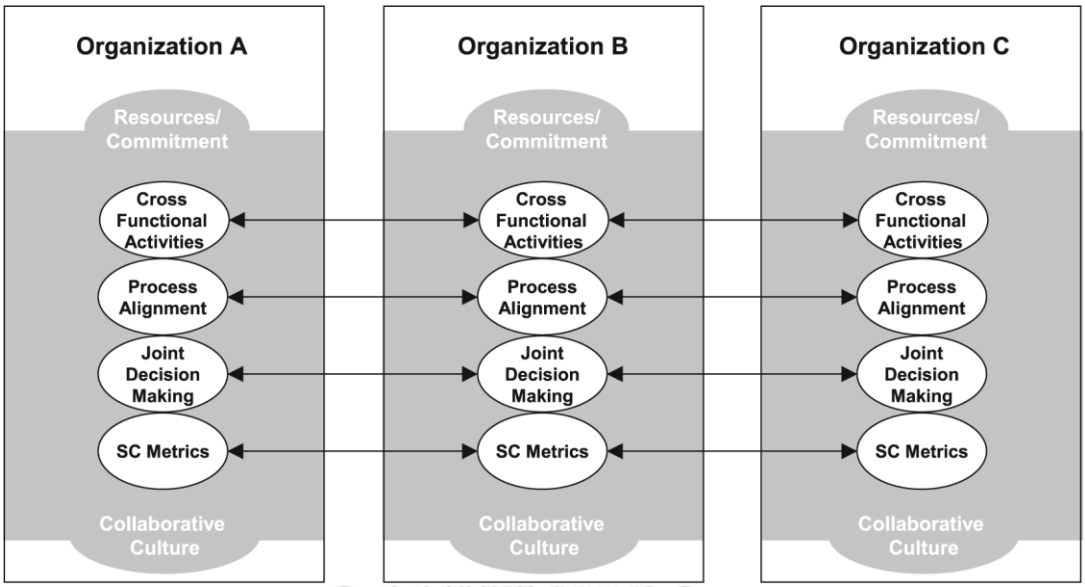


Figure 7 Vertical supply chain collaboration

(Barratt, 2004)

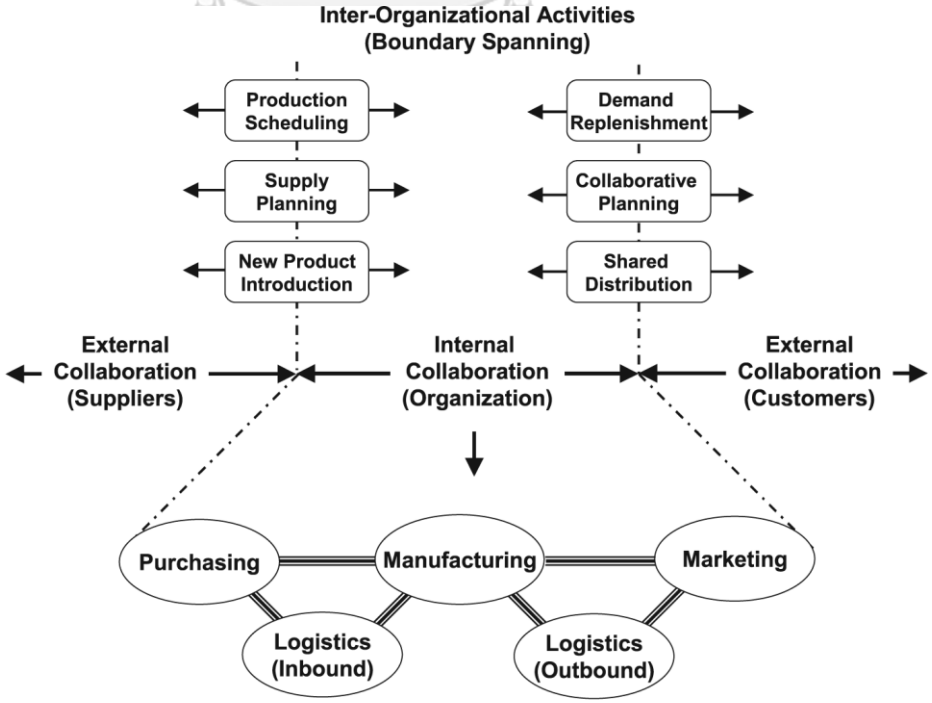


Figure 7 shows that vertically collaboration among functions or departments in organization. It has many activities that should align such as manufacturing and marketing with support by logistics activities.

Moreover, Chen et al. (2017) did a literature review together they addressed the future research agendas for sustainable collaboration in supply chain. It demonstrated the sustainable collaboration in supply chain has many factors involved. However, it can be grouped to be 5 groups to measure sustainability of supply chain as following: collaboration internally, supplier collaboration, customer collaboration, collaboration with competitors, and collaboration with other organizations. They also showed the model of supply chain collaboration for sustainability, and researcher can use this as an idea for the model.

While, U. Ramanathan and Gunasekaran (2014) published impact of success on long-term partnership of supply chain collaboration. This study showed that supply chain was successful by factors of collaboration. This is confirmed to researcher that collaboration in supply chain leads to business success. Moreover, they addressed that SEM can be used to study for collaboration context

Ramanathan, Lorentz, Gunasekaran, and Subramanian (2011) demonstrated a conceptual framework of supply chain collaboration in their study. They showed and identified metrics of supply chain collaboration performance that can be used in supply chain collaboration. this study showed a model that can be supported to

describe collaboration in supply chain. However, in some points of metrics, they need to consider with others researches for the important of the metrics (Usha Ramanathan, Gunasekaran, & Subramanian, 2011).

Soosay, Hyland, and Ferrer (2008) presented supply chain collaboration by using capabilities point of view, that explain the endless improvement of innovation. It showed that supply chain collaboration is important for firms and it enhances firm capabilities

Definitions

Regarding to supply chain collaboration, it was presented by many authors in definitions. Gathering the definitions were shown in Table 4.

Table 4 Definitions of supply chain collaboration.

Authors	Definition
Horvath (2001)	Supply chain collaboration is the energetic effort of high-performance supply chain management, between all parties in the value chain, it is not related about the size, function, or relative position
Simatupang and Sridharan (2002)	More than autonomous organizations joining to develop, arrange and implement supply chain activities
Wood and Gray (2016)	When a number of independent stakeholders of a problem sector engage in a participated step, sharing common rules, standard, and framework, network, to operate or determine on concerns linked to that sector then collaboration happens
Skjoett-Larsen, Thernøe, and Andresen (2003)	More than two organizations in the supply chain together plan several marketing activities and work out integrated forecasts, based on determination of the operation processes of production and product fulfillment

S. Cohen and Roussel (2005)	Firms within chain of supply pursue together with similar direction and objectives as a result the sharing of problems, risks, rewards, ideas, data, information, and knowledge
Simatupang and Sridharan (2008)	The operation of working together in the midst of independent organizations (more than two) along a chain in distributing goods to end consumers for standard objective of enhancing continuous profit for all stakeholders in the chain together with building a better capabilities for real competition

Supply chain collaboration variables

Review of factors

To identify the important factors that lead to success of supply chain collaboration, data was collected from 43 supply chain collaboration studies. This identified 95 variables leading to supply chain collaboration success in many industries, as shown in Table 5 below. However, in milk and related products, studies of supply chain collaboration are more limited.

Table 5 Important factors for supply chain collaboration.

Factors	Authors
Adaptation	Dania, Xing, and Amer (2018)
Alliance or conflict resolution	Kumar and Banerjee (2012); Lemma (2015)
Business objective (financial/operational)	U Ramanathan (2014); Usha Ramanathan et al. (2011)
Collaboration with competitors, collaborative capacity sharing	Chen et al. (2017)
Collaboration with other organizations	Chen et al. (2017)
Collaborative performance system	Simatupang and Sridharan (2004); Simatupang and Sridharan (2005a); Simatupang and Sridharan (2007)

Commitment	Fawcett, Magnan, and McCarter (2008); Kumar and Banerjee (2012); Touboulic and Walker (2015); Dania et al. (2018); Banomyong (2018)
Communicating/communication and understanding	van der Heijden and Cramer (2017); Touboulic and Walker (2015); Barratt (2004); Chen et al. (2017); Kottila and Ronni (2008); Kumar and Banerjee (2012); Chakraborty, Bhattacharya, and Dobrzykowski (2014); Cao and Zhang (2011); Soosay et al. (2008)
Continuous improvement	Dania et al. (2018)
Cost reduction/cost	U. Ramanathan and Gunasekaran (2014); Banchuen, Sadler, and Shee (2017)
Cross-functional collaboration - activities/ team	Ellinger (2000); Chen et al. (2017); Barratt (2004); Lemma (2015)
Customer structural collaboration	Chen et al. (2017); Vereecke and Muylle (2006)
Decision synchronization - decision sharing	Simatupang and Sridharan (2004); Simatupang and Sridharan (2005a); Simatupang and Sridharan (2007); Cao and Zhang (2011); Simatupang and Sridharan (2005a); Liao and

	Kuo (2014); Chen et al. (2017); Usha Ramanathan et al. (2011); U. Ramanathan and Gunasekaran (2014); Barratt (2004); Lemma (2015); Banomyong (2018)
Delivery/delivery schedules	Kumar and Banerjee (2012); U. Ramanathan and Gunasekaran (2014); Usha Ramanathan et al. (2011); Nagashima, Wehrle, Kerbache, and Lassagne (2015); Banchuen et al. (2017)
Degree of collaboration	Ramanathan (2014)
Demand forecast accuracy/forecast accuracy	Kumar and Banerjee (2012); Nagashima et al. (2015); Nakano (2009); Ramanathan (2013)
Rewards and correction actions or/evaluation and reward system	Kumar and Banerjee (2012); Ellinger (2000)
Environmental collaboration	Vachon and Klassen (2008)
External collaboration	Stank, Keller, and Daugherty (2001)
Feedback for Improvement (products and services)	Kumar and Banerjee (2012); Usha Ramanathan et al. (2011)
Goal congruence	Chakraborty et al. (2014); Cao and Zhang, 2011

Inventory improvement/inventory cost	Kumar and Banerjee (2012); Usha Ramanathan et al. (2011)
Incentive alignment	Simatupang and Sridharan (2004); Simatupang and Sridharan (2005a); Simatupang and Sridharan (2007); Kumar and Banerjee (2012); Chakraborty et al. (2014); Cao and Zhang (2011); Simatupang and Sridharan (2002); Simatupang and Sridharan (2005a); Liao and Kuo (2014); Lemma (2015); Herczeg, Akkerman, and Hauschild (2018); Banomyong (2018)
Information exchange with customers and suppliers/access	Chakraborty et al. (2014); Chen et al. (2017); Barratt (2004); Soosay et al. (2008); Vereecke and Muylle (2006)
Information quality	Usha Ramanathan et al. (2011)
Information sharing	Akintoye et al. (2000); Fawcett et al. (2008); Simatupang and Sridharan (2002); Simatupang and Sridharan (2004); Simatupang and Sridharan (2005a); Simatupang and Sridharan (2005b); Simatupang and Sridharan (2007); U

	Ramanathan (2014); Usha Ramanathan et al. (2011); U. Ramanathan and Gunasekaran (2014); Prajogo and Olhager (2012); Cao and Zhang (2011); Min et al. (2005); Liao and Kuo (2014); Soosay et al. (2008); Lemma (2015); Banomyong (2018); Raweewan and Ferrell (2018)
Infrastructure integration	Chen et al. (2017)
Maintaining standardized operations	Soosay et al. (2008)
Innovation or innovative in supply chain management	Simatupang and Sridharan (2008); Cao and Zhang (2010)
Integrated information systems/information technology	Akintoye et al. (2000); Aschemann-Witzel et al. (2017); Prajogo and Olhager (2012); Herczeg et al. (2018)
Integrated supply chain processes	Simatupang and Sridharan (2005b); Simatupang and Sridharan (2007); Chen et al. (2017)
Intelligence gathering and analysis	Horvath (2001)

Internal collaborative forecasting and planning	Stank et al. (2001); Nakano (2009)
Interorganizational systems	Zhang and Cao (2018)
Investment/joint investment	Ramanathan et al. (2011); Soosay et al. (2008); U. Ramanathan and Gunasekaran (2014)
Joint business planning	Akintoye et al. (2000); Soosay et al. (2008); Min et al. (2005); Chen et al. (2017); U. Ramanathan and Gunasekaran (2014); Cao and Zhang (2010)
Joint efforts	Dania et al. (2018)
Joint organizational learning	Kumar and Banerjee (2012)
Joint performance measurement	Min et al. (2005)
Joint problem solving	Min et al. (2005)
Joint production	Chen et al. (2017)
Joint teamwork	U. Ramanathan and Gunasekaran (2014)
Knowledge transfer and integration	Kumar and Nath Banerjee (2012); Cao and Zhang (2011); Herczeg et al. (2018); Soosay et al. (2008)
Leveraging resources and skills	Min et al. (2005)

Logistical and technological integration	Chen et al. (2017); Prajogo and Olhager (2012); Herczeg et al. (2018)
Loyalty	Kumar and Banerjee (2012)
Material requirement planning	Kumar and Banerjee (2012)
Measuring contribution of partners	Kumar and Banerjee (2012)
Monitoring by customer	Chen et al. (2017)
Mutual shared interest/benefit/risks and rewards	Akintoye et al. (2000); Kumar and Banerjee (2012); Chen et al. (2017); Barratt (2004); Lemma (2015)
New electronic commerce capability	Horvath (2001)
New product development	Kumar and Banerjee (2012); Lemma (2015)
Offering flexibility	Cao and Zhang (2010); Banchuen et al. (2017)
On time production	Ramanathan et al. (2011)
Outsourcing	Huang, Lin, Ieromonachou, Zhou, and Luo (2015)
People management and development	Akintoye et al. (2000); Fawcett et al. (2008)
Performance measurement	Fawcett et al. (2008)
Plan changing	U. Ramanathan and Gunasekaran (2014)

Planning and controlling product design	U. Ramanathan and Gunasekaran (2014)
Planning promotion	U. Ramanathan and Gunasekaran (2014)
Planning sharing replenishment	U. Ramanathan and Gunasekaran (2014)
Power	Dania et al. (2018)
Price	Kumar and Banerjee (2012); U. Ramanathan and Gunasekaran (2014); Lemma (2015)
Prioritizing goals and objectives	Kumar and Banerjee (2012)
Process efficiency	Cao and Zhang (2010)
Process and system integration/process management	Chen et al. (2017); Soosay et al. (2008); Barratt (2004); Horvath (2001); Dania et al. (2018)
Processes	Ramanathan (2014)
Product promotion	Kumar and Banerjee (2012)
Production and delivery systems	Herczeg et al. (2018)
Purchasing	Kumar and Banerjee (2012)
Quality	Cao and Zhang (2010); Banchuen et al. (2017)
Redistribution	Aschemann-Witzel et al. (2017)
Relationship management and trust building	Fawcett et al. (2008); Chakraborty et al. (2014); Ellinger (2000); Chen et al. (2017);

	Prajogo and Olhager (2012); van der Heijden and Cramer (2017)
Reliability of supply	Akintoye et al. (2000)
Resource sharing	Ramanathan and Gunasekaran (2014); Cao and Zhang (2011)
Retail and supply chain alteration initiatives	Aschemann-Witzel et al. (2017)
Supply chain mapping and role definition	Fawcett et al. (2008)
Security capability	Horvath (2001)
Shared supply chain processes	Simatupang and Sridharan (2004)
Sharing responsibility for product recovery	Chen et al. (2017)
Stability	Dania et al. (2018)
Strategic project definition	Herczeg et al. (2018)
Structural coordination with suppliers	Vereecke and Muylle (2006)
Supplier collaboration	Chen et al. (2017); Ramanathan et al. (2011); Vereecke and Muylle (2006)

Supplier development (e.g. training, support)	Chen et al. (2017)
Supplier integration	Chen et al. (2017)
Supplier involvement (e.g. product development)	Chen et al. (2017)
Supplier monitoring	Chen et al. (2017)
Supply chain capabilities	Liao and Kuo (2014)
Supply chain collaboration exchanges	Horvath (2001)
Supply chain metrics	Barratt (2004)
Supply-demand agreements	Herczeg et al. (2018)
Technology	Kumar and Banerjee (2012); Salam (2017)
Top management support	Akintoye et al. (2000)
Trust	Akintoye et al. (2000); Kumar and Banerjee (2012); Chen et al. (2017); Salam (2017); Barratt (2004); Kottila and Ronni (2008); Touboulic and Walker (2015); Lemma (2015); Dania et al. (2018); Banomyong (2018)

2.2 Sustainability

Sustainability in agriculture, especially in dairy business, is a complex concept and there is no standard point of view among researchers about. FAO and other agribusiness organizations also has proposed the sustainability for the agriculture as following

Economic Sustainability

- Farm performance such as production from Crop per year
- Net earnings or income of farm
- Cost Benefit ratio of investment in farm
- Ratio of production of food grain per citizen

Environmental Sustainability

- Quantity of chemical using in farm such as fertilizers, insecticide, disinfectants that used in one unit of land, or Chemical used per animal.
- Quantity of water used in land such as liter of water per square meter of land
- Soil quality
- groundwater table depth
- Groundwater quality
- Water use efficiency
- Nitrate contamination of groundwater and crops

Social Sustainability

- Food self sufficiency
- Fairness of income and food distribution
- Accessible of resources and services
- Farmers, knowledges, and awareness of resource protection and management

Table 6 Standard level of dimensions and alignment to assess agricultural sustainability
(von Wirén-Lehr, 2001)

Classification	Dimensions
Standard	Ecological or Environmental views
	Economic views
	Social views
Geographical	Local
	Regional
	National
Period of time	Long period
	Short period

However, Australian Dairy Industry: Sustainability Report 2018 showed the goal of sustainability in 2020 as per below (*Australian Dairy Industry Sustainability Report 2018*, 2018)

Economic Sustainability

- Increase the future competitiveness and profitability
- Increase the resilience and prosperity of dairy stake holders
- Provide a safe work environment for all farm workers
- People engagement by, motivate, develop, and engage, a skilled staff also motivated dairy workforce

Environmental Sustainability

- Improve nutrient, land, and water management
- Reduce the consumptive water intensity of dairy companies
- Reduce greenhouse gas emissions intensity
- Reduce waste to landfill

Social Sustainability

- Providing safe dairy products and ingredients
- Improving health outcomes for Australian communities by dairy
- Providing the best care for all animals

2.3 Sample size review

Since the research planning has planned to have 3 phases of the studies, expert interview, pilot study, and main study. In each phase of study, there are different requirements of sample size, type of data and data collection methods.

For the Index of Item-Objective Congruence (IOC), it requires small sample size, but they should be an expert in the study area. It can be 5 or 7 participants (Rovinelli & Hambleton, 1977)

Next, pilot study, exploratory factor analysis (EFA) was a key statistics tool for analysis. The sample size for EFA analysis need at least 100 participants as sample size of the pilot study (Awang, 2015; Hoque, Siddiqui, Awang, & Baharu, 2018)

Last, structural model (SEM) for main study, this analysis needs numbers of sample. The program that support sample size calculation, such as G*Power, a personal computer program, (Faul, Erdfelder, Buchner, & Lang, 2009; Faul, Erdfelder, Lang, & Buchner, 2007) it was demonstrating that as following

- Degree of Freedom (No. of variables multiply by No. of variables plus 1 then divide by 2 = N(N+1)/2) in this study, after variables cutting by expert interviewing and IOC tool, 49 variables were remaining. Plus, adding some variables from sustainability and success of supply chain collaboration, thus in total, it had maximum variables are 70 variables.
- Power = 0.8 that recommended as standard by Joseph Hair, Black, Babin, and Anderson (2010).

- Effect size = 0.5; regarding to effect size from J. Cohen (1988)

Finally, from calculation, 724 samples were needed to use in the analysis.

Researcher considered the 187 co-operatives or milk-collecting centers that certified GMP as a sample group. The main study survey was sending to 187 co-operatives or milk-collecting centers. Moreover, in each co-operatives and milk-collecting centers, 30 farmers were asking to answer the questionnaire. In total, a paper-based questionnaire was sending out 6,732 copies to 187 co-operatives and milk-collecting centers.

2.4 Factor Analysis

Factor Analysis is a statistical method that usually support the researcher to deduct number of variables when they are facing with many numbers of variables that related in the research design, moreover, it uses for grouping the variables to be sets of factors. Factor Analysis has no dependent variable. Factor Analysis is using for the studies that are planning or proposing mainly to find out the hidden framework of the data matrix. Factor loading, it is a value that used to explain the hidden relationship between single variable with another variable.

In general, definition regarding to factor analysis, we can separate as 2 main methods. First, this method called principal component analysis or PCA, the extraction of factor depended on the total variance of the factors. Next, called common factor analysis or CFA, which otherwise the extraction of factors based on the variance shared by the factors. Moreover, PCA is helping researcher to identify the lowest number of variables which interpret the most variance, while CFA is helping us to understand for the latent underlying factors. Generally, most of the variance are explained by the first extracted factor. The correlations of the variables and the factors is understood by the factor loading, as suggestion the value of factor loading that in general, at least 0.4, can assumed that a factor is attributed by an individual variable (Cutillo, 2019).

Rota, Pugliese, Hashem, and Zanasi (2018) showed that factor analysis can be used to explain the research question, that they were trying to do the determining level of supply chain collaboration in the organic and fair-trade cotton industry in

Egypt. This study demonstrated the level of supply chain collaboration, it helped to explain the findings in the industry and to create groups of variables by using factor analysis. Kim (2008) showed common CFA provided an accurate result when comparing with PCA.

2.5 Structural Equation Modelling (SEM)

Susanty, Bakhtiar, Jie, and Muthi (2017) studied of dairy milk supply chain on trust, loyalty and business performance and developed a model. This study showed that some technics have been use in dairy cattle business such as PLS-SEM to determine the model. They used rule of thumb to calculate the sample size, it leaded to small sample size when compare with others method of calculation. Likert scale that used in the study from 1-5. In this case, farmers are not familiar with the method, and too long scale might create some misunderstandings during the survey. Thus, Likert scale in this study, as well as scale 1 to 5 for farmers, or main study questionnaire, while the pilot group was using Likert-scale from 1 to 9.

Astrachan, Patel, and Wanzenried (2014) studied the comparison of CB-SEM and PLS-SEM for theory development in family firm research. The result from their study by showing both methods, CB-SEM and PLS-SEM. Then, they recommended that PLS-SEM more appropriates to use at the stage of theory development and data have low likelihood of normal distribution, it is more using in the study that related to the social sciences than CB-SEM, while in the stage of theory testing, the CB-SEM is more appropriated to use and it is more useful.

Moreover, Sarstedt, Ringle, Smith, Reams, and Hair (2014) studied the comparison of CB and PLS SEM on the estimation by simulation study with that the biases shown when studying. The outcome of this study presented that the use of PLS is preferable, especially when it is not sure whether the nature of data is common

factor-based or composite-based. In addition, Afthanorhan and Afthanorhan (2013) compared in the study about CB-SEM and PLS-SEM, it shown base on the calculation and the model formation, it can be accepted that PLS-SEM path modeling is advantageous to do the confirmatory factor analysis. As a result of this study shown that PLS gave the better values than CB-SEM in term of factor loading values, outer loading values, and average variance extracted (AVE) even the study was carrying by using the same set of data. As per literature review for the SEM methodology, it can conclude that PLS-SEM is a better tool to use in this study as a model formation.

Chapter 3
Methodology and Model development

3.1 Hypotheses

In this study, researcher would like to answer to hypotheses that link to the supply chain collaboration in the environment of Thailand's dairy industry.

First of all, researcher would like to understand the level of adoption of supply chain collaboration in Thai dairy with that the hypothesis is the level of adoption of supply chain collaboration in Thai dairy industry is low (1).

Second, researcher also has a question about type of supply chain collaboration in Thai dairy market, so a hypothesis is, transactional collaboration is the existing supply chain collaboration of dairy industry (2).

Moreover, supply chain collaboration has many factors lead to succession of the business, social and ecology; however, in case of supply chain collaboration in Thai dairy industry is not clear until now. Researcher listed down all the factors that link to it, but researcher needs to know that which one is good factor. Then the hypothesis on this context is "one or more the factors in supply lead to the successful of the industry" and "at least one group of variables effect supply chain" (3).

Last, this study concerns sustainability of the industry, researcher also would like to understand the farmers and co-operatives mind set about the sustainability and its sub-activities. Then the researcher comes up with the hypothesis: farmers and co-

operatives are equally concerning in economics, environment, and social in dairy industry (4).

3.2 Conceptual frameworks

In this study, it can be divided in 3 minor frameworks and 1 major framework. Each framework is going to visualization of each hypothesis in section 3.1

1 Supply Chain Collaboration Variable framework

2 Type of supply chain collaboration framework

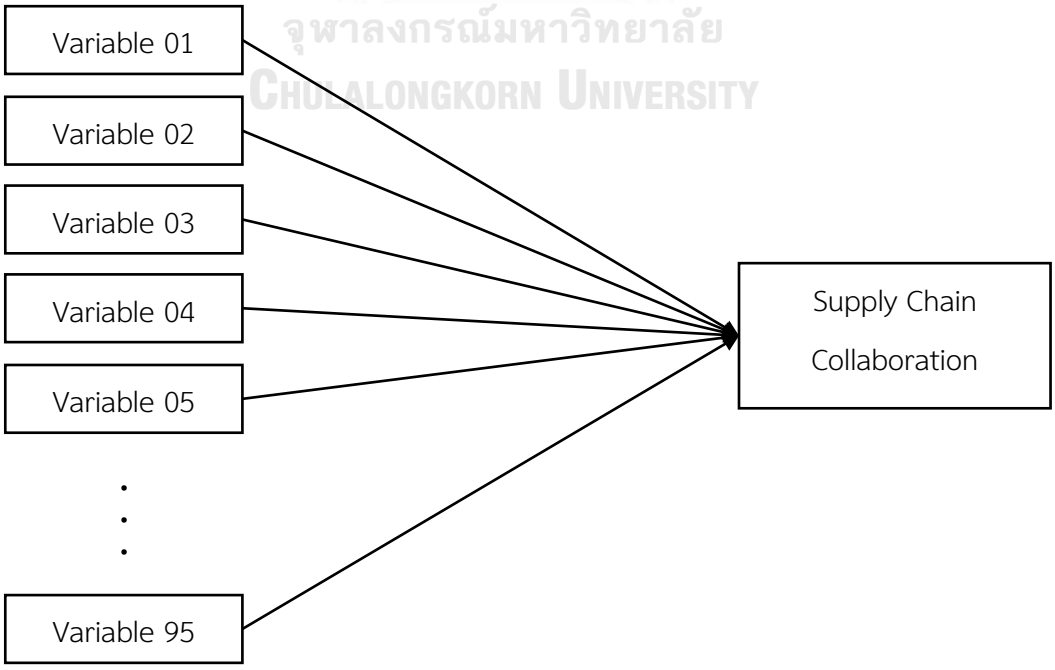
3 Framework of Sustainability in Thai dairy industry

4 Conceptual frameworks for supply chain collaboration in Thai dairy industry

3.2.1 Supply Chain Collaboration Variables framework

This framework explained variables that have positive impact to supply chain collaboration.

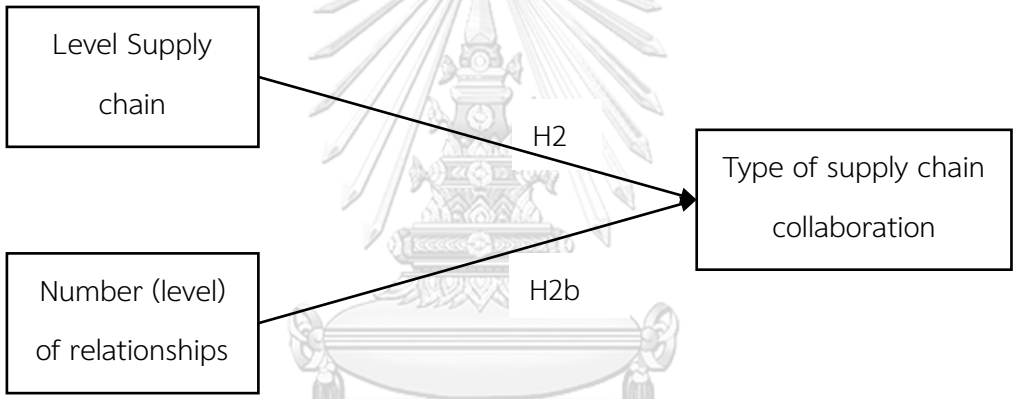
Figure 8 Supply Chain Collaboration Variables framework



3.2.2 Type of supply chain collaboration framework

This framework, Figure 9, is going to explain about type of supply chain collaboration in Thai dairy industry. There are two major constructs that impact type of supply chain collaboration. First, level of supply chain that be able to identify type of supply chain collaboration together with second, number of relationships (S. Cohen & Roussel, 2005)

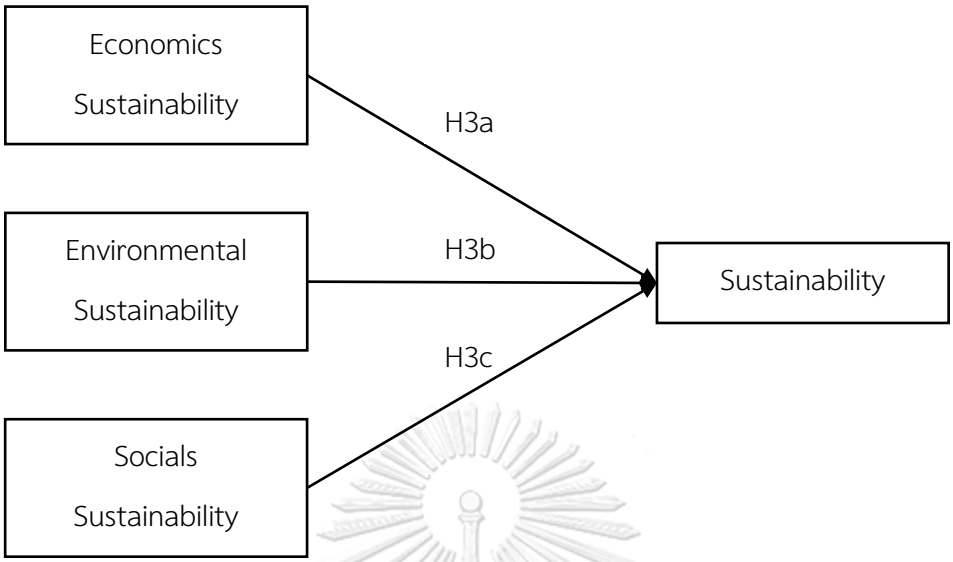
Figure 9 Type of supply chain collaboration framework



3.2.3 Framework of Sustainability in Thai dairy industry

In definition of sustainability, there are three major dimensions of sustainability. First, economics sustainability, environmental sustainability, and socials sustainability. Thus, H3a showed economics sustainability has a positive impact on sustainability in Thai dairy context, H3b showed environmental sustainability has a positive impact on sustainability in Thai dairy, and H3c: socials sustainability has a positive impact on sustainability in Thai dairy industry as showed in Figure 10.

