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Supply Chain Risk Management Model: Case Study of the Precast Concrete Company PT. Adi Jaya Beton Denpasar

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ABSTRACT: Risk management is the process of measuring or assessing risk and developing management strategies. Risk analysis in the supply chain is an important issue, because companies are often not aware of risks until these risks arise and become a problem for the company. This research aims to analyze supply chain risks in the precast concrete industry. The data used is qualitative and quantitative data with primary data sources and secondary data. The data collection techniques used were observation, interviews, questionnaires, literature study and documentation study. The data analysis technique used is risk analysis with a probability and impact matrix. The research results show that 1) There are 20 identified supply chain risks in the precast concrete industry with a made to order system. 2) Supply chain risks in the precast concrete industry are categorized into four levels, namely a minor level of four risks, a moderate level of 12 risks, a major level of three risks, and a critical level of one risk. 3) Supply chain risk handling in the precast concrete industry can be carried out based on the level of risk, namely by accepting risk, mitigating risk, sharing risk, and avoiding risk.

KEYWORDS: Risk Management, Supply Chain, Precast Concrete, PT. Adi Jaya Beton

1. INTRODUCTION

In the era of globalization, where the flow of products and/or services from many organizations has an international reach, it is important to be able to manage risk [16], and have a risk mitigation plan [5] to a greater or lesser degree of potential risk by any company [12]. Identifying and analyzing supply chain risks is very important to prevent disasters [11]. Recent studies analyze the impact of supply risk to be able to make optimal purchasing decisions for a company [17] and the importance of properly identifying sources of supply chain risk [4].

Risk management in the supply chain is the process of identifying, analyzing and managing risks in a supply chain network. In a supply chain network, there are five types of flows that must be managed well. Material flow or physical flow, is a flow or network in which there is actual movement of material flows both within companies and between companies, in the form of transportation, service mobilization, delivery movements, storage and inventory. Financial flow, is a flow or network that contains the movement of money flows between organizations, the use of investment for the entire chain (network), as well as the accounts payable and receivable processing system. Information flow is a flow or network in which there is a process of data movement, data capture and use, thereby enabling a structured information exchange process. Relational flow is a network of appropriate relationships between suppliers, organizations and customers of organizations in producing maximum benefits, including the internal supply network of the entire organization. Innovation Flow is a network of updates that occurs between the parties involved in the supply chain so as to create effective and efficient products and services. This network is very relevant today, considering that readiness is needed to face intense competition between construction companies [6].

Supply chain risks can also include supplier risks (delays in receiving raw materials or poor quality of materials). Within an organization, internal risk factors, such as those related to production forecast errors, production failures, capacity problems and inventory problems, should also not be ignored. Another example is operational risk, related to the internal activities of the organization [10]. The risk of poor quality of the final product may be caused by the organization's uncertainty regarding the opinion of its customers, so it is important to take action to inform about the customer's opinion about the product produced, that as an additional task of the supply chain is under the control of the organization. One possible effort is to adapt the supply chain to several global standards that accredit quality targets, such as ISO 9001:2015. This international standard takes into account the activities of the organization, focusing on all elements of quality management. Where a company must have an effective system that allows it to manage and improve the quality of its products or services [9].

Supply chains can effectively overcome their vulnerabilities when all sectors involved frequently share information. This will build trust, increase visibility, and reduce uncertainty in the network. Collaboration is related to visibility, as it includes an organization's willingness to share risks. Therefore, an organization, regardless of its location or operating environment, is part of a complex supply chain and has political, economic, competitive, logistical or infrastructure problems. Therefore, a current flow of information regarding the products and services produced is needed, which is highly coordinated within and outside the boundaries of the organization itself. All this leads us to confirm that information and its transfer are key in the process of identifying and managing risks. Risk management in supply chains is increasingly important not only for the activities carried out in them but also for managers. Logically, organizations are not born with risk management, but are created when events occur and based on the perspective that managers gain based on their knowledge and experience. Finally, it should be noted that the risk management process should not be an arbitrary process, but rather be carefully designed and prepared. The main tool to carry out this entire process is the creation of a department dedicated to risk management that analyzes and determines the scope of each situation and the actions to be taken, realizing that an important element is strong communication. between all members of this department and the various links in the chain. All this will give us the ability to face, avoid, mitigate or eliminate risks that affect us, whatever their nature. In this way, we will start the road to a strong, flexible and competitive chain [6].

