Mapping Upstream and Downstream Process in The Patchouli Oil Industry Using Supply Chain Operations Reference Model Version 12.0 (SCOR 12.0)

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Abstract. Supply chain characteristics in the agricultural industry differ from the industry in general, the structure is more complex and unique according to its agricultural commodities. All of the aspects starting from the upstream are very important to consider because of their dependence on the suitability of the environment and the processes that are carried out on the pre-source. Patchouli oil industry which is mainly located in Aceh Jaya Regency is the object of this study due to the fact it is the largest supplier of patchouli oil in Aceh Province. It is estimated that patchouli oil which is one of the superior local wisdom product is becoming an interesting subject again. This is indicated by several local products that use it as the main raw material. Certainly, this will be difficult to be applied if the supply chain from the upstream to the downstream is not evaluated and upgraded. For this reason, it is necessary to do a mapping process on the vulnerable side, including pre-source, source, make, and deliver. This mapping used the SCOR method version 12.0 and adapted to the make-to-stock industry scheme. The output of this study is a reliable and measurable process system in the patchouli oil industry.

1. Introduction
   The quality of Aceh Patchouli Oil has long been recognized internationally. The best Aceh Patchouli variety was Lhokseumawe Variety, Tapak Tuan Variety, and Sidikalang Variety. The varieties have become the priority crops for the cultivation in Indonesia. However, the patchouli oil deterioration and uncertainty price indicates the failure in the supply chain system. The supply chain system greatly determines its performance and reliability. Part of the system includes source, make, and deliver. This problem needs to be investigated and evaluated as an effort to restore the glory of the patchouli oil industry in Aceh.

   This study used the Supply Chain Operations Reference Model version 12.0 (SCOR 12.0) approach method. The method is used to map and evaluate the processes that occur in supply chain system.

Literature Review

Aceh Patchouli Plants (Pogostemon cablin Benth). Patchouli is a type of shrub plant with the height up to one meter. Aceh Patchouli plants has the best quality of oil content and patchouli alcohol (PA). The standard quality of Aceh patchouli oil content is about 2.5%-5.0% [1]. Patchouli oil is fixative as a
binding agent for other essential oil compounds. There is no alternative product that can replace the function and the role of the patchouli oil. The development of Aceh Patchouli has created the best variety called Tapak Tuan Variety, Lhokseumawe Variety and Sidikalang Variety. The advantage of Tapak Tuan Variety is the high level of patchouli alcohol (PA). Meanwhile the Lhokseumawe Variety has high oil content level. The Sidikalang Variety has resistance to bacterial wilt disease and nematodes. National Standardization Organization of Indonesia (SNI) has decided the standard quality of patchouli oil. The standard quality listed in SNI 06-2385-2006.

| No | Parameter | Requirement |
|----|-----------|-------------|
| 1  | Color     | Light yellow – Reddish brown |
| 2  | Density 20 °C/20 °C | 0.950 – 0.975 |
| 3  | Refractive index [nD20] | 1.507 – 1.515 |
| 4  | Solubility in ethanol 90% at temperature 20 °C | Clear solvent/opalescence in comparison 1:10 |
| 5  | Acid number | Maximum 8 |
| 6  | Ester number | Maximum 20 |
| 7  | Optical rotation | (-48° – (-65°) |
| 8  | Content of Fe [mg/kg] | Maximum 25 |
| 9  | Patchouli chromatography profile using a detector | Gas Liquid Chromatography (GLC) and FID |
| 10 | Component: | Minimum [%] | Maximum [%] |
|    | α-Copaene | - | 0.5 |
|    | Patchouli alcohol | 30 | - |

Source: National Standardization Organization (BSN) ICS 71.100.60.

**Supply Chain Management (SCM).** Supply chain is a process of material flow, information flow, and payment flow in the trading system of the product starting from the upstream to the downstream aimed at the end user. Supply chain includes planning and controlling production, material handling, purchasing and payment, warehousing, distributing and shipping. The main purpose of the supply chain is to balance supply and demand. Supply Chain Management (SCM) is a concept in managing a supply chain activity to maximize customer value. SCM perspective is integrated services, which includes interconnection and relation between companies (linked) not only covered the first tier but also reached the second tier. The relationship includes the downstream and the upstream industry.

![Supply chain system](image1)

**Figure 1.** Supply chain system.

**Supply Chain Operations Reference Model (SCOR 12.0).** The SCOR model is a model that describe business activities oriented towards customer satisfaction. Supply Chain Operations Reference Model (SCOR 12.0) presents a unique business framework, work indicators, best practices and technology to support communication and collaboration between partners or entities within a supply chain. The model can improve the effectiveness of supply chain management. SCOR model forms as hierarchy with several levels of process. The first level is the type of process used to identify the scope of a supply
The second level is the stage of formulating process categories that aim to configure supply chain. Meanwhile, the third level is a process that shows the elements of the process, determines the supply chain includes input/output, indicators of the process, and best practices can be implemented in the supply chain [3].

Table 2. Type and category process of SCOR

| SCOR Process | Plan | Source | Make | Deliver | Return |
|---------------|------|--------|------|---------|--------|
| Type of Process | Planning | P1 | P2 | P3 | P4 | P5 |
|                | Execution | S1-S3 | M1-M3 | D1-D4 | SR1-SR3 |
|                | Enable | EP | ES | EM | ED | ER |

2. Methodology

Procedure. The procedures performed in this study can be represented in the following flowchart.

Figure 2. Preparation and mapping process.

Variable. Process categories that mapping with SCOR Model 12.0 are particularly processed in the supply chain system. The process categories are represented in the following table.

Table 3. Process area of SCOR Model.

| Process | Process Area |
|---------|--------------|
| PLAN    | Supply and demand planning management. |
Raw material inventory management, acceptance management, supplier selection management, procurement strategy, and performance management.

