Risk mitigation on product distribution and delay delivery: A case study in an Indonesian manufacturing company

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Abstract. In a dynamic supply chain environment, problems that arise due to delays in the delivery of raw materials and distribution of products to consumers can pose risks and threats to the company. This study aims to identify and mitigate the risk of late delivery of goods. Risk management starts with identifying sources of risk, defining risks, creating risk maps and mitigating risks. A case study conducted at a manufacturing packaging company in Batam, Indonesia. The results showed that the biggest risks were supplier production capacity, supplier product quality, forecasting from consumers, daily finished good delivery schedule to consumers and loading and unloading processes at consumers. This research proposes mitigation to minimize the impact of short-term and long-term risks.

1. Introduction

Currently, the dynamics of competition efforts bring an impact on efforts that continuous so that goods can get to consumers at the right time and place. Many industrial companies are working to optimize the supply chain system to produce products and on-time delivery. The company seeks to work harder in order to delay in transport does not occur [1]. Respond to the level of production and the ever-changing technological innovation demands a conventional manufacturing company transformed into a more modern production system [2]. If the product does not arrive at the time of delivery in accordance with the agreed (delay delivery) by both sides then consumers will pick up the pace by giving sanction or fine [3]. Delivery time refers to the time customers wait between placing an order and receiving the order. As a consequence, the concept of the delivery time can be said to relate to the performance as perceived by customers [4, 5, 6, 7, 8].

Risk management can provide input or contribution is important for most types of management decisions and control, which is widely applied in various fields. Like the economy, insurance and manufacturing [9, 10, 11, 12]. The risk management process generally consists of 4 steps [13, 14]. That is as follows:

1) The first step is to identify the risks, to help improve the understanding of the current state against uncertainty in the future (the risk that may occur) to be able to receive an effective rule.
2) The second step is to evaluate the risk of identification with the possibility to associate events and identify the consequences.
3) The third step is to apply this action management risk, such as actions that are reactive (responding to risk identification who had previously occurred) or proactive (to reduce the likelihood of occurrence or the severity of the consequences and risk mitigation).
4) The fourth step is monitoring (monitoring) of risk on an ongoing basis in order to reduce the possibility of a major again.
This research takes a case study in one of the manufacturing companies in Indonesia, called PT X. PT X engaged in the manufacture of cardboard packaging (packaging boxes) distributing its products in the area of Batam and Singapore. The distribution of the products is carried out on a daily basis based on consumer demand with the distance and the amount varies. Raw materials import process is carried out by the State of Singapore, Taiwan, Thailand, and the United States. Often the onset delay or a very late arrival hamper company production and delivery to the customer, graphics delivery delays can be seen in Figures 1 and 2. The delay caused by a late booking from the purchasing, production capacity of suppliers, transportation, delivery of materials, production process, trucking and other. This has resulted in the delivery of the product to the consumer becomes delays and raises fines or sanctions from the consumer. For it on-time delivery of badly needed in order for the company's operations are not disrupted and the lead time of the consumers can be reached, therefore companies need to conduct analysis for risk management from the perspective of a company in dealing with things that are not in want in distribution or delivery of goods heading to the consumer.

Figure 1. Finished Goods Delay Delivery Chart

Figure 2. Delivery Case Chart Table

2. Literature Review
2.1. Risk management.

The risk is the likelihood of an event occurring and the impact on the success in achieving the strategic objectives of the organization [15]. The risk is the part that is inseparable from the decision-making process of the individual or organization in many situations. The risks cannot be eliminated. Organizations have to manage the factors that influenced the increase or decline the risk so that the organization can pursue strategic superiority with minimum fees [16]. Taking the risk seems to be the strategy that is available to resolve the risk [17]. Risk management in an organization contains the most important internal processes and strengthens resilience during period’s prevention and which could not have been avoided in ensuring the security of the process [18].

Risk management is about identifying the things that are wrong, stop wrong, reduce the consequences when there are errors and recover after a few things wrong. This is important because there is always the possibility of error, which is why a Manager spends a lot of time to prevent things that are incompatible with minimize the possibility of failure and its effects [19]. Awareness about risk management in the supply chain to improve in those industries in Europe [20]. There are 4 categories of risk on corporate finance namely, hazard, operational and strategic risks. Risks of Finance comes from the strength of the market, assets or financial obligations. They occur in various forms, such as risk capital, investment risk, interest rate risk, credit risk, currency risk and market risk capital [21]. The risk of danger is called "pure risk" and its impact is always negative. They arise from natural or deliberate accidents caused by third parties. The consequences of these risks, for example, damage to property, personnel illnesses and disabilities [22, 23]. Operational risk arises from the failure that resulted from both the potential for human error and processes that can occur in the functional business units (e.g. related to product development, human resources and it) or in the management of
Risk identification can be done by doing 1) identification of sources of risk, 2) Define the risks and consequences of encouraging risk identification) 3 4) to mitigate risk [25, 26].

