2018 IEEE International Conference on Industrial Engineering & Engineering Management

IEEE IEEM2018

16-19 Dec • Bangkok, Thailand

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Organizers:
IEEE TEMS Thailand Chapter
IEEE TEMS Singapore Chapter
IEEE TEMS Hong Kong Chapter

IEEM2018 Welcome

Highlights

Program

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About Bangkok

Conference Venue

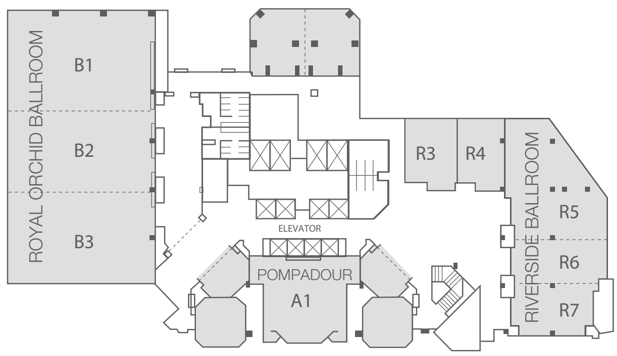
Royal Orchid Sheraton Hotel & Towers
2 Charoen Krung Road Soi 20
(Captain Bush Lane)
Siphya, Bangrak Bangkok, 10500 Thailand
Tel: +66 2660123

wifi password: ieem2018

Function Room Layout

2nd Floor

Chao Phraya River



1st Floor

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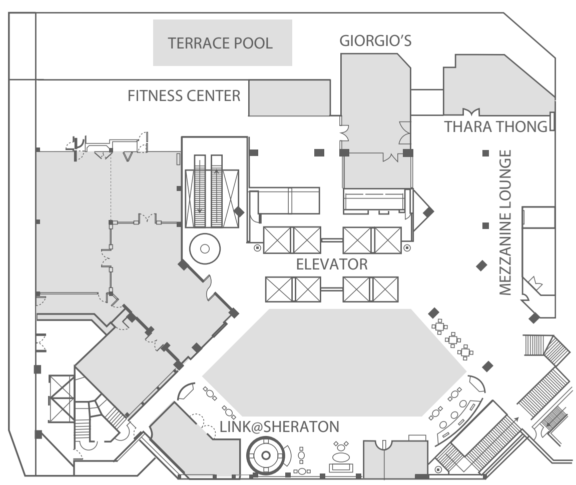

Welcome Message

Dear participants,

A very warm welcome to you to the 2018 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM2018) to be held from 16-19 December 2018 in Bangkok, Thailand.

Since the first IEEM was held in Singapore in 2007, IEEM conference has grown into a high-quality conference in the fields of industry engineering and engineering management, with participants from all corners of the world. This year, IEEM2018 received nearly 800 submissions from about 50 countries. As in the past, each paper was sent to three to five reviewers. The acceptance decisions were based on at least two consistent recommendations, ensuring the quality and standard of the conference. These papers, organized around 20 topics, will be presented in oral and poster sessions. We are also privileged to have with us two distinguished speakers to deliver the keynote presentations:

Professor Yonghua Song, Rector, University of Macau will present on "Harmonizing Fluctuating Renewable Energy and Flexible Demand Resources: A Smart Grid Solution in Deregulated Environment".

Dr. Krithpaka BoonFueng, Deputy Executive Director (Innovation System), National Innovation Agency will discuss on "The Myth of Technology, Innovation and Startup."

We are also honored to have Professor Kay Chen Tan, Editor-in-Chief of IEEE Transactions Evolutionary Computation, to run a workshop on "How to Publish", and lead a Meet-the-Editors panel.

We would like to thank all authors and participants for their interests, contributions and continued support to IEEM. Lastly, we are also grateful to the technical program committee members and reviewers for their help in the review process.

We wish all will have a fruitful conference, and we hope that you will enjoy the cultural experiences of Bangkok.

