

# **Supply Chain Performance System Development Using SCOR, AHP, OMAX, and Traffic Light System Methods in PT. Sunny Garden Property**

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## **Abstract**

The role of the supply chain is very important in the company's material flow process, starting from the delivery of raw materials by suppliers to the finished product in the form of apartment units into the hands of consumers. Therefore, it is necessary to conduct an analysis to measure and assess the extent to which the supply chain performance and the company's productivity level have been achieved so that it can provide suggestions for improvements to the company's performance indicators which are still below the target. This measurement is based on five core processes in the SCOR method and then weighted to each core process, work attributes, and each KPI using the AHP method, as well as a scoring system using OMAX and Traffic Light System analysis. The overall value of the company's supply chain performance achievement is 8,063, it is concluded that five supply chain performance indicators need to immediately take corrective action because they are still in the yellow level and are expected to help improve the company's supply chain performance.

## **Keywords**

SCOR, supply chain, objective matrix, productivity, performance.

## **1. Introduction**

The evolutionary development of the theory of logistics led to the emergence of a new logistic concept – Supply Chain Management at the end of the 20th century. Today, most researcher agree on the basic definition of a supply chain: “A supply chain is defined as a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a to a customer, (and return)” (Mukhamedjanova, 2020). To find out the implementation of the supply chain for the procurement of goods and services can be declared running well or not, it is necessary to review the effectiveness of supply chain activities in procuring goods and services by using the Supply Chain Operations Reference (SCOR) method. With the application of the SCOR method, the identification of supply chain work indicators can be assessed to what extent a company can fulfill a job, calculate the achievement of targets or the application of predetermined standards so that the company's performance is expected to be carried out effectively in accordance with company standards (Bolstorff and Rosenbaum, 2007). One way to achieve good indicators in assessing a problem is to use Key Performance Indicator (KPI). KPI compares what has been created with what has been set. Successful implementation is dependent on implementing a good maintenance strategy according to what has been established (Parmenter 2015). In addition, Analytic Hierarchy Process (AHP) method can be used as a tool to analyze decisions. In recent years, in a world of rapidly growing complexity, making the best decisions is an increasingly demanding task for corporate managers, government agencies, and many other decision and policy makers. Many methods derived from applied mathematical techniques and operations research have proven useful to help decision makers to make the right decisions (Brunelli, 2015). Moreover, one of the methods used to measure productivity in manufacturing companies is the Objective Matrix (OMAX) method. OMAX is a performance measurement method that evaluates several productivity criteria based on weights to obtain a company's overall productivity index. The use of the OMAX method can produce effective resources (Balkan, 2011).

The study taken on a real-estate company in Indonesia (PT. Sunny Garden Property) that began to experience a decline in production due to the actual difference in production activities with the targets to be achieved by the company in the last semester. This causes the productivity level of all supply chain activities to decrease. Initial

identification shows that the cause of the decline in productivity is caused by several factors, namely immature planning, inefficient construction work, and poor labor factors so that there are defective on the production. The company also experienced a condition where material requests were made suddenly so that there was chaos in the flow of materials to be received. This is detrimental to the company both in terms of time and cost. Therefore, in carrying out supply chain performance measurement activities effectively and to compete with other companies, company must have a clear indicator of the company's performance level as a consideration between maintaining or improving the company's work system.

## **1.1 Objectives**

This research will focus on the study of key performance indicators (KPI) for companies from any proposals, suggestions, and related changes to reduce the possibility of negative impacts caused by these risks and reduce the repetition of similar events in the future supported by the Supply Chain Operation Reference method for determine the scope of work, the Analytical Hierarchy Process (AHP) method to assist the decision-making process and determine the importance of the criteria obtained, as well as the Objective Matrix (OMAX) and Traffic Light System (TLS) methods to measure the performance level of each KPI so that corrective action can be taken by the company.

## **2. Literature Review**

### **2.1. Supply Chain**

The supply chain is a network of companies that work together to make and ship products to end users (Fauziyah, et.al. 2020). These companies usually include suppliers, manufacturers, distributors, stores, or retailers, as well as supporting companies such as logistics services. The supply chain is a physical network, a company engaged in supplying raw materials, producing goods, or sending to end users, SCM is a method, tool, or management approach.

### **2.2. Supply Chain Operation Reference**

One of the ways to measure supply chain performance is to use the SCOR method (Fauziyah, et.al. 2020). This method was introduced by the Supply Chain Council (SCC) as a model of measuring supply chain performance across industries. The SCOR model is a process reference model for supply chain operations developed by SCC, Pittsburgh, PA. SCOR breaks the supply chain process into five processes including plan, source, make, deliver, and return. These five elements have the following functions:

1. Plan, which is a process that balances demand and supply to determine the best course of action in meeting procurement, production, and shipping needs.
2. Source, which is the process of procuring goods and services to meet demand.
3. Make, which is a process for transforming raw materials or components into products that customers want.
4. Deliver is a process to meet the demand for goods and services. Usually includes order management, transportation, and distribution.
5. Return, which is the process of returning or receiving product control for various reasons. Activities involved include identifying the condition of the product, requesting a refund authority, scheduling a return, and making a return.