Precast concrete production is associated with many activities, many parties involved, requires enormous resources, and varied processes. For effective communication, this requires conveying appropriate and up-to-date information to enhance collaboration and improve integration[1]. The precast construction industry is often characterized by complexity, a non-integrated environment, and fragmentation. For 150 years, the precast concrete industry has been one of the core elements of the construction supply chain consisting of management with various activities that contribute to the flow of services, products and materials,[2] between suppliers, clients, manufacturers, architects/engineers, general contractors, consultants, subcontractors, and developers. As one component of the construction supply chain, the precast concrete industry contributes to improving the supply chain and the high demand for skilled and semi-skilled labor [3]. Therefore, systems that support efficient labor allocation will support overall construction supply chain improvements.

Based on the background description above and previous research and considering the many possible risks in the precast concrete industry supply chain, the researcher is currently interested in conducting research on risk analysis in the precast concrete industry supply chain. The difference between the current research and previous research lies in the focus of supply chain risk analysis carried out in the precast concrete industry using the made to order system from the producer's point of view. To identify risks that may occur in the precast concrete industry supply chain, find out which risks are classified as high in the precast concrete industry supply chain, as well as analyzing efforts to overcome high category risks that can occur in the precast concrete industry supply chain, this research was conducted with the topic "Supply Chain Risk Management Model". In this research, a risk analysis was carried out in the concrete industry supply chain, mainly using a make to order system in one of the precast concrete industries in Denpasar City.

2. METHOD

This research was conducted at a company in the precast concrete industry PT. Adi Jaya Beton Denpasar Bali Province. The type of data used in this research is qualitative and quantitative data with primary data sources and secondary data.The population in this study were all precast concrete industry workers at PT. Adi Jaya Beton, totaling 18 people. The method of determining the sample used is saturated sampling so that a sample of 18 people is obtained. Data collection techniques used in this study were observation, interviews, literature studies, documentation studies, and questionnaires using a Likert scale of 1-5. The data analysis technique used in this study is *Risk Failure Mode and Effect Analysis* (FMEA).

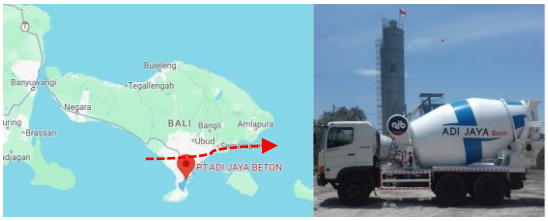

Figure 1: Location PT. Adi Jaya Beton

The data in this study were collected through a questionnaire. The questionnaire contains identification of any supply chain risks that have occurred at the research location. Next, grouping of risk identification is carried out based on the results of the questionnaire that has been filled in using a Likert scale of 1-5 to determine the value of the probability and impact of risk. Then proceed with the risk analysis stage using the Risk Failure Mode and Effect Analysis (FMEA) method, which is the calculation of risk on the probability scale and risk impact in order to obtain a risk index value. The next stage of risk analysis is to carry out risk mapping, by placing the risk value on the mapping level and risk management. In risk mapping, the risk levels are classified into four, namely minor, moderate, major, and critical.

Table 1: Probability and Impact Scale

Levels	Probability	Impact
1	Rare	Very insignificant (minimum)
2	Less likely to happen (unlikely)	Not significant (minor)
3	Likely to happen (possible)	Moderate
4	likely to occur (likely)	Significant (major)
5	almost certain to happen	Very significant (critical)

The supply chain stages of the make to order system at the study site are divided into five activities, namely planning (plan), procurement of raw materials (source), production (make), product delivery (deliver), and product return (return). At each stage of the supply chain, identification of the number of risks that arise or may arise is then carried out a risk analysis using the FMEA method. After conducting a risk analysis using the FMEA method, it is known that the level of risk for each type and stage of risk consists of minor, moderate, major, critical levels. Furthermore, an analysis of risk management is carried out with the following strategy.

1) Accept the risk, is a risk strategy at a minor level by accepting the risks that occur and keeping the risks as they are
2) Mitigate risk, is a risk strategy at a moderate level by reducing the impact and frequency of occurrence of risks that have the potential to harm the risk owner.
3) Share risk, is a risk strategy at the major level by sharing the risk with the parties involved in the Cooperation agreement that has been mutually agreed upon
4) Avoid risk, is a risk strategy at a critical level by accepting risk with an extraordinary action to minimize risk.

