CHAPTER V

DISCUSSION

1.1 Supplier Selection & order allocation

The research of sustainable supplier selection and order allocation have been done by defining the criteria first, which are the environmental, economic, and supply risk. The criteria are determined and obtained from supported literature and Chaharsooghi & Ashrafi (2014) for the categorization of the sustainable supplier selection criteria. This research conducted at PT. Yoska Prima Inti (YPI). In the company, the supplier selection only considers the economic criteria which makes the suppliers are unreliable because company doesn't consider the other factors and lack of the assesment of supplier evaluation. Therefore another criteria should be considered also, which are the environmental and supply risk criteria. By considering those 3 criteria, company can determine the selected supplier and assign the optimum order allocation with considering to minimize total purchasing cost and maximize supplier evaluation of reducing environmental impact. Not only that, but also company has higher chance of overcoming disruption in supply chain and reducing undesirable risk that may occur and make the suppliers more reliable.

1.2 Supplier selection

Supplier selection is done with evaluating suppliers by considering environmental criteria, which cosist of environmental management system (EMS), eco-design, and reduce, reuse, recycle (3R). EMS is from the reference of ISO 14001:2004 which is the most widely used standards in an environmental management system. Those 3 criteria of environment are

adopted from Song et al. (2017) and had been discussed with th expert. The method of supplier selection is using AHP analysis, which determine the weight of criteria and alternatives. The result from AHP analysis is the weight of criteria, which are 0.137, 0.239, and 0.623 respectively. Based on the result of weight criteria 3R is the most important of criteria to be considered, followed by eco-design and EMS. It means that for PT. Yoska Prima Inti concerns more on aspect of reduce, reuse, recycle (3R), than eco-design and EMS.

After obtaining the weights of criteria, then the weight of alternative is determined. The results of the global weight of supplier are supplier 1 with 0.097, supplier 2 with 0.215, supplier 3 with 0.232, and supplier 4 with 0.456. The higher the weight, the better of supplier evaluation will become. Based on the result of weight of alternative, supplier 4 has the highest weight of environment criteria, which makes supplier 4 to be the first priority of selected supplier for supplying the material, then followed by supplier 3, supplier 2 and supplier 1. The overall rank is supplier 4 is the first, second is supplier 3, third is supplier 2, and forth is supplier 1.

1.3 Initial Order Allocation

The initial order allocation is determined by obtaining the optimum order allocation. Determining the initial order allocation considers the environmental and economic criteria. For the environmental criteria, the weights of suppliers are used as the input for determining the optimum initial order allocation. For the economic criteria, costs are used as the parameter, capacity and demand are used as constraints. After that constructing the multi-objective model.

The method used to determine the initial order allocation is Multi Objective Linear programming (MOLP) with using Lingo 17.0 software. There are 2 objective functions, which are minimizing total purchasing cost (Z1) and maximizing supplier evaluation (Z2).

The first one, minimizing total purchasing cost consists of minimizing both purchasing cost and transportation cost with constraint of demand from manufacturer and capacity from

suppliers. The second one, maximizing the supplier evaluation means finding the optimal order allocation with maximizing supplier evaluation of reducing environmental impact.

Since the multi objective linear programming has multiple objectives, it means that the two objective functions may have different priorities. Therefore, the sum-weighted method is used. The weight is subjectively determined by the expert. In this case, the manager of logistic gives the weight to each objective function. The weight of objective function of Z1 is 0.8, while the objective function of Z2 is 0.2. It means, minimizing purchasing cost has higher priority than maximizing supplier evaluation of determining optimum order allocation. The second objective function doesn't give the significant impact to the result because of the weight is much less than the first objective, and the second objective could be eliminated from the calculation.

The result of MOLP with Lingo 17.0 software is the optimal solution of initial order allocation. The first supplier will supply product A1 with 150 items/month, product A2 with 450 items/month, product A3 with 100 items/month, product A4 with 1050 items/month, and product A5 with 1000 items/month. The second supplier will supply product A1 with 150 items/month, product A2 with 0 item/month, product A3 with 100 items/month, product A4 with 1000 items/month, and product A5 with 600 items/month. The third supplier will supply product A1 with 0 item/month, product A2 with 300 items/month, product A3 with 50 items/month, product A4 with 200 items/month, and product A5 with 100 items/month. The fourth supplier will supply product A1 with 150 items/month, product A2 with 400 items/month, product A3 with 0 item/month, product A4 with 1000 items/month, and product A5 with 600 items/month.