The five core processes are also measured based on the SCOR performance attributes which are divided into:

1. Reliability, namely supply chain performance in delivering the right product in the right condition and packaging at the right time, and with the right quantity and documents to the right consumers.
2. Responsiveness, namely the speed of the supply chain in providing products to consumers.
3. Agility or flexibility, namely the agility or agility of the supply chain in responding to market changes to maintain a competitive advantage.

### **2.3. Key Performance Indicators**

KPI is a management tool or instrument so that an activity/process can be followed, controlled (if it deviates, it can be identified for correction), and ensured to achieve the desired performance (Ariani, et.al., 2017). Identification and Determination of KPIs in a study is carried out to obtain KPIs that can be used as a measure of the company's success (Ishak, et.al., 2019). The KPIs collected has adhered to the principles of S.M.A.R.T. which stands for specific, measurable, agreeable, realistic, and time-bounded:

- Specific: project targets are defined clearly and definitively.

- Measurable: indicator development can be measured clearly.
- Agreeable: agreed upon by the owner of the performance indicator and relevant for use.
- Realistic: the targets set are possible to achieve.
- Time-bounded: has a time limit for the target to be achieved.

## **2.4. Analytical Hierarchy Process**

The AHP method is a useful method for analyzing decisions and has proven useful to help make the right decisions. This method takes both qualitative (from human perception) and quantitative (mathematical calculations according to the AHP formula or formula) technique simultaneously (Frieyadi, 2017). The preparation of the AHP consists of three basic steps (Fauziyah, et.al. 2020):

1. Designing a hierarchy to solve complex and multi-criteria problems into a hierarchy.
2. Prioritizing the procedure, after the problem is solved into a hierarchical structure, the priority procedure is chosen to obtain the relative significance of each element at each level.
3. Calculating the results after forming the preference matrix, the mathematical process begins to normalize and look for the priority weights on each matrix.

## **2.5. Objective Matrix and Traffic Light System**

OMAX is a partial productivity measurement method to monitor the productivity of each part by weighting to obtain a total productivity index (Ramayanti et.al, 2020). This measurement model has the characteristic of combining the productivity criteria of the working group in a matrix. The results of this measurement become an objective performance assessment in each section and a solution can be found for the cause of the decline in productivity. The OMAX method is evaluate existing performance by referring to predetermined indicators to improve the performance process for the better. In other hands, Traffic Light System is a tool to identify the good or bad achievement of each productivity indicator in a certain period by using color symbols (Sirait, 2020). With the traffic light system, indicators with the best and worst achievements can be determined. OMAX integration with traffic light system to make it easier to identify achievement of productivity indicators.

## **3. Methods**

Theory and Hypothesis

Relationship between factors - SCOR as a reference for supply chain processes

The SCOR method is a model that serves as a reference for supply chain operations. This method can map the parts and processes of the supply chain. SCOR data processing stages are as follows (Maulidiya, 2014):

1. Identify the company's supply chain

Observations of the company's supply chain were carried out during the internship practice, then continued with developing a supply chain framework for the company using the SCOR method.

2. Making KPI metrics based on the SCOR Model core process and determining weights using AHP.

The SCOR process is divided into three levels starting from the general level to the detail level so that the KPI serves as an indicator that can evaluate the success and performance of the company's supply chain. The perspective used in this study is plan, source, make, deliver, and return. Each perspective is then divided into three work attributes, namely reliability, responsiveness, and agility. All KPIs were described from the work attributes and a questionnaire was conducted to determine the weight of the importance of each attribute using AHP. KPI validation is then carried out to confirm whether the KPI properly represents the company's supply chain performance. This validation is carried out through discussions and brainstorming with the company.

3. Assessment of the weight of the KPI using the OMAX method

KPIs that have been validated are then assessed using a questionnaire. Questionnaires were distributed to parties involved in the company's supply chain. OMAX is a performance measurement method that evaluates several productivity criteria based on weights to get the company's overall productivity index. The results of the assessment are then processed using the OMAX method to identify whether the company's achievements have reached the target of each KPI.

4. Total index calculation using Traffic Light System

The results of the OMAX calculation are then parsed using the Traffic Light System method. This method acts as an indicator of whether a company's KPI needs to be improved or not. The total index value in the red category indicates that the company's performance points are still below the target, so it is recommended to immediately improve.

#### 4. Data Collection

Data collection methods were carried out using questionnaires and brainstorming with five manager-level employees (1 manager of the purchasing department, 1 manager of the property management department, and 3 managers of the project/engineering department) who were fully involved in the supply chain activities. The data that has been collected used as a reference in data processing.