3. RESULTS AND DISCUSSION

3.1 Research Respondent Data

Respondent characteristics indicate the identity of the respondents used in this research. Respondents in the precast concrete industry have different characteristics or identities when filling out the questionnaire. The characteristics of the respondents in this study can be seen in Table 2.

Table 2: Characteristics of Respondents

No.	Characteristics of Respondents	Frequency	Percentage
1	By Gender		
	Woman	5	27.78%
	Man	13	72.22%
	Amount	18	100%
2	By Age		
	21-30 Years	9	50%
	31-40 Years	5	27.78%
	> 40 Years	4	22.22%
	Amount	18	100%
3	By Job		
	Foreman	3	16.67%
	Worker	15	83.33%
	Amount	18	100%

Based on Table 2, it can be seen that the characteristics of the respondents used in this research are based on gender, age and occupation. Based on Table 2, it can also be seen that the majority of respondents in this study were male, aged > 40 years, with the majority being workers.

3.2 Probability and Impact Variables

With regard to the research variables used in this study include risk factors that are assessed as the probability of occurrence of the risk and the impact of these risk factors. The determination of probability and impact variables in this study is based on the results of identifying supply chain risks that may arise in the made to order system implemented by PT. Adi Jaya Beton runs the precast concrete industry. The identified risks will be assessed for the level of likelihood or probability as well as the severity or impact that may be felt when the risk occurs. The probability and impact variables used in this research are presented in Table 3.

Table 3: Variable Probability (P) and Impact (I)

No	Risk Factors	P	I
1	Uncertainty in sales prices for precast products due to fluctuating prices of raw materials	P1	I1
2	Errors in calculating the planning of raw material requirements between warehouse stock and procurement of orders to subcontractors	P2	I2
3	There are additions or changes to product orders	P3	I3
4	The number of production staff is limited or there is a lack of experienced production staff	P4	I4
5	The scarcity of natural materials and competition for raw materials has led to price monopoly	P5	I5
6	The supplier does not fulfill the commitment to deliver raw materials on time and in good condition	P6	I6

7	The number of orders for precast products exceeds the limit of the factory's production capacity	P7	I7
8	The production machine (batching plan) has problems or is in a damaged condition	P8	I8
9	Inexperienced production machine operators	Q9	I9
10	Limitations of precast product printing equipment	P10	I10
11	Many of the product printing tools were damaged	P11	I11
12	Miscalculation of precast mix composition	P12	I12
13	Production of precast products failed due to the quality of the finished product not meeting factory standards	P13	I13
14	Unprepared space for finished precast products	P14	I14
15	Errors in laying finished precast products	P15	I15
16	Uncertainty on the delivery schedule for printed products to contractors	P16	I16
17	Producers have limited means of transportation for delivering finished precast products due to the high volume of finished product deliveries	P17	I17
18	Delays in delivery of precast products to contractors due to road conditions (congestion, rough roads, flooding, etc.	P18	I18
19	Precast products experience cracks on the way of delivery to the contractor	P19	I19
20	Return of precast products because the product arrives in a defective condition such as porous, cracked, and bent	P20	I20

Based on Table 3, questionnaires will be distributed using a 1-5 Likert scale. The questionnaires distributed were tested for instruments in the form of validity and reliability tests to test the validity and reliability of a research instrument. This test was carried out using statistical software, namely IBM SPSS version 26 for Windows. An instrument is said to be valid if it has a coefficient greater than 0.30 with a significance value less than 0.05. Based on the results of the validity test that has been carried out, it can be seen that the risk indicators in the probability and impact assessment used in this study have a correlation coefficient value greater than 0.30 with a significance value less than 0.05. This shows that the statement items in the research instrument are valid and suitable for use as research instruments.

A research instrument is said to be reliable if the Cronbach's Alpha value is greater than or equal to 0.70. Based on the results of the reliability tests that have been carried out, it can be seen that all the indicators used in this research have a Cronbach's Alpha coefficient of more than 0.70. So, it can be stated that the research instrument has met the reliability or reliability requirements so that it can be used for further analysis.

3.3 Risk Analysis

Data analysis was carried out based on the results of filling out the questionnaire with a Likert scale of 1-5 from the level of rare risk with a value of 1 to 5 for the most common risk. Stages of the supply chain system made to order at PT. Adi Jaya Beton is divided into five activities, namely planning (plan), procurement of raw materials (source), production (make), product delivery (deliver), and product return (return) which can be mapped as shown in Figure 2 below.