Figure 10 Framework of Sustainability in Thai dairy industry



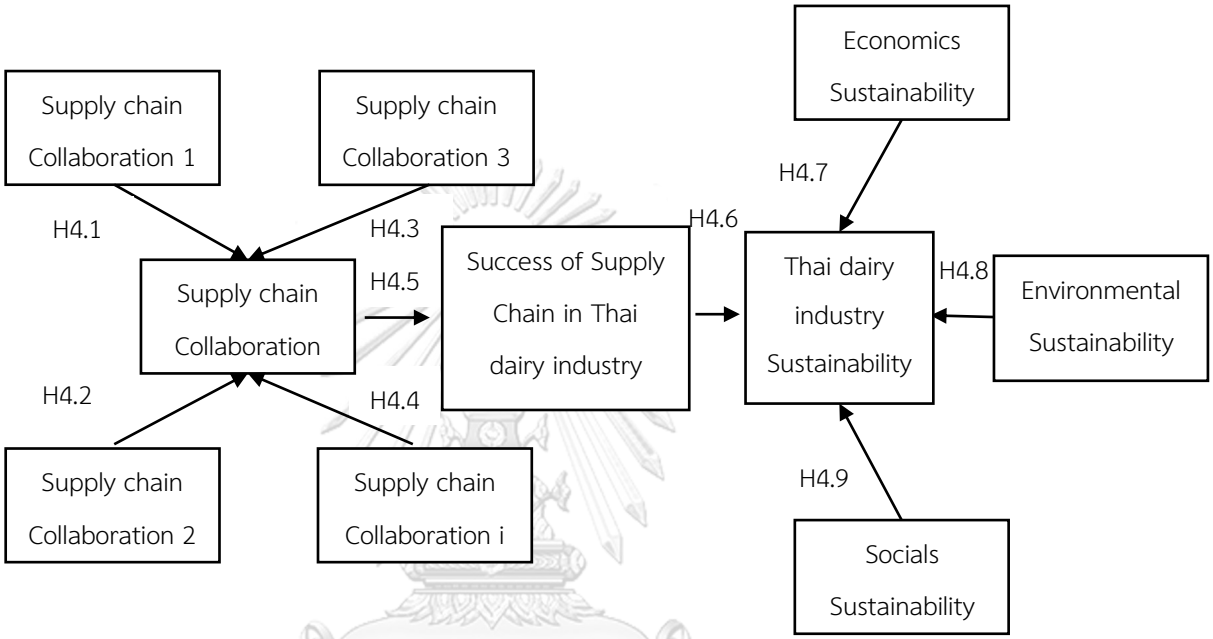
3.2.4 Conceptual frameworks for supply chain collaboration in Thai dairy industry

A theoretical framework was proposed by the researcher in this study as showed in Figure 8. First of all, supply chain collaboration from EFA result will be used as constructs in the model. As you in figure 8, H1 to H4 (tentatively, it might have more than 4) demonstrated that supply chain collaboration constructs have significant impacts on supply chain collaboration. Moreover, supply chain collaboration has a significant impact on success in supply chain in Thai dairy industry.

Moreover, regarding to sustainability theory, it combines with 3 dimensions as following economics sustainability, environmental sustainability, and socials sustainability. Thus, H7 showed economics sustainability has a positive impact on sustainability in Thai dairy context, H8 showed environmental sustainability has a

positive impact on sustainability in Thai dairy, and H9: socials sustainability has a positive impact on sustainability in Thai dairy.

Figure 11 Conceptual frameworks for supply chain collaboration in Thai dairy industry model 1



In summary, this reserch needs to prove the hypothesises as per below

H1: At least one factors has a positive impact on supply chain collaboration

H2a: Level of collaboration has a positive impact on type of supply chain collaboration

H2b: Number of relationship has a positive impact on type of supply chain collaboration

H3a: Economics Sustainability has a positive impact on Thai dairy industry sustainability

H3b: Environment Sustainability has a positive impact on Thai dairy industry sustainability

H3c: Socials Sustainability has a positive impact on Thai dairy industry sustainability

H4.1: Supply chain collaboration group 1 has a positive impact on supply chain collaboration

H4.2: Supply chain collaboration group 2 has a positive impact on supply chain collaboration

H4.3: Supply chain collaboration group 3 has a positive impact on supply chain collaboration

H4.4: Supply chain collaboration group 4 has a positive impact on supply chain collaboration

H4.5: Supply chain collaboration has a positive impact on Success of Supply Chain in Thai dairy industry

H4.6: Success of Supply Chain in Thai dairy industry has a positive impact on Thai dairy industry Sustainability

H4.7: Economics Sustainability has a positive impact on Thai dairy industry sustainability

H4.8: Environmental Sustainability has a positive impact on Thai dairy industry sustainability

H4.9: Socials Sustainability has a positive impact on Thai dairy industry sustainability

3.3 Expected outcome

The researcher has an ambitious to establish supply chain collaboration with sustainability concept for Thai dairy business. Together with the answering the questions on hypotheses, expected outcome of the study are following: -

1. Present the proper supply chain collaboration model of for dairy industry in Thailand
2. Develop the model of supply chain collaboration for sustainability for Thai dairy industry

3.4 Methodology

3.4.1 Scope and population

From the dairy supply chain, the important parties in the chain are farmers, co-operatives, and milk-collecting centers. In this study, the scope and population will consider from the farmers, co-operatives, and milk-collecting centers. The parties that beside the farmers and milk centers will not be observed.

Department of Livestock Development, Ministry of Agriculture and Co-operatives, reported data regarding to the number of co-operatives and milk-collecting centers in Thailand. There are, in total, about 670 co-operative and milk-collecting centers; however, the centers that have GMP certify are 187 centers. The rests about 470, this study will not be focused.

3.4.2 Sampling

Sampling is a process that researcher select some cases to examine in deep, and what researcher learns from sample, it can use to explain a population, or researcher can understand a larger group (Neuman, 2013). Sampling process is important for the study due to sampling process helps to increate validity of research. Moreover, Neuman (2013) demonstrated that in general types of sampling techniques are probability sampling techniques and nonprobability sampling techniques. In this study, researcher was using both probability and nonprobability sampling techniques.

The main source of information about dairy cooperative and dairy farmer are department of livestock development and Ministry of Agriculture and Co-operatives. The researcher got list of dairy co-operatives in Thailand, however, only 187 co-operatives were certified GMP. The list of email, mailing address of these 187 co-operatives are available by asking from the government officers. However, the researcher did not get the detail information of dairy farmers. It was a starting point that researcher needed to use cluster sampling techniques as a main technique in this study, together with theoretical sampling techniques for expert interview and purposive sampling techniques for the pilot study. Finally, convenience sampling techniques was used for the main study.

The researcher used cluster sampling techniques by separate dairy co-operatives and milk-collecting centers by GMP certified status. Then researcher got 187 out of total dairy co-operatives and milk-collecting centers, 670. Moreover, for the main study, it was limited number of questionnaires for one cooperative or milk-collecting center. It was on 30 copies for dairy farmers that belongs to one cooperative or milk-collecting center.

3.4.3 Sample size

This research conducted the index of item-objective congruence, common factor analysis by using exploratory factor analysis, and Structural Equation Modelling (SEM) to evaluate the hypotheses as well as propose a structural model. By reason of number of respondents is an important topic for any statistic's analytical tools. In addition, it is also critical for reliability of the study. Thus, sample size must be focus on.

In overall, there is no definite sample size in an ultimate significance, also many samples are preferable as always. Since in this study has 3 parts as mentioned, for the index of item-objective congruence, it was obvious that only 5- 7 experts enough to process the analysis. Moreover, for EFA, it needs more than 100 respondents to pursue the pilot study (Awang, 2015; Beavers et al., 2013; Hoque, Awang, Muhammad, & Gwadabe, 2019). Furthermore, for SEM, it is recommended a minimum qualified respondents of 100-200 or 5 cases per free parameter in the model (Kline, 2010; Tabachnick & Fidell, 2001). Moreover, Ding, Velicer, and Harlow (1995) suggested that samples for SEM is 100-150 samples while Boomsma (1982) gave suggestion to have

the samples 400 samples. Moreover, Schumacker and Lomax (2010) presented sample size should have ratio 10-20 subjects per variable and good to have 250-500 subjects. Others studied from Germany, they were using G*Power program to suggest number of subjects in the study (Faul et al., 2009; Faul et al., 2007). For this study, researcher considers using G*Power program to guide number of samples for SEM.

The study understood the important of number of subjects in each analytical tool. Thus, researcher considers doing the data collection with respectful suggestion of the number of subjects above.

Dairy co-operatives, the Dairy Farming Promotion Organization of Thailand (D.P.O.) and dairy farmers are key stake holders of the industry. From a department of livestock report, there are 187 certified GMP standard co-operatives and milk-collecting centers in Thailand.

Samples were separated into three groups, corresponding with the three elements of this study (expert interviews, pilot study, and large sample), as follows:

1. Expert interviews:

Heads of dairy co-operative communities and dairy co-operatives managers, members of co-operatives committees. In this part of the study, as per analysis tool and literature review, number of samples are small such as 5 participants, or 7 participants. Finally, total participants from the interviewing session were 11 samples

2. Pilot study:

Awang (2015) and Hoque et al. (2019) mentioned that a pilot study should have sample size more than 100 participants. Moreover, if threshold of factor loading is 0.6 or more, the number of samples, it is not a concerning point (Beavers et al., 2013) For this part of study, samples included as following heads of dairy co-operatives, managers of the Dairy Farming Promotion Organization of Thailand (D.P.O.), academic experts such as veterinary school lecturers working in the dairy industry, Department of Livestock development officers and veterinarians who are support dairy farms, and some dairy farmers together with some farmers. Sample size in detail, 64 face to face samples were obtained, and 94 mail samples, with 36 respondents with uncompleted questionnaires. Thus, the total of 122 respondents reached the minimum sample size of pilot research recommended. The pilot study was conducted using exploratory factor analysis (EFA).

3. Survey by questionnaire:

Since it had total 70 variables (for the structure model as showed in Figure 11. For the conceptual framework, from the calculation from sampling session, 724 samples were needed to use in the analysis. From the official data about co-operatives and milk-collecting centers in Thailand. Thailand's dairy farmers represent 16,248 farms, moreover, there are the centers that certified GMP in 2018 by 187 centers. With that, the study was sending the questionnaire to 186 co-operatives/centers (one center is not actively doing the activities). Moreover, in the 186 co-operatives or milk-

collecting centers, there are farmers that contracting with them. The researcher also planned to do the survey with those farmers by using co-operatives or milk-collecting centers as distribution centers. In total, 5,610 copies of the paper-based questionnaire were prepared. Finally, 5,610 copies were sent to co-operatives or milk-collecting centers. And questionnaire for co-operatives or milk-collecting centers was 1,122 copies. The grand total of survey was 6,732 copies.

3.4.4 Analysis tools

To find the answer for hypotheses above researcher needs to use statistics tools.

3.4.4.1 Factor Analysis

The factor analysis uses for separate or group the variables that has the relationship in the same group. The variable that do not have the relation between each other, it will be in the different group. In the case, one group that has the variables in the group, we called it one factor. The variables that is in the factor or the same group, they can have the relationship in the positive or negative.

In this study, we are going to use factor analysis in two objectives, first, we are intending to use factor analysis to reduces the variables that have the relation to be the same group, then, the factors will be used in another technique. Second, in order to answer the first question in this study, the level or weight of the variables, in this case, we would like to figure out and explain about level of supply chain collaboration in Thailand's dairy industry.

This study used confirmatory factor analysis to explain the exploratory factor analysis. Moreover, confirmatory factor analysis also used in measurement model for structural equation modelling study.

3.4.4.2 Structural equation model

Joe Hair, Sarstedt, Hopkins, and Kuppelwieser (2014) said that structural equation model is second version method to reduce the weak points of previous techniques, Structural equation model (SEM) enables the researchers to combine variables that cannot be observed then valuate indirectly by indicator variables.

Type of SEM, in general we can separate SEM into 2 types, firstly, covariance-based SEM (CB-SEM) then, second, partial least squares SEM (PLS-SEM) or path modelling. For CB-SEM is normally used to verify, confirm, or reject theories, for instance, experimentally testing the relationship between multiple variables. Furthermore explanation, there is done like this, a proposed theoretical framework is determined, by a sample data set to, how fit of the model by covariance matrix. Unlike, PLS-SEM is basically using in exploratory research to develop theories. When testing the framework, it is mainly concentrated explaining the variance in the dependent variables

Use PLS-SEM when	Use CB-SEM when
1. Predicting Key target constructs or identifying key “driver” constructs 2. Part of the structural model is measuring constructs 3. Complexity structural model 4. Non-normally distributed data/ Small sample size 5. In subsequent analyses plan to use latent variable	1. Testing a theory, confirming a theory, or comparison of alternative theories. 2. Additional specification is required when its error terms, such as the covariation. 3. Circular relationships for structural model 4. A global goodness-of-fit criterion is required.

3.4.5 Data Collection

For the data collection for this study, it was separated into three parts. First, it was expert interviewing. Second, it was for the pilot study, it was a step for developing the model by using common factor analysis to explain the exploratory factor analysis. Next, it used for developing questionnaire for main study, it will use SEM to get the structural model.

3.4.5.1 Qualitative Evidence: Expert Interviews

Our literature review has identified more than 95 factors potentially affecting supply chain collaboration in general. The list was narrowed down following interviews with dairy industry experts. We identified main experts in the industry and conducted interview sessions with them in 4 regions of Thailand: North-eastern, Eastern, Central and Western. There were 11 interviews with industry experts, as shown in Table 7.

Table 7 Experts interviewed in each region.

Region	No. of experts interviewed
North-eastern	2
Eastern	5
Central	3
Western	1
Total	11

3.4.5.2 Quantitative Evidence: Pilot Study

A paper-based pilot group survey was conducted with managers of the Dairy Farming Promotion Organization of Thailand (D.P.O.); academics such as the Dean of Veterinary Science, Walailuck University and the Dean of Veterinary Science, Mahasarakarn University; officers of the Department of Livestock development; managers of large farms in the central region; and members of dairy co-operative communities from 4 regions: North-eastern, Eastern, Central and Western. The survey

was conducted in Nakorn Ratchasima, Chantha Buri, Prajeub Kirikun and Saraburi provinces in October-December 2020, using the Likert-scale from 1-9 (strongly disagree to strongly agree). Moreover, the pilot survey was conducted with participants as dairy farmer from Northern, Central and North-eastern areas of Thailand. Finally, the pilot study had a sample size of 158.

However, from 158 samples, it can be used only 122 participants due to some missing data. These 122 samples were more than minimum sample size for pilot study (Awang, 2015; Hoque et al., 2019).

3.4.5.3 Questionnaire developing

A questionnaire was developed based on expert interviews and pilot study. From the expert interviews, numbers of variable were narrowed down from 95 variables that related to supply chain collaboration, and that was used to be the questions. Next, since IOC was conducted in Expert interviewing session, the 46 variables from supply chain collaboration were reducing, left over 49 variables for EFA analysis in the pilot study. EFA also was helping researcher to reduce dimensions together with grouping variables in the better structure way, finally, the 26 variables were presented as the high impacting level. These 26 variables with 6 constructs were used to develop the questionnaire with sustainability questions and some general information questions.

Questionnaires were developed, it separated into 2 sets one for farmers, and another for co-operatives and milk-collecting centers management committee, but variables were same for both farmers set, and co-operatives set. One for farmers, and one for co-operatives managers, management, and committees. To minimize confusion of the scale and differentiation of the score in each question, the Likert-scale from 1-5 (strongly disagree to strongly agree) was implementing in the main study.

3.4.5.4 Quantitative Evidence: Industry Survey

A paper-based industry survey was conducted with managers of the Dairy Co-operatives, Milk-collecting centers, Farmers nationwide. Questionnaires were distributed by Thai post with 30 copies for farmers per site. In total, researcher sent out questionnaire for farmers 5,580 copies. Moreover, questionnaire for co-operatives or milk-collecting centers was sent out 1,122 copies. Grand total, questionnaires were sent out 6,732 copies in January 2021, from 11 January to 17 January 2021. At the middle of March 2021, returned questionnaires are 1,308; however, after discounting some incomplete replies, there were 1,224 valid responses. Response rate of the survey from the total survey population is 18.85 percent as shown in Table 8.

Table 8 Survey response rate

	Numbers	Percent (%)
Total target population	6,732	100
Undelivered surveys	240	3.57
Total survey population	6,492	100
Total responses	1,308	20.15
Unusable samples	51	0.79
Total code samples	1,257	100
Missing value samples	24	1.91
Outliers	9	0.72
Total usable samples	1,224	18.85

Percent Total usable samples = 1,224/6,492

3.4.6 Measurement of Models

Measurement models were using in this study came from 2 ways. First, measurement models came from exploratory factor analysis from the pilot study. This measurement models, the variables are supply chain collaboration related variables, or supply chain collaboration variables. It will be presented in the result section. Second, measurement models from literature review, mainly the constructs of this

part are sustainability related, or sustainability variables. Moreover, Success of supply chain collaboration constructs also developed from literature review. Thus both, sustainability and success of supply chain collaboration constructs will be showed in this chapter.

3.4.6.1 Success of supply chain collaboration constructs

Success of supply chain collaboration constructs has major variables as per below list (Barratt, 2004; Mishra & Shah, 2009; U. Ramanathan & Gunasekaran, 2014; Vachon & Klassen, 2008)

Measurement of Success of supply chain collaboration

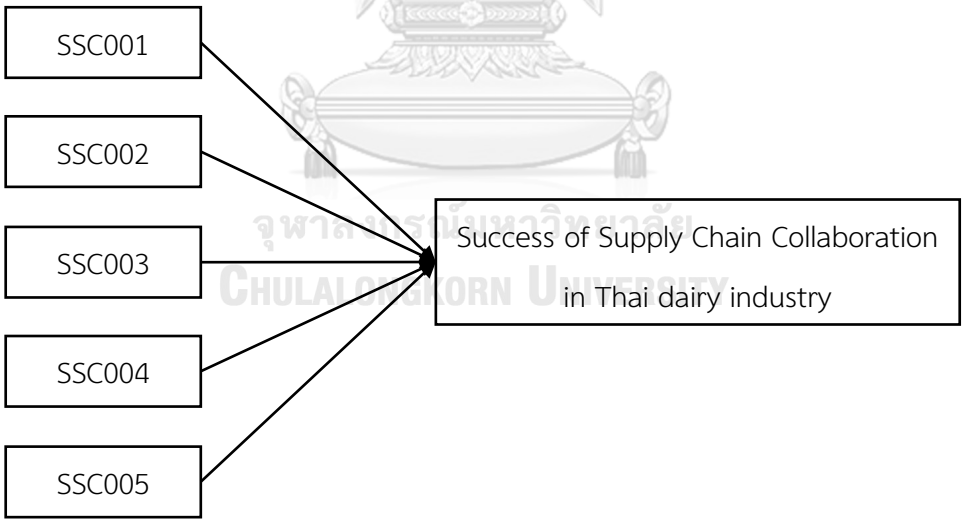
The researcher reviewed literatures about the success of supply chain collaboration key performances index, then it obviously shown up with 5 variables or item that shown in Table 9. These 5 items will be used as the questions in farmer's survey. A five-point Likert scale was designed as the response pattern with identified values ranging from 1 = strongly disagree to 5 = strongly agree. For the reliability of the measurement of Success of supply chain collaboration, it will be reported in the data analysis chapter.

Table 9 Measurement of Success of supply chain collaboration constructs

1. Sales growth, Market share
2. Environmental management
3. Cost
4. High profit margin
5. Customer satisfaction

Note: 1 = Strongly disagree, 2 = Disagree, 3 = Neither disagree nor agree, 4 = Agree, and 5 = Strongly agree

Figure 12 Measurement Model of Success of Supply Chain Collaboration



3.4.6.2 Sustainability constructs

The study has 3 constructs in category as sustainability constructs as economics sustainability construct, environmental sustainability construct, and social sustainability construct.

Sustainability in Thai dairy industry in 3 constructs as below

1. Measurement of economics sustainability

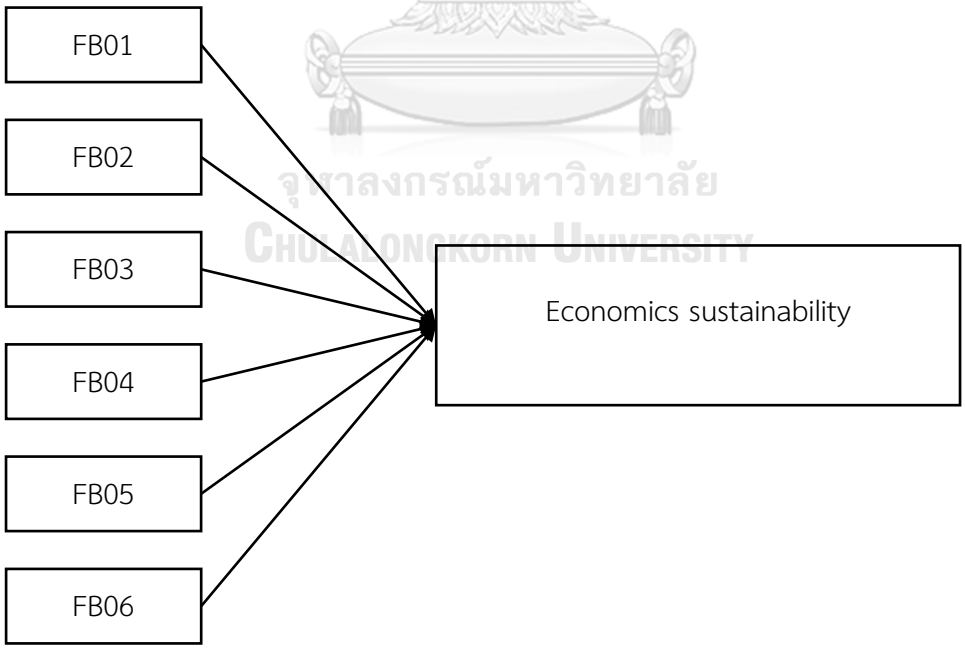
Economics sustainability in dairy industry is important for the farmers and industry. In this case, researcher developed the questions focus on farm economics benefits. The questions in this set were mainly demonstration the economics in many ways. 6 items as shown in Table 10 and model shown in Figure 13. Mainly of the items from Australian industry (*Australian Dairy Industry Sustainability Report 2018*, 2018). Moreover, others study from Poland (Gebska, Grontkowska, Swiderek, & Golebiewska, 2020) A five-point Likert scale was designed as the response pattern with identified values ranging from 1 = strongly disagree to 5 = strongly agree. For the reliability of the measurement of economics sustainability, it will be reported in the data analysis section.

Table 10 Measurement of economics sustainability constructs

1. Increasing profit and profitability
2. Easier sale of products
3. Getting price premium
4. Increasing the competitiveness
5. Increasing the resilience and prosperity of dairy communities
6. Attracting, developing, and retaining a skilled and motivated dairy workforce

Note: 1 = Strongly disagree, 2 = Disagree, 3 = Neither disagree nor agree, 4 = Agree, and 5 = Strongly agree

Figure 13 Measurement of economics sustainability constructs



Note: FB = Farm Economics Benefits

2. Measurement of environmental sustainability

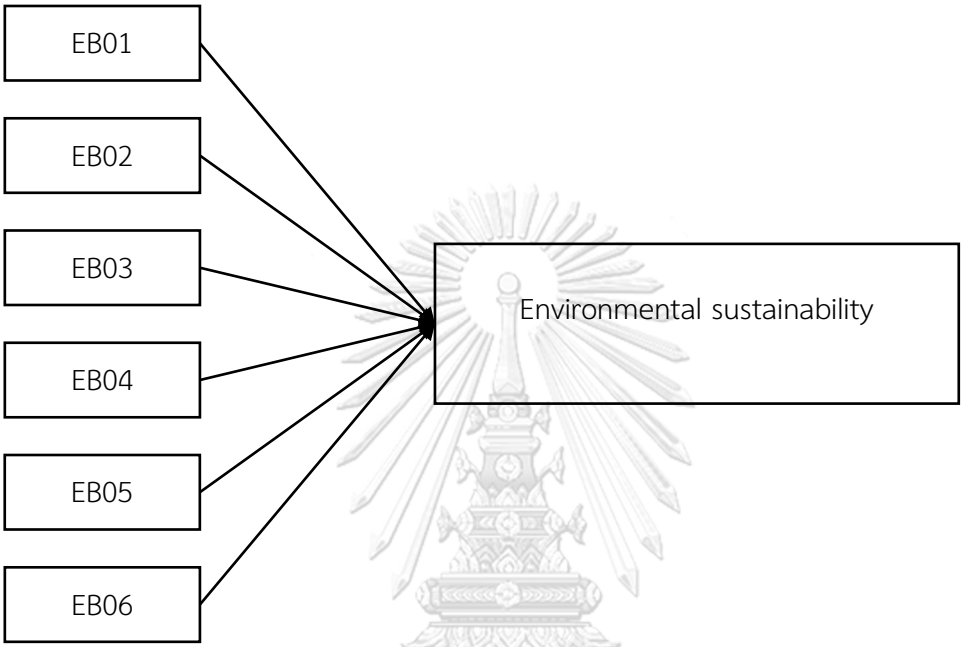
Environmental sustainability in dairy industry is important for the farmers and industry. In this case, researcher developed the questions focus on environmental benefits that linked with farmers. The questions in this set were mainly demonstration the environmental issues in many ways. In Table 11 and model shown in Figure 14, the 6 items as shown the concerns of environmental in dairy business, mainly of the items from Australian industry (*Australian Dairy Industry Sustainability Report 2018*, 2018). Furthermore, Gebska et al. (2020) shown in others study from Poland about environmental concerns. A five-point Likert scale was designed as the response pattern with identified values ranging from 1 = strongly disagree to 5 = strongly agree. For the reliability of the measurement of environmental sustainability, it will be reported in the data analysis section.

Table 11 Measurement of environmental sustainability constructs

1. Improving land and water management
2. Reducing the non-productive water consumption
3. Reducing waste
4. Increasing energy using from biogas
5. Reduction of energy consumption from non-renewable sources
6. Reduction of greenhouse gas emissions

Note: 1 = Strongly disagree, 2 = Disagree, 3 = Neither disagree nor agree, 4 = Agree, and 5 = Strongly agree

Figure 14 Measurement of environmental sustainability constructs



Note: EB = Environmental Sustainability Benefits

3. Measurement of socials sustainability

Socials sustainability in dairy industry is a critical issue for the farmers and dairy industry. In this study, researcher generated the questions focus on socials benefits that related with farmers. The questions in this set were mainly demonstration the socials benefits. In Table 12 and model shown in Figure 15, the 4 items as shown the benefits of socials that be able to get from dairy producers and co-operatives, The questions and items from literature review, Australian industry are advance in

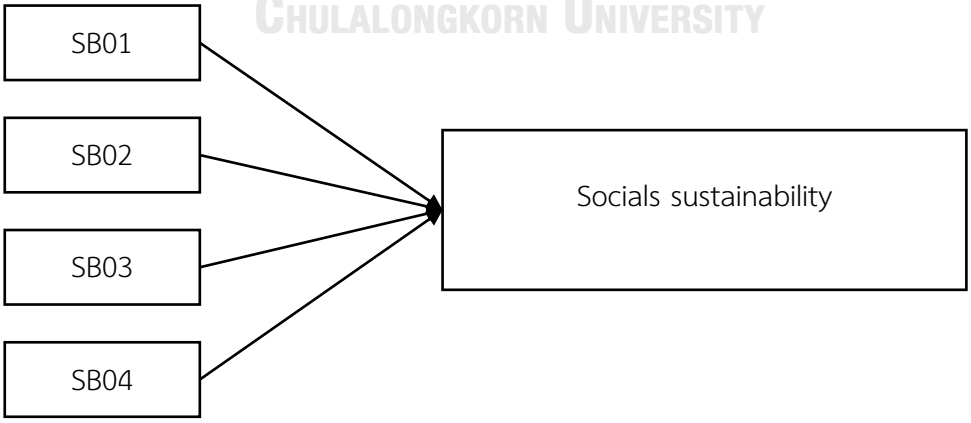
sustainability (*Australian Dairy Industry Sustainability Report 2018*, 2018). In Poland, Gebska et al. (2020) also presented in their study about sustainability in Agricultural and socials benefits as well to be addressed. A five-point Likert scale was ranging from 1 = strongly disagree to 5 = strongly agree. For the reliability of the measurement of environmental sustainability, it will be reported in the data analysis section.