After the company's supply chain flow is identified, the next step is to identify KPI metrics based on the 5 core processes (plan, source, make, deliver, and return) of the SCOR model. This identification process is carried out by brainstorming and interviews with the company and finally revealed 21 valid KPIs, namely 4 KPIs from a plan perspective, 4 KPIs from a source perspective, 4 KPIs from a make perspective, 5 KPIs from a deliver perspective, and 4 KPIs from a return perspective (Table 1 and Figure 1)

Table 1. Identification of Supply Chain Management Performance Measurement Matrix

| Core Process Weight   | Work Attribute Weight  | KPI Description                                      | Code                                      |
|-----------------------|--|--|---|
|                       | <i>Reliability</i>   | On-site material requirements planning               | A11                                       |
| <i>Plan</i>           |  | Time takes for the material to arrive at the site    | A21                                       |
|                       |  | Raw material procurement process planning            | A22                                       |
| <i>Source</i>         | <i>Responsiveness</i>  | Building planning on the project                     | A23                                       |
|                       |  | Fulfillment of perfect raw materials without defects | B11                                       |
|                       | <i>Reliability</i>   | Supplier reliability in delivering materials         | B12                                       |
|                       |  | Raw material fulfillment cycle                       | B21                                       |
| <i>Make</i>           | <i>Responsiveness</i>  | Handling or returning of defective materials         | B31                                       |
|                       |  | <i>Agility</i>                                       | Handling of defective work on site        |
|                       | <i>Reliability</i>   | Production completion according to schedule          | C12                                       |
| <i>Deliver</i>        | <i>Agility</i>   | Number of defective products/room units              | C21                                       |
|                       |  | Employee performance                                 | C22                                       |
|                       | <i>Reliability</i>   | Product quality of the unit provided                 | D11                                       |
|                       |  | Product handover on time                             | D21                                       |
|                       | <i>Return</i>  | <i>Responsiveness</i>                                | Job flexibility against falling demand    |
| <i>Agility</i>        |  |  | Job flexibility against increasing demand |
| <i>Reliability</i>    |  | Job flexibility to problems encountered on site      | D33                                       |
|                       |  | Number of complaints from buyers                     | E11                                       |
| <i>Responsiveness</i> | Percentage of use of defective products with the right quantity and type | E21  |   |
|                       | Handling complaints submitted by consumers                               | E22  |   |
|                       | Waiting time for handling defective products                             | E23  |   |