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The University of Melbourne

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Ivan GUNAWAN[1], Iwan VANANY[1], Erwin WIDODO[1], Jaka MULYANA[2]
[1]*Institut Teknologi Sepuluh Nopember, Indonesia*
[2]*Widya Mandala Catholic University, Indonesia*

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[1]*Kobe University, Japan*
[2]*Tokai University, Japan*

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[1]*Indian Institute of Management Udaipur, India*
[2]*Indian Institute of Management Bangalore, India*

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[1]*Waseda University, Japan*
[2]*Kanazawa University, Japan*

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Anders THORST
Aarhus University, Denmark

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Cost-model for Energy-oriented Production Control
Martin ROESCH[1], Christoph BERGER[1], Stefan BRAUNREUTHER[2], Gunther REINHART[1]
[1]*Fraunhofer IGCV, Germany*
[2]*Augsburg University of Applied Sciences, Germany*

Improving Traceability System in Indonesian Coconut Oil Company

Ivan Gunawan[1, 2], Iwan Vanany[1], Erwin Widodo[1], Ig. Jaka Mulyana[2]
[1]Department of Industrial Engineering, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia
[2]Department of Industrial Engineering, Widya Mandala Catholic University, Surabaya, Indonesia
(ivangunawan@ukwms.ac.id)

Abstract – **To improve a traceability system, both the internal and the chain one, the first important step is to identify the Critical Traceability Points (CTPs) along the supply chain. Therefore, the purpose of this study is to map out the CTPs of the Indonesian coconut oil company as the basis for improving the traceability system. Process mapping was used as the method to capture the CTPs in the production of Refined Bleached Deodorized Coconut Oil (RBDCNO). Critical Traceability Point Analysis (CTPA) was performed to find the feasible traceability improvement strategies. The process mapping successfully identified 13 CTPs from the reception of raw materials to the dispatch of finished products. The recommended improvement strategies are to integrate the identification record of material flow along the process and to develop an internal code system that allows the company to trace and track. This recommendation can be implemented by converting the information system into a digital system.**

Keywords - **traceability, coconut oil, process mapping**

I. INTRODUCTION

Coconut is a flagship commodity of tropical countries in Southeast Asia. Indonesia is among the countries that have the largest plantation areas and is even ranked first in the world's coconut production. However, Indonesia is not in a favorable position since the percentage of exported coconut (raw material) is greater than its derivative products. Raw coconut has lower value but this can be improved by further processing in the country of production to create its derivative products. One derivative product, which is highly demanded as an export commodity, is coconut oil. Global demand for coconut oil as a food commodity continues to increase year by year. This is an opportunity for Indonesia to make coconut oil a flagship export commodity instead of exporting raw coconuts. Nowadays, coconut oil occupies a portion of about 20% of all types of edible oil being used worldwide. Indonesia could have an advantage of this by improving the competitiveness of its exported coconut oil.

Supply chain management practice is considered as an effective solution to enhance competitive advantage [1], but its practice has not accommodated the assurance of food quality and safety along the processes. Recently, the increasing number of food safety incidents has made the practitioners in food supply chain more attentive to food safety regulations [2]. PAHs, dioxin, mineral oil, aflatoxin, pesticide residues are some of the potentially hazardous substances identified in coconut oil. This being considered, a new concept of supply chain quality management is proposed with the objective of increasing the visibility of food products through multilayered supply chain to ensure the quality and safety of food products to end consumers [3]. Furthermore, reference [3] describes the six "Ts" as a supply chain quality management framework. Traceability is one of the six "Ts", which needs to be met in the food supply chain in order to increase the global competitive advantage.

Moreover, governments of many countries also have an interest in the traceability system as a form of protection for consumers. They have set up a series of regulations that encourage every actor in the food chain to maintain traceability. For instance, the European Union (EU) has required all food business operators in the EU to establish a traceability system since January 1st, 2005 [4]. Well-educated markets also respond positively by showing higher willing-to-pay (WTP) for food products with credible traceability information. Thereby, the traceability system will be one of the factors that can increase the global recognition of Indonesian coconut oil products. However, improving a traceability system in food industry can often be hindered by various technical and economic barriers [5].

A coconut oil industry is a process industry like most food industries. Reference [6] defines "process industries" as "the businesses that add value to materials by mixing, separating, forming, or chemical reactions." The processes may be either continuous or batch-by-batch and generally require a rigid process control and high capital investment. Previous study shows that technical barriers in building internal traceability may occur if the production chain involves bulk products [7]. Reference [8] has identified some of the technical barriers in building chain traceability throughout the food chain. The technical barriers come from the combination of continuous and discrete product flows, the lot segregation issue in continuous products, the alternating of diverging and converging processes and the by-products emerging along the food chain, the highly interdependent product flows, the high perishability, and the complex network structure.