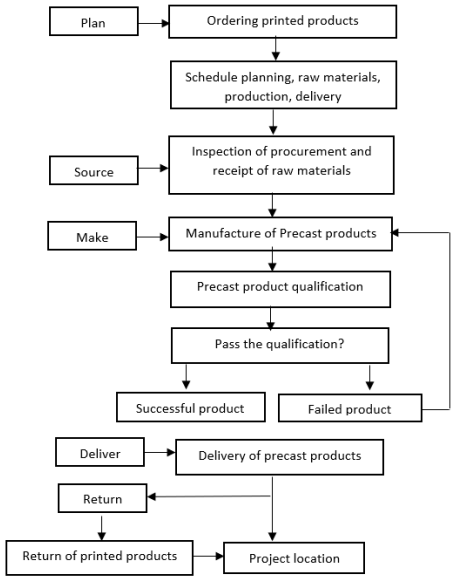

Figure 2: Mapping of the Precast Concrete Supply Chain at PT Adi Jaya Beton

3.3.1 Risk Identification

Based on the results of observations and interviews that the researchers conducted, there were 20 identified supply chain risks. The results of supply chain risk identification in the precast concrete industry are presented in Table 3 previously.

3.3.2 Risk Analysis with the FMEA Method

After testing the research instrument, namely the questionnaire and having been declared valid and reliable, then the questionnaire can then be used to conduct an analysis of the level of supply chain risk identified in the precast concrete industry based on the probability (P) and impact (I) of the risk. With regard to supply chain risk in the precast concrete industry, an assessment was carried out based on the probability and impact by the 18 respondents used in this study in relation to the 20 previously identified risks. The recapitulation of the results of respondents' perceptions regarding the probability and impact of risks in this study is presented in Table 4.

Table 4: Recapitulation of Risk Analysis Calculation Results

Risk Code	Probability Levels (P)	Impact Levels (I)	(PxI)	Risk Level
R1	2	3	6	Moderate
R2	1	3	3	Moderate
R3	2	3	6	Moderate
R4	1	2	2	Minor
R5	2	3	6	Moderate
R6	2	3	6	Moderate
R7	3	4	12	Major
R8	1	4	4	Moderate
R9	1	3	3	Moderate
R10	1	3	3	Moderate
R11	1	3	3	Moderate
R12	2	4	8	Major
R13	2	4	8	Major
R14	1	2	2	Minor
R15	1	3	3	Moderate
R16	2	3	6	Moderate
R17	1	2	2	Minor
R18	1	2	2	Minor
R19	2	3	6	Moderate
R20	4	4	16	critical

Based on the results of the risk analysis in Table 4, it can be seen that the risk level for each type and stage of risk consists of minor, moderate, major and critical levels. Table 4 also shows that the supply chain risk in the precast concrete industry is dominated by risks in the moderate category at 60%, followed by a minor risk level of 20%, a major risk level of 15%, and a critical risk level of 5%.

Next, a risk management analysis is carried out with the following strategies.

1) *Accept the risk*, is a risk strategy at a minor level by accepting the risks that occur and keeping the risks as they are
2) *Mitigate risk*, is a risk strategy at a moderate level by reducing the impact and frequency of risk occurrence which has the potential to harm the risk owner;
3) *Share risk*, is a risk strategy at a major level by sharing risks with the parties involved in a mutually agreed Cooperation agreement;
4) *Avoid risk*, is a risk strategy at a critical level by taking extraordinary actions to minimize risk.

Based on the predetermined risk levels in Table 4 regarding supply chain risks in the precast concrete industry, an analysis of risk management and handling efforts is carried out based on the risk level. Management and handling of this risk is carried out based on interviews with employees of PT. Adi Jaya Beton according to the company's experience in dealing with supply chain risks that occur or may occur in the precast concrete industry. Based on this, a critical risk is obtained that needs to be responded to by the company with the considerations that have been prepared at the initial order of the product in order to anticipate the risks that arise. As for the management and handling of supply chain risk, the strategies formulated based on the level of risk can be seen in Table 5.