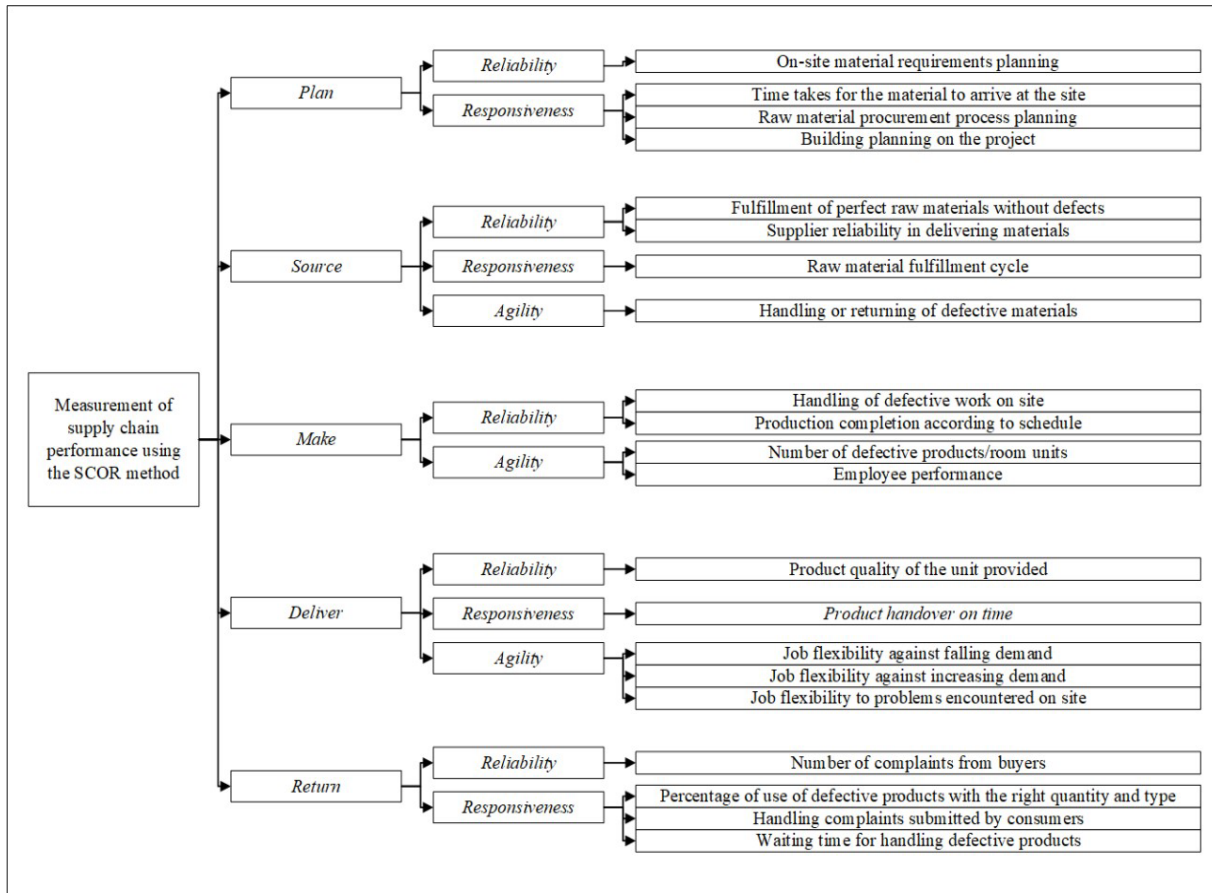


Figure 1. Hierarchy Structure of Supply chain’s KPI assessment

## 5. Results and Discussion

### 5.1 Numerical Results

Pairwise comparison calculations were then performed using the AHP method. The use of this method is processed using Expert Choice software. Previously, researchers had distributed questionnaires to expert’s respondent in their fields whom carrying out the work process, in this case the five managers in the company, in which the questionnaire contains pairwise comparisons of each core process, work attributes, and KPIs formed. Pairwise comparisons used to determine the importance of the elements being compared for each core process, work attributes and KPIs. The following is a hierarchy of KPI in the supply chain performance measurement system sourced from the questionnaire in Figure 2. Calculation of the KPI partial weight needs to be done to obtain the KPI weight for each work attribute criteria. The following are formulas and examples of calculations to obtain the partial weight of KPI A21:

$$\text{Partial weight} = \frac{\text{KPI weight}}{\text{Total weight KPI per Work Attribute}} \dots\dots\dots(1)$$

$$\text{Partial weight} = \frac{0.405}{0.405 + 0.239 + 0.140} = 0,517$$

After all the weighting between perspectives, work attributes and KPI has been carried out, then calculations are carried out to obtain the total weighting value of the KPI. The following is an example of weighting calculation for KPI A21:

$$\text{Total Weight KPI A21} = \text{“Plan” weight} \times \text{“Responsiveness” weight} \times \text{KPI A21 partial weight} \dots\dots\dots(2)$$

$$\text{Total Weight KPI A21} = 0.254 \times 0.727 \times 0.517 = 0.0954$$

After weighting each criterion, a scoring survey is then conducted on each KPI using a Google Form questionnaire. The assessments were collected using a Likert scale of 1-10 which was submitted to expert’s respondent. The weight value of all KPIs for measuring supply chain performance shown on table 2. After

calculations, the results of **questionnaire scores** are shown in the **table 2 column 4**

Table 2. Recapitulation of Partial Weights and Total Weights KPI

| Core Process | Attribute Weight | KPI Code       | Quest. Score | KPI Weight | PI Partial Weight | KPI Total Weight |             |        |        |
|--------------|------------------|----------------|--------------|------------|-------------------|------------------|-------------|--------|--------|
| Plan         | 0.254            | Reliability    | 0.273        | A11        | 7.20 7.40         | 0.216 0.216      | 1           | 0.0693 | 6.93%  |
| Source       | 0.129            | Responsiveness | 0.727        | A21        | 7.60 8.00         | 0.405 0.784      | 0.517 0.305 | 0.0954 | 9.54%  |
| Make         | 0.164            | Reliability    | 0.392        | A22        | 8.20 8.40         | 0.239 0.690      | 0.179 0.674 | 0.0563 | 5.63%  |
| Deliver      | 0.257            | Responsiveness | 0.419        | A23 B11    | 8.40 8.20         | 0.140 0.150      | 0.326 1     | 0.0330 | 3.30%  |
| Return       | 0.196            | Agility        | 0.189        | B12        | 7.80 8.00         | 0.465 0.161      | 1           | 0.0341 | 3.41%  |
|              |                  | Reliability    | 0.368        | B21        | 8.60 7.80         | 0.225 0.621      | 0.348 0.652 | 0.0165 | 1.65%  |
|              |                  | Agility        | 0.632        | B31        | 8.00 8.40         | 0.150 0.379      | 0.631       | 0.0541 | 5.41%  |
|              |                  | Reliability    | 0.503        | C11        | 8.00 8.00         | 0.161 0.299      | 0.369       | 0.0244 | 2.44%  |
|              |                  | Responsiveness | 0.271        | C12        | 8.20 8.80         | 0.216 0.354      | 1           | 0.0210 | 2.10%  |
|              |                  | Agility        | 0.226        | C21        | 8.20              | 0.405 0.348      | 1           | 0.0394 | 3.94%  |
|              |                  | Reliability    | 0.368        | C22        | 8.40              | 0.239 0.458      | 0.330 0.325 | 0.0654 | 6.54%  |
|              |                  | Responsiveness | 0.632        | D11        | 8.40              | 0.140 0.541      | 0.345 1     | 0.0383 | 3.83%  |
|              |                  |                |              | D21        |                   | 0.299            | 0.323       | 0.1293 | 12.93% |
|              |                  |                |              | D31        |                   | 0.354            | 0.253 0.423 | 0.0696 | 6.96%  |
|              |                  |                |              | D32        |                   | 0.115            | Total       | 0.0192 | 1.92%  |
|              |                  |                |              | D33        |                   | 0.113            |             | 0.0189 | 1.89%  |
|              |                  |                |              | E11        |                   | 0.120            |             | 0.0200 | 2.00%  |
|              |                  |                |              | E21        |                   | 0.458            |             | 0.0721 | 7.21%  |
|              |                  |                |              | E22        |                   | 0.175            |             | 0.0401 | 4.01%  |
|              |                  |                |              | E23        |                   | 0.137            |             | 0.0314 | 3.14%  |
|              |                  |                |              |            |                   | 0.229            |             | 0.0524 | 5.24%  |
|              |                  |                |              |            |                   |                  | 1           |        |        |