Table 12 Measurement of socials sustainability constructs.

1. All dairy products and ingredients sold are safe
2. Dairy contributes to improved health outcomes for Thai's
3. Providing best care for all animals
4. Improving working conditions on a farm

Note: 1 = Strongly disagree, 2 = Disagree, 3 = Neither disagree nor agree, 4 = Agree, and 5 = Strongly agree

Figure 15 Measurement of socials sustainability constructs.



Note: SB = Social Sustainability Benefits

3.4.7 Reliability of the measurement scales

Reliability analysis of the items can be explained by Cronbach's Alpha value, which should be more than 0.5; however, Hoque and Awang (2016) suggest that a value above 0.6 can ensure consistency. Moreover, composite reliability (CR) can also be assessing the reliability of a principle measure of each construct in the measurement model. A cut-off point for composite construct normally it used reliability is .70 (J. F. Hair, Ringle, & Sarstedt, 2011) However, sometime the CR values below .70, it could be acceptable if the study is exploratory in nature, but the CR value more than 0.6 it can be accepted as well (J. F. Hair et al., 2011). As another evaluation method for construct reliability, the convergent validity by result of the average variance extracted (AVE), the overall variance can be explained by variance extracted. It was the indicators explain by the latent construct. the variance extracted measure can be calculated to explain A higher variance extracted value can be interpreted that the indicators are exactly representative of the latent construct. The average variance extracted (AVE) value, it is recommended the proper value should be higher than 0.50 (J. F. Hair et al., 2011).

Composite reliability and average variance extracted can calculate from the mathematics formulars as follows.

Construct Reliability =

$$\frac{(\text{Sum of standardized loadings})^2}{(\text{Sum of standardized loadings})^2 + \text{Sum of indicator measurement error}}$$

Average Variance Extracted = Sum of (standardized loadings^2) / N

3.4.8 Criterion of Scale

Since the study was using Likert Scale from 1 to 5 as below

1 = Strongly disagree

2 = Disagree

3 = Neither disagree nor agree

4 = Agree and

5 = Strongly agree

However, interpretation of average scores in the study, the researcher gave the criteria for 5 scales as following

Average of Score	Interpretation
1.00-1.80	Minimum level
1.81-2.60	Low level
2.61-3.40	Intermediate level
3.41-4.20	High level
4.20-5.00	Levels at the most

3.4.9 Indices for assessment and evaluation

3.4.9.1 Exploratory factor analysis assessment

This analysis required both Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity assessment. The KMO value ranges from 0-1; however, more than 0.6 is recommended (Hoque and Awang, 2016). Bartlett's Test of Sphericity should be significant at $P<0.05$ (Awang, 2015).

3.4.9.2 The fit indices in the process of SEM model testing and evaluation

Structural Equation Modelling for study both measurement model and structural model for supply chain collaboration and sustainability in Thai dairy industry. All models needed to evaluation the global fit indices before the researcher used the models. The global fit indices in the process of SEM model testing and evaluation as below list (Hooper, Coughlan, & Mullen, 2007)

1. Relative Chi-Square $\chi 2$ of the discrepancy ($\chi 2/df$) < 5.00
2. Goodness of Fit Index: GFI not less than 0.90
3. Adjusted Goodness of Fit Index: AGFI not less than 0.90
4. Comparative Fit Index: CFI not less than 0.90
5. Standardized Root Mean Square Residual: Standardized RMR < 0.09
6. Root Mean Squared Error Approximation: RMSEA < 0.07

Summary of the chapter

The research methodology which used in this study was demonstrated in this chapter. Foremost, researcher displayed and presented the research questions and research framework. Moreover, the study as well as addressed the research design and survey instrument, including the population, sampling, sample size, together with collecting data procedure for all of 3 phases of studies. The statistical method such as the index of item-objective congruence (IOC), factor analysis with common factor analysis, structural equation modelling implemented in this research ware discussed. Next, the measurement model and constructs from success of supply chain collaboration and sustainability were presented. The researcher also demonstrated the validity and reliability of the measurement scales. Finally, the indices for assessment and evaluation for both exploratory factor analysis by common factor analysis and structural equation modelling.

Chapter 4
Data Analysis and Result

4.1 Data analysis

4.1.1 Expert Interviews

1. Rovinelli and Hambleton (1977) was introduced a technique that gathering rating from the experts individually. This technique called the index of item-objective congruence (IOC). The IOC is a processing that evaluates the index of item-objective congruence items, the researcher listed specific objectives, items, questions that need to measure, it will base on the rating degree
2. In the interview for rating, the experts, from the industry or the well-known experts in each area, will evaluate variable one by one with a rating of 1 (for definitely examining or definitely related), –1 (clearly not examining or not related), or 0 (rating to the item or variable which examines the content area is unclear, or not sure) for each item. In this study, all 95 variables were validated by the experts in order to identify the proper items that will be used to mapping the Thailand's dairy supply chain collaboration.

4.1.2 Pilot Study

1. Qualified questionnaires, 158 respondents were evaluated in term of quality of data by removing missing data and outliers, were gathered to do the analysis. The Cronbach's alpha was a statistic used to examine the reliability of the constructs and variables.
2. The interrelationship of each variable or item was observed, examined, and explained by exploratory factor analysis (EFA), moreover, it can be used to identify the construct of appreciation. Exploratory factor analysis is suitable for this purpose, as per Fabrigar and Wegener (2012). EFA was used to reduce the dimension of the variables and explain the interrelationship of the major components. Principal axis factoring (PAF) was performed, the rotation type for this common factor analysis was Oblimin rotation, as the relation between variables cannot be ignored. This analysis required both Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity assessment. The KMO value ranges from 0-1; however, more than 0.6 is recommended (Hoque and Awang, 2016). Bartlett's Test of Sphericity should be significant at $P<0.05$ (Awang, 2015).

4.1.3 Main Study

4.1.3.1 Preliminary Data Analysis

Because Structural Equation Modelling (SEM) was used for examining the questions or hypotheses of the research, this analysis could not validate the univariate or multivariate normality of the testing statistical hypothesis (Kline, 2010). It is because in SEM, it uses Chi-squared statistic to explain significance value; however, Chi-squared does not explain or determine normality. It was led the researcher to evaluate the normality of data before analyses further. Normality can be estimated or evaluated by many methods. The inspection of non-normality is usually proceeded by the observation of the skewness and kurtosis. In this study, it would be tested 3 methods to test. One for an extremely value or outliers and two methods for normality as following: Mahalanobis Distance, Skewness and Kurtosis.

4.1.3.1.1 Mahalanobis Distance

Mahalanobis Distance is method to explain distance of samples, it observes the distance from the centroid. The value of report, it will show d-squared value, p1, and p2. The researcher needs to evaluation the Mahalanobis distance then consider deleting the farthest distance out of further study. In this study, Mahalanobis Distance was scrutinized by IBM® SPSS® Amos version 22. The dropping value of the distance, normally, it should cut off the samples that have the p-value (p1 and p2 in the reports) that > 0.001.

In this study, researcher cut of the respondents that have had high distance from centroid 316 respondents as shown in Appendix. Finally, the remaining respondents were 906 respondents.

4.1.3.1.2 Skewness

Two paths of the skewness can be classified, positive and negative skewness. First, an asymmetric tail extending toward more a positive distribution value, this indicates as a positive skewness. Next, the asymmetric tail extending toward more negative distribution values, this illustrates as negative skewness. In this study, Skewness was tested by IBM® SPSS® Amos version 22. The absolute value of skewness is not more than 2.0, it is normal, and data can be used for further study (West, Finch, & Curran, 1995). However, Kline (2005) presented the absolute value of skewness, it is normal distribution of sample, is less than 3.0. Then, data can be used for further study.

4.1.3.1.3 Kurtosis

Normal distribution of data, this is an important for the data analysis. One indication for structural equation modelling, on top of skewness it called kurtosis. Kurtosis indicates against the middle of a distribution with a normal curve. It mostly explains the height of the data distribution by comparing with normal distribution. A relative peak of kurtosis, it displays as a positive value, while a relative flat of the data set, it demonstrates as the negative values. In this study, Kurtosis was investigated by

IBM® SPSS® Amos version 22. West et al. (1995) reported that the kurtosis absolute values above 7.0 is indicated as a serious problem of non-normal distribution. Then the cut off value is < 7.0 in this study.

4.1.3.2 Confirmatory Factor Analysis (CFA)

In the pilot study, the exploratory factor analysis would be conducted, by proceed with confirmatory factor analysis. CFA would be helped to explain the EFA model in pilot study and developed the model for the main study. Moreover, CFA would examine the collected data from farmers in measurement models. In this study, it has 2 groups of models, one is about supply chain collaboration and another one is sustainability concept. The researcher would do 2 steps of analysis. First, an individual model would be examined, then the measurement model would be investigated later. It is parameter estimation that it has statistically significant or not. This critical ratio (CR) would be the value that the researcher would be monitoring, The critical ration, it should higher than 1.96, then the individual model would significant. Moreover, it can we evaluate by p-value as well.

The global fit indices would be used to estimate the model that has a global fit or not. The global fit indices as per following (Hooper et al., 2007)

1. Relative Chi-Square $\chi 2$ of the discrepancy ($\chi 2/df$) < 5.00
2. Goodness of Fit Index: GFI not less than 0.90
3. Adjusted Goodness of Fit Index: AGFI not less than 0.90
4. Comparative Fit Index: CFI not less than 0.90

5. Standardized Root Mean Square Residual: Standardized RMR < 0.09

6. Root Mean Squared Error Approximation: RMSEA < 0.07

4.1.3.3 Structural Modelling

In this part, researcher would test the proposed model from the beginning together with the result from EFA and from measurement models. It is parameter estimation that it has statistically significant or not. This critical ratio (CR) would be the value that the researcher would be investigating, The t-value, it should higher than 1.96, then the structural model would significant. Moreover, it can we evaluate by p-value with <0.001, <0.01, and <0.05. The global fit indices would be used to estimate the model that has a global fit or not. The global fit indices as per following (Hooper et al., 2007)

1. Relative Chi-Square $\chi 2$ of the discrepancy ($\chi 2$/df) < 5.00

2. Goodness of Fit Index: GFI not less than 0.90

3. Adjusted Goodness of Fit Index: AGFI not less than 0.90

4. Comparative Fit Index: CFI not less than 0.90

5. Standardized Root Mean Square Residual: Standardized RMR < 0.09

6. Root Mean Squared Error Approximation: RMSEA < 0.07

4.2 Results

4.2.1 Expert Interviews

The index of item-objective congruence (IOC) was used, from 11 experts in Thailand's dairy industry, at this stage to evaluate the variables and, as a result of IOC, 49 variables were selected with scores from 0.64 to 1.0. The results of the analysis are showed in Table 13. The items with scores higher than or equal to 0.5 were considered appropriate (Rovinelli & Hambleton, 1977). However, the variables were not grouped at this stage.

Table 13 The index of item-objective congruence score for supply chain collaboration testing.

Level of IOC score	No. of variables
Variable with IOC score = 1	37
Variable with IOC score > 0.7 - < 1	7
Variable with IOC score > 0.6 - < 0.7	5
Variable with IOC score > 0.5 - < 0.6	0
Variable with IOC score < 0.5	46
Total variables	95

As shown in Table 14. The 49 variables were identified. These all 49 items, researcher would use them in pilot study.

Table 14 Identified variables from IOC

Item	Variable	IOC	Author
V01	Adaptation	1.00	Dania, Xing and Amer (2018)
V02	Alliance and conflict resolution	0.64	Kumar and Banerjee (2012); Lemma (2015)
V03	Business objective (financial/operational)	1.00	Ramanathan (2014); Ramanathan, Gunasekaran and Subramanian (2011)
V06	Collaborative performance system	1.00	Simatupang and Sridharan (2007)
V07	Commitment	1.00	Banomyong (2018)
V08	Communication and understanding	1.00	Barratt (2004); Cao and Zhang (2011);
V09	Continuous improvement	1.00	Dania et al. (2018)
V10	Cost reduction	1.00	Ramanathan and Gunasekaran (2013); Banchuen et al. (2017)
V13	Decision synchronization	1.00	Ramanathan and Gunasekaran (2013); Lemma (2015); Banomyong (2018)
V14	Delivery schedules	1.00	Kumar and Banerjee (2012);

V16	Demand forecast accuracy	0.73	Ramanathan (2013)
V18	Environmental collaboration	0.73	Vachona and Klassen (2008)
V25	Information quality	1.00	Ramanathan et al. (2011)
V26	Information sharing	0.73	Prajogo and Jan (2012); Lemma (2015); Banomyong (2018)
V28	Initiating and maintaining operations	1.00	Ramanathan et al. (2011); Soosay et al. (2008)
V29	Innovative supply chain processes	0.64	Cao and Zhang (2010)
V30	Integrated information technology	0.64	Prajogo and Jan (2012);
V32	Intelligence gathering and analysis	1.00	Horvath (2001)
V36	Joint business planning	1.00	Ramanathan and Gunasekaran (2013); Cao and Zhang (2010)
V37	Joint efforts	1.00	Dania et al. (2018)
V38	Joint organizational learning	1.00	Kumar and Banerjee (2012)
V40	Joint problem solving	1.00	Min et al. (2005)

V41	Joint production	0.82	Chen et al. (2017)
V42	Joint teamwork	0.82	Ramanathan and Gunasekaran (2013)
V43	Knowledge transfer and integration	1.00	Kumar and Banerjee (2012); Herczeg et al. (2017); Soosay et al. (2008)
V46	Loyalty	1.00	Kumar and Banerjee (2012)
V49	Monitoring by customer	1.00	Chen et al. (2017)
V50	Mutual interest, benefits, risks, and rewards	1.00	Kumar and Banerjee (2012); Chen et al. (2017); Lemma (2015)
V54	On time production	1.00	Ramanathan et al. (2011)
V56	People management and development	1.00	Fawcett, Magnan and McCarter (2008)
V62	Power	1.00	Dania et al. (2018); Suong (2017)
V63	Price	1.00	Ramanathan and Gunasekaran (2013); Lemma (2015)
V64	Prioritizing goals and objectives	1.00	Kumar and Banerjee (2012)
V69	Production and delivery systems	1.00	Herczeg et al. (2017)
V70	Purchasing	1.00	Kumar and Banerjee 2012

V71	Quality	1.00	Cao and Zhang (2010); Banchuen et al. (2017)
V73	Relationship management & trust building	1.00	Fawcett et al. (2008); Chen et al. (2017); Prajogo and Jan (2012);
V74	Reliability of supply	1.00	Akintoye, McIntosh and Fitzgerald (2000)
V79	Shared supply chain processes	0.82	Simatupang and Sridharan (2004)
V80	Sharing responsibility for product recovery	0.64	Chen et al. (2017)
V81	Stability	1.00	Dania et al. (2018)
V82	Strategic project definition	1.00	Herczeg et al. (2017)
V88	Supplier monitoring	1.00	Chen et al. (2017)
V90	Supply chain collaboration exchanges	0.82	Horvath (2001)
V91	Supply chain metrics	0.64	Barratt (2004)
V92	Supply-demand agreements	1.00	Herczeg et al. (2017)
V93	Technology	1.00	Kumar and Banerjee (2012)
V94	Top management support	1.00	Akintoye et al. (2000)

V95	Trust	1.00	Lemma (2015); Banomyong (2018); Suong (2017)

It means, these 49 items had the impact on supply chain collaboration in the expert's point of view. However, this is not enough to develop the models. The researcher needed to do further study. A pilot study would be conducted to answer the research questions.

4.2.2 Pilot Study

The results of descriptive statistics analysis for the pilot study displayed in Table 15. Respondents were asked to answer the questions, each variable from total of 49 items, was measured by a nine-point Likert scale ranging from 1 represents strongly disagree to 9 as strongly agree. Referring to the mean score of each item, the result from the respondents tended to strong agree that Quality has impacted on supply chain collaboration (Mean 7.44, SD =1.95) also Delivery and Delivery schedules has impacted on supply chain collaboration in dairy industry (Mean 7.28, SD = 2.14). Furthermore, they also agreed that Loyalty (Mean 7.20, SD = 2.03), Trust (Mean = 7.20 SD = 2.27), Information quality (Mean = 7.08 SD = 2.08), Reliability of supply (Mean = 7.02 SD = 2.15), Joint problem solving (Mean = 6.98 SD = 1.88), People Management and Development (Mean = 6.95 SD = 2.23), Price (Mean = 6.95 SD = 2.13), Relationship Management and Trust Building (Mean = 6.95 SD = 1.98), Continuous Improvement (Mean = 6.93 SD = 1.97), Top management support (Mean = 6.93 SD = 2.3), Communicating/ Communication and understanding (Mean = 6.93 SD = 1.95), Production and delivery systems (Mean = 6.91 SD = 2), Stability (Mean = 6.87 SD = 2.19), Supply demand agreements (Mean = 6.86 SD = 2.21), On time production (Mean = 6.81 SD = 1.87), Commitment (Mean = 6.79 SD = 1.99), Information sharing (Mean = 6.76 SD = 2.22), Maintain operations (Mean = 6.76 SD = 2.02), Business Objective Financial Operational (Mean = 6.74 SD = 1.95), Environmental collaboration (Mean = 6.67 SD = 2.13), Prioritizing goals and objectives (Mean = 6.63 SD = 1.95), Alliance or

Conflict resolution (Mean = 6.61 SD = 2.47), Supplier monitoring (Mean = 6.58 SD = 2.32), Purchasing (Mean = 6.57 SD = 2.29), Decision synchronization/ Decision sharing (Mean = 6.52 SD = 2.36), Adaptation (Mean = 6.5 SD = 1.97), Joint organizational learning (Mean = 6.48 SD = 2.03), Supply chain metrics (Mean = 6.44 SD = 2.24), Joint Efforts (Mean = 6.43 SD = 1.95), Knowledge transfer and integration (Mean = 6.43 SD = 1.96), Power, Joint teamwork (Mean = 6.43 SD = 2.45), Monitoring by customer (Mean = 6.42 SD = 2.28), Cost reduction Cost (Mean = 6.39 SD = 2.46), Strategic project definition (Mean = 6.36 SD = 2.17), Demand forecast accuracy Forecast accuracy (Mean = 6.35 SD = 2.48), Supply chain collaboration exchanges (Mean = 6.34 SD = 2.29)

Table 15 Descriptive Statistics for the pilot study of supply chain collaboration

Variables	Mean	Std. Deviation
Adaptation	6.5000	1.96771
Alliance or Conflict resolution	6.6148	2.47449
Business Objective Financial Operational	6.7377	1.95318
Collaborative performance system	6.2295	2.20363
Commitment	6.7869	1.98852
Communicating Communication and understanding	6.9262	1.95473
Continuous Improvement	6.9344	1.96976
Cost reduction Cost	6.3607	2.55215

Decision synchronization/ Decision sharing	6.5246	2.36438
Delivery/ Delivery schedules	7.2787	2.14847
Demand forecast accuracy Forecast accuracy	6.3525	2.47941
Environmental collaboration	6.6721	2.12596
Information quality	7.0820	2.07938
Information sharing	6.7623	2.22329
Maintain operations	6.7623	2.02486
Innovation Innovative supply chain processes	5.8361	2.10611
Integrated information systems Information technology	5.6803	2.35055
Intelligence gathering and analysis	6.0000	2.00825
Joint business planning	6.0410	2.22085
Joint Efforts	6.4344	1.94973
Joint organizational learning	6.4754	2.03366
Joint problem solving	6.9836	1.88067
Joint production	6.0164	2.20437
Joint teamwork	6.4180	2.27760
Knowledge transfer and integration	6.4262	1.96211
Loyalty	7.1967	2.03132
Monitoring by customer	6.3852	2.45773

Mutual sharing interest/ benefit risks and rewards	6.1066	2.07228
On time production	6.8115	1.87340
People Management and Development	6.9508	2.22997
Power	6.4262	2.44584
Price	6.9508	2.12755
Prioritizing goals and objectives	6.6311	1.95487
Production and delivery systems	6.9098	1.99588
Purchasing	6.5656	2.28899
Quality	7.4426	1.94999
Relationship Management and Trust Building	6.9508	1.98279
Reliability of supply	7.0164	2.14739
Shared supply chain processes	6.2951	2.16161
Sharing responsibility for product recovery	6.1557	2.30709
Stability	6.8689	2.19297
Strategic project definition	6.3607	2.17067
Supplier monitoring	6.5820	2.32429
Supply chain collaboration exchanges	6.3361	2.28763
Supply chain metrics	6.4426	2.24179
Supply demand agreements	6.8607	2.21309

Technology	5.9508	2.49579
Top management support	6.9344	2.29890
Trust	7.1967	2.26595

The outcomes of the pretest examination are demonstrated in Table 16., the KMO measure of sampling adequacy score was 0.901, the data from the samples were confirmed that it was appropriate to be used. In addition, Bartlett's Test significance value is 0.000, less than 0.05. Therefore, the data set of samples was suitable for the EFA process.

Table 16 KMO and Bartlett's Test result for the items of EFA

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		**.901**
Bartlett's Test of Sphericity	Approx Chi-Square	7919.962
	df	1176
	Sig	.000

The EFA result expresses that all 7 extracted contracts exceed the recommended quality of more than 1.0. Component 1's Eigenvalue is 27.390, component 2's is 3.326, component 3's is 2.241, component 4's is 1.857, component 5's is 1.712, component 6's is 1.411, and component 7's is 1.069 as shown in Table 17.

The cumulative % variance of these 7 components is 77.422 percent, which is higher than the suggested value of 60% (Hair, Black, Babin and Anderson, 2019). However, these 7 components could not be used since their factor loadings were cut off at 0.5. Finally, 6 components were used to develop the questionnaire.

Reliability analysis of the items can be explained by Cronbach's Alpha value, which should be more than 0.5; however, Hoque et al. (2019) suggest that a value above 0.6 can ensure consistency.

As presented in Table 18, components in this study were calculated according to Cronbach's Alpha component 1-6 at 0.939, 0.930, 0.917, 0.906, 0.808, and 0.911 respectively. All components exceeded 0.8, which is higher than the suggested minimum of 0.7, and the results can therefore be regarded as reliable measurements.

Table 17 Total Variance Explained of Pilot Study

Total Variance Explained							
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	27.390	55.898	55.898	27.160	55.429	55.429	19.847
2	3.326	6.789	62.686	3.098	6.322	61.751	11.828
3	2.241	4.574	67.260	2.016	4.114	65.866	11.599
4	1.857	3.789	71.049	1.610	3.285	69.151	13.597
5	1.712	3.494	74.543	1.439	2.938	72.089	10.282
6	1.411	2.880	77.422	1.142	2.331	74.420	16.235
7	1.069	2.181	79.604	.838	1.710	76.130	4.024
8	.947	1.932	81.535				
9	.838	1.711	83.246				
10	.772	1.576	84.822				
11	.638	1.302	86.124				
12	.615	1.256	87.380				
13	.576	1.176	88.557				
14	.496	1.012	89.569				
15	.493	1.006	90.575				
16	.430	.878	91.453				
17	.373	.761	92.214				
18	.299	.610	92.824				
19	.278	.567	93.390				
20	.273	.558	93.948				
21	.239	.489	94.437				
22	.225	.458	94.895				
23	.216	.440	95.336				

24	.203	.415	95.751				
25	.186	.379	96.130				
26	.178	.364	96.494				
27	.163	.333	96.827				
28	.144	.294	97.121				
29	.142	.289	97.410				
30	.130	.265	97.675				
31	.121	.246	97.921				
32	.114	.232	98.153				
33	.106	.217	98.370				
34	.098	.201	98.571				
35	.094	.192	98.762				
36	.079	.162	98.924				
37	.075	.154	99.078				
38	.063	.129	99.208				
39	.057	.117	99.325				
40	.052	.107	99.431				
41	.048	.098	99.530				
42	.045	.091	99.621				
43	.041	.083	99.704				
44	.034	.070	99.774				
45	.032	.065	99.839				
46	.027	.056	99.895				
47	.022	.045	99.939				
48	.018	.037	99.977				
49	.011	.023	100.000				
Extraction Method: Principal Axis Factoring.							
a. When factors are correlated, sums of squared loadings cannot be added to obtain a total variance.							

Table 18 Reliability statistics for the 7 construct factors of EFA output

		Cronbach's alpha
Construct	Item	
Performance and commitment	PC1	0.939
	PC2	
	PC3	
	PC4	
	PC5	
	PC6	
	PC7	
Internal and external collaboration	IEC1	0.930
	IEC2	
	IEC3	
	IEC4	
Measurement and evaluation	ME1	0.917
	ME2	
	ME3	
	ME4	
Joint operation	JO1	0.906
	JO2	

	JO3	
	JO4	
	JO5	
Sharing and innovation	SI1	0.808
	SI2	
	SI3	
Negotiation	NEO1	0.911
	NEO2	
	NEO3	

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

Table 19 EFA output for supply chain collaboration

			LOADING						
CONSTRUCT	Item	Variables	1	2	3	4	5	6	7
Performance and commitment	PC1	Communicating and understanding	.791						
	PC2	Continuous Improvement	.747						
	PC3	Information quality	.738						
	PC4	Delivery	.736						
	PC5	Collaborative performance system	.678						
	PC6	People Management and Development	.649						
	PC7	Commitment	.601						
Internal and external collaboration	IEC1	Environmental collaboration		.928					
	IEC2	Information sharing		.919					
	IEC3	Alliance or Conflict resolution		.857					

	IEC4	Demand forecast accuracy Forecast accuracy	.857			
Measurement and evaluation	ME1	On time production		.679		
	ME2	Prioritizing goals and objectives		.641		
	ME3	Mutual sharing		.567		
	ME4	Supply chain metrics		.503		
Joint operation	JO1	Joint teamwork			.792	
	JO2	Cost reduction Cost			.758	
	JO3	Joint production			.669	
	JO4	Technology			.663	
	JO5	Joint Efforts			.636	
Sharing and innovation	SI1	Shared supply chain processes				.870
	SI2	Sharing responsibility for product recovery				.599

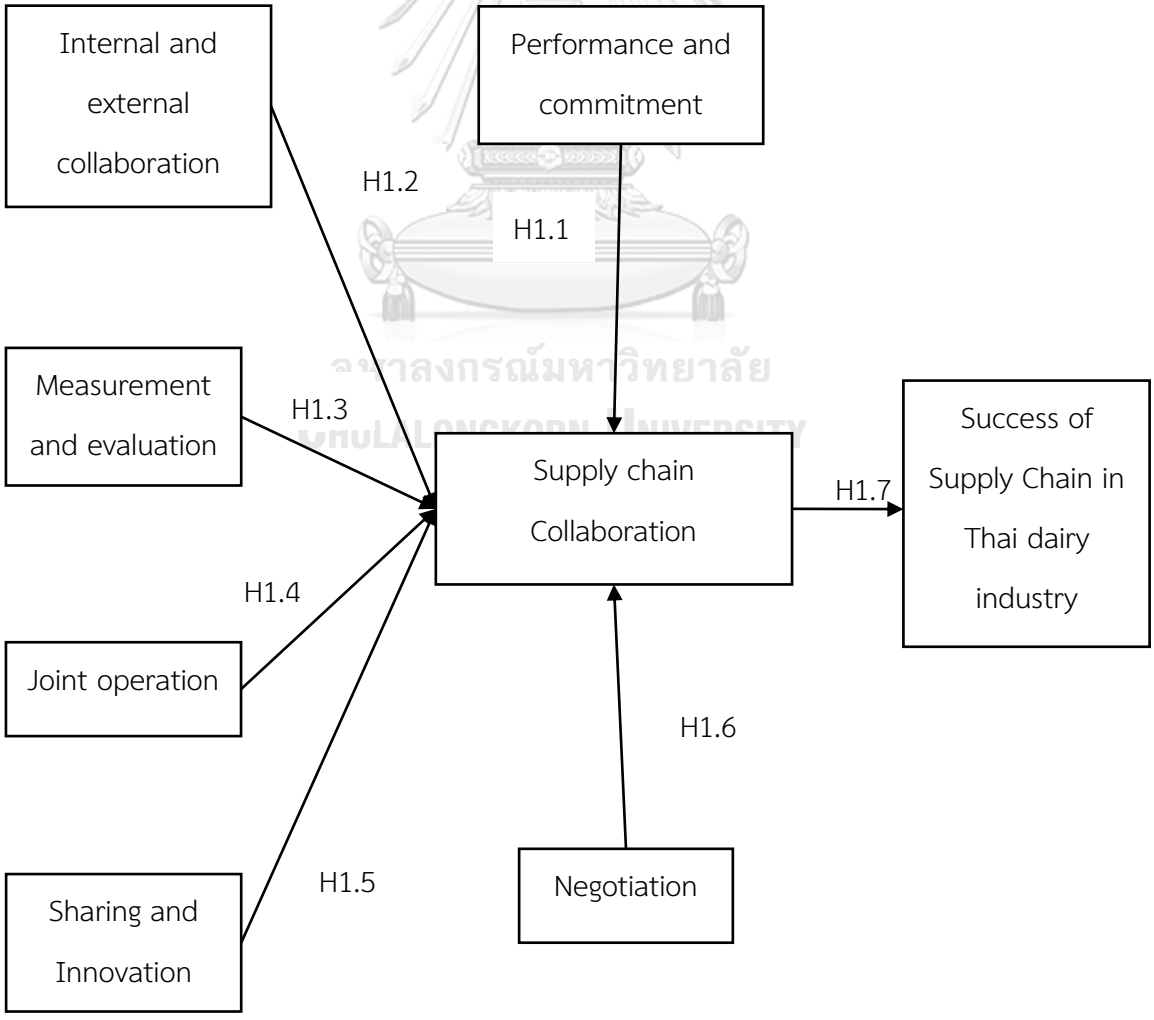
	SI3	Innovation Innovative supply chain processes	.552
Negotiation	NEO1	Purchasing	-.696
	NEO2	Stability	-.686
	NEO3	Power	-.680

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

The cumulative % variance of these 7 components is 77.422 percent, as displayed in Table 17., which is higher than the recommended value of 60% (Joe Hair, Black, Babin, & Anderson, 2019). However, these 7 components could not be used since their factor loadings were cut off at 0.5. Finally, 6 components were developed as shown in Table 18 and 19. These 6 constructs were used to develop the questionnaire. The researchers also propose the framework as showed in Figure 16. Also, the researchers considered the following hypothesizes:

Figure 16 Proposed Framework from Supply Chain Collaboration part.