Table 5: Risk Management/Handling Strategy Based on Risk Level

Code	Risk Level	Management/Handling Strategy
R1	Moderate	Monitor product sales prices with comparisons from other factories;
R2	Moderate	Monitoring and reviewing data on raw material requirements owned and purchased from subcontractors;
R3	Moderate	Communicate and discuss again with the buyer regarding the certainty of the number of products ordered;
R4	Minor	Seeking or lending additional workers from other factories;
R5	Moderate	Discuss with parties involved from buyers and subcontractors;
R6	Moderate	Ask about delivery delays and discuss related risks;
R7	Major	Production of products can be sub-divided to other factories or, if possible, production at the project location;
R8	Moderate	Discuss with buyers regarding delays, and immediately look for equipment maintenance operators;
R9	Moderate	Providing training to less trained workers;
R10	Moderate	Borrowing printing equipment from other factories or other precast subcontractors;
R11	Moderate	Bringing in workers specifically to repair printing equipment;
R12	Major	Negotiate with the buyer about problems in production that may cause delivery to be late;
R13	Major	Conduct discussions and reviews with buyers;
R14	Minor	Searching for temporary locations for transit of finished precast products;
R15	Moderate	Carry out patching efforts if the product damage is not serious;
R16	Moderate	Negotiation with the buyer;
R17	Minor	Procurement of transportation equipment from sub-contractors;
R18	Minor	Provide clarity to buyers regarding problems on the road;
R19	Moderate	Sending production workers to delivery locations for on-site repairs;
R20	critical	Remanufacturing of precast products.

Based on the risk analysis carried out, the level of risk that is of particular concern to companies with a very significant impact is the risk with a critical level, namely the risk of returning precast products because the product arrives in a defective condition such as porous, cracked, shrunken, and bent. This shows that the risk with the highest ranking is at the return stage where the level is critical with an explanation of the risk of product returns from consumers due to precast products that arrive not in accordance with the agreed standards or quality. Risk management at a critical level is included in avoid risk, where risks cannot be avoided, extraordinary handling must be carried out, immediately and as quickly as possible in order to minimize the impact of greater risks.

3.3.3 Discussion of Research Results

Precast concrete industry run by PT Adi Jaya Beton located at South Denpasar District, precisely on By Pass Ngurah Rai Suwung street, in its operational implementation uses a made to order system where the company will carry out production when an order comes in. In the process of this made to order system, there are several stages or activities, namely:

1) Planning/planning stage
2) Procurement of raw materials / sources
3) Production/make
4) Product delivery / deliver
5) Product returns / returns

Based on these five stages of activity, based on research results, 20 supply chain risks have been identified in the precast concrete industry using a make to order system. Make to order is a configuration of the supply chain process, where the production system is carried out by producers based on customer orders for these product items. This system is referred to as a type of industry that makes products only to fulfill customer orders. The supply chain of the make to order system has characteristics that can be controlled independently, timing of production to delivery that can be planned at the time specified by the consumer.

1. Risk Planning
   At this planning stage there are activities for ordering precast products then planning schedules, prices, raw materials, production, and shipping. From the research results, four risks were identified which include:
   1) Uncertainty in sales prices for precast products due to fluctuating prices of raw materials;
   2) Errors in calculating the planning of raw material requirements between warehouse stock and procurement of orders to subcontractors;
   3) There are additions or changes to product orders;
   4) The number of production personnel is limited or there is a lack of experienced production personnel;
2. Risk of Procurement of Raw Materials
   At this stage of raw material procurement there are inspection activities for the procurement and receipt of raw materials. From the research results, three risks were identified which include:
   1) The scarcity of natural materials and competition for raw materials has led to price monopoly;
   2) The supplier does not fulfill the commitment to deliver raw materials on time and in good condition;
   3) The number of orders for precast product requests exceeds the limit of the factory's production capacity;
3. Risk Production
   At this production stage there are activities for making precast concrete products, then qualifying precast concrete products and determining whether the product passes precast qualification or fails. In this stage, based on the research results identified as many as eight risks, which include:
   1) The production machine (batching plan) has problems or is in a damaged condition;
   2) Operator machine which production inexperienced;
   3) Limitations of preprinted product printing tools;
   4) Many products printing equipment were damaged;
   5) Calculation error precast mortar compositions;
   6) Production of precast products failed due to the quality of the finished product not meeting factory standards
   7) Unavailability of space for ready-made precast products;
   8) Errors in laying finished precast products;
4. Product Delivery Risk
   At this product delivery stage, there is the activity of sending products that have passed the qualifications according to the order. Based on the research results, four risks have been identified, which include:
   1) Uncertainty on the delivery schedule for printed products to contractors;
   2) Limited means of transportation for delivery of finished precast products owned by manufacturers due to the high volume of delivery of finished products;
   3) Delays in delivery of precast products to contractors due to road conditions (jams, freeways, floods, etc.);
   4) Precast products experience cracks on the way of delivery to the contractor;
5. Product Return Risk
   In the product return or return stage, there are product return activities when the product sent is not in accordance with the order. In this regard, this study identified one risk that has a very significant effect, namely the risk of returning precast products because the product arrives in a defective condition such as porous, cracked, shrunken, and bent.