The research was continued by measuring the company's performance using the OMAX method. The performance value in the OMAX table is an indicator of the productivity of each KPI. The performance value is obtained by multiplying the weight value of a KPI with the actual value of the questionnaire results (using a Likert scale between 1 to 10). The performance value is obtained from the result of multiplying the actual value with the KPI weight value

## 5.2 Graphical Result – Traffic Light System

The results of the performance value assessment on the KPI plan shown in **Figure 2, 3, 4, 5, and 6**, where shown “traffic light system” for each "core process" namely Plan, source, make, delivery, and return. The first column (far left), the "attribute weight" row is colored symbol as red (bad), yellow (need attention) and green (good)

The total KPI performance values for the plan core process are:

$$= (7.200 \times 0.273) + (7.568 \times 0.727)$$

$$= 1.966 + 5.502$$

$$= 7.468$$

The total KPI performance values for the source core process are:

$$= (8.265 \times 0.392) + (8.40 \times 0.419) + (8.20 \times 0.189)$$

$$= 3.240 + 3.520 + 1.550$$

$$= 8.309$$

| <b>Plan</b>       |             |   |       |   |                |   |       |   |      |
|-------------------|-------------|---|-------|---|----------------|---|-------|---|------|
| No. KPI           | Reliability |   |       |   | Responsiveness |   |       |   |      |
|                   | A11         |   | A21   |   | A22            |   | A23   |   |      |
| Attribute Weight  | 0.273       |   |       |   | 0.727          |   |       |   |      |
| 10                | 10          | - | 10    | - | 10             | - | 10    | - | 100% |
| 9                 | 9           | - | 9     | - | 9              | - | 9     | - | 95%  |
| 8                 | 8           | - | 8     | - | 8              | - | 8     | - | 90%  |
| 7                 | 7           | - | 7     | - | 7              | - | 7     | - | 80%  |
| 6                 | 6           | - | 6     | - | 6              | - | 6     | - | 75%  |
| 5                 | 5           | - | 5     | - | 5              | - | 5     | - | 70%  |
| 4                 | 4           | - | 4     | - | 4              | - | 4     | - | 65%  |
| 3                 | 3           | - | 3     | - | 3              | - | 3     | - | 60%  |
| 2                 | 2           | - | 2     | - | 2              | - | 2     | - | 55%  |
| 1                 | 1           | - | 1     | - | 1              | - | 1     | - | 50%  |
| 0                 | 0           | - | 0     | - | 0              | - | 0     | - | <50% |
| Actual Score      | 7.20        |   | 7.40  |   | 7.60           |   | 8.00  |   |      |
| Partial Weight    | 1           |   | 0.517 |   | 0.305          |   | 0.179 |   |      |
| Performance Score | 7.200       |   | 3.823 |   | 2.317          |   | 1.429 |   |      |
|                   | 7.200       |   |       |   | 7.568          |   |       |   |      |

Figure 2. Traffic Light System Plan Core process

| <b>Source</b>     |             |      |       |      |                |      |     |         |        |       |
|-------------------|-------------|------|-------|------|----------------|------|-----|---------|--------|-------|
| No. KPI           | Reliability |      |       |      | Responsiveness |      |     | Agility |        |       |
|                   | B11         |      | B12   |      | B21            |      | B31 |         |        |       |
| Attribute Weight  | 0.392       |      |       |      | 0.419          |      |     | 0.189   |        |       |
| 10                | 10          | 100% | 10    | 100% | 10             | 100% | 10  | 100.0%  | 100.0% |       |
| 9                 | 9           | 95%  | 9     | 95%  | 9              | 98%  | 9   | 99.2%   | 99.2%  |       |
| 8                 | 8           | 90%  | 8     | 90%  | 8              | 95%  | 8   | 98.5%   | 98.5%  |       |
| 7                 | 7           | 80%  | 7     | 80%  | 7              | 90%  | 7   | 97.8%   | 97.8%  |       |
| 6                 | 6           | 75%  | 6     | 75%  | 6              | 85%  | 6   | 97.1%   | 97.1%  |       |
| 5                 | 5           | 70%  | 5     | 70%  | 5              | 80%  | 5   | 96.4%   | 96.4%  |       |
| 4                 | 4           | 65%  | 4     | 65%  | 4              | 75%  | 4   | 95.7%   | 95.7%  |       |
| 3                 | 3           | 60%  | 3     | 60%  | 3              | 70%  | 3   | 95.0%   | 95.0%  |       |
| 2                 | 2           | 55%  | 2     | 55%  | 2              | 60%  | 2   | 93.3%   | 93.3%  |       |
| 1                 | 1           | 50%  | 1     | 50%  | 1              | 50%  | 1   | 91.6%   | 91.6%  |       |
| 0                 | 0           | <50% | 0     | <50% | 0              | <50% | 0   | <90%    | <90%   |       |
| Actual Score      | 8.20        |      | 8.40  |      | 8.40           |      |     | 8.20    |        |       |
| Partial Weight    | 0.674       |      | 0.326 |      | 1.000          |      |     | 1.000   |        |       |
| Performance Score | 5.526       |      | 2.739 |      | 8.400          |      |     | 8.200   |        |       |
|                   | 8.265       |      |       |      | 8.400          |      |     |         |        | 8.200 |