H 1.1: Performance and commitment have a positive impact on supply chain collaboration

H 1.2: Internal and external collaboration have a positive impact on supply chain collaboration

H 1.3: Measurement and evaluation have a positive impact on supply chain collaboration

H 1.4: Joint operation has a positive impact on supply chain collaboration

H 1.5: Sharing and innovation have a positive impact on supply chain collaboration

H 1.6: Negotiation has a positive impact on supply chain collaboration

H 1.7: Supply chain collaboration has a positive impact on Success of Supply Chain in Thai dairy industry

Moreover, hypotheses for sustainability for Thai dairy industry sustainability were identified as per below

H 3a: Economics Sustainability has a positive impact on Thai dairy industry sustainability

H 3b: Environmental Sustainability has a positive impact on Thai dairy industry sustainability

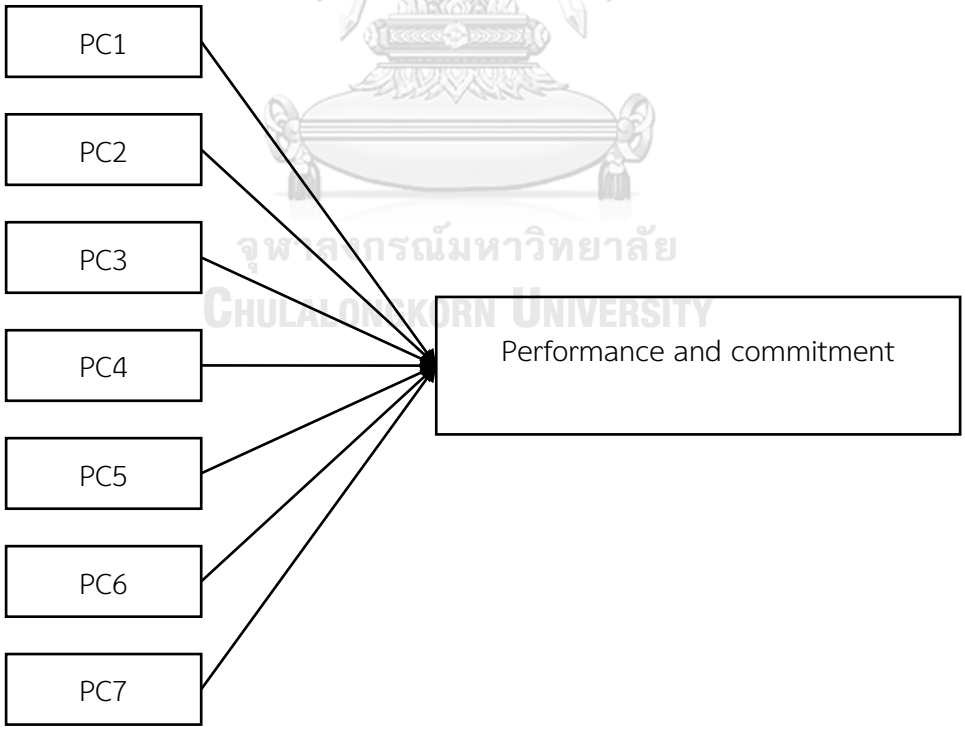
H 3c: Socials Sustainability has a positive impact on Thai dairy industry sustainability

6 Individual Models from pilot study

Moreover, for the further study in the main model, the researcher not only for the model from EFA shown in Figure 16. In each construct, that the researcher did not propose the framework in methodology chapter, now the frameworks were calculated from the EFA as per demonstrated in Figure 17 – Figure 22.

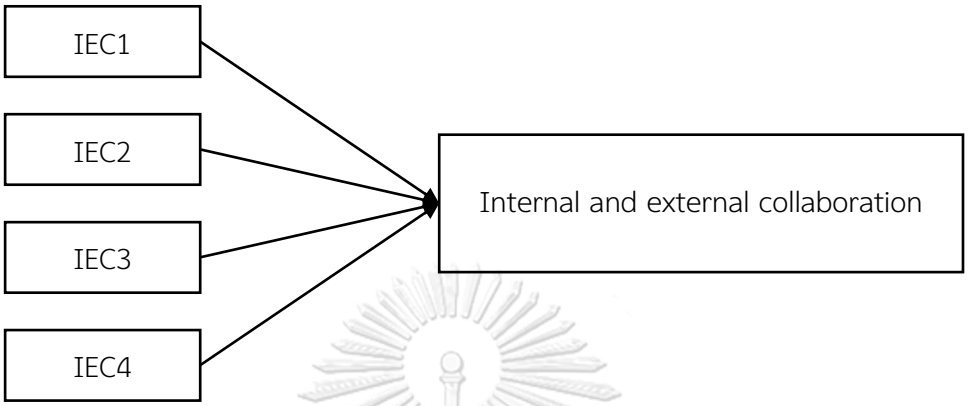
Performance and commitment (PC) constructs

Figure 17 Performance and commitment (PC) constructs



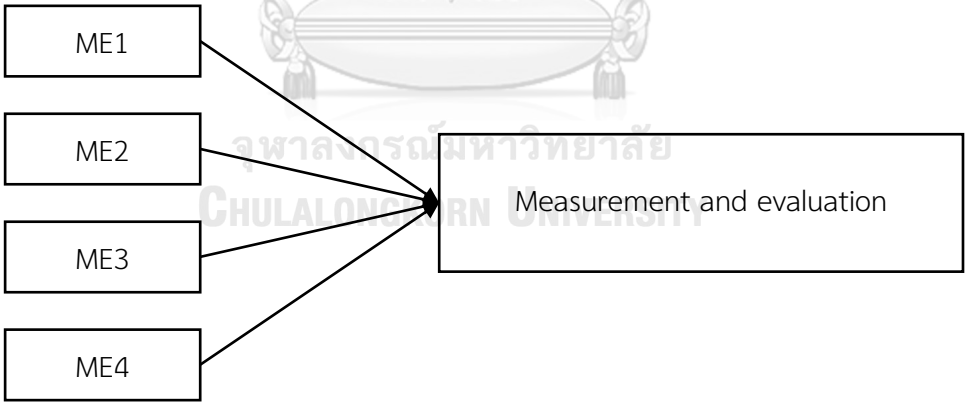
Internal and external collaboration (IEC) construct

Figure 18 Internal and external collaboration (IEC) construct



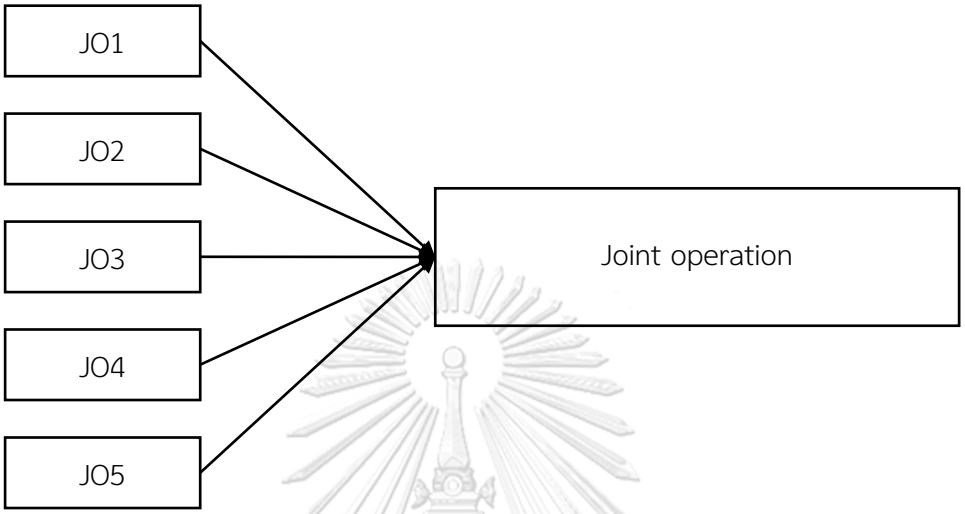
Measurement and evaluation (ME) construct

Figure 19 Measurement and evaluation (ME) construct



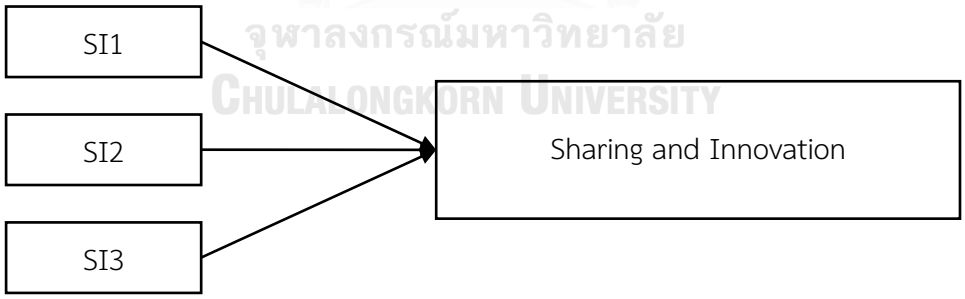
Joint operation (JO) construct

Figure 20 Joint operation (JO) construct



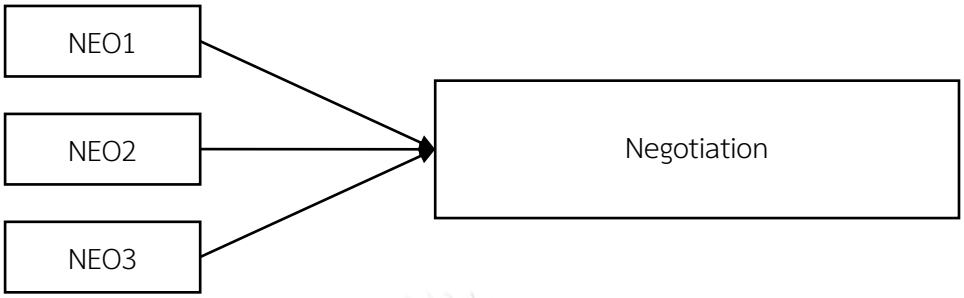
Sharing and Innovation (SI) construct

Figure 21 Sharing and Innovation (SI) construct



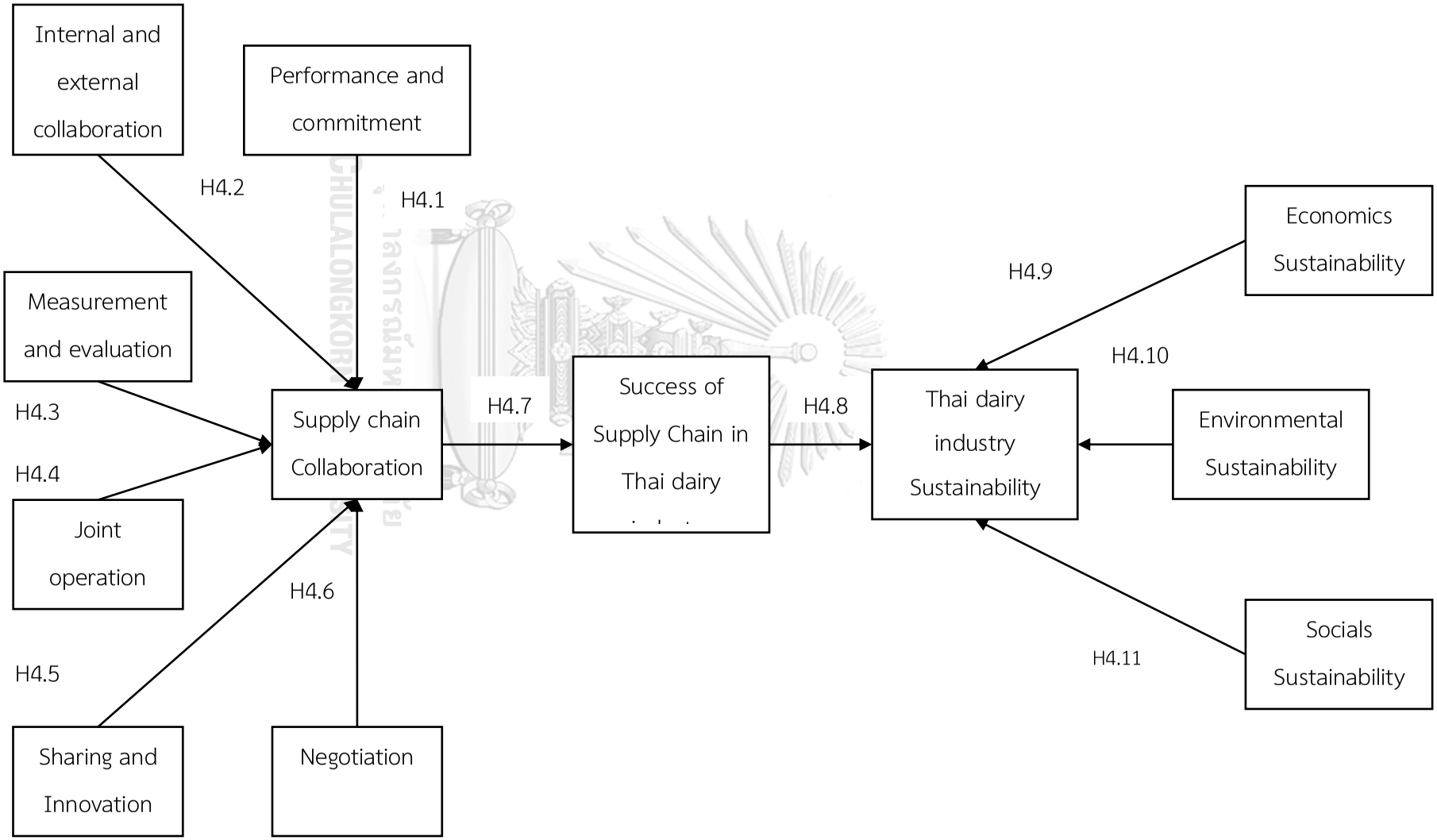
Negotiation (NEO) construct

Figure 22 Negotiation (NEO) construct



Additionally, the main study model was formed due to the EFA result, and it was shown in Figure 23. These models would be tested and analyzed by confirmatory factor analysis and structural equation modelling in main study.

Figure 23 Proposed Framework of the study



Moreover, the resercher demonstrared the hypothese for the main model that it would be tested as per listing below:-

H4.1: Performance and commitment have a positive impact on supply chain collaboration

H4.2: Internal and external collaboration have a positive impact on supply chain collaboration

H4.3: Measurement and evaluation have a positive impact on supply chain collaboration

H4.4: Joint operation has a positive impact on supply chain collaboration

H4.5: Sharing and innovation have a positive impact on supply chain collaboration

H4.6: Negotiation has a positive impact on supply chain collaboration

H4.7: Supply chain collaboration has a positive impact on Success of Supply Chain in Thai dairy industry

H4.8: Success of Supply Chain in Thai dairy industry has a positive impact on Thai dairy industry Sustainability

H4.9: Economics Sustainability has a positive impact on Thai dairy industry sustainability

H4.10: Environmental Sustainability has a positive impact on Thai dairy industry sustainability

H4.11: Socials Sustainability has a positive impact on Thai dairy industry sustainability

4.2.3 Main Study

4.2.3.1 Normality of data

Mahalanobis Distance

In this study, researcher cut of the respondents that have had high distance from centroid 316 respondents as shown in Appendix. Finally, the remaining respondents were 906 respondents.

Skewness

Skewness was tested by IBM® SPSS® Amos version 22. The absolute value of skewness is not more than 2.0, it is normal, and data can be used for further study (West et al., 1995). However, Kline (2005) presented the absolute value of skewness, it is normal distribution of sample, is less than 3.0. AS a result of testing the Skewness, it was 0.330 to -0.276 as shown in Table 20. Then, data can be used for further study.

Table 20 Skewness of sample

Variable	skewness
JO5	0.282
EB06	-0.236
EB05	-0.137
EB03	0.248
EB02	0.248

EB01	0.332
SB01	-0.12
SB04	-0.192
SB03	-0.073
SB02	-0.141
FB06	-0.045
FB05	0.018
FB04	0.038
FB03	0.018
FB02	0.069
FB01	0.162
SCC05	0.27
SCC04	0.238
SCC03	-0.162
SCC02	0.159
SCC01	0.138
PC7	-0.213
NEO1	-0.118
NEO2	-0.164
NEO3	-0.067

SI1	0.071
SI2	-0.256
SI3	0.085
JO4	-0.344
JO1	0.045
JO3	-0.161
ME1	-0.133
ME2	-0.261
ME3	0.016
ME4	-0.093
IEC1	0.091
IEC2	-0.006
IEC3	0.037
IEC4	-0.031
PC1	0
PC2	-0.075
PC3	-0.177
PC4	-0.276
PC5	0.038
PC6	-0.129

Kurtosis

In this study, Kurtosis was investigated by IBM® SPSS® Amos version 22. West et al. (1995) reported that the kurtosis absolute values above 7.0 is indicated as a serious problem of non-normal distribution. Then the cut off, < 7.0 in this study. From the result of testing Kurtosis was between -0.925 to 0.583 as demonstrated in Table 21., it meant the data can be used for further analyses.

Table 21 Kurtosis analysis of data

Variable	kurtosis
JO5	-0.69
EB06	0.189
EB05	-0.035
EB03	0.583
EB02	0.322
EB01	0.551
SB01	-0.661
SB04	-0.165
SB03	-0.734
SB02	-0.726
FB06	0.388
FB05	0.046

FB04	0.181
FB03	-0.025
FB02	0.001
FB01	0.216
SCC05	-0.589
SCC04	-0.159
SCC03	0.317
SCC02	-0.207
SCC01	-0.115
PC7	-0.03
NEO1	-0.245
NEO2	-0.623
NEO3	-0.415
SI1	-0.647
SI2	-0.166
SI3	-0.147
JO4	0.017
JO1	-0.334
JO3	-0.206
ME1	-0.773

ME2	-0.158
ME3	-0.309
ME4	-0.299
IEC1	-0.925
IEC2	-0.684
IEC3	-0.733
IEC4	-0.186
PC1	-0.363
PC2	-0.436
PC3	-0.353
PC4	-0.378
PC5	0.407
PC6	-0.231

4.2.3.2 Supply chain collaboration model

4.2.3.2.1 Level of collaboration

In dairy industry, level of collaboration was 3.26 out of 5.00 the interpretation of the scale was medium level. Thus, this impacted to supply chain collaboration as Table 22.

Moreover, planning and inventory were in the medium level as score 3.21 and 3.28 respectively. The researcher also asked the respondents about the supply chain collaboration related questions such as "Do you know about supply chain collaboration?", "In you working environment in dairy industry, do you plan and use planning among the parties, in which score?" and "In you working environment in dairy industry, do you share and use inventory among the parties, in which score?". Moreover, they were asked about number of relationships in the dairy business in past 12 months.

Table 22 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Knowing	1053	1.00	5.00	2.62	.942
Planning	1053	1.00	5.00	3.21	.931
Inventory	1053	1.00	5.00	3.28	.997
Level	1053	1.00	5.00	3.26	.871
Relationship	1053	5.00	1.00	4.79	.655

The analysis was conducted to 2 models comparing to different ways, by different questions.

Supply chain collaboration model 1

This model, the researchers aim to compare supply chain collaboration in Thailand dairy farmers with model from Cohen and Roussel (2005) as Figure 24. As presents in Figure 25, the result can explain that, supply chain collaboration in Thailand dairy farmer is in the *coordinated collaboration type*. There are low in term of number of relationship (in the analysis the researchers indicated that low relationship to high score) while there are in the medium level of collaboration among parties.

Figure 24 Type of Supply Chain Collaboration by number of relationships versus level of collaboration

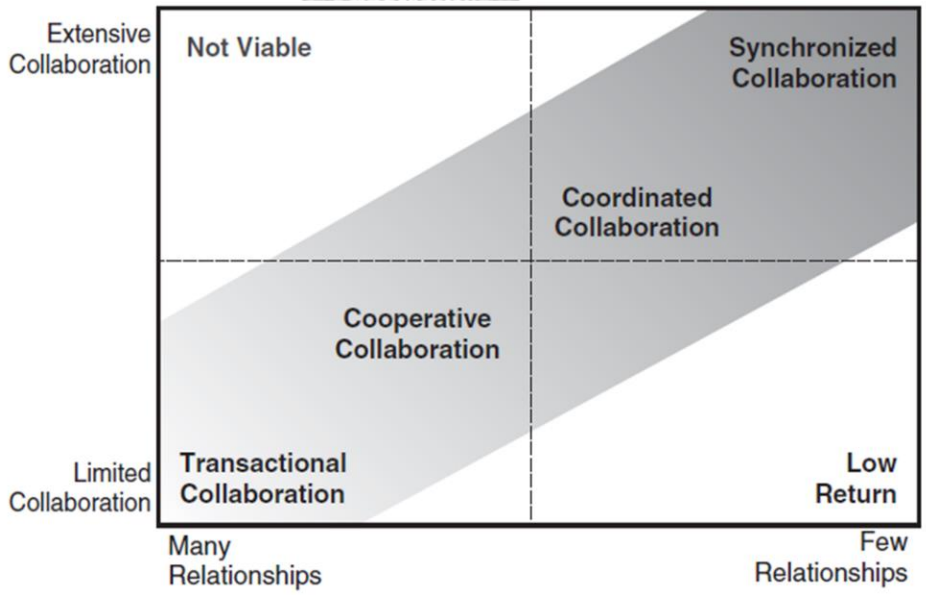
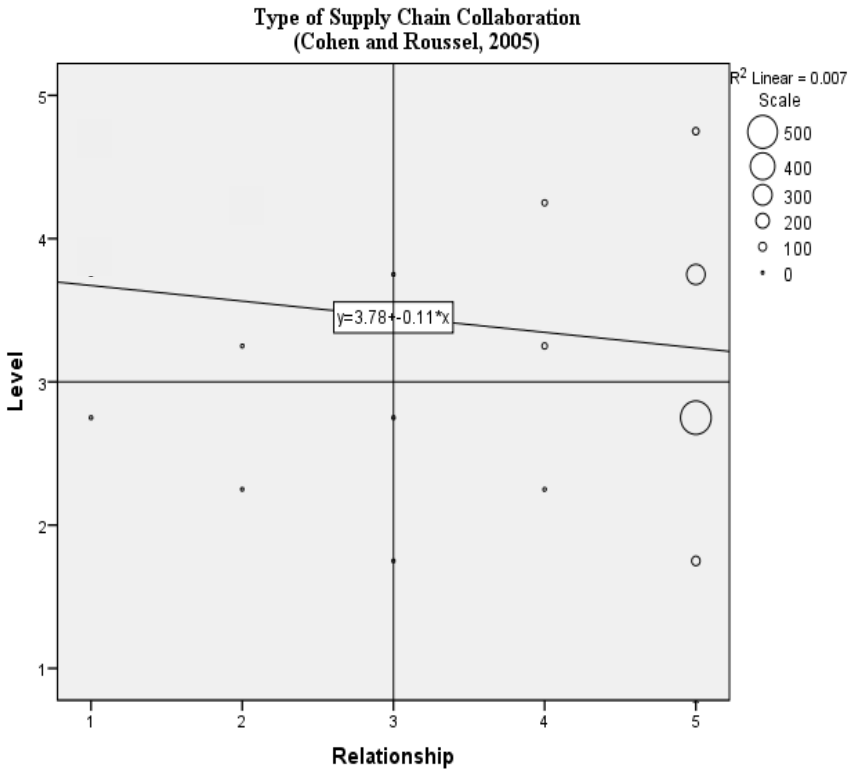


Figure 25 Supply Chain Collaboration of Thai dairy industry by number of relationships versus level of collaboration



Supply chain collaboration model 2

This model, the researchers have objective to compare supply chain collaboration in Thailand's dairy farmers with model from Holweg, Disney, and Holmström (2005) as in Figure 26. The result of the scatter plot analysis between planning versus inventory collaboration shows in Figure 27. An interpretation of this scatter plot, it can explain that supply chain collaboration in this scope, Thailand's dairy farmers have majority that sharing plan and inventory among the chain. As show in Figure 27, it shows a biggest circle in the middle of the chart, while second bigger, it is in the *synchronized supply type*.

Figure 26 Type of Supply Chain Collaboration by planning versus inventory collaboration

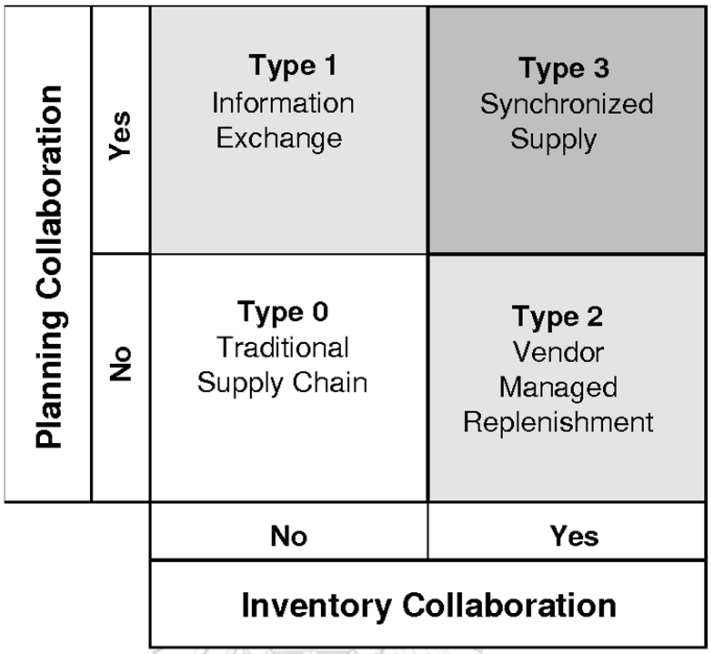
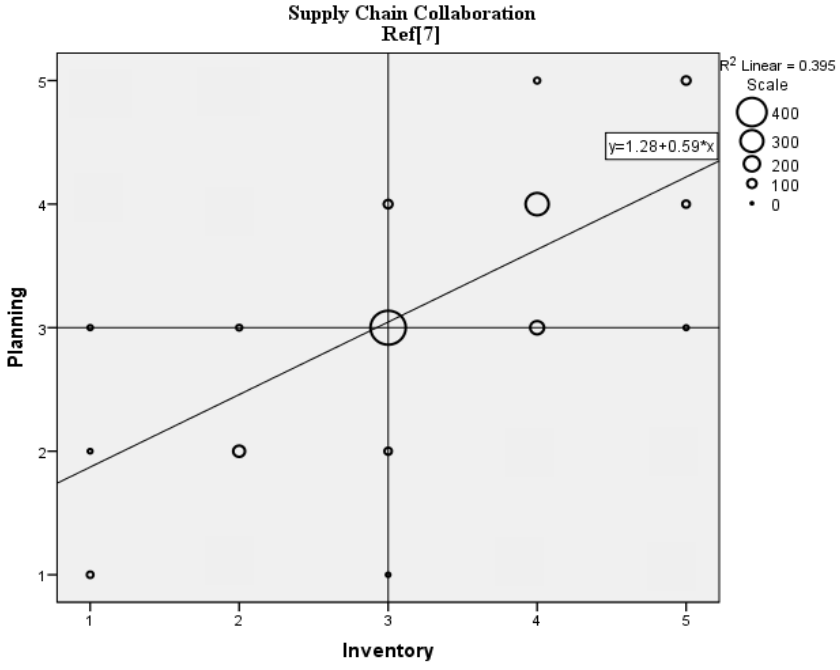


Figure 27 Supply Chain Collaboration of Thai dairy industry by planning versus inventory collaboration



4.2.3.2.2 Level of Supply chain collaboration understanding

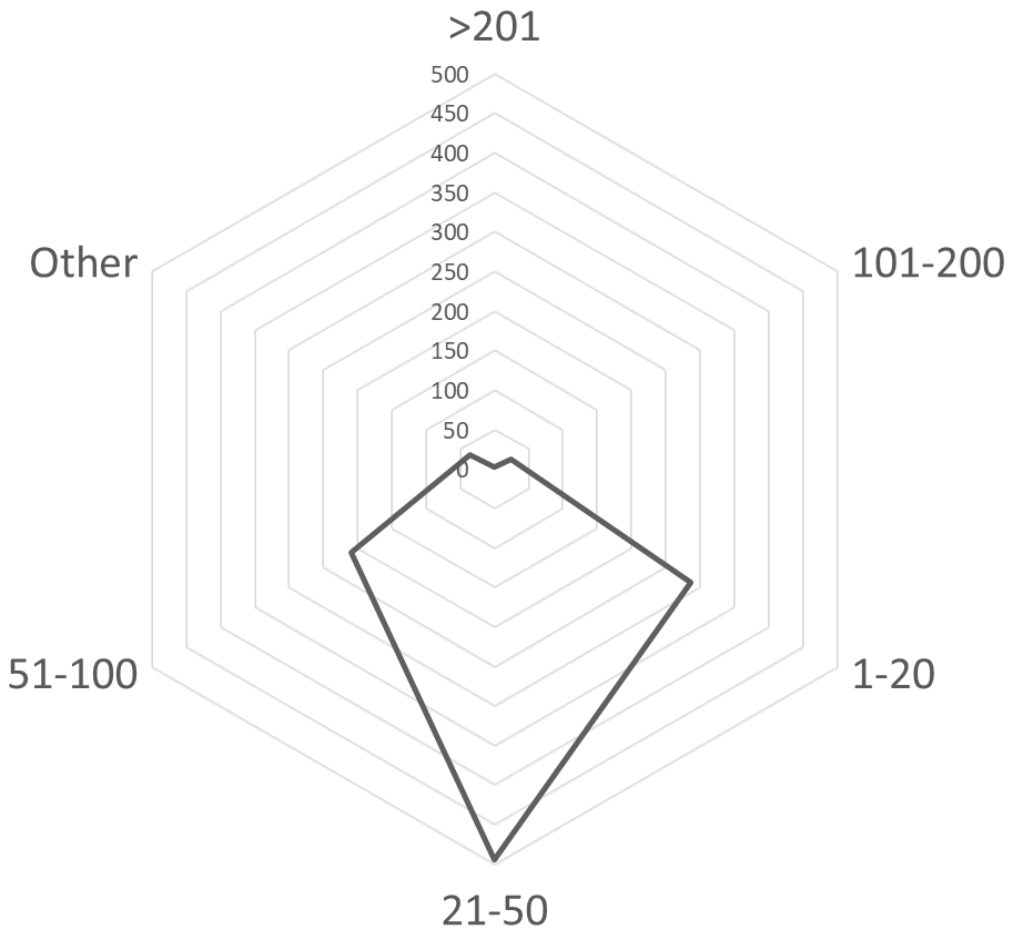
The result of survey is showing that Thailand's dairy farmers have an understanding regarding to Supply chain collaboration 2.618 out of 5.00 scores. An interpretation of this score, it means, Thailand's dairy farmers have understanding in the medium level (2.61-3.40 scores indicated as medium). However, this score is nearly low level as shown in Table 22.