There is a lot of research about managing risk. [27] Conducts research on risk management in the supply chain of fresh produce in Thailand. From the results of the research, there are nine known categories of risk in the supply chain of fresh produce that is weather risk, risk of demand, Finance risk, risk information, risk operational, risk policies, risk, price risk, and regulation.

2.2. Delay Delivery
Delivery is expected by customers is timely delivery (OTD) and delivery without damage. The delivery is delayed or late have a negative impact on the satisfaction of [28]. Delivery delays harm the next customer, a customer would not consider buying again because the company did not submit a time for the products ordered. Delivery delays lead to negative results and a lack of customer satisfaction [29].

2.3. Risk Mitigation
Mitigation is the action to reduce or minimize the potential negative impact of a disaster [30]. Risk is defined on the basis of the two points of view [31], namely: 1) point of view the results (output) where results cannot be predicted with certainty because it would be counter-productive. 2) point of view the process whereby the factor-factors that may affect the achievement of the goals, so unintended consequences. Mitigation in an enterprise is required to determine whether the company's risk in it can be fixed with good and right so that it does not risk impeding the activities of the company [32]. The base model introduced serves as the base for determining the magnitude of costs and risks. So as to provide the first phase of strategic decisions and could build a model to evaluate the risk mitigation options of the supply chain [33]. According to [34] to propose the theoretical decision framework that includes relevant elements derived from the literature on supply chain risk management, by providing quantitative decision support systems of the general framework the decision to select the risk mitigation strategy for the supply chain.

The research of [35] risk mitigation is done to minimize the impact of the environmental risks posed by the use of the game theory approach. [36] Conduct mitigation against supply chain risk and uncertainty. The results of this research to identify the type of supply chain flexibility appropriate to mitigate the risk of the three major risks of supply, the risk of the manufacturing process and the risk of shipment.

3. Methodology
Stages of research methods are as follows:

3.1. Identification of the source of the risk.
   a. The identification process business
      Process business is material flow from supplier to the finished product into the hands of customers.
   b. Identification of the risk
      Do the identification over the incident or potential incident in the case will affect the achievement of the objectives of the company or would potentially harm the company.

3.2. Defining the risk.
   a. Identification of the point the number of cases of risk, using a table of researchers taking points or risk which is often the case and grouped based on areas.
   b. Risk Measurement.
      Measurement (measurement) is performed to find out the level of risk by using the probability of the occurrence of the risk requirements.

3.3. Risk Maps
   Are used to show the position of risk and determine priorities risk response. In the making of maps can be made with 2 models i.e.: inherent risk map and map of the residual risk.
3.4. Risk mitigation
Follow-up development to respond to the risk, this is a detailed and documented explanation of the strategic treatment of risk will be applied.

4. Discussion
4.1. Identification of the source of the risk
4.1.1. Identification Process business
Process business in PT. X showed in Figure 3. in the following.

![Figure 3. PT. X Business Process](image)

4.1.2. Identification of Risk.
Identification risk for delay in distributing products either from the supplier or consumer to do with the analysis of fishbone diagrams [37], fishbone diagrams identification risk can be seen in Figure 4. Cases and the frequency with which led to delivery delays from suppliers and to consumers can be seen in Table 1 and 2.

![Figure 4. Risk Indicator (Fishbone Analysis)](image)

| No | Risk event                                      |
|----|------------------------------------------------|
| Supplier |                                                |
| 1  | PO from purchasing                               |
| 2  | Communication problem                            |
| 3  | Supplier production capacity                     |
| 4  | Product quality from suppliers                   |
| 5  | Shipping Documents                               |
| 6  | Unloading and loading goods by the forwarder     |
| 7  | Weather                                          |
| 8  | Truck Settings                                   |
| Customer |                                               |
| 9  | Forecast from consumers                          |
| 10 | Daily FG delivery schedule to consumers          |
| 11 | Planning in production                           |
| No | Risk event                                      |
|----|------------------------------------------------|
| 12 | Ordering raw materials                         |
| 13 | Quality checking of material                   |
| 14 | Company production capacity                     |
| 15 | Transfer of finished goods to the warehouse     |
| 16 | Lorry preparation for shipping to consumers     |
| 17 | The process of loading and unloading on consumers|
| 18 | Lorry queues at consumers                       |
| 19 | The process of receiving goods documents        |