Figure 3. Traffic Light System Source Core process

| <b>Make</b>       |             |      |       |       |    |         |    |       |   |
|-------------------|-------------|------|-------|-------|----|---------|----|-------|---|
| No. KPI           | Reliability |      |       |       |    | Agility |    |       |   |
|                   | C11         |      | C12   |       |    | C21     |    | C22   |   |
| Attribute Weight  | 0.368       |      |       |       |    | 0.632   |    |       |   |
| 10                | 10          | >90% | 10    | 100%  | 10 | <5      | 10 | -     | - |
| 9                 | 9           | 90%  | 9     | 97.5% | 9  | 10      | 9  | -     | - |
| 8                 | 8           | 85%  | 8     | 95%   | 8  | 15      | 8  | -     | - |
| 7                 | 7           | 80%  | 7     | 90%   | 7  | 20      | 7  | -     | - |
| 6                 | 6           | 75%  | 6     | 85%   | 6  | 25      | 6  | -     | - |
| 5                 | 5           | 70%  | 5     | 80%   | 5  | 30      | 5  | -     | - |
| 4                 | 4           | 65%  | 4     | 75%   | 4  | 35      | 4  | -     | - |
| 3                 | 3           | 60%  | 3     | 70%   | 3  | 40      | 3  | -     | - |
| 2                 | 2           | 55%  | 2     | 65%   | 2  | 45      | 2  | -     | - |
| 1                 | 1           | 50%  | 1     | 60%   | 1  | 50      | 1  | -     | - |
| 0                 | 0           | <50% | 0     | <60%  | 0  | >50     | 0  | -     | - |
| Actual Score      | 7.80        |      | 8.00  |       |    | 8.60    |    | 7.80  |   |
| Partial Weight    | 0.348       |      | 0.652 |       |    | 0.631   |    | 0.369 |   |
| Performance Score | 2.713       |      | 5.217 |       |    | 5.423   |    | 2.881 |   |
|                   | 7.930       |      |       |       |    | 8.304   |    |       |   |

Figure 4. Traffic Light System Make Core process

The number of KPI performance values for the Make core process are:

$$\begin{aligned}
 &= (7.930 \times 0.368) + (8.304 \times 0.632) \\
 &= 2.918 + 5.248 \\
 &= 8.167
 \end{aligned}$$

The number of KPI performance scores for the Deliver core process are:

$$\begin{aligned}
 &= (8.00 \times 0.503) + (8.40 \times 0.271) + (8.069 \times 0.226) \\
 &= 4.024 + 2.276 + 1.824 \\
 &= 8.124
 \end{aligned}$$

The total value of the Return core process is:

$$\begin{aligned}
 &= (8.800 \times 0.368) + (8.335 \times 0.632) \\
 &= 3.238 + 5.268 \\
 &= 8.506
 \end{aligned}$$

| <b>Deliver</b>    |             |       |       |                |       |   |         |   |       |   |
|-------------------|-------------|-------|-------|----------------|-------|---|---------|---|-------|---|
| No. KPI           | Reliability |       |       | Responsiveness |       |   | Agility |   |       |   |
|                   | D11         |       | D21   |                | D31   |   | D32     |   | D33   |   |
| Attribute Weight  | 0.503       |       |       | 0.271          |       |   | 0.226   |   |       |   |
| 10                | 10          | 100%  | 10    | -              | 10    | - | 10      | - | 10    | - |
| 9                 | 9           | 97.5% | 9     | -              | 9     | - | 9       | - | 9     | - |
| 8                 | 8           | 95%   | 8     | -              | 8     | - | 8       | - | 8     | - |
| 7                 | 7           | 92.5% | 7     | -              | 7     | - | 7       | - | 7     | - |
| 6                 | 6           | 90%   | 6     | -              | 6     | - | 6       | - | 6     | - |
| 5                 | 5           | 87.5% | 5     | -              | 5     | - | 5       | - | 5     | - |
| 4                 | 4           | 85%   | 4     | -              | 4     | - | 4       | - | 4     | - |
| 3                 | 3           | 82.5% | 3     | -              | 3     | - | 3       | - | 3     | - |
| 2                 | 2           | 80%   | 2     | -              | 2     | - | 2       | - | 2     | - |
| 1                 | 1           | 77.5% | 1     | -              | 1     | - | 1       | - | 1     | - |
| 0                 | 0           | <75%  | 0     | -              | 0     | - | 0       | - | 0     | - |
| Actual Score      | 8.00        |       | 8.40  |                | 8.00  |   | 8.00    |   | 8.20  |   |
| Partial Weight    | 1           |       | 1     |                | 0.330 |   | 0.325   |   | 0.345 |   |
| Performance Score | 8.000       |       | 8.400 |                | 2.644 |   | 2.598   |   | 2.828 |   |
|                   | 8.000       |       |       | 8.400          |       |   | 8.069   |   |       |   |