4.2.3.3 Profile of respondents

Farm size

Respondents were dairy cattle farmers and co-operatives and milk-collecting centers, As showed in Figure 28, most participants (46.91%) have approximately 21-50 cows per farm, followed by 1-20 cows per farm (27.16%), and 210 cows per farm (19.94%). These three groups constituted 94.02%. Also as shown in Figure 24, questionnaires were received from many regions of Thailand.

Figure 28 Farm size of respondents

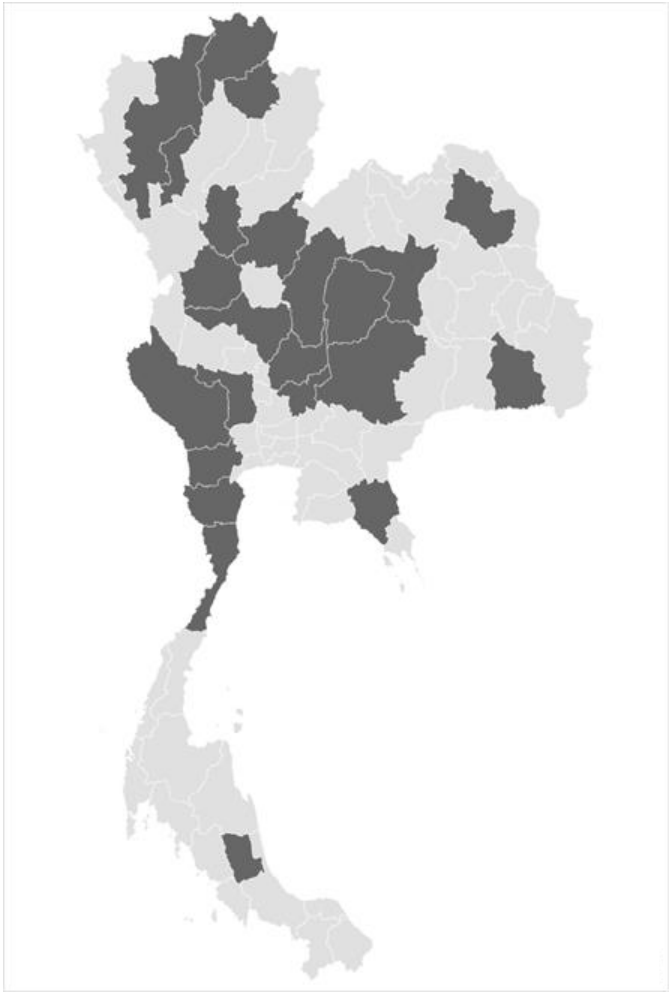


Area of respondents

From 187 co-operatives and milk-collecting centers that certified GMP were used as the sample for the main study, the respondents actively reply the survey by sending the questionnaire back from 23 provinces following as shown in Figure 29, Chiang Mai, Chiang Rai, Phetchaburi, Phetchabun, Kanchanaburi, Kamphaeng Phet, Khon Kaen, Chanthaburi, Chaiyaphum, Nakhon Ratchasima, Nakhon Sawan, Prachuap

Khiri Khan, Phayao, Phatthalung, Phitsanulok, Ratchaburi, Lop Buri, Lamphun, Si Sa Ket, Sakon Nakhon, Saraburi, Sukhothai, Suphan Buri

Figure 29 Respondents location map



Education

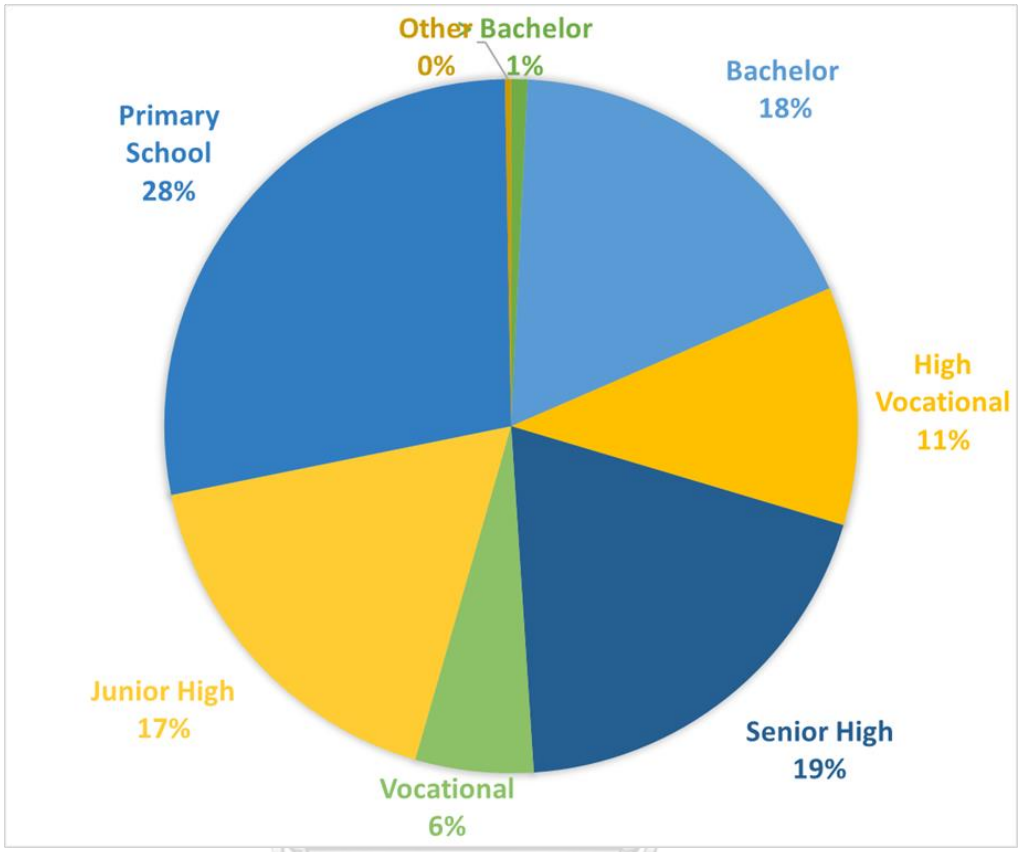
In term of education, as a result of analysis, it showed that majority of farmers are graduated primary school 27.9%, then, the second rank of education of farmer is senior high school, they graduated 19.4%, and the third rank is bachelor degree. While, the undergraduate schools are contributing 81.2%, and the education of farmers that

graduated from university is 18.5% as showed in Table 23. Moreover, primary school, and both junior and senior high school are contributing 64.6% as shown in Table 23 and distribution of data in Figure 30.

Table 23 Educations of Thailand dairy farmers

	Frequency	%	Valid %	Cumulative %
> Bachelor	8.0	0.8	0.8	0.8
Bachelor	187.0	17.8	17.8	18.6
High Vocational Certificate	117.0	11.1	11.1	29.7
Senior High School	204.0	19.4	19.4	49.1
Vocational Certificate	58.0	5.5	5.5	54.6
Junior High School	183.0	17.4	17.4	72.0
Primary School	294.0	27.9	27.9	99.9
Other	2.0	0.2	0.2	100.0
Total	1053.0	100.0	100.0	

Figure 30 Distribution of Farmers education



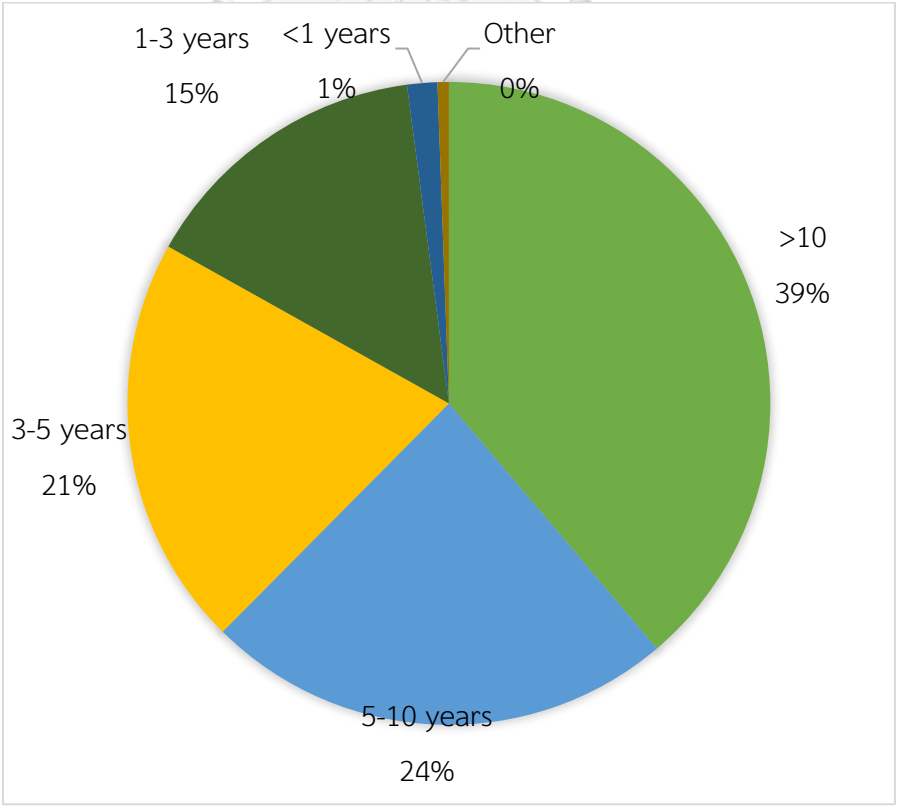
Experiences

Dairy farmers can or cannot manage cattle farms, not only knowledges from educations, but also experiences, Thus, experiences are important to run the farms. As a result of analysis, showed in Table II, Thai dairy farmers 38.8% have more than 10 years experiences in the business, 23.6% have 5-10 years experiences, and 20.7% have 3-5 year of experiences. Only 16.3% of dairy farmers have experiences less than 3 years as presented in Table 24 and Figure 31.

Table 24 Experiences of Thailand dairy farmers (years)

Experiences	Frequency	Valid Percent	%Cumulative
>10	409	38.8%	38.8%
5-10 years	249	23.6%	62.4%
3-5 years	218	20.7%	83.1%
1-3 years	156	14.8%	97.9%
<1 year	16	1.5%	99.5%
Other	5	0.5%	100.00%
Total	1053	100	

Figure 31 Distribution of Thai farmer experiences



4.2.3.4 Analysis of Variance

This study also conducted the analysis of variance to understand effect of farm size, dairy farm experiences, educations to number of relationships in supply chain. Regarding to the variables and numbers of category in each item in Table 25 and 26.

Table 25 Items matching with number of categories

Categories	Education	Experiences	Farm Size
1	Primary School	<1 year	1-20 Cows
2	Junior High School	1-3 years	21-50 Cows
3	Vocational Certificate	3-5 years	51-100 Cows
4	Senior High School	5-10 years	101-200 Cows
5	High Vocational Certificate	>10	>201 Cows
6	Bachelor	Other	Other
7	> Bachelor		0
8	Other		

Table 26 Modification of number of relationships to be ordinal

Level	Number of organizations that contact in 12 months
1	1-2
2	3-5
3	5-10

4	10-15
5	15-20
6	20-40
7	40-100
8	> 100

Hypotheses for ANOVA analysis

Hypothesis Set 1

H_0 : Years of experiences has no effect to number of relationships

H_1 : Years of experiences has an effect to number of relationships

Hypothesis Set 2

H_0 : Education has no effect to number of relationships

H_1 : Education has an effect to number of relationships

Hypothesis Set 3

H_0 : Farm size has no effect to number of relationships

H_1 : Farm size has an effect to number of relationships

The researcher used IBM® SPSS® Statistics Version 22 for analysis the data, it was conducted by General Linear Model > Univariate. Thus, the results of the analysis were demonstrated in Table 27 - 29

Result from Analysis of variances by Univariate Model

Table 27 Between-Subjects Factors

		Value Label	N
Education	1	Primary School	294
	2	Junior High School	183
	3	Senior High School	204
	4	Vocational Certificate	58
	5	High Vocational Certificate	117
	6	Bachelor	187
	7	> Bachelor	8
	8	Other	2
Experiences	1	<1	16
	2	1-3	156
	3	3-5	218
	4	5-10	249
	5	>10	409
	6	Other	5
Farm Size	1	Small 1-20 Cows	286
	2	Medium 21-50 Cows	494

	3	Large 51-100 Cows	210
	4	XL 101-200 Cows	24
	5	XXL >201 Cows	3
	6	Other	30
	7	0	6

Table 28 Descriptive Statistics (Dependent Variable: Number of Relationship)

Education	Experiences	Farm Size	Mean	Std. Deviation	N
Primary School	<1	Small 1-20 Cows	1.60	.548	5
		Total	1.60	.548	5
	1-3	Small 1-20 Cows	1.44	.512	16
		Medium 21-50 Cows	1.58	.669	12
		Large 51-100 Cows	2.00	.	1
		Total	1.52	.574	29
	3-5	Small 1-20 Cows	1.80	.561	15
		Medium 21-50 Cows	1.38	.619	16
		Large 51-100 Cows	2.57	2.440	7
		Other	2.00	.000	5
		Total	1.79	1.125	43
	5-10	Small 1-20 Cows	1.85	.745	20
		Medium 21-50 Cows	1.97	.566	29

		Large 51-100 Cows	1.89	.601	9
		XL 101-200 Cows	1.50	.707	2
		Total	1.90	.630	60
	>10	Small 1-20 Cows	2.13	1.910	31
		Medium 21-50 Cows	2.11	1.282	71
		Large 51-100 Cows	2.16	1.362	43
		XL 101-200 Cows	2.00	.000	2
		XXL >201 Cows	2.00	.	1
		Other	2.13	.354	8
		Total	2.13	1.399	156
	Other	Large 51-100 Cows	2.00	.	1
		Total	2.00	.	1
	Total	Small 1-20 Cows	1.85	1.253	87
		Medium 21-50 Cows	1.94	1.063	128
		Large 51-100 Cows	2.16	1.405	61
		XL 101-200 Cows	1.75	.500	4
		XXL >201 Cows	2.00	.	1
		Other	2.08	.277	13
		Total	1.96	1.172	294
Junior High School	1-3	Small 1-20 Cows	1.67	.488	15
		Medium 21-50 Cows	1.22	.441	9

		Other	2.00	.	1
		Total	1.52	.510	25
	3-5	Small 1-20 Cows	2.17	1.249	18
		Medium 21-50 Cows	2.06	1.749	17
		Other	2.00	.000	9
		Total	2.09	1.326	44
	5-10	Small 1-20 Cows	1.86	.378	7
		Medium 21-50 Cows	2.05	1.284	21
		Large 51-100 Cows	1.88	.835	8
		Other	2.00	.000	2
		Total	1.97	1.026	38
	>10	Small 1-20 Cows	1.45	.688	11
		Medium 21-50 Cows	2.35	1.418	46
		Large 51-100 Cows	3.25	2.793	16
		XL 101-200 Cows	1.33	.577	3
		Total	2.37	1.780	76
	Total	Small 1-20 Cows	1.82	.888	51
		Medium 21-50 Cows	2.12	1.413	93
		Large 51-100 Cows	2.79	2.395	24
		XL 101-200 Cows	1.33	.577	3
		Other	2.00	.000	12

		Total	2.10	1.432	183
Senior High School	<1	Small 1-20 Cows	1.67	.577	3
		Medium 21-50 Cows	2.00	.	1
		Total	1.75	.500	4
	1-3	Small 1-20 Cows	1.33	.500	9
		Medium 21-50 Cows	2.24	.926	25
		Large 51-100 Cows	2.00	.	1
		0	2.00	.	1
		Total	2.00	.894	36
	3-5	Small 1-20 Cows	1.31	.479	16
		Medium 21-50 Cows	1.83	.816	24
		Large 51-100 Cows	1.80	.447	5
		Total	1.64	.712	45
	5-10	Small 1-20 Cows	2.00	.667	10
		Medium 21-50 Cows	1.88	1.250	34
		Large 51-100 Cows	2.67	2.160	6
		XL 101-200 Cows	2.00	.	1
		Other	2.00	.	1
		Total	2.00	1.268	52
	>10	Small 1-20 Cows	1.56	.527	9
		Medium 21-50 Cows	1.85	.662	27

		Large 51-100 Cows	2.72	2.283	25
		XL 101-200 Cows	1.33	.577	3
		XXL >201 Cows	1.00	.	1
		Other	1.00	.	1
		Total	2.09	1.556	66
	Other	Medium 21-50 Cows	2.00	.	1
		Total	2.00	.	1
	Total	Small 1-20 Cows	1.53	.584	47
		Medium 21-50 Cows	1.95	.957	112
		Large 51-100 Cows	2.57	2.062	37
		XL 101-200 Cows	1.50	.577	4
		XXL >201 Cows	1.00	.	1
		Other	1.50	.707	2
		0	2.00	.	1
		Total	1.95	1.208	204
Vocational Certificate	<1	Small 1-20 Cows	3.00	2.646	3
		Total	3.00	2.646	3
	1-3	Small 1-20 Cows	2.00	1.000	3
		Medium 21-50 Cows	2.00	.	1
		0	1.00	.	1
		Total	1.80	.837	5

	3-5	Small 1-20 Cows	1.67	.516	6
		Medium 21-50 Cows	1.33	.492	12
		Large 51-100 Cows	1.00	.	1
		Total	1.42	.507	19
	5-10	Small 1-20 Cows	2.25	.886	8
		Medium 21-50 Cows	2.00	.816	4
		Large 51-100 Cows	1.00	.	1
		Total	2.08	.862	13
	>10	Small 1-20 Cows	1.50	.577	4
		Medium 21-50 Cows	1.60	.894	5
		Large 51-100 Cows	1.83	.983	6
		XL 101-200 Cows	4.00	4.243	2
		Total	1.94	1.519	17
	Other	Medium 21-50 Cows	1.00	.	1
		Total	1.00	.	1
	Total	Small 1-20 Cows	2.04	1.122	24
		Medium 21-50 Cows	1.52	.665	23
		Large 51-100 Cows	1.63	.916	8
		XL 101-200 Cows	4.00	4.243	2
		0	1.00	.	1
		Total	1.83	1.157	58

High Vocational Certificate	<1	Small 1-20 Cows	1.50	.707	2
		Total	1.50	.707	2
	1-3	Small 1-20 Cows	2.33	2.060	12
		Medium 21-50 Cows	1.43	.535	7
		0	2.00	.	1
		Total	2.00	1.654	20
	3-5	Small 1-20 Cows	1.50	.707	2
		Medium 21-50 Cows	2.21	2.007	14
		Large 51-100 Cows	1.67	1.033	6
		Total	2.00	1.690	22
	5-10	Small 1-20 Cows	1.00	.000	6
		Medium 21-50 Cows	2.17	1.543	18
		Large 51-100 Cows	1.60	.548	5
		XL 101-200 Cows	1.00	.	1
		0	2.00	.	1
		Total	1.81	1.276	31
	>10	Small 1-20 Cows	1.20	.447	5
		Medium 21-50 Cows	1.80	1.361	20
		Large 51-100 Cows	1.58	.900	12
		XL 101-200 Cows	1.67	.577	3
		XXL >201 Cows	1.00	.	1

		Total	1.63	1.090	41
	Other	Large 51-100 Cows	1.00	.	1
		Total	1.00	.	1
	Total	Small 1-20 Cows	1.70	1.489	27
		Medium 21-50 Cows	1.97	1.520	59
		Large 51-100 Cows	1.58	.830	24
		XL 101-200 Cows	1.50	.577	4
		XXL >201 Cows	1.00	.	1
		0	2.00	.000	2
		Total	1.80	1.353	117
Bachelor	<1	Small 1-20 Cows	1.50	.707	2
		Total	1.50	.707	2
	1-3	Small 1-20 Cows	1.88	.600	17
		Medium 21-50 Cows	1.81	.655	16
		Large 51-100 Cows	1.25	.500	4
		XL 101-200 Cows	1.00	.	1
		Total	1.76	.634	38
	3-5	Small 1-20 Cows	1.36	.497	14
		Medium 21-50 Cows	1.95	.653	22
		Large 51-100 Cows	1.38	.518	8
		Total	1.66	.645	44

	5-10	Small 1-20 Cows	1.86	.378	7
		Medium 21-50 Cows	1.74	.541	23
		Large 51-100 Cows	1.87	.743	15
		XL 101-200 Cows	1.75	.500	4
		Other	8.00	.	1
		0	2.00	.000	2
		Total	1.92	1.026	52
	>10	Small 1-20 Cows	1.78	.972	9
		Medium 21-50 Cows	2.00	.632	16
		Large 51-100 Cows	2.08	1.060	24
		XL 101-200 Cows	2.00	.	1
		Other	4.00	.	1
		Total	2.04	.937	51
	Total	Small 1-20 Cows	1.69	.652	49
		Medium 21-50 Cows	1.87	.615	77
		Large 51-100 Cows	1.84	.903	51
		XL 101-200 Cows	1.67	.516	6
		Other	6.00	2.828	2
		0	2.00	.000	2
		Total	1.86	.852	187
> Bachelor	1-3	Small 1-20 Cows	1.00	.	1

		Medium 21-50 Cows	2.00	.	1
		Total	1.50	.707	2
	3-5	XL 101-200 Cows	1.00	.	1
		Total	1.00	.	1
	5-10	Large 51-100 Cows	1.33	.577	3
		Total	1.33	.577	3
	>10	Large 51-100 Cows	1.50	.707	2
		Total	1.50	.707	2
	Total	Small 1-20 Cows	1.00	.	1
		Medium 21-50 Cows	2.00	.	1
		Large 51-100 Cows	1.40	.548	5
		XL 101-200 Cows	1.00	.	1
		Total	1.38	.518	8
Other	1-3	Medium 21-50 Cows	2.00	.	1
		Total	2.00	.	1
	Other	Other	8.00	.	1
		Total	8.00	.	1
	Total	Medium 21-50 Cows	2.00	.	1
		Other	8.00	.	1
		Total	5.00	4.243	2
Total	<1	Small 1-20 Cows	1.87	1.246	15

		Medium 21-50 Cows	2.00	.	1
		Total	1.88	1.204	16
	1-3	Small 1-20 Cows	1.74	1.000	73
		Medium 21-50 Cows	1.82	.793	72
		Large 51-100 Cows	1.50	.548	6
		XL 101-200 Cows	1.00	.	1
		Other	2.00	.	1
		0	1.67	.577	3
		Total	1.76	.881	156
	3-5	Small 1-20 Cows	1.68	.824	71
		Medium 21-50 Cows	1.82	1.175	105
		Large 51-100 Cows	1.81	1.388	27
		XL 101-200 Cows	1.00	.	1
		Other	2.00	.000	14
		Total	1.78	1.059	218
	5-10	Small 1-20 Cows	1.84	.696	58
		Medium 21-50 Cows	1.95	1.063	129
		Large 51-100 Cows	1.89	1.005	47
		XL 101-200 Cows	1.63	.518	8
		Other	3.50	3.000	4
		0	2.00	.000	3

		Total	1.93	1.021	249
	>10	Small 1-20 Cows	1.80	1.399	69
		Medium 21-50 Cows	2.08	1.209	185
		Large 51-100 Cows	2.31	1.751	128
		XL 101-200 Cows	1.93	1.542	14
		XXL >201 Cows	1.33	.577	3
		Other	2.20	.789	10
		Total	2.10	1.438	409
	Other	Medium 21-50 Cows	1.50	.707	2
		Large 51-100 Cows	1.50	.707	2
		Other	8.00	.	1
		Total	2.80	2.950	5
	Total	Small 1-20 Cows	1.77	1.032	286
		Medium 21-50 Cows	1.95	1.111	494
		Large 51-100 Cows	2.12	1.548	210
		XL 101-200 Cows	1.75	1.225	24
		XXL >201 Cows	1.33	.577	3
		Other	2.47	1.570	30
		0	1.83	.408	6
		Total	1.94	1.212	1053

Table 29 Tests of Between-Subjects Effects

Dependent Variable: Number of Relationship

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	238.654[a]	112	2.131	1.532	.001	.154
Intercept	259.627	1	259.627	186.625	.000	.166
Education	7.497	7	1.071	.770	.613	.006
Experiences	3.335	5	.667	.479	.792	.003
Farm Size	13.686	6	2.281	1.640	.133	.010
Education * Experiences	24.083	22	1.095	.787	.745	.018
Education * Farm Size	60.845	24	2.535	1.822	.009	.044
Experiences * Farm Size	13.195	13	1.015	.730	.735	.010
Education * Experiences * Farm Size	44.023	31	1.420	1.021	.436	.033
Error	1307.696	940	1.391			
Total	5514.000	1053				
Corrected Total	1546.349	1052				

a. R Squared = .154 (Adjusted R Squared = .054)

From the Table 29, it showed the results in F, and Sig column, regarding for the F of testing Education, Experiences, Farm size are .770, .479, and 1.640. Moreover, Sig. value of testing Education, Experiences, Farm size are .613, .792, and .133

Hypothesis Set 1

H_0 : Years of experiences has no effect to number of relationships Accepted

H_1 : Years of experiences has an effect to number of relationships

Hypothesis Set 2

H_0 : Education has no effect to number of relationships Accepted

H_1 : Education has an effect to number of relationships

Hypothesis Set 3

H_0 : Farm size has no effect to number of relationships Accepted

H_1 : Farm size has an effect to number of relationships

All 3 hypotheses were proven by the F values and Sig. from the IBM® SPSS® Statistics Version 22 analysis that all were accepted H_0

In summarized, Years of experiences, Education, Farm size has no effect to number of relationships significant level at $p<0.05$.

4.2.3.5 Descriptive analysis for Structural Modelling

Descriptive analysis of constructs

Result of Performance and commitment

The outputs of descriptive statistics analysis for the Performance and commitment construct are displayed in the Table 30. It shown that Delivery/ Delivery schedules had the highest score in this group (Mean = 3.904, SD = 0.834) Moreover, six variables were shown agree in high, only Collaborative performance system had intermediate agree (Mean = 3.322, SD = 0.825)

Table 30 Descriptive analysis of Performance and commitment

Item	Variables	Mean	Std. Deviation
PC0	Performance and commitment	3.6597	0.69044
PC1	Communicating and understanding	3.646	0.8048
PC2	Continuous Improvement	3.781	0.7839
PC3	Information quality	3.659	0.8874
PC4	Delivery/ Delivery schedules	3.904	0.8339
PC5	Collaborative performance system	3.322	0.8255
PC6	People Management and Development	3.696	0.8505
PC7	Commitment	3.61	0.8569

Result of Internal and external collaboration

The results of descriptive statistics analysis for the Internal and external collaboration construct are presented in the Table 31., there shown agree in high level for 4 variables, moreover, the variable that got the highest score is Information sharing (Mean = 3.835; SD = 0.791) while the lowest one is Demand forecast accuracy/ Forecast accuracy (Mean = 3.677; SD = 0.832).

Table 31 Descriptive analysis of Internal and external collaboration

Item	Variables	Mean	Std. Deviation
IEC0	Internal and external collaboration	3.778	0.7291
IEC1	Environmental collaboration	3.790	0.8112
IEC2	Information sharing	3.835	0.7908
IEC3	Alliance or Conflict resolution	3.808	0.8015
IEC4	Demand forecast accuracy/ Forecast accuracy	3.677	0.8390

Result of Measurement and evaluation

The results of descriptive statistics analysis for Measurement and evaluation construct are shown in Table 32. On time production is the highest one in this group with Mean = 3.903; SD = 0.8103. All variables were scored in high level.