**Table 2. Number of Delay**

| Month     | Where Delays occur |
|-----------|--------------------|
|           | Suppliers |  Consumer |
| Jan 19    | 8         | 9         |
| Feb 19    | -         | 3         |
| March 19  | 10        | 26        |
| April 19  | 10        | 30        |
| May 19    | 21        | 24        |
| Jun 19    | 15        | 10        |
| Total     | 64        | 102       |

The identification of points of the number of cases the risk of eliminating the risk derived from the risk of repeat cases every month can be seen in table 3 and the identification of risk impact can be seen in table 4, so it will be easier to determine the measurement.

**Table 3. Risk Identification**

| No | Risk Indicator                                      | Code | Case |
|----|-----------------------------------------------------|------|------|
| Supplier                               |                                                |      |      |
| 1 | PO from purchasing                                  | L1   | 6    |
| 2 | Supplier production capacity                         | L2   | 30   |
| 3 | Quality products from suppliers                      | L3   | 20   |
| 4 | Truck Settings                                      | L4   | 8    |
| Customer                               |                                                |      |      |
| 5 | Forecast from consumers                              | L5   | 15   |
| 6 | Daily FG delivery schedule to consumers              | L6   | 30   |
| 7 | Planning in production                               | L7   | 5    |
| 8 | Ordering raw materials                               | L8   | 7    |
| 9 | Transfer of finished goods to the warehouse          | L9   | 15   |
| 10| The process of loading and unloading on consumers     | L10  | 20   |
| 11| Lorry queues at consumers                            | L11  | 10   |
### Table 4. Risk Impact Identification

| No | Impact Indicator                                      | Value           |
|----|-------------------------------------------------------|-----------------|
| 1  | Consumers stop producing                             | 30 USD / Hrs    |
| 2  | Increased production costs                            | 23 USD / Hrs    |
| 3  | High maintenance costs for Production Machines        | 500 USD / Month  |
| 4  | The number of products damaged in the production area | 300 USD / Month  |
| 5  | Consumer Confidence                                   | -               |

### 4.2. Defining Risk

#### 4.2.1. Risk Point Identification

In measuring risk, the probability scale and risk impact scale data are needed, presented in tables 5 and 6.

#### Table 5. Risk Probability Scale

| Scale   | Criteria                  | Range  | Explanation                        |
|---------|---------------------------|--------|-----------------------------------|
| (1)     | Almost never happens      | <20%   | Max occurs 1 in 6 months          |
| (2)     | Can (might happen)        | 20–50% | Max occurs 5 times in 6 months    |
| (3)     | Rarely happening          | 50-70% | Max occurs 10 times in 6 months   |
| (4)     | Often occur               | 70-90% | Max occurs 15 times in 6 months   |
| (5)     | Very often happens        | 90-100%| Occurred more than 20 times in 6 months |

#### Table 6. Risk Impact Scale

| Scale   | Impact     | Indicator                                                                 |
|---------|------------|---------------------------------------------------------------------------|
| (1)     | Small      | Easy to complete, does not cause late, does not affect the overall distribution process |
| (2)     | Very small | Does not cause delays when arriving at the customer                         |
| (3)     | Is         | Cause delay to the customer                                               |
| (4)     | Big        | Causing delays, there are many complaints to the company                   |
| (5)     | Very large | The source of the problem is very difficult to identify, causing delays, many complaints to the company, termination of employment |

Source: Wiryani, et al., 2013

#### 4.2.2. Risk Measurement

Risk Measurement Step for next was done by calculating each risk by multiplying the probability scale and the scale of the resulting impact. Risk measurement results can be seen in table 7.
Table 7. Measurement of Risk Points

| No | Risk Indicator                                  | Scale  | Score |
|----|-----------------------------------------------|--------|-------|
|    |                                              | Impact | Probability |
| Supplier |                                              |        |         |
| 1   | PO from purchasing                            | 1      | 3      | 3    |
| 2   | Supplier production capacity                   | 4      | 5      | 20   |
| 3   | Quality products from suppliers               | 4      | 5      | 20   |
| 4   | Truck Settings                                | 3      | 2      | 6    |
| Customer |                                              |        |         |
| 5   | Forecast from consumers                       | 4      | 4      | 16   |
| 6   | Daily FG shipping schedule to consumers       | 4      | 5      | 20   |
| 7   | Planning in production                         | 3      | 2      | 6    |
| 8   | Ordering raw materials                         | 2      | 2      | 4    |
| 9   | Transfer of finished goods to the warehouse   | 2      | 4      | 8    |
| 10  | The process of loading and unloading on consumers | 4      | 4      | 16   |
| 11  | Lorry queues at consumers                     | 3      | 3      | 9    |

4.3. Risk Map
Risk maps are made based on the scale of impact and probability of each risk indicator. Green areas indicate a low-risk level, yellow indicates a moderate risk level, and red indicates a high-risk level. The risk map can be seen in Figure 5.