Figure 5. Traffic Light System Deliver Core process

| <b>Return</b>     |                    |     |       |       |    |                       |    |           |  |
|-------------------|--------------------|-----|-------|-------|----|-----------------------|----|-----------|--|
| No. KPI           | <i>Reliability</i> |     |       |       |    | <i>Responsiveness</i> |    |           |  |
|                   | E11                |     | E21   |       |    | E22                   |    | E23       |  |
| Attribute Weight  | 0.368              |     |       |       |    | 0.632                 |    |           |  |
| 10                | 10                 | <5  | 10    | 100%  | 10 | >90%                  | 10 | 1 week    |  |
| 9                 | 9                  | 10  | 9     | 97.5% | 9  | 90%                   | 9  | 1,5 weeks |  |
| 8                 | 8                  | 15  | 8     | 95%   | 8  | 85%                   | 8  | 2 weeks   |  |
| 7                 | 7                  | 20  | 7     | 92.5% | 7  | 80%                   | 7  | 2,5 weeks |  |
| 6                 | 6                  | 25  | 6     | 90%   | 6  | 75%                   | 6  | 3 weeks   |  |
| 5                 | 5                  | 30  | 5     | 87.5% | 5  | 70%                   | 5  | 3,5 weeks |  |
| 4                 | 4                  | 35  | 4     | 85%   | 4  | 65%                   | 4  | 4 weeks   |  |
| 3                 | 3                  | 40  | 3     | 82.5% | 3  | 60%                   | 3  | 4,5 weeks |  |
| 2                 | 2                  | 45  | 2     | 80%   | 2  | 55%                   | 2  | 5 weeks   |  |
| 1                 | 1                  | 50  | 1     | 77.5% | 1  | 50%                   | 1  | 5,5 weeks |  |
| 0                 | 0                  | >50 | 0     | <75%  | 0  | <50%                  | 0  | 6 weeks   |  |
| Actual Score      | 8.80               |     | 8.20  |       |    | 8.40                  |    | 8.40      |  |
| Partial Weight    | 1                  |     | 0.323 |       |    | 0.253                 |    | 0.423     |  |
| Performance Score | 8.800              |     | 2.652 |       |    | 2.127                 |    | 3.556     |  |
|                   | 8.800              |     |       |       |    | 8.335                 |    |           |  |

Figure 6. Traffic Light System Return Core process

Table 3. Recapitulation of Criteria Performance Values and Weights

| No | Core Process | Core Process Performance Score | Weight | Core Process Performance Value |
|----|--------------|--------------------------------|--------|--------------------------------|
| 1  | Plan         | 7.468                          | 0.254  | 1.897                          |
| 2  | Source       | 8.309                          | 0.129  | 1.072                          |
| 3  | Make         | 8.167                          | 0.164  | 1.339                          |
| 4  | Deliver      | 8.124                          | 0.257  | 2.088                          |
| 5  | Return       | 8.506                          | 0.196  | 1.667                          |
|    |              |                                | Total  | 8.06315                        |

After getting all the core process performance values, the next step is to calculate the company's performance value. The company's performance value is the performance value of each core process multiplied by the weight of each core process.

$$= (7.468 \times 0.254) + (8.309 \times 0.129) + (8.167 \times 0.164) + (8.124 \times 0.257) + (8.506 \times 0.196) = 1.897 + 1.072 + 1.339 + 2.088 + 1.667 = 8.063$$

The calculation on the SCOR has obtained a partial performance value for each criterion, obtained in the plan criteria of 1.897, the source criteria obtained a value of 1.072, the make criteria obtained a value of 1.339, the deliver criteria obtained a value of 2.088, and the return criteria obtained the value of 1.667, then the total value of the company's performance is 8.063 which is in the range of  $\leq 8.00$  therefore conclude that the performance is considered good.

### 5.3 Proposed Improvements

The improvement index is obtained by the following calculation:

$$\text{Improvement index} = \frac{\text{performance value} - \text{previous periode performance value}}{\text{previous periode performance value}} \dots\dots\dots(4)$$

If the result of the improvement index value is 100, the company's performance classifies as positive, which means that the company's performance shows an increase in performance compared to the previous period. The design of the performance appraisal system and targets for yellow-level KPIs have been summarized by researchers and approved by the company. The design shown on table 4:

Table 4. Table of Supply Chain Performance Assessment System Design

| Work Attributes       | KPI  | Performance K           |         | Success Indicator   |
|-----------------------|--|-------------------------|---------|---|
|                       |  | PI Weight               | Targets |   |
|                       |  | <b>Plan Perspective</b> |         |   |
| <i>Responsiveness</i> | Time required for material to arrive at site (A21) | 95%                     | 9.54%   | The percentage of on time for materials to arrive at the site is at least 95% in the next period  |
| <i>Reliability</i>    | On-site material requirements planning (A11)       | 90%                     | 6.93%   | The percentage of completion of the minimum material order flow is 90% in the next period   |
| <i>Responsiveness</i> | Raw material procurement process planning (A22)    | 90%                     | 5.63%   |   |
|                       |  | <b>Make Perspective</b> |         |   |
| <i>Agility</i>        | Employee performance (C22)                         | 80%                     | 3.83%   | Employee turnover does not reach 20% of total employees<br>85% of consumers (respondents) stated that they are feasible in handling unit production defects |
| <i>Reliability</i>    | Handling of defective work on site (C11)           | 85%                     | 2.10%   |   |

Performance measurement is an important step to evaluate performance so that if there are KPIs that are experiencing obstacles, then action can be taken immediately. This study only designs KPIs as the basis for performance measurement tools, so it is necessary to develop measuring tools first for the KPIs that have been prepared. KPIs that have been prepared need to be confirmed beforehand whether it is easy or difficult to obtain the data so that if the data can be obtained easily and possible, then the performance measurement tool against the KPIs can be carried out. However, if obtaining data makes it difficult for the company, then the KPI needs to be reviewed.