The transportation cost for one time delivery equals to one container for one delivery. Based on standard size of container, the volume of plate materials is less than the volume of the container. In another word, the delivery of each month takes only one container. Therefore, the total transportation cost already represents for one time delivery.

The initial order allocation for 3 months makes the total purchasing cost (Z1) of Rp 324,684,600. The result of objective function of Z2 does not represent any quantity, but the weight of supplier satisfies in determining the initial order allocation.

1.4 Revised Order Allocation

After the initial order allocation is determined, the initial order allocation is incorporated with risk rating in determining revised order allocation for mitigating supply risk. Supply risk is related to risk that occur in supply chain. Hence, supply chain is directly affected by the supplier when supply risks are occurred. If there are any disruptions from supplier in supplying the materials to manufacturer, manufacturer needs to focus on mitigating the supply risk before the risk occurs. Therefore, Risk management is used to mitigate supply risk.

The risk management is used to determine the revised order quantity by obtaining risk rating of each supplier then incorporate it with initial order allocation with transferring the product from risky supplier to a less risky supplier. Based on the calculation of order allocation corresponding to total risk rating, it will maximizing the flow of product transfer from risky supplier to a less risky supplier, constraint are considered. The calculation is using Lingo 17.0 software.

The risk is obtained from previous study and performs the brainstorming with the expert for selecting suitable risk that might occur in suppliers. The risks that have been identified are delivery failures, quality problems, price/cost increases, inability to meet quantity demand, discontinuity of supply, bankruptcy of supplier, supplier capacity, machined breakdowns, malfunction of IT system, accident risk, and extreme weather condition.

Based on calculation of risk measurement, the total risk ratings are obtained. From the result, it can be seen which supplier has the high risk supplier and the least risky supplier. The risky supplier is not the priority supplier for supplying the product. The least risky

supplier is the most reliable supplier, which manufacturer is likely to order the product from this supplier. The least risky supplier is supplier 4 with total risk rating of 29, it means supplier 4 is the first priority and the most reliable supplier. Supplier 1 is the highest risky supplier with total risk rating of 45, which followed by supplier 3 with total risk rating of 40. Supplier 2 with total risk rating of 33.

In risk evaluation, according to the risk rating which has been determined, some of the risk ratings are identified as acceptable risks and some are undesirable and need to take action to mitigate it. Hence, the risk mitigation plan is needed to mitigate supply risk. The supply risk need to be mitigated to maintain the supply chain continuity.

In risk mitigation, the revised order allocation plans are identified. The result of revised order allocation of product A1 are supplier 1 will be supply 73 items/month, supplier 2 will be supply 150 items/month, supplier 3 will be supply 77 items/month, and supplier 4 will be supply 150 items/month.

The revised order allocation of product A2 are supplier 1 will be supply 218 items/month, supplier 2 will be supply 338 items/month, supplier 3 will be supply 194 items/month, and supplier 4 will be supply 400 items/month.

The revised order allocation of product A3 are supplier 1 will be supply 48 items/month, supplier 2 will be supply 87 items/month, supplier 3 will be supply 37 items/month, and supplier 4 will be supply 83 items/month.

The revised order allocation of product A4 are supplier 1 will be supply 508 items/month, supplier 2 will be supply 1000 items/month, supplier 3 will be supply 742 items/month, and supplier 4 will be supply 1000 items/month.

The revised order allocation of product A5 are supplier 1 will be supply 500 items/month, supplier 2 will be supply 600 items/month, supplier 3 will be supply 600 items/month, and supplier 4 will be supply 600 items/month.

The revised order allocation is an order allocation plan for manufacturer to also consider the aspect of supply risk. The aim of this research is to determine the revised order allocation in order to decrease the risk level in case of disruption occurs. So the supply risks are mitigated. The revised order allocation doesn't minimize the cost technically, because its concern is assigning the order corresponding to risk rating, but if supply risk occur, company will spend more cost to overcome that problem. Therefore, this order allocation plan is worth to be considered. Kırılmaz & Erol (2017) agrees that the increase of cost when inclusion of risk criterion into the procurement plan is the average of 2.60%. Hendricks & Singhal (2005) mentioned companies that suffering from occurrence of uncertain events experienced 33-40% lower in stock return relative to their industry benchmarks, which means the cost increase of incorporating risk management is considerably low and company can reduce the vulnerability of their supply chain.