![Figure 5. Current Risk Map](image)

4.4. Risk Mitigation.
After the measurement and mapping, obtained the greatest impact from the risk of delay in distributing the products get to the consumers on a scaled score of 20 and 16. Risk indicators that are at the highest score become a priority for the company. High-risk indicators grouped into 8 tables and do a repair using the guidelines of risk control, then mapped back to an estimated decline of shifting the impact.
and probability of the risk. Expected improvement occurs so that the risk can be decreased from high risk to medium risk and continue to do repairs in order to continue to decline to low risk.

**Table 8. Risk Mitigation Control Guidelines**

| No | Risk Indicator                             | Risk Level | Risk Management Guidelines                                      | 4T strategy |
|----|--------------------------------------------|------------|-----------------------------------------------------------------|-------------|
| 1  | Supplier production capacity                | High       | Transparency                                                    | Treat       |
|    |                                            |            | Request planning collaboration                                   | Treat       |
| 2  | Quality products from suppliers             | High       | Making quality standards                                        | Treat       |
|    |                                            |            | Planning a business process together                            | Treat       |
| 3  | Forecasting from consumers                  | High       | Integrating system information                                  | Treat       |
| 4  | Daily FG shipping schedule to consumers     | High       | Perform data sharing for daily shipping schedules               | Treat       |
| 5  | The process of loading and unloading on consumers | High   | Delivery time sharing so that no stuck vehicle in the consumer | Treat       |

Risk mitigation strategies against the five indicators of risk that has a high level of risk are shown in table 8. The fifth indicator of risk mitigation can be done by doing some treatment. In particular, treatment is done in table 8 spelled out the company. Treatment was done in an effort to 1) information sharing both data or process lead time in finishing products; 2) conduct discussions with the buyer to discuss the problem of forecasting and daily delivery schedules, as well as the duration of the time unloading goods at the consumer's location; 3) Collaboration plan request (collaboration demand planning); 4) Monitoring the production process, specifically in the supplier due to a lot of the occurrence of defects during a process lasting; 5) Perform regular inspections for production machines and recorded for monitoring; 6) Customer service and planner team to be more active in following up on the production process and production lead time. On the research of supply chain risk and Uncertainty: a moderation role supply chain flexibility in risk mitigation risk three stated that the major risk of supply, the risk of manufacturing and delivery risk [38].

**Table 9. Risk Scale after Mitigation**

| No | Risk Indicator                               | Scale | Score |
|----|---------------------------------------------|-------|-------|
|    |                                             | Impact| Probability |
| Supplier |                                             |       |               |
| 1  | PO from purchasing                          | 1     | 3     | 3             |
| 2  | Supplier production capacity                | 3     | 4     | 12            |
| 3  | Quality products from suppliers             | 3     | 4     | 12            |
| 4  | Truck Settings                              | 3     | 2     | 6             |
| Customer |                                             |       |               |
| 5  | Forecast from consumers                     | 3     | 3     | 9             |
| 6  | Daily FG shipping schedule to consumers     | 3     | 4     | 12            |
| 7  | Planning in production                      | 3     | 2     | 6             |
| 8  | Ordering raw materials                      | 2     | 2     | 4             |
| 9  | Transfer of finished goods to the warehouse| 2     | 4     | 8             |
| 10 | The process of loading and unloading on consumers | 3     | 3     | 9             |
| 11 | Lorry queues at consumers                   | 3     | 3     | 9             |
After mitigation is carried out, the impact and probability of risk decreases, shown in table 9.

The risk mitigation map shows the five risk indicators that were originally in the red quadrant move to the yellow quadrant. The risk map for mitigation results can be seen in Figure 6.

5. Conclusion
Some conclusions that can be drawn from this study are as follows:
1. The risk that has the greatest impact and has an effect on delivery delay comes from supplier production capacity, product quality, daily delivery schedules from consumers, forecasts and loading and unloading processes at consumers.
2. Risk mitigation is done by improving the system to suppliers and consumers by sharing information using an integrated system so that lead-time can be more accurate, as well as collaborating on demand plans between suppliers and manufacturing companies. This is done continuously and monitored, whether there are changes and developments that occur in the future.

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