FMEA Approach to Risk Factors as a Factor in Implementing Green Supply Chain Management
(Study in PT. Gresik Cipta Sejahtera)

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Abstract. A process that gives a negative impact on the environment is the existence of a production process that has the residual product in the form of non-biodegradable waste. Environmental impact studies do not only focus on waste but also its management, one of them is supply chain management in industry. It is important factors including the design of the product itself, selection of suppliers for the purchase of material products, manufacturing processes, how to deliver products to consumers and processing product remains to reduce environmental impact. PT. Gresik Cipta Sejahtera has a commodity of fertilizer products that are well known among the community of farmers and general users. So, this research’s aim is making the factors that cause danger in the company will be changed into factors that can help the creation of Green Supply Chain Management related to warehouse and transportation. The results show that the problems in the company which make problems for the company, can be analyzed Supply Chain Management to realize Green Supply Chain Management, which will bring a better influence for the company. The total problem is 16 already have a solution to be applied to the company in order to realize Green Supply Chain Management in the warehouse area and transportation equipment.

1. Introduction
A process that gives a negative impact on the environment is the existence of a production process that has the residual product in the form of non-biodegradable waste. In the waste, much is wasted in the industrial environment which ultimately causes negative impacts on the environment. In industry, environmental impact studies not only focus on waste but can focus on the supply chain of products that can have negative impacts on the environment [13]. In this case, the impact of the supply chain is that there can be delays in the delivery of the destination locations which causes the quality of the shipping service to be blamed for an improper way of working. Then the cost of shipping costs is different each time, the use of transportation equipment that is not feasible to use because it does not have a maintenance schedule in the end when transportation is damaged spare parts [1].

The most important of supply chain problems besides these factors namely the condition of the storage warehouse that has not been arranged facilities [2]. In this case, the product will be...
piled high and still messy, in the end, there is an error taking the product, product A should be the product that will be used to send orders to city B, but the product is not taken to be sent but instead takes product X. From this description, the product will be exchanged because there is no entry in or out of the warehouse. If the product has an expiration period, it is better if the product is buried long in the warehouse it should be absorbed for shipping, while new products entering the warehouse can be stored first to spend the old product for shipping [10]. According [1] management of the supply chain, important factors include the design of the product itself, selection of suppliers for the purchase of material products, manufacturing processes therein, how to deliver products to consumers, processing remnants of products to reduce the environmental impact.

| Characteristics                    | Conventional SCM | Green SCM               |
|-----------------------------------|-----------------|-------------------------|
| The Purpose and Values            | Economic        | Economics and Ecology   |
| Ecological Optimization           | impact on high ecology | integrated approach and low ecological impact |
| Supplier selection criteria       | Price of short-term relationships | Ecological aspects and prices and long-term relationships |
| Costs and selling                 | Low manufacturing costs and low selling | Low production costs but selling prices can be expensive and can be cheap |
| speed and flexibility             | High            | Medium                  |

Basically, the existence of a Green Supply Chain has a higher cost than a conventional supply chain, but from this it will have a positive impact if the existence of an environmental Green Supply Chain can be saved and the company will have a reputation for environmental care compared to other companies [17].

PT. Gresik Cipta Sejahtera has a commodity of fertilizer products that are well known among the community of farmers and general users. So, in this case, the research will be conducted with the aim of making the factors that cause danger in the company will be changed into factors that can help the creation of Green Supply Chain Management related to warehouse and transportation. In terms of warehousing and transportation that is identifying the factors that cause negative impacts, the negative impacts will be benefited to produce solutions to realize Green Supply Chain Management. Warehouse management system will be needed for the implementation of Green Supply Chain Management, and also the use of transportation, so that the product delivery is immediately handled by consumers in good condition without any product defects assuming the use of fuel, the use of shipping costs that can be minimized but have a positive impact on the environment. Thus, the main components are as follows [21]:

(i) Plan, which is the stage for carrying out a series of supply chains carried out in the planning process to reduce energy consumption, handling, and storage of hazardous materials related to waste.

(ii) Source, which focuses on the selection of raw materials sold by suppliers, as well as packaging methods that do not harm the environment and pass quality control.