These barriers will definitely increase the risk of interruption in collecting traceability information along the supply chain. To improve the granularity of a traceability system, the first step is to capture the existing situation of the supply chain being studied just like what reference [9] did in mineral water bottling plant; and what reference [10] did in a fish feed factory and salmon farm. Therefore, this study aims to map out the points where important traceability information is lost along the processes of coconut oil production. Critical Traceability

Points Analysis (CTPA) was conducted to support the data in establishing full traceability “from-plantation-to-plant” and “from-plant-to-pan” in coconut oil supply chain. The traceability information is gathered from an on-line method, which is used in collecting process data, traceable units, and timely material signature recorded on a regular basis [11]. SMP, a coconut oil company in East Java-Indonesia, is presented in this paper as real case study. SMP has a production capacity of 400 tons per day and sells Refined Bleached Deodorized Coconut Oil (RBDCNO) both in packages and in bulk.

II. METHODOLOGY

An Indonesian coconut oil company was selected as a case study because Indonesian food industries are experiencing several problems and requiring traceability improvement as an approach to reduce losses [12]. The case narrative data was collected in conjunction with the previous exploratory study about the influence of traceability practice on product recall capability [2]. Interviews, field observations, and document analyses were used as data collection methods. Interviewees were selected in a referral sampling. The first interviewee was a procurement manager with a good supply network overview. Then, the following recommended interviewees were a warehouse manager, a plant manager, a PPIC manager, and a logistics manager in respective order. .

The case study approach was used to retell the ‘how and why’ of the contemporary phenomenon from multiple sources of evidence [13]. Process mapping was carried out with the systematic procedure proposed by reference [14]. The process mapping was conducted to identify the Critical Traceability Points (CTPs). Then, Critical Traceability Point Analysis (CTPA) was performed using reference [15] validated method.

III. RESULTS

SMP is a producer of coconut oil derived from copra. Copra is dried coconut flesh, which is rich of oil. The quality of copra depends on the coconut drying method. Natural sun-drying method produces the best quality of copra and it is the brown coconuts only which are processed to become copra. Therefore, if young coconut demand increases, the brown coconuts supply will drop and coconut oil producers will have difficulty fulfilling their warehouse with copra.

Copra, which reaches coconut oil producers' warehouses, has passed through a multilayered network. Copra is usually purchased from farmers by collectors and is usually stored in small warehouses close to the coconut plantations. Then, copra will be sold to local traders or directly to wholesalers depending on each collector channel. Coconut oil producers will buy through brokers/ consolidators who usually live in the same city as the coconut oil producers. Such conditions lead to the loss of traceability information from the upstream supply chain. Brokers/ consolidators will hold back the information about the origin of copra to sustain their role in the coconut supply chain. The overview of coconut oil supply chain network can be seen in Figure 1.

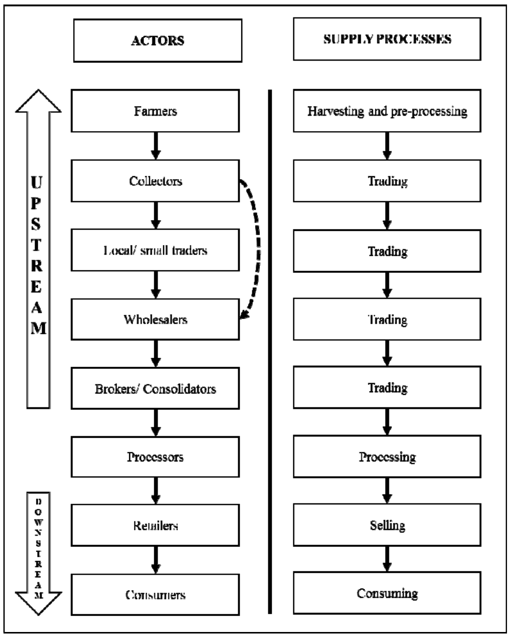

Fig. 1. Coconut oil supply network

To produce 400 tons of RBDCNO in a day, SMP needs copra as raw material at about 650 tons or crude coconut oil (CCNO) as intermediary material at about 450 tons per day. The supply capacity of their suppliers cannot fulfill this requirement. Therefore, SMP must accumulate raw materials for some time before running a production batch. Besides, the production of RBDCNO also requires supporting materials such as Bleaching Earth (BE), Carbon Active (CA), and Phosphoric Acid (PA). The materials of the RBDCNO production can be seen in Table 1.