Table 32 Descriptive analysis of Measurement and evaluation

Item	Variables	Mean	Std. Deviation
ME0	Measurement and evaluation	3.7673	0.71508
ME1	On time production	3.903	0.8103
ME2	Prioritizing goals and objectives	3.765	0.8703
ME3	Mutual sharing interest, benefit, risks, and rewards	3.685	0.8078
ME4	Supply chain metrics	3.716	0.8206

Result of Joint operation

The results of descriptive statistics analysis for Measurement and evaluation construct are shown in Table 33. All 5 variables of this group are in the high level

Table 33 Descriptive analysis of Joint operation

Item	Variables	Mean	Std. Deviation
JO0	Joint operation	3.5784	0.72976
JO1	Joint teamwork	3.598	0.831
JO2	Cost reduction Cost	3.532	0.9345
JO3	Joint production	3.559	0.8908
JO4	Technology	3.519	0.9685
JO5	Joint Efforts	3.684	0.7943

Result of Sharing and Innovation

The results of descriptive statistics analysis for Sharing and Innovation construct as shown in Table 34. All 3 variables of this group are in the high level

Table 34 Descriptive analysis of Sharing and Innovation

Item	Variables	Mean	Std. Deviation
SI0	Sharing and Innovation	3.584	0.7816
SI1	Shared supply chain processes	3.655	0.8486
SI2	Sharing responsibility for product recovery	3.622	0.9341
SI3	Innovation/ Innovative supply chain processes	3.476	0.8674

Result of Negotiation

The results of descriptive statistics analysis for Negotiation construct as shown in Table 35. All 3 variables of this group are in the high level while Stability is the highest one in this group with Mean = 3.861, SD = 0.849

Table 35 Descriptive analysis of Negotiation

Item	Variables	Mean	Std. Deviation
NEO0	Negotiation	3.686	0.779
NEO1	Purchasing	3.659	0.866
NEO2	Stability	3.861	0.849
NEO3	Power	3.539	0.927

Result of Farm Business Benefits

The outcomes of descriptive statistics analysis regarding to sustainability in the context of Farm Business Benefits as demonstrated in Table 36. All 6 items in economics sustainability were scored in the high level.

Table 36 Descriptive analysis of Farm Business Benefits

Item	Variables	Mean	Std. Deviation
FB	Farm Business Benefits	3.511	0.699
FB01	Increasing profit and profitability	3.457	0.788
FB02	Easier sale of products	3.579	0.788
FB03	Getting price premium	3.475	0.835
FB04	Increasing the competitiveness	3.542	0.787
FB05	Increasing the resilience and prosperity of dairy communities	3.464	0.832

FB06	Attracting, developing, and retaining a skilled and motivated dairy workforce	3.546	0.789

Result of Environment Benefits

The outputs of descriptive statistics analysis for sustainability in the context of Environment Benefits as presented in Table 37. All 6 items in environmental sustainability were scored in the high level.

Table 37 Descriptive analysis of Environment Benefits

Item	Variables	Mean	Std. Deviation
EB	Environment Benefits	3.232	0.685
EB01	Improving land and water management	3.347	0.720
EB02	Reducing the nonproductive water consumption	3.323	0.749
EB03	Reducing waste	3.337	0.734
EB04	Increasing energy using from bio-gas	3.034	0.978
EB05	Reduction of energy consumption from non-renewable sources	3.113	0.981
EB06	Reduction of greenhouse gas emissions	3.236	0.882

Result of Social Benefits

The reports of descriptive statistics analysis for sustainability in the context of Social Benefits as shown in Table 38. All 4 items in social sustainability were scored in the high level. The highest score item was Dairy contributes to improved health outcomes for Thai's (Mean = 3.938; SD = 0.782)

Table 38 Descriptive analysis of Social Benefits

Item	Variables	Mean	Std. Deviation
SB	Social Benefits	3.884	0.714
SB01	All dairy products and ingredients sold are safe	3.904	0.793
SB02	Dairy contributes to improved health outcomes for Thai's	3.938	0.782
SB03	Providing best care for all animals	3.887	0.784
SB04	Improving working conditions on a farm	3.808	0.797

Result of Success of Supply Chain Collaboration

The products of descriptive statistics analysis for Success of Supply Chain Collaboration as shown in Table 39. 3 items in Success of Supply Chain Collaboration were scored in the high level. Moreover, 2 items in Success of Supply Chain

Collaboration were scored in the intermediated level. The 2 lowest score items were Cost (Mean = 3.284; SD = 0.917) and High Profit Margin (Mean = 3.396; SD = 0.822)

Table 39 Descriptive analysis of Success of Supply Chain Collaboration

Item	Variables	Mean	Std. Deviation
SCC	Success of Supply Chain Collaboration	3.473	0.662
SCC01	Sales growth, Market share	3.475	0.811
SCC02	Environmental management	3.535	0.753
SCC03	Cost	3.284	0.917
SCC04	High profit margin	3.396	0.822
SCC05	Customer satisfaction	3.674	0.751

Result of Sustainability awareness of Thai Dairy Industry

The results of descriptive statistics analysis for Sustainability awareness of Thai Dairy Industry was shown in Table 40. 5 items had high score level. It meant, Thai dairy farmers and co-operatives and milk-collecting centers have high level of awareness about sustainability as well as implementation sustainability concept in dairy business.

Table 40 Sustainability awareness of Thai Dairy Industry: Descriptive Analysis

Item	Variables	Mean	Std. Deviation
SS	Sustainability awareness in dairy farming	3.635	0.722
SS01	I understand concept of sustainable farming	3.635	0.763
SS02	I know concept of sustainable farming	3.649	0.778
SS03	I know concept of sustainable farming including: Economics, Social, Environment	3.598	0.816
SS04	I use sustainable farming methods	3.610	0.816
SS05	I apply farming practices according to standard recommendations.	3.682	0.774

4.2.3.2 Confirmatory Factor Analysis

Measurement Model Reliability

Reliability is a theoretical concern for measurement models in general. (DeVellis, 1991; Gable & Wolf, 1993) It normally is examined by internal consistency reliability that illustrates the uniformity of variables including in a measurement model. The definition of internal consistency is the measure that its items are inter-correlated. It meant if the model has high inter-variable correlations then can explain that the variables of a model have a strong relationship to the latent construct and are possibly measuring the same thing.

In general, the internal consistency of a measurement scale is determined by using Cronbach's coefficient alpha and calculating the Cronbach's alpha along with the item-to-total correlation for each item examined in the overall reliability of the measurement model. It is usually suggested that the acceptable value of Cronbach's alpha in each measurement scale should have more than 0.7, it shows the consistency within the scale then further study can be conducted. In case that the Cronbach's alpha value less than 0.7, the researcher should revisit the scale, and the scale should be investigated for any type of errors from the data such as incomplete sampling of items, data gathering errors, data filling errors, situational factors, characteristics of sample, items number, and errors of theoretical in developing a model of measurement (Gable & Wolf, 1993)

Measurement Reliability of Performance and commitment

The reliability of Performance and commitment construct was tested by Cronbach's Alpha from IBM® SPSS® Statistics Version 22. The Cronbach's Alpha was 0.894, it was better than 0.7. This construct can be used for further study as shown in Table 41.

Table 41 Measurement Reliability of Performance and commitment

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.892	.894	7

Measurement Reliability of Internal and external collaboration

The reliability of Internal and external collaboration construct was tested by Cronbach's Alpha from IBM® SPSS® Statistics Version 22. The Cronbach's Alpha was 0.877, it was better than 0.7. This construct can be used for further study as shown in Table 42.

Table 42 Measurement Reliability of Internal and external collaboration

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.877	.877	4

Measurement Reliability of Measurement and evaluation

The reliability of Measurement and evaluation construct was examined by Cronbach's Alpha from IBM® SPSS® Statistics Version 22. The Cronbach's Alpha was 0.853, it is better than 0.7. This construct can be used for further study as shown in Table 43.

Table 43 Measurement Reliability of Measurement and evaluation

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.853	.853	4

Measurement Reliability of Joint operation

The reliability of Joint operation construct was tested by Cronbach's Alpha from IBM® SPSS® Statistics Version 22. The Cronbach's Alpha was 0.827, it is better than 0.7. This construct can be used for further study as shown in Table 44.

Table 44 Measurement Reliability of Joint operation

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.822	.827	5

Measurement Reliability of Sharing and Innovation

The reliability of Sharing and Innovation construct was tested by Cronbach's Alpha from IBM® SPSS® Statistics Version 22. The Cronbach's Alpha was 0.782, it is better than 0.7. This construct can be used for further study as shown in Table 45.

Table 45 Measurement Reliability of Sharing and Innovation

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.779	.782	3

Measurement Reliability of Negotiation

The reliability of Negotiation construct was tested by Cronbach's Alpha from IBM® SPSS® Statistics Version 22. The Cronbach's Alpha was 0.812, it is better than 0.7. This construct can be used for further study as shown in Table 46.

Table 46 Measurement Reliability of Negotiation

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.811	.812	3

Measurement Reliability of Success of supply chain collaboration

The reliability of Success of supply chain collaboration was tested by Cronbach's Alpha from IBM® SPSS® Statistics Version 22. The Cronbach's Alpha was 0.873, it is better than 0.7. This construct can be used for further study as shown in Table 47.

Table 47 Measurement Reliability of Success of supply chain collaboration

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.872	.873	5

Measurement Reliability of Sustainability awareness of Thai Dairy Industry

The reliability of Sustainability awareness of Thai Dairy Industry was tested by Cronbach's Alpha from IBM® SPSS® Statistics Version 22. The Cronbach's Alpha was 0.946, it is better than 0.7. This construct can be used for further study as shown in Table 48.

Table 48 Measurement Reliability of Sustainability awareness of Thai Dairy Industry

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.946	.946	5

Measurement Reliability of Sustainability: Farm Business Benefits

The reliability of Farm Business Benefits was tested by Cronbach's Alpha from IBM® SPSS® Statistics Version 22. The Cronbach's Alpha was 0.925, it is better than 0.7. This construct can be used for further study as shown in Table 49.

Table 49 Measurement Reliability of Sustainability: Farm Business Benefits

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.925	.925	6

Measurement Reliability of Sustainability: Environmental Benefits

The reliability of Environmental Benefits was tested by Cronbach's Alpha from IBM® SPSS® Statistics Version 22. The Cronbach's Alpha was 0.877, it is better than 0.7. This construct can be used for further study as shown in Table 50.

Table 50 Measurement Reliability of Sustainability: Environmental Benefits

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.873	.877	6

Measurement Reliability of Sustainability: Socials Benefits

The reliability of Environmental Benefits was tested by Cronbach's Alpha from IBM® SPSS® Statistics Version 22. The Cronbach's Alpha was 0.9, it is better than 0.7. This construct can be used for further study as shown in Table 51.

Table 51 Measurement Reliability of Sustainability: Socials Benefits

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.899	.900	4

Regarding the results shown the reliability of measurement were pass the threshold 0.7 for Cronbach's Alpha. Thus, the researcher would examine the confirmatory factor analysis (CFA) in later steps.

Confirmatory Factor Analysis (CFA) for Performance and commitment

The result of CFA for Performance and commitment were significant that PC1 to PC7 had the positive impact to PC as per shown in Table 52.

Table 52 Result of CFA for Performance and commitment

Dimension	Factor	Standardized Loading	t-value	SE	CR	AVE
Performance and commitment	PC1	0.854	-	-	0.923	0.634
	PC2	0.909	36.607	0.028		
	PC3	0.800	29.669	0.035		
	PC4	0.740	26.388	0.034		
	PC5	0.689	22.962	0.036		
	PC6	0.781	28.554	0.034		
	PC7	0.783	28.628	0.034		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics were satisfied as below table

The fit indices	Value from Model	Cut-off	Comments
Chi-Square ($\chi 2$)	52.963		
$\chi 2$/df	4.815	<5.00	Satisfactory result
Goodness of Fit Index: GFI	0.983	> 0.9	Satisfactory result
Adjusted GFI: AGFI	0.957	> 0.9	Satisfactory result

Comparative Fit Index: CFI	0.990	> 0.9	Satisfactory result
Normed Fit Index: NFI	0.988	> 0.9	Satisfactory result
Bentler-Bonett non-normed fit index (NNFI) or TLI	0.982	> 0.8	Satisfactory result
RMR	0.014	< 0.09	Satisfactory result
RMSEA	0.065	< 0.07	Satisfactory result

Confirmatory Factor Analysis (CFA) for Internal and external collaboration

The result of CFA for Internal and external collaboration significant that IEC1 to IEC4 had the positive impact to IEC as per shown in Table 53.

Table 53 Result of CFA for Internal and external collaboration

Dimension	Factor	Standardized Loading	t-value	SE	CR	AVE
Internal and external collaboration	IEC1	0.840	-	-	0.922	0.747
	IEC2	0.910	35.142	0.030		
	IEC3	0.828	30.376	0.032		
	IEC4	0.876	33.231	0.032		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics were satisfied as below table

The fit indices	Value from Model	Cut-off	Comments
Chi-Square (χ2)	5.493		
χ2/df	2.747	<5.00	Satisfactory result
Goodness of Fit Index: GFI	0.997	> 0.9	Satisfactory result
Adjusted GFI: AGFI	0.985	> 0.9	Satisfactory result
Comparative Fit Index: CFI	.0999	> 0.9	Satisfactory result
Normed Fit Index: NFI	0.998	> 0.9	Satisfactory result
Bentler-Bonett non-normed fit index (NNFI) or TLI	0.996	> 0.8	Satisfactory result
RMR	0.004	< 0.09	Satisfactory result
RMSEA	0.044	< 0.07	Satisfactory result

Confirmatory Factor Analysis (CFA) for Measurement and evaluation

The result of CFA for Measurement and evaluation were significant had positive impact from ME1 to ME4 as demonstrated in Table 54.

Table 54 Result of CFA for Measurement and evaluation

Dimension	Factor	Standardized Loading	t-value	SE	CR	AVE
Measurement and evaluation	ME1	0.849	-	-	0.876	0.640
	ME2	0.870	25.578	0.043		
	ME3	0.715	22.608	0.037		
	ME4	0.755	22.624	0.04		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics were satisfied

The fit indices	Value from Model	Cut-off	Comments
Chi-Square (χ2)	0.000		
χ2/df	-	<5.00	
Goodness of Fit Index: GFI	1.000	> 0.9	Satisfactory result
Comparative Fit Index: CFI	1.000	> 0.9	Satisfactory result
Normed Fit Index: NFI	1.000	> 0.9	Satisfactory result
RMR	0.00	< 0.09	Satisfactory result

Confirmatory Factor Analysis (CFA) for Joint operation

The result of CFA for Joint operation was significant impacted by JO1 to JO5 in positive impact as presented in Table 55.

Table 55 Result of CFA for Joint operation

Dimension	Factor	Standardized Loading	t-value	SE	CR	AVE
Joint operation	JO1	0.858	-	-	0.879	0.596
	JO2	0.660	21.477	0.040		
	JO3	0.883	30.706	0.036		
	JO4	0.740	25.032	0.040		
	JO5	0.693	29.536	0.026		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics were supported the model

The fit indices	Value from Model	Cut-off	Comments
Chi-Square (χ2)	16.951		
χ2/df	4.238	<5.00	Satisfactory result
Goodness of Fit Index: GFI	0.992	> 0.9	Satisfactory result
Adjusted GFI: AGFI	0.972	> 0.9	Satisfactory result
Comparative Fit Index: CFI	0.995	> 0.9	Satisfactory result
Normed Fit Index: NFI	0.993	> 0.9	Satisfactory result

Bentler-Bonett non-normed fit index (NNFI) or TLI	0.988	> 0.8	Satisfactory result
RMR	0.014	< 0.09	Satisfactory result
RMSEA	0.060	< 0.07	Satisfactory result

Confirmatory Factor Analysis (CFA) for Sharing and Innovation

The testing result of CFA for Sharing and Innovation shown that SI1 to SI3 had positive impact to SI as presented in Table 56.

Table 56 Output of CFA for Sharing and Innovation

Dimension	Factor	Standardized Loading	t-value	SE	CR	AVE
Sharing and innovation	SI1	0.876	-	-	0.862	0.677
	SI2	0.803	25.875	0.039		
	SI3	0.786	24.314	0.036		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics were supported

The fit indices	Value from Model	Cut-off	Comments
Chi-Square (χ2)	0.000		
χ2/df	-	<5.00	
Goodness of Fit Index: GFI	1.000	> 0.9	Satisfactory result

Comparative Fit Index: CFI	1.000	> 0.9	Satisfactory result
Normed Fit Index: NFI	1.000	> 0.9	Satisfactory result
RMR	0.00	< 0.09	Satisfactory result

Confirmatory Factor Analysis (CFA) for Negotiation

The result of CFA for Negotiation was shown the positive impact from NEO1 to NEO3 on NEO as shown in Table 57.

Table 57 Result of CFA for Negotiation

Dimension	Factor	Standardized Loading	t-value	SE	CR	AVE
Negotiation	NEO1	0.928	-	-	0.864	0.682
	NEO2	0.745	24.314	0.032		
	NEO3	0.793	25.875	0.035		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics were supported

The fit indices	Value from Model	Cut-off	Comments
Chi-Square ($\chi 2$)	0.000		
$\chi 2$/df	-	<5.00	
Goodness of Fit Index: GFI	1.000	> 0.9	Satisfactory result
Comparative Fit Index: CFI	1.000	> 0.9	Satisfactory result

Normed Fit Index: NFI	1.000	> 0.9	Satisfactory result
RMR	0.000	< 0.09	Satisfactory result

Confirmatory Factor Analysis (CFA) for Success of Supply Chain Collaboration

The result of CFA for Success of Supply Chain Collaboration, it was shown that SCC1 to SCC5 impacted positively to success of supply chain collaboration as a Table 58

Table 58 Result of CFA for Success of Supply Chain Collaboration

Dimension	Factor	Standardized Loading	t-value	SE	CR	AVE
Success of Supply Chain Collaboration	SCC01	0.804	-	-	0.866	0.565
	SCC02	0.660	19.716	0.039		
	SCC03	0.712	20.588	0.049		
	SCC04	0.821	24.418	0.042		
	SCC05	0.750	22.712	0.038		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics were satisfied with the result

The fit indices	Value from Model	Cut-off	Comments
Chi-Square (χ2)	10.620		
χ2/df	2.655	<5.00	Satisfactory result

Goodness of Fit Index: GFI	0.995	> 0.9	Satisfactory result
Adjusted GFI: AGFI	0.982	> 0.9	Satisfactory result
Comparative Fit Index: CFI	0.997	> 0.9	Satisfactory result
Normed Fit Index: NFI	0.995	> 0.9	Satisfactory result
Bentler-Bonett non-normed fit index (NNFI) or TLI	0.993	> 0.8	Satisfactory result
RMR	0.006	< 0.09	Satisfactory result
RMSEA	0.043	< 0.07	Satisfactory result

Confirmatory Factor Analysis (CFA) for Sustainability: Farm Business Benefits

The result of Sustainability: Farm Business Benefits in CFA analysis, the researcher reported that FB01 to FB06 had the positive impacts on Farm Business Benefits significantly as reported in Table 59.

Table 59 Result of CFA for Sustainability: Farm Business Benefits

Dimension	Factor	Standardized Loading	t-value	SE	CR	AVE
Sustainability: Farm Business Benefits	FB01	0.822	-	-	0.939	0.718
	FB02	0.836	39.439	0.026		
	FB03	0.878	31.613	0.036		
	FB04	0.854	30.905	0.034		

	FB05	0.879	29.25	0.039		
	FB06	0.813	28.213	0.035		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics shown the satisfied result for the model fit

The fit indices	Value from Model	Cut-off	Comments
Chi-Square (χ2)	7.705		
χ2/df	1.541	<5.00	Satisfactory result
Goodness of Fit Index: GFI	0.997	> 0.9	Satisfactory result
Adjusted GFI: AGFI	0.988	> 0.9	Satisfactory result
Comparative Fit Index: CFI	0.999	> 0.9	Satisfactory result
Normed Fit Index: NFI	0.998	> 0.9	Satisfactory result
Bentler-Bonett non-normed fit index (NNFI) or TLI	0.998	> 0.8	Satisfactory result
RMR	0.005	< 0.09	Satisfactory result
RMSEA	0.024	< 0.07	Satisfactory result

Confirmatory Factor Analysis (CFA) for Sustainability: Environmental Benefits

As the result of CFA for Sustainability: Environmental Benefits shown in Table 60. EB01 to EB06 had the positive impact to EB. It was all significantly impact.

Table 60 Result of CFA for Sustainability: Environmental Benefits

Dimension	Factor	Standardized Loading	t-value	SE	CR	AVE
Sustainability: Environmental Benefits	EB01	0.847	-	-	0.868	0.536
	EB02	0.896	33.32	0.033		
	EB03	0.856	31.755	0.032		
	EB04	0.484	14.831	0.052		
	EB05	0.577	17.961	0.052		
	EB06	0.627	20.374	0.045		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics were supported the model

The fit indices	Value from Model	Cut-off	Comments
Chi-Square (χ2)			
χ2/df	1.346	<5.00	Satisfactory result
Goodness of Fit Index: GFI	0.998	> 0.9	Satisfactory result
Adjusted GFI: AGFI	0.989	> 0.9	Satisfactory result
Comparative Fit Index: CFI	1.000	> 0.9	Satisfactory result

Normed Fit Index: NFI	0.999	> 0.9	Satisfactory result
Bentler-Bonett non-normed fit index (NNFI) or TLI	0.999	> 0.8	Satisfactory result
RMR	0.007	< 0.09	Satisfactory result
RMSEA	0.020	< 0.07	Satisfactory result

Confirmatory Factor Analysis (CFA) for Sustainability: Social Benefits

The result of CFA for Sustainability: Social Benefits as per Table 61. that shown the result. SB01 to SB04 had positive impact on SB significantly.

Table 61 Result of CFA for Sustainability: Social Benefits

Dimension	Factor	Standardized Loading	t-value	SE	CR	AVE
Sustainability: Social Benefits	SB01	0.925	-	-	0.922	0.748
	SB02	0.945	47.503	0.021		
	SB03	0.848	31.814	0.034		
	SB04	0.749	27.266	0.035		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics

The fit indices	Value from Model	Cut-off	Comments
Chi-Square ($\chi 2$)	0.000		
$\chi 2$/df	-	<5.00	
Goodness of Fit Index: GFI	1.000	> 0.9	Satisfactory result
Comparative Fit Index: CFI	1.000	> 0.9	Satisfactory result
Normed Fit Index: NFI	1.000	> 0.9	Satisfactory result
RMR	0.000	< 0.09	Satisfactory result

All items in each construct were support the model with highly significant level at p-vale 0.001

Next step, the researcher also considered all constructs in one model. However, it can be separated to be 2 sets of testing. One is supply chain collaboration part, and sustainability part.

Overall Supply Chain Collaboration Measurement Model

In Table 62, it shown the result of CFA for Supply chain collaboration model as a measurement model. All items and construct were significant confirmed the model that can be used for structural model testing.

Table 62 Result of CFA for Supply Chain Collaboration Measurement Model

Dimension	Factor	Loading	t-value	SE	CR	AVE
PC	PC1	0.86			0.925	0.64
	PC2	0.889	36.65	0.027		
	PC3	0.82	31.843	0.034		
	PC4	0.741	27.118	0.033		
	PC5	0.689	23.854	0.034		
	PC6	0.804	30.62	0.032		
	PC7	0.78	29.115	0.033		
IEC	IEC1	0.841			0.922	0.747
	IEC2	0.906	36.106	0.029		
	IEC3	0.828	31.301	0.031		
	IEC4	0.88	34.403	0.031		
ME	ME1	0.749			0.863	0.611
	ME2	0.803	32.21	0.036		
	ME3	0.777	24.062	0.043		

	ME4	0.797	24.812	0.044		
JO	JO1	0.877			0.9	0.644
	JO2	0.637	21.937	0.037		
	JO3	0.823	33.427	0.03		
	JO4	0.799	26.277	0.04		
	JO5	0.855	32.091	0.029		
SI	SI1	0.87	-	-	0.858	0.669
	SI2	0.781	28.29	0.035		
	SI3	0.801	29.457	0.032		
NEO	NEO1	0.907	-	-	0.863	0.679
	NEO2	0.76	28.711	0.028		
	NEO3	0.798	30.946	0.031		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics were support to model, it was saturated model.

The fit indices	Value from Model	Cut-off	Comments
Chi-Square ($\chi 2$)	1209.558		
$\chi 2$/df	4.762	<5.00	Satisfactory result
Goodness of Fit Index: GFI	0.901	> 0.9	Satisfactory result
Adjusted GFI: AGFI	0.863	> 0.9	Acceptable result
Comparative Fit Index: CFI	0.901	> 0.9	Satisfactory result

Normed Fit Index: NFI	0.942	> 0.9	Satisfactory result
Bentler-Bonett non-normed fit index (NNFI) or TLI	0.940	> 0.8	Satisfactory result
RMR	0.0303	< 0.09	Satisfactory result
RMSEA	0.064	< 0.07	Satisfactory result

Overall Sustainability Measurement Model

In Table 63, it shown the result of CFA for Sustainability model as a measurement model. All items and construct were significant confirmed the model that can be used for structural model testing. However, for the EB04, the standardized loading was lower than 0.5. This can be used a cutoff point. Finally, EB04 was removed from the model.

Table 63 Result of CFA for Sustainability Measurement Model

Dimension	Factor	Loading	t-value	SE	CR	AVE
Sustainability: Farm Business Benefits	FB01	0.819	-	-	0.939	0.719
	FB02	0.843	39.703	0.026		
	FB03	0.872	31.681	0.035		
	FB04	0.856	31.246	0.034		
	FB05	0.878	29.333	0.039		
	FB06	0.819	28.849	0.035		
Sustainability: Environmental Benefits	EB01	0.854	-	-	0.868	0.534
	EB02	0.891	34.494	0.032		
	EB03	0.854	32.472	0.032		
	EB04	0.489	15.163	0.051		
	EB05	0.563	17.856	0.05		
	EB06	0.629	20.749	0.044		

Sustainability: Social Benefits	SB01	0.782	-	-	0.928	0.765
	SB02	0.8	46.817	0.021		
	SB03	0.987	22.723	0.054		
	SB04	0.913	20.368	0.058		

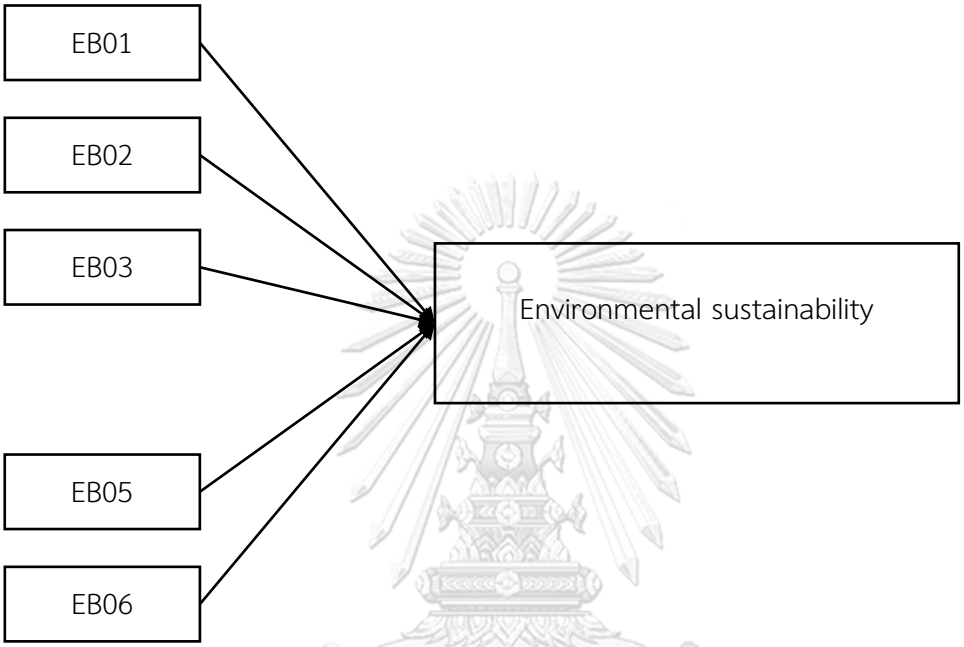
Goodness-of-Fit Statistics shown that the model was saturated and fit

The fit indices	Value from Model	Cut-off	Comments
Chi-Square (χ2)	1209.558		
χ2/df	4.762	<5.00	Satisfactory result
Goodness of Fit Index: GFI	0.901	> 0.9	Satisfactory result
Adjusted GFI: AGFI	0.863	> 0.9	Acceptable result
Comparative Fit Index: CFI	0.901	> 0.9	Satisfactory result
Normed Fit Index: NFI	0.942	> 0.9	Satisfactory result
Bentler-Bonett non-normed fit index (NNFI) or TLI	0.940	> 0.8	Satisfactory result
RMR	0.0303	< 0.09	Satisfactory result
RMSEA	0.064	< 0.07	Satisfactory result

For the result of individual CFA by constructs and the CFA for the Supply Chain Collaboration and Sustainability in dairy farms, it showed that all items were qualified to be in measurement model. However, one item called EB04 had standardized

loading 0.489. It was less than 0.5 as we set for the benchmark. Thus, the model will adapt to be in the Figure 32.

Figure 32 Adapted Environmental sustainability



Recheck: Confirmatory Factor Analysis (CFA) for Sustainability: Environmental Benefits

Once recheck again, the result shown that no others item had low loading, as Table 64, and all were significant at p = 0.001 level

Table 64 Result of modification model of CFA for Sustainability: Environmental Benefits

Dimension	Factor	Standardized Loading	t-value	SE	CR	AVE
Sustainability: Environmental Benefits	EB01	0.848	-	-	0.878	0.597
	EB02	0.896	33.253	0.033		
	EB03	0.856	31.741	0.032		
	EB05	0.579	17.985	0.052		
	EB06	0.627	20.378	0.045		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics were all fit and supported the modified model

The fit indices	Value from Model	Cut-off	Comments
Chi-Square (χ^2)			
χ^2/df	1.654	<5.00	Satisfactory result
Goodness of Fit Index: GFI	0.998	> 0.9	Satisfactory result
Adjusted GFI: AGFI	0.989	> 0.9	Satisfactory result
Comparative Fit Index: CFI	0.999	> 0.9	Satisfactory result
Normed Fit Index: NFI	0.998	> 0.9	Satisfactory result
Bentler-Bonett non-normed fit index (NNFI) or TLI	0.998	> 0.8	Satisfactory result

RMR	0.006	< 0.09	Satisfactory result
RMSEA	0.027	< 0.07	Satisfactory result

Adapted Overall Sustainability Measurement Model

As removing of EB04, the researcher conducted another analysis without EB04, and the result was shown the all items were well fit with the model as shown in Table 65.