(iii) Make, which focuses on the process of making products that always consider environmental aspects without the use of ingredients that make up dangerous products, saving raw materials.
(iv) Deliver, from this component is useful in the process of fulfilling customer requests related to the management of orders, the way of delivery of the distribution associated with the delivery target that is demanded by the company.

(v) Return, namely activities that are in charge of the product return process because there are certain reasons to support the product to be better.

(vi) Enable, which is a process to make it possible to make realization so that there is an implementation for the supply chain process.

Then, in the next step there are performance attributes for evaluating the supply chain as follows [14]:

(i) Reliability aspect, related to reducing the negative impact on the environment in the manufacturing process.

(ii) Aspects of Reaction Ability (Responsiveness), related to the rapid delivery of responses in handling negative impacts on the environment.

(iii) The aspect of Flexibility (Agility), related to the meeting between the company and the customer due to negative impacts on the environment.

(iv) Cost aspect, which is related to the cost of cleaning and energy use.

(v) Aspects of Assets (Assets), related to assets - assets owned by the company so that it can be arranged to reduce internal costs.

In the supply chain, there will be things that can interfere with the realization of the Green Supply Chain, then these things will be examined using the Failure Mode and Effect Analysis approach. In this approach, there are related factors, namely: Severity (S), Occurrence (O), Detection (D), of these factors will be used to search for Risk Priority Number (RPN) in Table 1. With the calculation below [17]:

\[ RPN = S \times O \times D \]  

(1)

After doing the calculations, it will be used as a step to make these factors into factors that can be used for the application of Green Supply Chain Management. Assuming the following:

| RPN       | Condition                                      |
|-----------|------------------------------------------------|
| 95-125    | First priority in process control             |
| 61-94     | Second priority in process control            |
| 27-60     | The third priority in process control         |
| 1-26      | Risk can be accepted based on conditions as long as there is no change in RPN parameters |

2. Methodology

Conducting interviews or conducting direct communication with the company and looking for literature studies as a reference in the form of research journals, sources of books on similar topics. Conduct research observations on warehouse areas and transportation equipment used with the current use of SCM and Green SCM expectations in Table 2 and Table 3, then make findings of problems. Perform data processing using the Failure Mode and Effect Analysis (FMEA) approach to the problem findings in Table 4. Conduct the results of the analysis and rank the Risk Priority Number from the \( S \times O \times D \) product. Change the results of the analysis into factors that support the realization of the Green Supply Chain by providing solutions with a Focus Group Discussion. Conclusions.
Table 3: SCM and SCM Green Hope

| Components | SCM current conditions | Hope Green SCM |
|------------|------------------------|----------------|
| Plan       | Planning production activities | Production scheduling on demand and checking the machine in good condition |
|            | Control the supply of raw materials | Conducting planning and inventory activities and checking raw materials to avoid dangerous materials for humans and the environment |
| Source     | Select raw materials from suppliers | Selecting raw materials from several suppliers to ensure the quality of raw materials |
| Make       | Production control activities | Conducting production control activities by taking into account the use of energy by reducing to adjust to the environment |
|            | Savings in the use of raw materials | Weighing the raw materials to be used, so that the composition is in accordance with company regulations and so as not to cause the disposal of raw materials due to incorrect composition during the production process |
| Delivery   | Shipping to consumers | Sending consumers by understanding the supply chain flow in each destination that will be carried out |
|            | Use transportation without checking conditions | Check transportation equipment starting from engine condition, using environmentally friendly fuels, calculating mileage for the fuel cost planning process |
| Return     | Returns the product because it doesn’t fit the consumer without extracting information from the consumer | Product returns because it is not appropriate for consumers to extract information to consumers to make feedback on the next product |
| Enable     | Do the best service for consumers | Do the best service for consumers and provide criticism and suggestions for service improvement |

3. Results and Discussion
In the research conducted to get the factors of the current conditions in the company and the expectations of Green Supply Chain Management as follows