Based on the description above, it can be seen that as many as 20 risks were identified at each stage of the made to order system activities in the precast concrete industry run by PT Adi Jaya Beton Denpasar, where there are five activity stages which are the main activities of this precast concrete industry. Research conducted explains that in the precast concrete industry, there are potential risks identified starting from the planning carried out to run the business well (plan), the resources used (source), the transformation process carried out carried out to manage raw materials into products (make),

delivery of consumer products (deliver), and returns that occur from consumers and suppliers (return).

The risks identified in the precast concrete industry are mainly related to supply chain risks that have different levels of risk. The results of this study found that there are four risk levels for each type and stage of risk identified in the precast concrete industry, consisting of minor, moderate, major, and critical levels.

1. Minor level shows that from the identified risks the assessment was carried out by the respondents in this study where the possibility of a risk occurring was very small with an insignificant impact. Based on the research results, the risks included in this minor level include:
   1) The number of production staff is limited or there is a lack of experienced production staff
   2) Unavailability of space for ready-made precast products;
   3) Limited means of transportation for delivery of finished precast products owned by manufacturers due to the high volume of delivery of finished products;
   4) Delays in delivery of precast products to contractors due to road conditions (congestion, damaged roads, flooding, etc.);
2. The moderate level indicates that from the identified risks the assessment was carried out by respondents in this study where these risks have the possibility of occurring with a significant impact. Based on the research results, the risks included in this moderate level include:
   1) Uncertainty in sales prices for precast products due to fluctuating prices of raw materials;
   2) Errors in calculating the planning of raw material requirements between warehouse stock and procurement of orders to subcontractors;
   3) There are additions or changes to product orders;
   4) The scarcity of natural materials and competition for raw materials has led to price monopoly;
   5) The supplier does not fulfill the commitment to deliver raw materials on time and in good condition;
   6) The production machine (batching plan) has problems or is in a damaged condition;
   7) Operatormachine which production inexperienced;
   8) Limitations of preprinted product printing tools;
   9) Many products printing equipment were damaged;
   10) Errors in laying finished precast products;
   11) Uncertainty on the delivery schedule for printed products to contractors;
   12) Precast products experience cracks on the way of delivery to the contractor
3. The major level indicates that the risks identified have an assessment carried out by respondents in this study where these risks have a high probability of occurring with a significant impact. Based on the research results, the risks included in this major level include:
   1) The number of orders for precast product requests exceeds the limit of the factory's production capacity;
   2) Calculation error precast mortar composition;
   3) Production of precast products failed due to the quality of the finished product not complying with factory standards;
4. The critical level indicates that the identified risks have an assessment carried out by respondents in this study where these risks are almost certain to occur with a very significant impact. Based on the research results, the risk included in this critical level is the risk of returning precast products because the product arrives in a defective condition such as porous, cracked, shrunken, and bent.

Based on this description, it can be seen that supply chain risk in the precast concrete industry implemented by PT Adi Jaya Beton is dominated by risks with a moderate level of 12 risks with a percentage of 60%. Then, followed by risks at a minor level, namely four risks with a percentage of 20%, risks at a major level, namely three risks with a percentage of 15%, and one risk at a critical level with a percentage of 5%. Based on this, the risks that have the highest rank and need to get special treatment or require extraordinary measures to minimize risk are at a critical level.

Identified risks have different levels of risk probability and impact values and handling of different risk treatments. Therefore, the handling of each risk with a different category or level is also carried out in a different way. According there are four ways or strategies that can be used to deal with risk based on the level of risk. Based on these four risk management strategies, related to supply chain risks identified in the precast concrete industry PT Adi Jaya Beton with four risk levels namely minor, moderate, major and critical, risk management is carried out with several risk management strategies based on the company's experience. The risk management strategy according to the risk level is described as follows.