Order management, production schedule, production activity, and engineering/customization.

Finished goods inventory management, supply and demand information management, product distribution, and installation management.

Management of returning activities to suppliers or receiving returns from consumers.

Planning and execution arrangements.

**Mapping Analysis**

**Supply Chain Existing System Configuration.** Supply chain configuration that has been implemented includes several entities that play an important role in the patchouli oil supply chain system in Aceh Jaya Regency. The entities are Farmer I, Farmer II, Maker, Local Collector, The Cooperative, Local Customer, Exporter, and International Customer.

**Figure 3.** The entities of the existing supply chain system.

| Type of Process | Pre-Source | Source | Make | Deliver |
|-----------------|------------|--------|------|---------|
| SC              | Farmer I   | Farmer I | Farmer II | Farmer II |
| Actors          | Farmer I   | Farmer II | Maker | Local Collector |
| Main Activities | Cultivating | Drying | Distillation | Marketing |
|                 | Harvesting | Chopping | Oil Separation | |
|                 |            |          | Purification | |
|                 |            |          | Packaging   | |
| Output          | Leaves     | Raw Material | Patchouli Oil | Waste |
|                 | Stems      |            |            | |
|                 | Roots      |            |            | |

**Figure 4.** Process flow of the supply chain system.
The following is a detailed mapping process.
- Plantation land management is not complete at all. The farmers use the available plantation land without land management first.
- The cultivation process is not carried out.
- Farmer plants the crop cutting directly on the land. The treatment has a high failure rate.
- In the process of maintaining the plants, not only weeding and pruning are not carried out, but also there is no effort to control pests, viruses, and diseases attack.
- Harvesting process is done by fully cutting to the base of the stem. As the result of this treatment, there is no secondary harvesting period.
- Harvested plants are placed on the ground, so that they are exposed to sunlight in relatively long period.
- Distribution activities include distribution of raw materials to the warehouse and distribution of the product to the customer. Generally, the distribution activities have not been carried out regularly and systematically.
- There is no representative warehouse.
- There is no selection of raw material quality.
- There is no fermentation process as an effort to improve the quality of patchouli oil.
- There is no control over the quality of production facility and infrastructure.
- There is no waste management.

![Diagram of the patchouli oil industry]

Fig. 5. Detail processes of the patchouli oil industry.

![Pie chart showing percentage of detail processes]

Figure 6. Percentage of detail processes.
Mapping of The Industrial Process Schemes with SCOR 12.0. The purpose of adjusting the process scheme with the SCOR Model version 12.0 approach is to identify the weaknesses of the supply chain system. It creates a strategy or an alternative improvement to the supply chain system. Eventually, the supply chain system will be more effective and reliable.

**Figure 7.** Profile of mapping with SCOR 12.0.

**sS-Source Process.** Mapping the source process metric in the patchouli oil industry only covers the source stocked product scheme, which is the process of raw material supply for production to maintain stability and availability of the products in inventory. The product is still available as a penetration of customer needs. The following is steps that fit the SCOR model version 12.0 for the source process.

**Figure 8.** Source process scheme SCOR 12.0.

**Figure 9.** Source process scheme existing.

**sM-Make Process.** In the production process, most of the processes have been carried out in accordance with the process scheme approach in the SCOR Model. The mapped process scheme is make-to-stocked scheme.

**Figure 10.** Make process scheme SCOR 12.0.
**Figure 11.** Make process scheme existing.

**sD-Deliver Process.** The *deliver* process is a process that determines the level of customer satisfaction with the accuracy of both product performance and delivery service. Thus it is very important to pay attention to every detail of the stages in the distribution process with the reference to the SCOR 12.0 approach.

**Figure 12.** Deliver process scheme SCOR 12.0.

**Figure 13.** Deliver process scheme existing.

### 3. Summary

Mapping the supply chain model using the Supply Chain Operations Reference Model (SCOR 12.0) which includes *pre-source, source, make, and deliver* is very effective to identify the problems that occur in the supply chain. The calculation shows that only 5% of the process is carried out with systematic and measurable standardization process. Meanwhile about 55% of the process have not been completely conducted by following the standard and 40% of the process is not at all carried out by industry in accordance with the standard.

From the supply chain mapping using SCOR Model version 12.0, it was concluded that the average of the process that was not carried out on the existing supply chain system was 41%.
References

[1] Adharini, Dwi Wulan, 2009, *Aceh Patchouli Cultivation and Distillation (Pogostemon cablin Benth) at Deni Nursery and Gardening*, Sebelas Maret University, Surakarta

[2] Nasional Standardization Organization, 2006, *Patchouli Oil*, ICS 71.100.60, BSN, Jakarta, Indonesia.

[3] Paul, John, 2014, *Supply Chain Transformation with the SCOR Model*, PPM, Indonesia.

[4] APICS, 2017. *Quick Reference Guide Supply Chain Operations Reference (SCOR) Version 12.0*, APICS.

[5] Muharam, Salih, et al., *Quality Improvement of Patchouli Oil (Pogostemon cablin Benth) using Combination Method of Fermentation, Delignification and Distillation*, Jurnal Kimia Valensi Vol. 3 No. 2 (2017) 116-121.

[6] Wahyuniardi, Rizki, et al., *Performance Measurement of Supply Chain using Supply Chain Operations Reference (SCOR)*, Jurnal Ilmiah Teknik Industri Vol. 16 No. 2 (2017) 123-132.

[7] Mutakin, Anas & Musa Hubeis, *Management Performance Measurement of Supply Chain using SCOR Model 9.0*, Jurnal Manajemen dan Organisasi Vol. II No. 3 (2011) 89-103.