TABLE I
MATERIALS USED TO PRODUCE RBDCNO

Material	Form	Supplier	Quantity order (ton)	Time of delivery	Identification from supplier
BE	Powder	BAI	28	3-4 times a month	Prod. no. per sack
CA	Powder	IPKI	5	3-4 times a month	Prod. no. per sack
PA	Liquid	KC	5.25	once a month	Prod. no. per jerry can
Hexane	Liquid	BT, MA, and AG	1.3-1.7	twice a month	No ID
Copra	Solid	Unrevealed	12-20	10-15 times a day	No ID
CCNO	Liquid	Unrevealed	20-2000	Tentative	No ID

Ninety percent of the copra in the SMP’s warehouses comes from brokers/ consolidators. The rest comes from direct purchases to farmers or local traders through the company's warehouses placed in copra-producing areas. Copra from Sumatera, Nusa Tenggara, and Sulawesi is shipped to East Java by container or truck, in big sacks ranging from 65-100 kilograms per sack

The first stage of copra processing is through the crushing process. Copra is chopped into small pieces then is put into the bucket elevator and the expeller pressing process. The crushing and expeller pressing are running in a series. The expeller pressing produces CCNO and copra cake. The CCNO will be stored in a buffer tank while the copra cake is stored in a warehouse. Copra cake, which still contains oil, is prepared for the extracting process. Hexane is the supporting material in extracting the coconut cake. The outputs of the extracting process are CCNO and copra powder. The latter is not discussed in this paper as it is a non-food product.

CCNO in this case study is termed as intermediary material in the RBDCNO production. There are two types of CCNO used in the RBDCNO production. First, CCNO which is produced from copra by the plant and CCNO which is supplied by suppliers. All CCNO is stored in 2200 tons storage tanks. The CCNO identification is derived only from the storage tank number and there is no further identification made from the convertion of copra to CCNO. Material arrival identification is only based on the arrival date and is lost during the storage process.

CCNO from storage tank is then pumped to the refining process. In this process, supporting materials such as BE, CA, and PA are required. These materials are industrial products so they have production codes. Unfortunately, the production code is not utilized by SMP as the basis for building the traceability information. The warehouse only records product arrival date to allow FIFO (First-In-First-Out) rule.

The outputs of refining process are RBDCNO and Coconut Fatty Acid Distillate (CFAD). RBDCNO and CFAD are liquid products so they are stored in storage tanks. CFAD is excluded in this study for the same reason as copra powder. The only identification of RBDCNO during the process is the production time. SMP can actually trace the input materials of RBDCNO through the production time and storage tank number. The next process is to fill RBDCNO into the package. Some types of the packaging offered to the customers are bag-in-box (BIB), jerry-can, shipping tank, and flexi-bag. The shipping tank and flexi-bag are categorized as selling in bulk. The products sold in shipping tank and flexi-bag cannot be traced by the company. The detail of the product flow can be seen in Figure 2.

IV. DISCUSSION

The multilayered network on the upstream of copra procurement makes the plant unable to trace the source of raw material. Currently, coconut oil companies concern only with the characteristics of quality as the basis for determining copra price. Mixing is a common practice done along the supply chain to improve the quality of copra so that the profit made by the upstream actors are greater. Therefore, there is no single identity attached to the copra that arrives into the SMP’s warehouse. Warehouse staff only record the arrival date and the quantity. These records cannot be the basis neither for tracing nor for tracking.