From the current supply chain management, there will be hope that will be done to do Green Supply Chain Management. After knowing the current supply chain conditions and future expectations, identification of problems found in the warehouse area and transportation equipment, with data analysis as follows: After finding out the problem in the warehouse and transportation area, an analysis of the risks arising in Table 5 from the warehouse and transportation area will be carried out as follows
Table 4: Identification of Problem Findings

| Location   | Problem Findings                                                                 | Code |
|------------|----------------------------------------------------------------------------------|------|
| Warehouse  | The capacity of the warehouse exceeds the capacity                               | A1   |
|            | Dirty warehouse area                                                             | A2   |
|            | There is no maintenance of the warehouse area                                     | A3   |
|            | There is no warehouse maintenance schedule                                        | A4   |
|            | Officers change the subject if asked about the quality of the product that is not in line with consumer expectations | A5   |
|            | Late delivery service                                                             | A6   |
|            | The shipping amount does not match                                                | A7   |
|            | Record of inventory data is not continuous                                        | A8   |
|            | How to pack goods using plastic that smells bad                                  | A9   |
|            | The distribution of goods in warehouses to the destination address is always delayed because warehouse stock cannot be ascertained every month | A10  |
|            | Returned items will be resold without checking their condition                    | A11  |
| Transportation | Do not do maintenance for an ankle truck                                        | B1   |
|            | The fuel used has emissions that endanger the environment                         | B2   |
|            | How to do packaging in a truck without being arranged properly                   | B3   |
|            | The capacity of the unit in the truck is not the same every time because the arrangement of goods is not appropriate | B4   |
|            | Delivering goods without knowing the route, finally the commute location          | B5   |

After knowing the risks arising from the identification of the problem, a Failure Mode and Effect Analysis approach will be carried out to determine the severity of the Supply Chain Management that the company is currently running in the warehouse area and transportation equipment. Then the results of the Failure Mode and Effect Analysis are as follows:

$CD$: Code of discovery of problems, $CR$: Code of risk that occurs.

After knowing the calculation results in Table 6 of the Failure Mode And Effect Analysis approach, Ranking 1 is obtained, namely: Code B4 (Load conditions are not appropriate and if there is a shipment amounting to X will not be fulfilled) in this case will affect the performance of the transportation while carrying out unmet drivers that occur namely the route back and forth the destination location to deliver goods. Notation Table 6 are $CF$: Code finding problem and $CR$: Risk codes that occur. If the condition of goods to distant destinations will be detrimental in terms of costs and emissions of fuel disposal will occur twice disposal, because the capacity that can be accommodated in a single load is 150 units of goods if it is less than that, then there is an orderly arrangement of goods. After these calculations, problem-solving is carried out to achieve Green Supply Chain Management using Focus Group Discussions conducted by researchers and the company [1–21]. From the Focus Group Discussion resulted in the target planning for implementing Green Supply Chain Management as follows:
### Table 5: Risks arising from problems

| Risks that occur                                                                 | Code |
|---------------------------------------------------------------------------------|------|
| The temperature in the warehouse is unstable and makes the workers inside feel uncomfortable | C1   |
| Causing decreased working mood                                                   | C2   |
| The warehouse will be dirty and affect the state of the goods in the store       | C3   |
| The warehouse will look dirty and the equipment and buildings will be damaged without realizing it | C4   |
| The service will affect the purchasing power of consumers forever                | C5   |
| The service will affect the purchasing power of consumers forever                | C6   |
| The service will affect the purchasing power of consumers forever                | C7   |
| Uncertain stock causes purchases from consumers to feel disadvantaged           | C8   |
| It will harm the company if consumers feel dissatisfied and cause people and the environment to experience its effects | C9   |
| The service will affect the purchasing power of consumers forever                | C10  |
| The service will affect the purchasing power of consumers forever                | C11  |
| When an unusual load is carried out from before, it will cause truck problems   | C12  |
| Harms the environment and humans and impacts on society can also be harmed because of the smoke | C13  |
| The loading conditions are not appropriate and if there are shipments totaling X will not be fulfilled | C14  |
| The loading conditions are not appropriate and if there are shipments totaling X will not be fulfilled | C15  |
| Causing increased accommodation costs and driver loss of energy                 | C16  |