Table 65 Result of CFA for Sustainability Measurement Model

Dimension	Factor	Loading	t-value	SE	CR	AVE
Sustainability: Farm Business Benefits	FB01	0.819	-	-	0.939	0.719
	FB02	0.843	39.703	0.026		
	FB03	0.872	31.681	0.035		
	FB04	0.856	31.246	0.034		
	FB05	0.878	29.333	0.039		
	FB06	0.819	28.849	0.035		
Sustainability: Environmental Benefits	EB01	0.854	-	-	0.877	0.595
	EB02	0.891	34.494	0.032		
	EB03	0.854	32.472	0.032		
	EB05	0.563	17.856	0.05		
	EB06	0.629	20.749	0.044		

Sustainability: Social Benefits	SB01	0.782	-	-	0.928	0.765
	SB02	0.8	46.817	0.021		
	SB03	0.987	22.723	0.054		
	SB04	0.913	20.368	0.058		

All t-value were significant at the level of 0.001

Goodness-of-Fit Statistics were all supported

The fit indices	Value from Model	Cut-off	Comments
Chi-Square (χ2)	345.054		
χ2/df	4.860	<5.00	Satisfactory result
Goodness of Fit Index: GFI	0.950	> 0.9	Satisfactory result
Adjusted GFI: AGFI	0.915	> 0.9	Satisfactory result
Comparative Fit Index: CFI	0.977	> 0.9	Satisfactory result
Normed Fit Index: NFI	0.971	> 0.9	Satisfactory result
Bentler-Bonett non-normed fit index (NNFI) or TLI	0.966	> 0.8	Satisfactory result
RMR	0.031	< 0.09	Satisfactory result
RMSEA	0.065	< 0.07	Satisfactory result

Measurement Modelling

Since the result of measurement models from supply chain collaboration and sustainability were examined by CFA with the 908 respondents and both models were qualified to process for the modelling step. The results of this part, it would show the Measurement Modelling processes before structural the model together.

Supply chain collaboration measurement modelling

In this modelling, the researcher evaluated all 6 constructs had positive impacts to success of supply chain collaboration in Thai dairy industry, or not? The result explained that all 6 constructs had positive impacts to success of supply chain collaboration in dairy industry

H 1.1: Performance and commitment construct has a positive impact on supply chain collaboration

H 1.2: Internal and external collaboration construct has a positive impact on supply chain collaboration

H 1.3: Measurement and evaluation construct has a positive impact on supply chain collaboration

H 1.4: Joint operation construct has a positive impact on supply chain collaboration

H 1.5: Sharing and innovation construct has a positive impact on supply chain collaboration

H 1.6: Negotiation construct has a positive impact on supply chain collaboration

H 1.7: Supply chain collaboration has a positive impact on Success of Supply Chain in Thai dairy industry

Table 66 Testing Model for H1.1-1.7

Path			Standardized Loading	SE	CR	p
PC0	<---	SCC	0.916	0.022	28.541	***
IEC0	<---	SCC	0.890	0.022	26.885	***
ME0	<---	SCC	0.942	0.024	24.315	***
JO0	<---	SCC	0.776	0.025	23.245	***
SI0	<---	SCC	0.911	0.023	28.328	***
NEO0	<---	SCC	0.897	0.024	29.432	***
SofSCC	<---	SCC	0.408	0.037	12.219	***
PC1	<---	PC0	0.857	-	-	
PC2	<---	PC0	0.883	0.028	35.962	***
PC3	<---	PC0	0.811	0.034	31.034	***
PC4	<---	PC0	0.734	0.034	26.641	***
PC5	<---	PC0	0.704	0.035	24.8	***
PC6	<---	PC0	0.797	0.033	30.06	***
PC7	<---	PC0	0.782	0.034	29.125	***

IEC1	<---	IEC0	0.833	-	-	
IEC2	<---	IEC0	0.901	0.03	35.599	***
IEC3	<---	IEC0	0.838	0.031	31.733	***
IEC4	<---	IEC0	0.880	0.032	34.164	***
ME1	<---	ME0	0.748	-	-	
ME2	<---	ME0	0.791	0.034	32.454	***
ME3	<---	ME0	0.739	0.043	22.6	***
ME4	<---	ME0	0.817	0.044	25.409	***
JO1	<---	JO0	0.906	-	-	
JO2	<---	JO0	0.594	0.035	20.927	***
JO3	<---	JO0	0.838	0.029	33.744	***
JO4	<---	JO0	0.782	0.038	26.574	***
JO5	<---	JO0	0.842	0.026	33.833	***
SI1	<---	SI0	0.867	-	-	
SI2	<---	SI0	0.792	0.035	29.15	***
SI3	<---	SI0	0.797	0.032	29.357	***
NEO1	<---	NEO0	0.907	-	-	
NEO2	<---	NEO0	0.770	0.028	29.362	***
NEO3	<---	NEO0	0.792	0.031	30.507	***
SCC01	<---	SofSCC	0.930	-	-	

SCC02	<---	SofSCC	0.767	0.019	31.734	***
SCC03	<---	SofSCC	0.778	0.024	31.457	***
SCC04	<---	SofSCC	0.860	0.021	37.905	***
SCC05	<---	SofSCC	0.836	0.019	34.458	***

*** t-value were significant at the level of 0.001

Goodness-of-Fit Statistics: The model is saturated, and the fit was satisfied.

Table 67 Table of Hypotheses H1.1-1.7

Hypothesis	Standardized Loading	CR	p	Result
H 1.1: Performance and commitment construct has a positive impact on supply chain collaboration	0.916	28.541	***	Support
H 1.2: Internal and external collaboration construct has a positive impact on supply chain collaboration	0.890	26.885	***	Support
H 1.3: Measurement and evaluation construct has a positive impact on supply chain collaboration	0.942	24.315	***	Support

H 1.4: Joint operation construct has a positive impact on supply chain collaboration	0.776	23.245	***	Support
H 1.5: Sharing and innovation construct has a positive impact on supply chain collaboration	0.911	28.328	***	Support
H 1.6: Negotiation construct has a positive impact on supply chain collaboration	0.897	29.432	***	Support
H 1.7: Supply chain collaboration has a positive impact on Success of Supply Chain in	0.408	12.219	***	Support

*** t-value were significant at the level of 0.001

From Table 66 and 67, all hypotheses such as 1.1 to 1.7 were supported. It meant supply chain collaboration had positive impact on success of supply chain collaboration. And in each item and 6 constructs were support the supply chain collaboration in Thai dairy industry.

Sustainability measurement modelling

The sustainability measurement was modelling by CFA with IBM® SPSS® Amos version 22, The result from the analysis shown the positive impact for from economics sustainability, environmental sustainability, and social sustainability to the industry sustainability as hypotheses testing result in Table 60

Table 68 Testing Model for H3a to H3c

			Standardized Loading	SE	CR	p
FBSustain	<---	Sustain	0.953			
EBSustain	<---	Sustain	0.756	0.055	13.343	***
SBSustain	<---	Sustain	0.533	0.053	12.055	***
FB01	<---	FBSustain	0.811			
FB02	<---	FBSustain	0.844	0.028	37.452	***
FB03	<---	FBSustain	0.869	0.038	30.195	***
FB04	<---	FBSustain	0.859	0.034	30.991	***
FB05	<---	FBSustain	0.86	0.037	30.241	***
FB06	<---	FBSustain	0.822	0.035	28.742	***
EB01	<---	EBSustain	0.845			
EB02	<---	EBSustain	0.893	0.033	34.088	***
EB03	<---	EBSustain	0.848	0.033	31.611	***

EB05	<---	EBSustain	0.53	0.052	16.649	***
EB06	<---	EBSustain	0.634	0.045	20.849	***
SB01	<---	SBSustain	0.926			
SB02	<---	SBSustain	0.925	0.021	47.467	***
SB03	<---	SBSustain	0.87	0.023	40.602	***
SB04	<---	SBSustain	0.801	0.03	29.038	***

*** t-value were significant at the level of 0.001

Goodness-of-Fit Statistics: The model is saturated, and the fit was satisfied.

Table 69 Table of Hypotheses H3a to H3c

Hypothesis	Standardized Loading	CR	p	Result
H 3a: Economics Sustainability has a positive impact on Thai dairy industry sustainability	0.953			
H 3b: Environmental Sustainability has a positive impact on Thai dairy industry sustainability	0.756	13.343	***	Support
H 3c: Socials Sustainability has a positive impact on Thai dairy industry sustainability	0.533	12.055	***	Support

As shown in Table 68 and 69, all hypotheses such as 3a, 3b, and 3c were supported. It meant sustainability in each item and 3 constructs were support the sustainability in Thai dairy industry.

4.2.3.4 Structural Modelling

From both measurement models from supply chain collaboration model and sustainability model of measurement. It was joining together for the structural modelling, and the result was presented in Table 70

Table 70 Structural Modelling testing for H4.1 – H4.11

			Standardized Loading	SE	CR	p
SucofSCC	<---	Sustain	0.673	0.045	15.265	***
SCC	<---	SucofSCC	0.591	0.041	16.026	***
PC0	<---	SCC	0.913	-	-	
IEC0	<---	SCC	0.906	0.036	26.803	***
ME0	<---	SCC	0.825	0.035	22.662	***
JO0	<---	SCC	0.657	0.039	19.621	***
SI0	<---	SCC	0.921	0.038	27.767	***
NEO0	<---	SCC	0.894	0.039	28.517	***
FBSus	<---	Sustain	0.859	-	-	
EBSus	<---	Sustain	0.817	0.046	19.192	***

SBSus	<---	Sustain	0.624	0.048	14.962	***
PC1	<---	PC0	0.862	0.028	36.155	***
PC2	<---	PC0	0.884	-	-	
PC3	<---	PC0	0.823	0.032	33.103	***
PC4	<---	PC0	0.718	0.03	28.374	***
PC5	<---	PC0	0.697	0.035	23.359	***
PC6	<---	PC0	0.803	0.032	31.523	***
PC7	<---	PC0	0.776	0.032	29.828	***
IEC1	<---	IEC0	0.839	-	-	
IEC2	<---	IEC0	0.902	0.029	35.805	***
IEC3	<---	IEC0	0.832	0.03	31.767	***
IEC4	<---	IEC0	0.877	0.031	34.12	***
ME1	<---	ME0	0.762	-	-	
ME2	<---	ME0	0.796	0.035	32.481	***
ME3	<---	ME0	0.781	0.042	24.459	***
ME4	<---	ME0	0.805	0.043	24.757	***
SI1	<---	SI0	0.864	-	-	
SI2	<---	SI0	0.784	0.035	28.353	***
SI3	<---	SI0	0.797	0.032	29.094	***
NEO1	<---	NEO0	0.906	-	-	

NEO2	<---	NEO0	0.764	0.028	28.944	***
NEO3	<---	NEO0	0.796	0.031	30.607	***
SCC01	<---	SucofSCC	0.787	-	-	
SCC02	<---	SucofSCC	0.685	0.039	20.992	***
SCC03	<---	SucofSCC	0.696	0.047	20.913	***
SCC04	<---	SucofSCC	0.813	0.042	24.999	***
SCC05	<---	SucofSCC	0.755	0.038	23.441	***
FB01	<---	FBSus	0.822	-	-	
FB02	<---	FBSus	0.844	0.026	39.786	***
FB03	<---	FBSus	0.881	0.035	32.591	***
FB04	<---	FBSus	0.854	0.033	31.48	***
FB05	<---	FBSus	0.878	0.038	30.137	***
FB06	<---	FBSus	0.817	0.034	29.077	***
SB01	<---	SBSus	0.815	-	-	
SB02	<---	SBSus	0.828	0.021	46.836	***
SB03	<---	SBSus	0.955	0.04	28.906	***
SB04	<---	SBSus	0.878	0.045	24.42	***
EB01	<---	EBSus	0.852	-	-	
EB02	<---	EBSus	0.892	0.031	35.058	***
EB03	<---	EBSus	0.842	0.032	31.858	***

EB05	<---	EBSus	0.522	0.051	16.516	***
EB06	<---	EBSus	0.624	0.043	20.679	***
JO1	<---	JO0	0.891	-	-	
JO2	<---	JO0	0.734	0.049	18.806	***
JO3	<---	JO0	0.832	0.029	33.725	***
JO4	<---	JO0	0.752	0.037	26.269	***
JO5	<---	JO0	0.803	0.027	32.216	***

*** t-value were significant at the level of 0.001

Goodness-of-Fit Statistics: The model is saturated, and the fit was satisfied.

Goodness-of-Fit Statistics

The fit indices	Value from Model	Cut-off	Comments
Chi-Square (χ2)	3542.127		
χ2/df	4.007	<5.00	Satisfactory result
Goodness of Fit Index: GFI	0.837	> 0.9	Acceptable result (Baumgartner & Homburg, 1996; Doll, Xia, & Torkzadeh, 1994)
Adjusted GFI: AGFI	0.801	> 0.9	Acceptable result (Baumgartner &

			Homburg, 1996; Doll et al., 1994)
Comparative Fit Index: CFI	0.930	> 0.9	Satisfactory result
Normed Fit Index: NFI	0.909	> 0.9	Satisfactory result
Bentler-Bonett non-normed fit index (NNFI) or TLI	0.918	> 0.8	Satisfactory result
RMR	0.039	< 0.09	Satisfactory result
RMSEA	0.058	< 0.07	Satisfactory result

Hypotheses testing result for the structural modelling of Supply Chain collaboration for Sustainability in Thai dairy industry.

Table 71 Table of Hypotheses H4.1 to H 4.11

Hypothesis	Standardized Loading	CR	p	Result
H4.1: Performance and commitment construct has a positive impact on supply chain collaboration	0.913	-	-	Support
H4.2: Internal and external collaboration construct has a positive impact on supply chain collaboration	0.906	26.803	***	Support

H4.3: Measurement and evaluation construct has a positive impact on supply chain collaboration	0.825	22.662	***	Support
H4.4: Joint operation construct has a positive impact on supply chain collaboration	0.657	19.621	***	Support
H4.5: Sharing and innovation construct has a positive impact on supply chain collaboration	0.921	27.767	***	Support
H4.6: Negotiation construct has a positive impact on supply chain collaboration	0.894	28.517	***	Support
H4.7: Supply chain collaboration has a positive impact on Success of Supply Chain in Thai dairy industry	0.591	16.026	***	Support
H4.8: Success of Supply Chain in Thai dairy industry has a positive impact on Thai dairy industry Sustainability	0.673	15.265	***	Support

H4.9: Economics Sustainability has a positive impact on Thai dairy industry sustainability	0.859	-	-	Support
H4.10: Environmental Sustainability has a positive impact on Thai dairy industry sustainability	0.817	19.192	***	Support
H4.11: Socials Sustainability has a positive impact on Thai dairy industry sustainability	0.624	14.962	***	Support

*** t-value were significant at the level of 0.001

All hypotheses such as 4.1 to 4.11 were supported. Supply chain collaboration had a positive impact on success of supply chain collaboration. Moreover, success of supply chain collaboration had a positive impact on sustainability in Thai dairy industry

Chapter 5
Discussions and Conclusions

5.1 General Findings and Discussion

As demonstrated by the literature review, there are few existing studies of supply chain collaboration in the dairy business, and such studies specifically related to Thailand or Asia are even more scarce. Some researchers examined the strategies and supply chain management of dairy products in Thailand environment, though they presented a general overview of industry, while the results of this study show the specific dimensions that are impacted.

In general, Thai dairy farmers have an average of 21-50 cows and the majority is in central and north regions. The co-operatives and milk-collecting centers are the main drivers of the Thai dairy industry; however, the study surveyed both farmers and co-operatives, as it is important to understand the mindset of Thai farmers as well as the co-operatives. A further study is planned, to survey in the same context with the co-operatives and milk-collecting centers here in Thailand, and to include other SEA countries in an expanded CFA analysis.

From a starting point of 95 variables, after the various testing and analytical methodologies were applied, it can ultimately be determined that the variables positively impacting Thai dairy industry. Six groups of variables of supply chain collaboration were classified into as follows: performance and commitment, internal

and external collaboration, measurement and evaluation, joint operation, sharing and innovation, and negotiation. While Al-Mansour and Al-Ajmi (2020) said that cross-functional team and stabilize supply chain are critical in serious situations. Moreover, from the result, it can conclude that the success of supply chains for Thai dairy industry is positively impacted by supply chain collaboration. This aligns with Lee and Ha (2020) who showed that sustainable supply chain performance was positively affected by supply chain collaboration.

5.2 Findings and Discussion of Research Questions

5.2.1 Factors

The study found that at least one factor or item that had positive impact on supply chain collaboration and they leaded to success of supply chain collaboration. In this case, 26 items from supply chain collaboration were used in the main research, and these 26 items, it can be separated into 6 constructs. However, the focusing of these 26 items came from 95 items from the beginning. The researcher proposes that if the co-operatives or the farmers can implement this all 26 items in the dairy working processes, it will bring them up to the high level of collaboration in the chain of supply activities and this success will be impact to sustainability of the industry. However, the priority of the core 26 items is not the same, in the study, it can see the priority of among these 26 items. From the analysis it can differentiated, in this case, researcher propose 10 items to focus first as the following items list

1. NEO1 Purchasing
2. IEC2 Information sharing
3. PC2 Continuous Improvement
4. IEC4 Demand forecast accuracy Forecast accuracy
5. JO1 Joint teamwork
6. SI1 Shared supply chain processes
7. PC1 Communicating and understanding
8. JO5 Joint Efforts
9. IEC1 Environmental collaboration
10. IEC3 Alliance or Conflict resolution

Since these 10 items had the highest loading factors from the analysis, this recommendation is just a guideline, in the different environment or context, co-operatives and milk-collecting centers together with dairy farmers communities might have different important factors to concern. In this case, the priority might be change from what the researcher proposed top 10 item list.

Moreover, the co-operatives, milk-collecting centers together with the dairy farmers can also do the implementation of supply chain collaboration regarding to the validated constructs as the result of study analysis. The researcher recommended to implement all 6 constructs. The priority of the implementation supply chain collaboration all 6 constructs, in case of limited resources, time, or people. The study be able to identify the ranking of priority based on loading factors, it shows below list

For these 6 constructs ranking by loading factors

1. Sharing and innovation
2. Performance and commitment
3. Internal and external
4. Negotiation
5. Measurement and evaluation
6. Joint operation

5.2.2 Understanding of supply chain collaboration

In this report, the questionnaire asked dairy farmers, co-operatives and, milk-collecting centers in content of supply chain collaboration understanding. From the descriptive analysis, the researcher found that the understanding of supply chain collaboration from the answers in the medium level, it was in the lowest border of medium level. Since the result was nearly low, it can be concluded that this topic, supply chain collaboration did not well understand in Thai dairy farmers. It can be considered in 2 meanings, first, they did not really have ideas about supply chain collaboration and did not aware about supply chain management concept in the industry. Second, they did not really know the technical word of supply chain collaboration, and this was leading to the answers from them were low-medium scores. In this point, researcher do recommend that the meaning of this score, it can relate to the second point due to many reasons. First, farmers, co-operatives, and milking-centers did not aware about the term of supply chain collaboration. Second,

they could understand and answer the questions that related to supply chain collaboration in the practice ways such as trust, joint production, transportation time, and so forth. In conclusion, Thailand's dairy farmers and co-operatives or milk-collecting centers did not aware that activities they were doing, there were supply chain collaboration activities. However, they were in the supply chain management scope.

5.2.3 Level of supply chain collaboration

Moreover, in the questionnaire, it asked dairy farmers, co-operative and, milk-collecting centers in content of supply chain collaboration. Finally, the result of the level of supply chain collaboration in Thai dairy industry were medium close to high level. This result shown that farmers, co-operative and milk-collecting centers had some certain areas or activities that support each other by using supply chain collaboration concept. This was in the mid-point, it was not low; however, once it compared with others industry, this was quite low. Since level of supply chain collaboration is one out of two dimension that normally uses to identify type of supply chain collaboration, it means this level is very important and it was mentioned by S. Cohen and Roussel (2005). These 26 variables or items that researcher was gathering and analyzing will be a tool for farmers, dairy co-operatives and milk-collecting centers for use to improving collaboration in supply chain entire in industry. Moreover, once improving of level of supply chain collaboration happens, it leads to enhance all dimensions of industry sustainability.

5.2.4 Number of relationships

Number of relationships in the dairy industry was analyzed in term of descriptive analysis, the number of relationships means number of organizations or parties that farmers together with dairy co-operatives and milk-collecting centers were dealing with in past 12 months. The result was very low, it can determine Thai dairy industry is limited relationship. However, while limited relationship this created strong relationship among the parties. S. Cohen and Roussel (2005) demonstrated about type of supply chain collaboration, the second dimension is number of relationships. The limited relationships or few relationships can create synchronized collaboration type. It meant, nature of the industry, it helps and supports the supply chain collaboration in higher type. Thus, this is very good status at the moment, and need to keep this status for further development in order to improve type of supply chain collaboration from coordinated collaboration to synchronized collaboration.

5.2.5 Analysis of Variance

Since it was not significant effect of Experiences, Education, and Farm size or number of cows per farm on number of relationships in supply chain in dairy industry. This finding shown that number of relationships in the dairy industry, it is low number of relationships by nature of the industry. This is very help full for government and policy-maker to identify the supply chain collaboration in term of type, moreover, it is

easier for all stakeholders in the industry to improve and implement 26 items, 6 constructs in the industry due to less organizations and people involved.

5.2.6 Type of supply chain collaboration

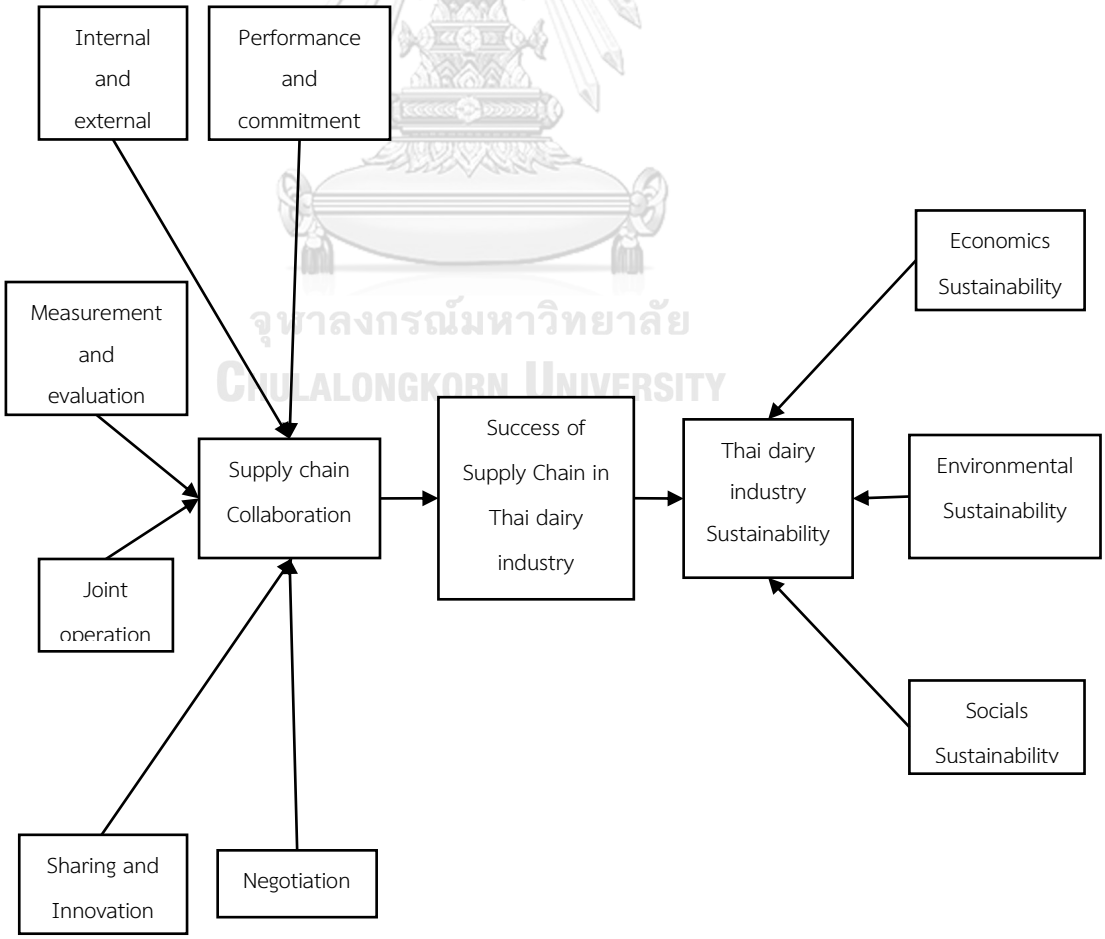
Supply Chain Collaboration type in Thai dairy industry is coordinated collaboration as result from the study in chapter 4. However, the desire type of supply chain collaboration in the industry should be synchronized collaboration. As mention by S. Cohen and Roussel (2005) two dimensions of type of supply chain collaboration are Level of collaboration and number of relationships. In this study, the researcher found out that number of relationships in this industry were normally low or few. While the level of collaboration, it is the part that can be improved. The researcher would like to suggest government and policy-maker together with private sectors such as farmer and private milk-collecting centers to implement these 26 items of supply chain collaboration as per suggested above discussion. Moreover, for the further study, the researcher does strongly recommend evaluating the level of supply chain collaboration in overall picture as well as by items of collaboration. It can deep dive evaluation all 26 items (at least) or just do the evaluation just superficial level by 6 constructs.

5.2.7 Sustainability in dairy industry: Measurement Model

From the result, it shown all dimension had positive impacts on sustainability in dairy business. First, economics or dairy farm benefits was the most impacted on sustainability, then environment, and last was social sustainability. The researcher is very clear that economics and farmers benefits are an important dimension to due to normal of the business aims to get the benefits. However, some more concerned about social and environmental issues. Regarding to the environmental dimension, 5 out 6 items were significant to use a KPI for improvement, will discuss later in the implication in 5.3.2. Things would like to address is Bio-gas. From the result of the study, Bio-gas system was no support the environmental sustainability; however, the researcher does not agree with this point in some reason. First, Bio-gas system is using in many agriculture industries such as pig farms, poultry production, as well as in some crop operation. Second, if in dairy cattle implement Bio-gas system, it can be help the farmers to reduce household costs by reducing natural gas costs, as well as the gas from Bio-gas system can be used as source of energy for electricity generator for the households. Third, Bio-gas system, it can support the low carbon emission to the environment, this is one of the important benefits from the system to the global warming crisis. In conclusion, this issue can be another point of study for further research in the future.

5.2.8 Structural Modelling

Finally, this study proposed the model that are suitable for the Thailand dairy industry. This is a first model proposed in Thailand, and it can be used to explain the link of supply chain management and dairy business sustainability since supply chain activities are main activities of the business apart from sales and marketing activities, moreover, sustainability, in this study, consist all three parts, it covers all sustainability concepts already. The researcher also suggested that the stakeholders can do the evaluation regarding to ROI of implementation of 26 items and 6 constructs to ensure before investing the money.



5.3 Implications of the Research Findings

The researchers strongly believe that these results will lead Thai farmers and co-operatives to start implementing supply chain strategies to create competitive advantages such as economics sustainability, social benefits, and environmental benefits over other exporter countries. Moreover, the findings can also be implemented in neighboring countries in South-East Asia to create a competitive advantage for SEA countries in the global market.

5.3.1 Desire supply chain collaboration type

Since the results from the study shown that coordination collaboration was the existing type in Thailand's dairy industry. The target of supply chain collaboration in many industries such as automobile, oil and gas, etc. is synchronized collaboration. As same as other industries, dairy industry needs to have some kind of supply chain collaboration to support the industry activities. As mentioned above in level of relationship in this industry are limited, and it is specialty commodity products, producers as well as special as farmers and co-operatives.

5.3.2 Key performance indicators recommendation for sustainability

5.3.2.1 Farm Benefits (Economics Sustainability)

For the economics benefits, from the study, it was significantly beneficial for farmer and co-operative if they can implement these 6 KPIs in the industry; however, the researcher recommended the priority of the KPIs, it has intention that it will be a message for the policy-makers or government sector. Moreover, these priority list, it can be switched depend on readiness and organization culture of dairy co-operatives and milk-collecting centers.

1. Getting price premium
2. Increasing the resilience and prosperity of dairy communities
3. Increasing the competitiveness
4. Easier sale of products
5. Attracting, developing, and retaining a skilled and motivated dairy workforce
6. Increasing profit and profitability

5.3.2.2 Environmental sustainability

For the environmental dimension, it was significantly beneficial for farmer, co-operative, and milk-collecting centers if they can implement these 6 KPIs. However, since the analysis and interpretation of the result of analysis, the 6 KPIs, one KPI was removed with the reason of low value of factor loading. The environmental sustainability is important many industries as well as Thailand's dairy industry. The researcher would like to propose the recommendation to the key stakeholders to implement the policy of environmental concerned. It will be beneficial for the industry and farmers if they can implement all 6 KPIs, however, 5 proposed KPIs are important. They also can choose the KPIs that they be able to implement first, and later. The researcher also proposes the priority of the KPIs as below list.