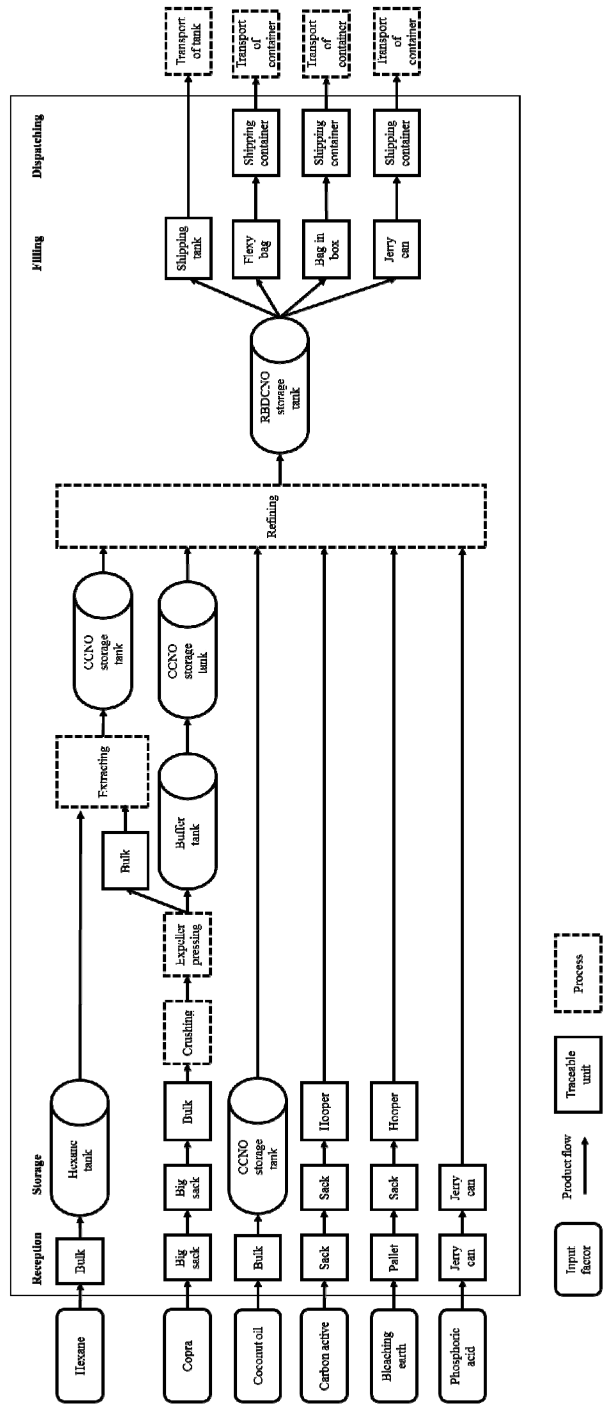

Fig. 2. Material flow overview at SMP

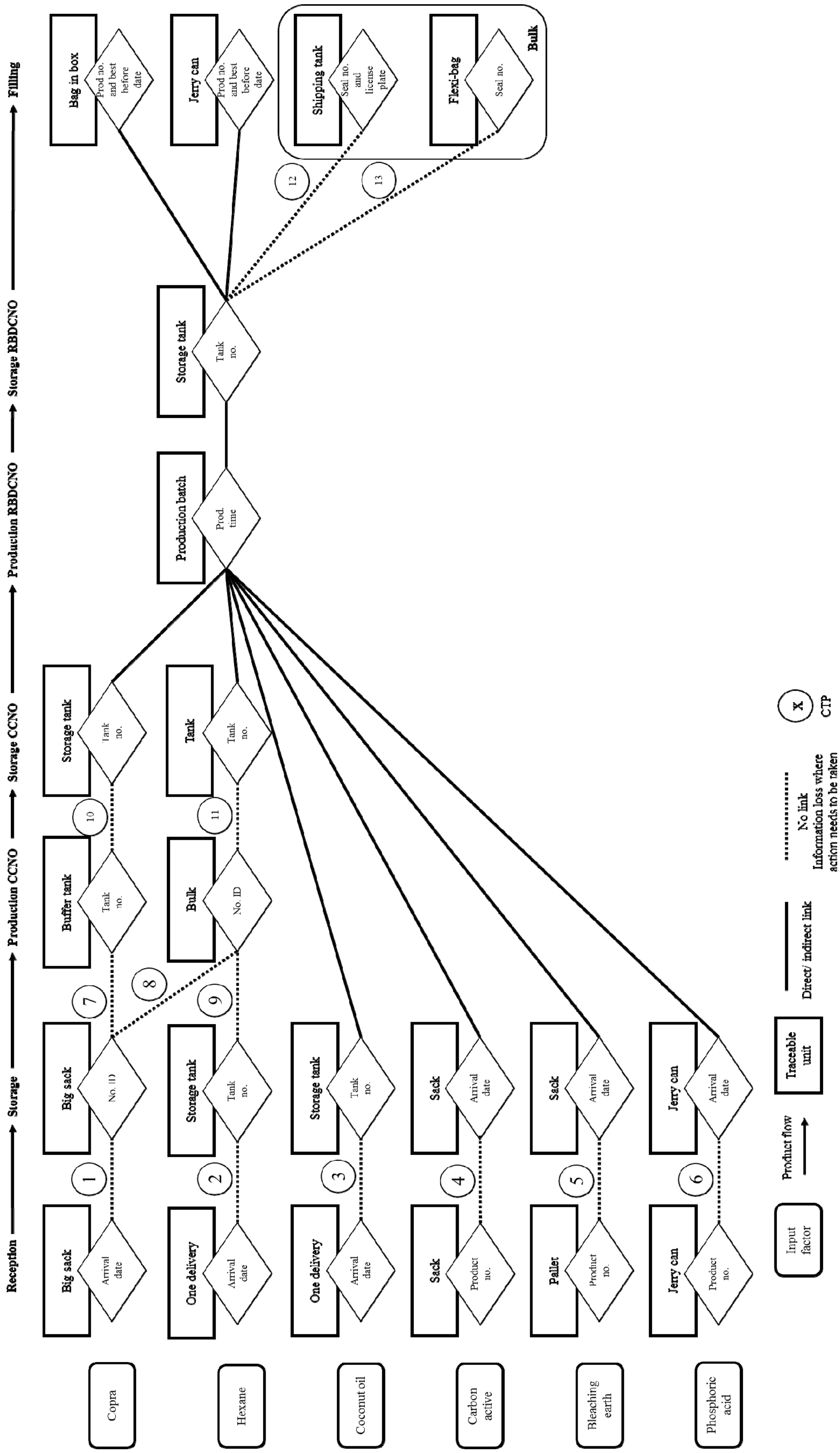

Fig. 3. Information flow overview at SMP

CCNO, which comes from the suppliers, undergoes the same situation, but CCNO's producer is still traceable at reception stage. The loss of identity occurs during the storing process in the tank due to the mixing between the CCNO from the suppliers and the CCNO produced by SMP. In the storage tank, CCNO gets a tank number as a new identity. The liquid product characteristic causes the product to become perfectly mixed in the tank and impossible to trace. If there is a problem either in copra or external CCNO, the product number recalls will not be controllable. Separating storage between the internal CCNO and the external CCNO is the first step recommended for the company to improve the traceability. This improvement only requires new tank management and a production planning policy.

The RBDCNO which has been produced can be traced back to the CCNO storage tank by checking the production time because the production department records the input material source regularly. As opposed to CCNO, the supporting materials come from the warehouse and are not recorded by the production department. Warehouse department only has stock cards to record the supporting materials quantity. This CTP can be improved by generating internal codes when receiving supporting materials or recording the production codes from suppliers then integrate them with the production record.

In the filling process only RBDCNO packaged in jerry-can and BIB that can be traced. A proposed improvement for jerry-can is to convert the measurement unit to become kilogram. RBDCNO sold in bulk by using a flexi-bag or shipping tank cannot be traced because the logistics department uses a seal number as the identification. The seal number is a random combination number that is not associated with anything in the previous process. The proposed improvement is to replace the seal number with a meaningful internal code so that the product can be traced back to the production.

V. CONCLUSION

Improving a traceability system is essential for food industry to increase the competitiveness. Thirteen CTPs of the coconut oil company which need improvement have been successfully identified in this study. The upstream trade chain of copra causes the loss of traceability information on the stage before raw materials enter the company's warehouse. The process of receiving and storing raw materials and supporting materials cannot provide the one-step-backward information, which is important for the company to do tracing. The detail actions to improve traceability in this area has been mentioned previously. The existing condition only allows tracking the product one-step-forward and it is only products that are marketed in jerry-can and BIB that can be traced to the production stage. The identification records of the seal number and license number for bulk cannot be the basis for tracing. The recommendation to improve traceability is to build identification systems using meaningful internal codes for each stage of the material flow. This recommendation can be implemented by developing a digital information system.

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