### Table 6: Calculation of RPN and Rank

| No | CD  | CR  | S (1-10) | O (1-10) | D (1-10) | RPN  | Rank |
|----|-----|-----|----------|----------|----------|-------|------|
| 1  | A1  | C1  | 3        | 5        | 5        | 75    | 6    |
| 2  | A2  | C2  | 4        | 4        | 5        | 80    | 2    |
| 3  | A3  | C3  | 2        | 3        | 4        | 24    | 14   |
| 4  | A4  | C4  | 4        | 3        | 6        | 72    | 9    |
| 5  | A5  | C5  | 4        | 5        | 3        | 60    | 11   |
| 6  | A6  | C6  | 5        | 4        | 3        | 60    | 11   |
| 7  | A7  | C7  | 5        | 5        | 3        | 75    | 6    |
| 8  | A8  | C8  | 5        | 5        | 3        | 75    | 6    |
| 9  | A9  | C9  | 5        | 4        | 4        | 80    | 2    |
| 10 | A10 | C10 | 2        | 4        | 1        | 8     | 16   |
| 11 | A11 | C11 | 4        | 3        | 2        | 24    | 14   |
| 12 | B1  | C12 | 5        | 4        | 4        | 80    | 2    |
| 13 | B2  | C13 | 5        | 4        | 4        | 80    | 2    |
| 14 | B3  | C14 | 5        | 4        | 3        | 60    | 11   |
| 15 | B4  | C15 | 5        | 3        | 6        | 90    | 1    |
| 16 | B5  | C16 | 3        | 4        | 6        | 72    | 9    |
Table 7: Focus SCM Green Group Discussion

| A | C | Solutions for implementing Green SCM |
|---|---|---------------------------------------|
| 1 | 1 | Determine the capacity of the warehouse so that it does not cause overload in the warehouse |
| 2 | 2 | Making picket schedules so that workers are more in the mood at work and not be bored with the work done |
| 3 | 3 | Making maintenance and repair plans so that the condition of the warehouse building is maintained and the conditions inside and outside the room are clean and well maintained |
| 4 | 4 | Making maintenance and repair plans so that the condition of the warehouse building is maintained and the conditions inside and outside the room are clean and well maintained |
| 5 | 5 | Doing services to create harmony between buyers and sellers and be open to each other in terms of business inquiries to advance the business |
| 6 | 6 | Always make a delivery schedule and post on the information board and do a briefing every time there is delivery |
| 7 | 7 | Check the destination correctly and don’t forget to recap every delivery of the item |
| 8 | 8 | Make a recap of inventory data and there are data reports every month for workers’ accountability for their work |
| 9 | 9 | Packing using materials that are safe and do not cause pollution to the environment |
| 10 | 10 | The cause of delay is because each item enters the warehouse, the available stock is not suitable, it is necessary to carry out a safety inventory for the goods so that if there is an excess ordering it can be overcome and not harming consumers |
| 11 | 11 | Always check the return of goods to be unloaded goods so as not to harm consumers |
| 12 | 12 | Provide maintenance time for truck ankle for the process of shipping goods |
| 13 | 13 | Using fuel that is recommended by the government, in addition to not harming the environment and humans will benefit the conditions of transportation |
| 14 | 14 | Arranging goods every shipment to the destination correctly |
| 15 | 15 | Arranging goods every shipment to the destination correctly |
| 16 | 16 | Through google maps, it can be monitored the route that will be traversed to prevent a U-turn that causes excessive costs if not in an emergency phase |

From the results of Table 7 Focus Group Discussion, as many as 16 problems at an early stage became a problem in companies related to Supply Chain Management, then it was able to be changed using the FMEA approach and analysis using Focus Group Discussion into an application to realize Green Supply Chain Management in the warehouse area and equipment transportation.

4. Conclusions
Problems - problems in companies that the findings make problems for companies, can be analyzed supply chain management to realize green supply chain management, which will bring a better influence for the company. Problem items totaling 16 already have solutions to be applied to companies to realize green supply chain management in warehouse areas and transportation.
equipment. From the results of the solutions raised, it cannot be separated from the role of the company to express ideas that support this research.

Acknowledgments

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