1. Level Risk Management Minor
   Within levels minor those risks identified is a risk that is likely to occur is very small with an insignificant impact so that risk management is carried out by accepting risk which is a risk strategy by accepting the risk that occurs and keeping the risk as it is. The coping strategies include:
   1) Looking for or lending additional workers from other factories
   2) Looking for a temporary location for transit of finished precast products
   3) Procurement of transportation equipment from subcontractors
   4) Provide clarity to buyers regarding problems on the road
2. Level Risk Management Moderate
   Within levels moderate those risks identified are those that have the possibility of occurrence of risks with quite a significant impact so that risk management is carried out by mitigating risk, which is a risk management strategy by reducing the impact and frequency of occurrence of risks that have the potential to harm the risk owner. This

handling strategy includes:

1) Monitor product sales prices with comparisons from other factories;
2) Monitoring and reviewing data on raw material requirements owned and purchased from subcontractors;
3) Communicate and discuss again with the buyer regarding the certainty of the number of products ordered;
4) Discuss with parties involved from buyers and subcontractors;
5) Ask about delivery delays and discuss related risks;
6) Discuss with buyers regarding delays, and immediately look for equipment maintenance operators;
7) Providing training to less trained workers;
8) Borrowing printing equipment from other factories or other precast subcontractors;
9) Bringing in workers specifically to repair printing equipment;
10) Carry out patching efforts if the product damage is not serious;
11) Negotiation with the buyer;
12) Send production workers to delivery locations for on-site repairs

3. Level Risk Management Major
   Within levels major those risks identified are those that have a high probability of occurring with significant impact so that risk management is carried out by sharing risk, which is a risk management strategy by sharing risk with the parties involved in a mutually agreed cooperation agreement. This handling strategy includes:
   1) Production of products can be subdivided to other factories or, if possible, production at the project location;
   2) Negotiate with the buyer about problems in production that may cause delivery to be late;
   3) Conduct discussions and reviews with buyers;
4. Level Risk Management Critical
   Within levels critical those risks identified are those that are almost certain to occur with a very significant impact, so that risk management is carried out by avoiding risk, which is a risk management strategy by taking extraordinary actions to minimize risk. The risk management strategy at this critical level is to remanufacture the product.

Based on the research results, it can be seen that the risk with the highest ranking is at the return stage where the level is critical with an explanation of the risk of product returns from consumers due to preprinted products arriving not in accordance with agreed standards or quality. Risk management at the critical level is included in avoid risk, where risk cannot be avoided and must be accepted with extraordinary handling, immediately and as quickly as possible in order to minimize the impact of greater risks. Other emerging risk categories fall into the risk management group with accept risk, mitigate risk, and share risk where risk management is still considered to be more easily handled by the company.

4. CONCLUSION

The supply chain risks identified in the precast concrete industry are 20 risks; uncertainty in sales prices for precast products, miscalculations in planning raw material requirements, additional or changes in product orders, limited number of production personnel, scarcity of natural materials and competition, suppliers do not fulfill raw material delivery commitments, the number of orders for precast product requests exceeds the capability limit, production machines have problems or are in damaged condition, inexperienced production machine operators, limitations printing equipment for precast products, printing equipment for many products is damaged, error in calculating the composition of precast mortar, production of precast products fails, unprepared space for finished precast products, errors in placing finished precast products, uncertainty in the delivery schedule for printed products to contractors, limited means of transportation for delivery, delays in sending precast products to contractors due to road conditions, precast products cracked on the way to delivery contractor, return of precast products because the product arrived in a defective condition such as crumbling, shrinkage cracks, and bending. In relation to the level of risk, supply chain risk in the precast concrete industry is categorized into four levels, namely minor, moderate, major, critical levels. At the minor level there are four risks, at the moderate level there are 12 risks, at the major level there are 3 risks, while at the critical level there is one risk. Supply chain risk handling in the precast concrete industry can be carried out based on the level of risk, namely by accepting risk, mitigating risk, sharing risk, and avoiding risk. Risk management at a critical level is included in avoid risk, where risks cannot be avoided, extraordinary handling must be carried out, immediately and as quickly as possible in order to minimize the impact of greater risks. The risk categories that arise gradually are included in the risk management group with accept risk, mitigate risk, and share risk where risk management is still considered to be more easily handled by the company.

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