1. Reducing the nonproductive water consumption
2. Reducing waste
3. Improving land and water management
4. Reduction of greenhouse gas emissions
5. Reduction of energy consumption from non-renewable sources

5.3.2.3 Social sustainability

Last dimension of sustainability, social sustainability is as well as important for in sustainability for the businesses. It can be many things about social concern in some case they call as corporate social responsibility (CSR). However, the social sustainability is not only do something for the social, but the industry also operate or run the businesses in the social concern way. For the Dairy industry, the main concerned points are 4 things. Moreover, these 4 topics are important for the farmers, dairy co-operatives, and milk-collecting center, the researcher does recommended that it should be implement in the proper way for these 4 topics, it can implement all 4 topics, or select the most important for the individually co-operatives and mil-collecting centers. The priority for these 4 topics as showed below

1. All dairy products and ingredients sold are safe
2. Dairy contributes to improved health outcomes for Thai's
3. Providing best care for all animals
4. Improving working conditions on a farm

5.4 Limitations and Suggestions for the Future Research

Study of supply chain collaboration in Dairy industry globally is limited, it might be this industry treated as agriculture and less focus when compare with others sector. Almost all of literatures that were reviewed, they were from other sectors or other industries. It might have some gap between the industrial sector versus agriculture sector.

Thai dairy farmers and co-operatives most of them are limited in standard education system, this also impact for the understanding of the questions, data collection, and impact on responsiveness of the questionnaires.

Researcher also was facing with resistant of not only Thai dairy farmers, but also from the co-operatives and milk-collecting centers. Sharing benefits concept was used by researcher to convince target samples to participant in the survey.

As this study was conducted during the COVID-19 pandemic in Thailand, this presents a challenge when it comes to passing on the findings to farmers themselves. Face-to-face meetings between the researchers and farmers would likely be a productive forum in which to present the results more effectively.

In a further study, more variables linked to supply chain collaboration could be added to the questionnaire, it might support the further study can be captured new information and knowledge.

5.5 Conclusions

Given the fact that, if any, there is a limited number of empirical studies on supply chain collaboration and sustainability in dairy industry especially the study that related to Thailand or South East-Asia. Thus, this study developed and empirically tested an exploratory factor analysis together with IOC testing, developing, and proposing the verified items as well as constructs for confirmation study.

Accordingly, as discussed in the research findings, it is hoped that this study has made valuable contributions to the understanding and insights about Thailand's dairy industry, supply chain collaboration, success of supply chain collaboration, and sustainability that focused on Thailand's dairy business.

From the results of the comprehensive data analyses and procedures, this study may summarize that in all 95 items or variables listed can be used in Thai dairy industry only 26 items. It might have effect of nature of the business and industry processes. The exploratory study provided the 26 variables can be groups to be 6 constructs or groups. This knowledge can be helped government sector and dairy co-operatives or milk-collecting centers to focus on build up their capacity, and ability based on these 26 items. Moreover, implementation of supply chain collaboration, it is not only impact on success of supply chain collaboration; however, this also a path that is leading to success of sustainability dairy business. Farmers together with co-

operative and milk-collecting center were not concerning more about sustainability in the environmental benefits.

Finally, even though the results and findings of this study are containing expert interviewing, pilot study with exploratory in nature of supply chain collaboration, and the CFA with Structural Equation Modelling analysis, it is expected that the information produced and the implications of the study may be of help to Thai dairy farms, dairy co-operatives, milk-collecting centers, policy-makers, and marketers to build more sustainability of dairy industry.

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Appendix

Appendix 1. Respondents have had high distance from centroid

Observation number	Mahalanobis d-squared	p1	p2
221	260.595	0	0
239	236.186	0	0
441	192.734	0	0
1035	178.632	0	0
1125	176.085	0	0
981	173.566	0	0
982	173.566	0	0
493	168.12	0	0
320	159.46	0	0
433	159.128	0	0
606	158.644	0	0
795	154.249	0	0
995	153.286	0	0
724	152.072	0	0
1109	151.13	0	0
1110	151.13	0	0
1139	151.083	0	0
400	146.099	0	0
412	146.099	0	0
659	136.162	0	0
642	135.842	0	0
471	135.173	0	0
334	133.922	0	0
335	127.378	0	0
668	127.182	0	0
474	126.411	0	0
583	126.278	0	0
458	125.214	0	0
651	124.738	0	0

652	124.738	0	0
996	124.584	0	0
614	123.428	0	0
1121	122.153	0	0
1033	121.745	0	0
439	119.614	0	0
1108	119.26	0	0
142	118.014	0	0
753	117.226	0	0
220	117.134	0	0
291	116.548	0	0
931	115.87	0	0
612	115.408	0	0
573	115.016	0	0
584	115.016	0	0
664	114.456	0	0
731	113.816	0	0
758	113.416	0	0
641	113.199	0	0
1039	112.645	0	0
1008	111.394	0	0
1011	111.394	0	0
541	111.331	0	0
1075	111.072	0	0
855	110.97	0	0
577	110.93	0	0
721	109.431	0	0
426	108.94	0	0
551	105.538	0	0
311	105.114	0	0
207	104.341	0	0

595	102.294	0	0
826	101.036	0	0
638	100.507	0	0
555	99.613	0	0
997	99.536	0	0
823	99.3	0	0
849	99.108	0	0
533	98.526	0	0
628	98.438	0	0
1160	98.209	0	0
475	98.128	0	0
453	97.619	0	0
218	97.018	0	0
1007	96.559	0	0
1010	96.559	0	0
827	96.373	0	0
790	95.035	0	0
558	94.884	0	0
984	94.507	0	0
1169	94.164	0	0
637	93.772	0	0
582	93.77	0	0
554	92.618	0	0
532	92.509	0	0
148	92.378	0	0
694	91.899	0	0
703	91.899	0	0
712	91.899	0	0
202	91.749	0	0
743	91.21	0	0
785	90.904	0	0

757	89.657	0	0
81	89.176	0	0
149	87.702	0	0
300	87.396	0	0
621	87.235	0	0
675	87.14	0	0
538	86.943	0	0
528	86.511	0	0
725	86.099	0	0

Observation number	Mahalanobis d-squared	p1	p2
779	120.619	0	0
549	107.283	0	0
431	105.481	0	0
914	105.251	0	0
759	104.121	0	0
197	103.701	0	0
1055	103.542	0	0
245	102.615	0	0
602	100.761	0	0
124	100.199	0	0
712	99.426	0	0
609	98.447	0	0
434	96.992	0	0
218	96.892	0	0
79	96.868	0	0
522	96.566	0	0
591	96.558	0	0
781	96.498	0	0
310	96.352	0	0
136	95.996	0	0

147	95.98	0	0
544	95.284	0	0
298	95.098	0	0
89	95.083	0	0
844	95.054	0	0
521	94.631	0	0
133	94.457	0	0
309	94.418	0	0
1019	94.296	0	0
312	94.211	0	0
172	94.174	0	0
748	93.613	0	0
237	93.453	0	0
40	93.207	0	0
308	93.177	0	0
601	92.784	0	0
1009	92.766	0	0
451	92.464	0	0
141	92.429	0	0
64	92.334	0	0
244	92.303	0	0
73	91.93	0	0
374	91.689	0	0
588	91.271	0	0
874	91.025	0	0
241	90.838	0	0
163	90.625	0	0
678	90.558	0	0
877	90.286	0	0
80	89.954	0	0
388	89.709	0	0

399	89.709	0	0
509	89.473	0	0
661	89.432	0	0
432	89.285	0	0
589	89.08	0	0
608	88.951	0	0
688	88.733	0	0
731	88.252	0	0
800	88.217	0	0
730	87.574	0	0
425	87.098	0	0
243	87.08	0	0
366	86.924	0	0
367	86.924	0	0
450	86.844	0	0
773	86.738	0	0
160	86.604	0	0
597	86.396	0	0
213	86.329	0	0
545	86.099	0	0
615	85.98	0	0
81	85.976	0	0
494	85.962	0	0

Observation number	Mahalanobis d-squared	p1	p2
215	103.32	0	0.004
217	101.753	0	0
119	95.275	0	0
856	93.642	0	0
117	93.514	0	0

72	93.44	0	0
267	93.387	0	0
264	93.08	0	0
209	92.849	0	0
720	92.816	0	0
861	92.691	0	0
519	92.492	0	0
357	91.775	0	0
367	91.775	0	0
709	90.709	0	0
189	90.464	0	0
873	90.439	0	0
416	89.318	0	0
439	89.273	0	0
718	89.106	0	0
973	88.799	0	0
150	88.66	0	0
188	88.555	0	0
141	88.545	0	0
222	88.481	0	0
212	88.383	0	0
231	88.272	0	0
245	88.272	0	0
90	88.25	0	0
975	88.004	0	0
851	87.772	0	0
259	87.765	0	0
632	87.549	0	0
359	87.482	0	0
221	87.319	0	0
995	86.955	0	0

412	86.839	0	0
544	86.492	0	0
96	86.468	0	0
580	86.378	0	0
588	86.378	0	0
596	86.378	0	0
621	86.215	0	0
984	86.195	0	0
219	86.127	0	0
708	85.872	0	0
284	85.793	0	0
853	85.635	0	0
269	85.622	0	0

Observation number	Mahalanobis d-squared	p1	p2
205	101.853	0	0
206	96.743	0	0
39	92.432	0	0
302	90.922	0	0
939	90.619	0	0
244	90.203	0	0
75	90.178	0	0
191	90.034	0	0
658	89.935	0	0
197	89.642	0	0
386	89.561	0	0
761	89.467	0	0
119	89.038	0	0
618	88.377	0	0
931	88.043	0	0
397	87.993	0	0

532	87.706	0	0
158	87.626	0	0
173	87.292	0	0
139	87.104	0	0
324	87.085	0	0
488	87.031	0	0
626	86.437	0	0
929	86.372	0	0
826	85.973	0	0
475	85.722	0	0
51	85.615	0	0

Observation number	Mahalanobis d-squared	p1	p2
195	122.283	0	0
584	88.538	0	0.023
636	88.511	0	0.002
493	87.284	0	0
491	87.085	0	0
427	86.982	0	0
429	86.94	0	0
347	86.875	0	0
522	86.787	0	0
895	86.623	0	0
911	86.447	0	0
307	86.235	0	0
451	86.085	0	0
442	86.001	0	0
338	85.938	0	0
465	85.861	0	0
534	85.853	0	0
541	85.853	0	0

548	85.853	0	0
586	85.824	0	0
187	85.647	0	0
718	85.589	0	0
101	85.584	0	0

Observation number	Mahalanobis d-squared	p1	p2
226	89.08	0	0.177
336	87.545	0	0.034
387	87.443	0	0.003
748	87.431	0	0
154	87.325	0	0
605	87.251	0	0
468	86.804	0	0
230	86.611	0	0
843	86.181	0	0
232	85.913	0	0
412	85.808	0	0
335	85.664	0	0
343	85.664	0	0
325	85.567	0	0

Observation number	Mahalanobis d-squared	p1	p2
419	87.598	0	0.245
464	87.196	0	0.039
73	86.732	0	0.005
379	86.444	0	0.001
154	86.165	0	0
155	86.165	0	0
141	86.119	0	0
456	85.9	0	0

281	85.844	0	0

Observation number	Mahalanobis d-squared	p1	p2
120	86.732	0	0.292
711	85.995	0	0.066
717	85.995	0	0.009
723	85.995	0	0.001
467	85.889	0	0
461	85.622	0	0

Observation number	Mahalanobis d-squared	p1	p2
795	86.761	0	0.289
226	86.152	0	0.061
157	85.772	0	0.01

Observation number	Mahalanobis d-squared	p1	p2
859	86.041	0	0.335
544	85.752	0	0.072

Observation number	Mahalanobis d-squared	p1	p2
212	86.215	0	0.322
452	85.654	0	0.075

Observation number	Mahalanobis d-squared	p1	p2
401	85.705	0	0.357
402	85.705	0	0.073

Observation number	Mahalanobis d-squared	p1	p2
760	85.864	0	0.345
117	85.714	0	0.072

Observation number	Mahalanobis d-squared	p1	p2
58	85.922	0	0.34
353	85.654	0	0.074

Appendix 2.

ที่ อว64.25/ลจต211/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์
และโซ่อุปทาน บัณฑิตวิทยาลัย
จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

10 กรกฎาคม 2563

เรื่อง ขอความอนุเคราะห์เข้าพบเพื่อนำเสนองานวิจัย และสอบถามข้อมูล

เรียน ผู้อำนวยการองค์การส่งเสริมกิจการโคนมแห่งประเทศไทย (อ.ส.ค.)
ผู้ช่วยผู้อำนวยการด้านกิจการโคนม

ด้วย นายวิรยศ วชิรโภคา รหัสประจำตัว 6087797620 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิต สาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านโลจิสติกส์ เรื่อง “ความร่วมมือในห่วงโซ่อุปทานเพื่อความยั่งยืน กรณีศึกษาในอุตสาหกรรมโคนมประเทศไทย: Supply Chain Collaboration for Sustainability: A Thailand Dairy Industry” เพื่อศึกษาความร่วมมือในห่วงโซ่อุปทานในอุตสาหกรรมโคนมในประเทศไทย ทั้งนี้โดยใช้ทฤษฎี Supply Chain Collaboration โดยมี ศาสตราจารย์ ดร. กมลชนก สุทธิวาทนฤพุฒิ เป็นอาจารย์ที่ปรึกษา

ทั้งนี้ได้ทำการประสานงานกับผู้ช่วยผู้อำนวยการด้านกิจการโคนมในเบื้องต้นแล้ว เพื่อเข้าพบขอความอนุเคราะห์นำเสนอหลักการงานวิจัย และประโยชน์ที่จะได้รับ และความร่วมมือทางด้านข้อมูลสารสนเทศเพื่อใช้วิเคราะห์ในงานวิจัย เช่น การทำแบบสอบถาม การให้ข้อมูลกลุ่มย่อย ทั้งนี้ นิสิตผู้วิจัยจะได้ประสานงานในรายละเอียดต่อไป

ในการนี้หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ข้อมูลดังกล่าว โดยนิสิต นายวิรยศ วชิรโภคา หมายเลขโทรศัพท์ 080-915-9954 อีเมล virayos.v@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

.....

(นายวิรยศ วชิรโภคา)
นิสิตปริญญาเอกหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน

.....

(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ โมกขมรรคกุล)
ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน
โทร. 02–2183113-4 โทรสาร. 02-251-2354

ที่ อว64.25/ลจต343/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์
และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

28 ตุลาคม 2563

เรื่อง ขอความอนุเคราะห์เข้าพบเพื่อเก็บข้อมูลสำหรับงานวิจัย

เรียน ประธานกรรมการ ชุมนุมสหกรณ์โคนมแห่งประเทศไทย จำกัด

ด้วย นายวิรยศ วชิรโภคา รหัสประจำตัว 6087797620 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านและโซ่อุปทาน เรื่อง “ความร่วมมือในห่วงโซ่อุปทานเพื่อความยั่งยืน ในอุตสาหกรรมโคนมประเทศไทย” เพื่อศึกษาความร่วมมือในห่วงโซ่อุปทานในอุตสาหกรรมโคนมในประเทศไทย ซึ่งการศึกษานี้สอดคล้องกับพันธกิจข้อ 4 ในแผนปฏิบัติการด้านโคนมและผลิตภัณฑ์นม ระยะที่ 1 (ปี 2564-2570) นอกจากนี้เพื่อที่จะปรับตัวสหกรณ์โคนมฯ และเกษตรกรผู้เลี้ยงโคนมฯ ให้พร้อมรับการเปลี่ยนที่จะเกิดขึ้นจากผลกระทบจาก FTA โดยผลการศึกษานี้จะส่งมอบกลับไปยังชุมนุมสหกรณ์ฯ สหกรณ์โคนมฯ เพื่อนำไปพิจารณาปรับใช้ต่อไป

ทั้งนี้ผู้ทำวิจัยจะทำการติดต่อเพื่อเข้าพบขอความอนุเคราะห์นำเสนอหลักการและประโยชน์จะได้รับ และขอความร่วมมือสอบถามข้อมูลเพื่อใช้ในงานวิจัยเช่น การทำแบบสอบถาม การให้ข้อมูลกลุ่มย่อย

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายวิรยศ วชิรโภคา หมายเลขโทรศัพท์ 080-915-9954 อีเมล virayos.v@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

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(นายวิรยศ วชิรโภคา)
นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ)

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(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ โมกขมรรคกุล)
ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)

หลักสูตรสหสาขาวชิาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
โทร. 02–2183113-4 โทรสาร. 02-251-2354

ที่ อว64.25/ลจต347/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์
และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

28 ตุลาคม 2563

เรื่อง ขอความอนุเคราะห์เข้าพบเพื่อเก็บข้อมูลสำหรับงานวิจัย

เรียน ประธานกรรมการ ชุมนุมสหกรณ์โคนมภาคตะวันออกและอิสานใต้ จำกัด

ด้วย นายวิรยศ วชิรโภคา รหัสประจำตัว 6087797620 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านและโซ่อุปทาน เรื่อง “ความร่วมมือในห่วงโซ่อุปทานเพื่อความยั่งยืน ในอุตสาหกรรมโคนมประเทศไทย” เพื่อศึกษาความร่วมมือในห่วงโซ่อุปทานในอุตสาหกรรมโคนมในประเทศไทย ซึ่งการศึกษานี้สอดคล้องกับพันธกิจข้อ 4 ในแผนปฏิบัติการด้านโคนมและผลิตภัณฑ์นม ระยะที่ 1 (ปี 2564-2570) นอกจากนี้เพื่อที่จะปรับตัวสหกรณ์โคนมฯ และเกษตรกรผู้เลี้ยงโคนมฯ ให้พร้อมรับการเปลี่ยนที่จะเกิดขึ้นจากผลกระทบจาก FTA โดยผลการศึกษานี้จะส่งมอบกลับไปยังชุมนุมสหกรณ์ฯ สหกรณ์โคนมฯ เพื่อนำไปพิจารณาปรับใช้ต่อไป

ทั้งนี้ผู้ทำวิจัยจะทำการติดต่อเพื่อเข้าพบขอความอนุเคราะห์นำเสนอหลักการและประโยชน์จะได้รับ และขอความร่วมมือสอบถามข้อมูลเพื่อใช้ในงานวิจัยเช่น การทำแบบสอบถาม การให้ข้อมูลกลุ่มย่อย

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายวิรยศ วชิรโภคา หมายเลขโทรศัพท์ 080-915-9954 อีเมล virayos.v@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

.....

(นายวิรยศ วชิรโภคา)

นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ)

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(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ โมกขมรรคกุล)

ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
โทร. 02–2183113-4 โทรสาร. 02-251-2354

ที่ อว64.25/ลจต348/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์
และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

28 ตุลาคม 2563

เรื่อง ขอความอนุเคราะห์เข้าพบเพื่อเก็บข้อมูลสำหรับงานวิจัย

เรียน ประธานกรรมการ ชุมนุมสหกรณ์โคนมภาคใต้และตะวันตก จำกัด

ด้วย นายวิรยศ วชิรโภคา รหัสประจำตัว 6087797620 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านและโซ่อุปทาน เรื่อง “ความร่วมมือในห่วงโซ่อุปทานเพื่อความยั่งยืน ในอุตสาหกรรมโคนมประเทศไทย” เพื่อศึกษาความร่วมมือในห่วงโซ่อุปทานในอุตสาหกรรมโคนมในประเทศไทย ซึ่งการศึกษานี้สอดคล้องกับพันธกิจข้อ 4 ในแผนปฏิบัติการด้านโคนมและผลิตภัณฑ์นม ระยะที่ 1 (ปี 2564-2570) นอกจากนี้เพื่อที่จะปรับตัวสหกรณ์โคนมฯ และเกษตรกรผู้เลี้ยงโคนมฯ ให้พร้อมรับการเปลี่ยนที่จะเกิดขึ้นจากผลกระทบจาก FTA โดยผลการศึกษานี้จะส่งมอบกลับไปยังชุมนุมสหกรณ์ฯ สหกรณ์โคนมฯ เพื่อนำไปพิจารณาปรับใช้ต่อไป

ทั้งนี้ผู้ทำวิจัยจะทำการติดต่อเพื่อเข้าพบขอความอนุเคราะห์นำเสนอหลักการและประโยชน์จะได้รับ และขอความร่วมมือสอบถามข้อมูลเพื่อใช้ในงานวิจัยเช่น การทำแบบสอบถาม การให้ข้อมูลกลุ่มย่อย

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายวิรยศ วชิรโภคา หมายเลขโทรศัพท์ 080-915-9954 อีเมล virayos.v@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

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(นายวิรยศ วชิรโภคา)

นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ)

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(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ โมกขมรรคกุล)

ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)

หลักสูตรสหสาขาวชิาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
โทร. 02–2183113-4 โทรสาร. 02-251-2354

ที่ อว64.25/ลจต346/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์
และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

28 ตุลาคม 2563

เรื่อง ขอความอนุเคราะห์เข้าพบเพื่อเก็บข้อมูลสำหรับงานวิจัย

เรียน ประธานกรรมการ ชุมนุมสหกรณ์โคนมภาคเหนือ จำกัด

ด้วย นายวิรยศ วชิรโภคา รหัสประจำตัว 6087797620 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านและโซ่อุปทาน เรื่อง “ความร่วมมือในห่วงโซ่อุปทานเพื่อความยั่งยืน ในอุตสาหกรรมโคนมประเทศไทย” เพื่อศึกษาความร่วมมือในห่วงโซ่อุปทานในอุตสาหกรรมโคนมในประเทศไทย ซึ่งการศึกษานี้สอดคล้องกับพันธกิจข้อ 4 ในแผนปฏิบัติการด้านโคนมและผลิตภัณฑ์นม ระยะที่ 1 (ปี 2564-2570) นอกจากนี้เพื่อที่จะปรับตัวสหกรณ์โคนมฯ และเกษตรกรผู้เลี้ยงโคนมฯ ให้พร้อมรับการเปลี่ยนที่จะเกิดขึ้นจากผลกระทบจาก FTA โดยผลการศึกษานี้จะส่งมอบกลับไปยังชุมนุมสหกรณ์ฯ สหกรณ์โคนมฯ เพื่อนำไปพิจารณาปรับใช้ต่อไป

ทั้งนี้ผู้ทำวิจัยจะทำการติดต่อเพื่อเข้าพบขอความอนุเคราะห์นำเสนอหลักการและประโยชน์จะได้รับ และขอความร่วมมือสอบถามข้อมูลเพื่อใช้ในงานวิจัยเช่น การทำแบบสอบถาม การให้ข้อมูลกลุ่มย่อย

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายวิรยศ วชิรโภคา หมายเลขโทรศัพท์ 080-915-9954 อีเมล virayos.v@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

.....

(นายวิรยศ วชิรโภคา)

นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ)

....

(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ โมกขมรรคกุล)

ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
โทร. 02–2183113-4 โทรสาร. 02-251-2354

ที่ อว64.25/ลจต345/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์
และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

28 ตุลาคม 2563

เรื่อง ขอความอนุเคราะห์เข้าพบเพื่อเก็บข้อมูลสำหรับงานวิจัย

เรียน ประธานกรรมการ ชุมนุมสหกรณ์โคนมภาคกลาง จำกัด

ด้วย นายวิรยศ วชิรโภคา รหัสประจำตัว 6087797620 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านและโซ่อุปทาน เรื่อง “ความร่วมมือในห่วงโซ่อุปทานเพื่อความยั่งยืน ในอุตสาหกรรมโคนมประเทศไทย” เพื่อศึกษาความร่วมมือในห่วงโซ่อุปทานในอุตสาหกรรมโคนมในประเทศไทย ซึ่งการศึกษานี้สอดคล้องกับพันธกิจข้อ 4 ในแผนปฏิบัติการด้านโคนมและผลิตภัณฑ์นม ระยะที่ 1 (ปี 2564-2570) นอกจากนี้เพื่อที่จะปรับตัวสหกรณ์โคนมฯ และเกษตรกรผู้เลี้ยงโคนมฯ ให้พร้อมรับการเปลี่ยนที่จะเกิดขึ้นจากผลกระทบจาก FTA โดยผลการศึกษานี้จะส่งมอบกลับไปยังชุมนุมสหกรณ์ฯ สหกรณ์โคนมฯ เพื่อนำไปพิจารณาปรับใช้ต่อไป

ทั้งนี้ผู้ทำวิจัยจะทำการติดต่อเพื่อเข้าพบขอความอนุเคราะห์นำเสนอหลักการและประโยชน์จะได้รับ และขอความร่วมมือสอบถามข้อมูลเพื่อใช้ในงานวิจัยเช่น การทำแบบสอบถาม การให้ข้อมูลกลุ่มย่อย

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายวิรยศ วชิรโภคา หมายเลขโทรศัพท์ 080-915-9954 อีเมล virayos.v@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

.....

(นายวิรยศ วชิรโภคา)

นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ)

....

(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ โมกขมรรคกุล)

ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
โทร. 02–2183113-4 โทรสาร. 02-251-2354

ที่ อว64.25/ลจต344/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์
และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

28 ตุลาคม 2563

เรื่อง ขอความอนุเคราะห์เข้าพบเพื่อเก็บข้อมูลสำหรับงานวิจัย

เรียน ประธานกรรมการ ชุมนุมสหกรณ์โคนมภาคอิสาน จำกัด

ด้วย นายวิรยศ วชิรโภคา รหัสประจำตัว 6087797620 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านและโซ่อุปทาน เรื่อง “ความร่วมมือในห่วงโซ่อุปทานเพื่อความยั่งยืน ในอุตสาหกรรมโคนมประเทศไทย” เพื่อศึกษาความร่วมมือในห่วงโซ่อุปทานในอุตสาหกรรมโคนมในประเทศไทย ซึ่งการศึกษานี้สอดคล้องกับพันธกิจข้อ 4 ในแผนปฏิบัติการด้านโคนมและผลิตภัณฑ์นม ระยะที่ 1 (ปี 2564-2570) นอกจากนี้เพื่อที่จะปรับตัวสหกรณ์โคนมฯ และเกษตรกรผู้เลี้ยงโคนมฯ ให้พร้อมรับการเปลี่ยนที่จะเกิดขึ้นจากผลกระทบจาก FTA โดยผลการศึกษานี้จะส่งมอบกลับไปยังชุมนุมสหกรณ์ฯ สหกรณ์โคนมฯ เพื่อนำไปพิจารณาปรับใช้ต่อไป

ทั้งนี้ผู้ทำวิจัยจะทำการติดต่อเพื่อเข้าพบขอความอนุเคราะห์นำเสนอหลักการและประโยชน์จะได้รับ และขอความร่วมมือสอบถามข้อมูลเพื่อใช้ในงานวิจัยเช่น การทำแบบสอบถาม การให้ข้อมูลกลุ่มย่อย

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายวิรยศ วชิรโภคา หมายเลขโทรศัพท์ 080-915-9954 อีเมล virayos.v@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

.....

(นายวิรยศ วชิรโภคา)

นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ)

....

(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ โมกขมรรคกุล)

ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)

หลักสูตรสหสาขาวชิาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
โทร. 02–2183113-4 โทรสาร. 02-251-2354

ที่ อว64.25/ลจต5/64

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์
และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)บัณฑิต
วิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

4 มกราคม 2564

เรื่อง ขอความอนุเคราะห์ตอบแบบสอบถามเพื่อเก็บข้อมูลสำหรับงานวิจัย

เรียน ประธานสหกรณ์/ ผู้จัดการสหกรณ์/ ประธานศูนย์รับนมเอกชน/ ผู้จัดการศูนย์รับนมเอกชน

ด้วย นายวิรยศ วชิรโภคา รหัสประจำตัว 6087797620 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิต สาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านและโซ่อุปทาน เรื่อง “ความร่วมมือในห่วงโซ่อุปทานเพื่อความยั่งยืน ในอุตสาหกรรมโคนมประเทศไทย” เพื่อศึกษาความร่วมมือในห่วงโซ่อุปทานในอุตสาหกรรมโคนมในประเทศไทย ซึ่งการศึกษานี้สอดคล้องกับพันธกิจข้อ 4 ในแผนปฏิบัติการด้านโคนมและผลิตภัณฑ์นม ระยะที่ 1 (ปี 2564-2570) นอกจากนี้เพื่อที่จะปรับตัวสหกรณ์โคนมฯ และเกษตรกรผู้เลี้ยงโคนมฯ ให้พร้อมรับการเปลี่ยนที่จะเกิดขึ้นจากผลกระทบจาก FTA โดยผลการศึกษานี้จะส่งมอบกลับไปยังชุมนุมสหกรณ์ฯ สหกรณ์โคนมฯ เพื่อนำไปพิจารณาปรับใช้ต่อไป

ทั้งนี้ผู้ทำวิจัยขอความอนุเคราะห์**การทำแบบสอบถามเพื่อเก็บข้อมูลสำหรับงานวิจัย โดยกลุ่มเป้าหมายตอบแบบสอบถาม ได้แก่ ประธานสหกรณ์ ผู้จัดการสหกรณ์หรือ ผู้จัดการศูนย์นมหรือ ผู้จัดการ และเกษตรกรผู้เลี้ยงโคนม โดยมีแบบสอบถามจำนวน 25 ชุด โดยแบบสอบถามได้แนบมาพร้อมกับ** เมื่อทำการรวบรวมเสร็จเรียบร้อย สามารถจัดส่งกลับทางไปรษณีย์ตามซองจดหมายที่ได้แนบมาด้วยนี้ ภายในวันที่ 16 กุมภาพันธ์ 2564

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายวิรยศ วชิรโภคา หมายเลขโทรศัพท์ 080-915-9954 อีเมล virayos.v@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

.....

(นายวิรยศ วชิรโภคา)

นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ)

.....

(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ โมกขมรรคกุล)

ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
โทร. 02–2183113-4 โทรสาร. 02-251-2354

VITA

NAME	Virayos Vajirabhoga
DATE OF BIRTH	06 July 1978
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Chulalongkorn University
HOME ADDRESS	122/160 Phuttha Bucha 36, Puttha Bucha road, Bang Mot, Thungkhru, Bangkok, Thailand
PUBLICATION	- Decision Making Models of Distribution Channels for Animal Health Products. - Type and Understanding of Supply Chain Collaboration in Thailand's dairy farmers
AWARD RECEIVED	Best Poster Presetation