Table 5. Identification of Yellow Levels in the Supply Chain Process

| Core Process | Work Attributes | KPI  | Level Score | Reason  | Recommendation   |
|--------------|-----------------|--|-------------|---|--|
| Plan         | Reliability     | Time required for material to arrive at site (A21) | 7 7.2       | Lack of preparation from the project team in preparing what is needed in construction | *Form a special team to plan shopping and production needs                 |
| Plan         | Responsiveness  | On-site material requirements planning (A11)       | 7 7.4       | The company does not apply the forecasting method in planning demand to suppliers     | *Setting the right forecasting method according to the demand data pattern |

|      |                |   |   |     |  |  |
|------|----------------|---|---|-----|--|--|
| Plan | Responsiveness | Raw material procurement process planning (A22) | 7 | 7.6 | The difference in the speed of work on the site with the amount of material coming from the supplier | <ul style="list-style-type: none"> <li>*Create a special team to manage the company's inventory and production needs</li> <li>*Provide free time to communicate with suppliers regarding the availability of goods</li> <li>*Setting the right forecasting method according to the demand pattern</li> </ul> |
| Make | Reliability    | Employee performance (C22)                      | 7 | 7.8 | Lack of quality human resources and not implementing SOP (Standard Operational Procedure)            | <ul style="list-style-type: none"> <li>*Improve the quality of both workers and the products produced, establish standard operating procedures (SOPs)</li> <li>*Conducting surveys to consumers (respondents) stating the feasibility of overcoming unit production defects</li> </ul>                       |
| Make | Agility        | Handling of defective work on site (C11)        | 7 | 7.8 | Lack of HR potential development   | <ul style="list-style-type: none"> <li>*Provide training to employees</li> </ul>   |

### 5.4 Validation

The results of the performance assessment using (OMAX) and the traffic light system for the company's supply chain process show that there are 5 KPIs that are classified as yellow level. The results of this overall assessment indicate that for now the company's performance is quite good with no KPIs that are classified as bad or that fall into the red level. However, the company needs to improve the performance of the yellow KPI level so that its position can be raised to the green level.

The result of the OMAX KPI A11 calculation, namely "on-site material requirements planning" is positioned at level 7, due to the lack of preparation from the project team in preparing what materials are needed for apartment construction. This often happens so that the wrong goods are purchased, causing a waste of development expenditure budget. Therefore, the recommendation for improvement that can be applied is to form a special team for planning production material requirements so that the specifications of the goods spent are accurate so that the expenditures made on the project are not repeated.

The results of the OMAX KPI A21 calculation, namely "the time it takes for the material to arrive at the site" is at level 7, first, due to the lack of time provided in making a production schedule, so often orders from users to the purchasing department are carried out with high urgency. Secondly, caused by the absence of application of appropriate forecasting methods in material requirements planning. Recommendations for improvement are to determine the right forecasting method according to the pattern of goods demand data so that the material expenditure schedule is regular.

The results of the OMAX KPI A22 calculation, namely "the planning of the raw material procurement process" is positioned at level 7. The first reason is, the lack of time preparation from the project team in preparing what is needed in development, which causes an imbalance between the speed of work in the field and the amount of material to be sent by the supplier. The second reason is, causes the supply chain process from the supplier to falter due to limited storage space and the speed of material production. The recommendations are, determine a special team to manage field inventories, namely PPIC (Production Planning and Inventory Control) staff, provide free time to communicate with suppliers regarding the availability of goods, and determine the right forecasting method

according to demand patterns so that companies can adjust between inventory held with inventory forecasting results.

The results of the calculation of OMAX KPI C11, namely "handling defective work on site" and KPI C12, namely "employee performance" positioned at level 7 due to lack of quality and potential development of human resources (HR) involved in development projects. HR does not have much knowledge in building construction in accordance with the company's standard operating procedure (SOP) so that repeated production errors often occur. The recommended solution is to improve the quality of workers and products produced by establishing and applying SOP correctly in the field. The addition of new production machines could be applied so that the quality of production is more consistent as well as providing training and awards to workers to increase work motivation. The feasibility survey and handling of defective work on the site can be distributed to consumers so that the company gets valid data to be reviewed for future improvements.

## **6. Conclusion**

The identification of the company's performance level was compiled based on a questionnaire and brainstorming, then by grouping the supply chain activities based on SCOR model approach; the first stage is the identification and weighting of the five core SCOR processes, namely plan, source, make, deliver, and return; the second stage is the identification and measurement of the work attributes of the SCOR dimensions which are divided into three namely reliability, responsiveness, and agility; and the third stage is the design and determination of the weights of 21 KPI which are all supply chain activities on the company.

The results of the calculation of supply chain performance are based on OMAX and Traffic Light System method is 8,063 it is concluded that overall supply chain activities on the company is considered good but there are still KPIs that are still at the yellow level that need corrective action, which is KPI A11, A21, A22, C11, and C22.

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