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Research paper, Short communication, and Review

Production Stage and Risk Identification on Asphalt Mixing Plant in Bali

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ABSTRACT

Cost, quality and time are an important performance indicators in the project success. To achieve these objectives various risks are faced in each project life cycle. One of these risks is supply chain risk, which must be managed properly, doe to the uncertainty in this activity. There are still many companies that do not understand the importance of supply chains, so they often become obstacles in achieving project goals

This study aims to identify risk factors in each stage of supply chain activities, in road infrastructure in Bali Province. Data were collected from questionnaire survey, interviews and focus group discussion from 15 units asphalt mixing plant supplier in Bali, who understand supply chain issues, especially in road infrastructure work in the province of Bali.

The results of research on risk is firstly AMP production processes identified as a field of manufacturing industry that produces hot asphalt used in infrastructure projects in Bali. This research was conducted at the AMP unit found in Bali. From research, the production process and AMP business are based on Supply, Input, Process, Output and Customer activities. (SIPOC). After the activities contained in the Asphalt production process, it is known that further risks can be identified. Second identity the risk on SIPOC process.

Keywords: Risk, Production Stage, Supply Chain, Asphalt Mixing Plant, SIPOC

I. Background

The construction market in Indonesia in 2018 is predicted to reach Rp 451 trillion, an increase of 3% compared to 2017. This number exceeds other neighboring countries such as Malaysia, which only has the potential worth US $ 32 billion and Singapore worth US $ 24 billion. From BPS and Ministry of PUPR data, the construction market figures increased by 3% compared to 2017. So, in 2018, the total construction project market is predicted to be Rp. 451 trillion, of which 65% are civil works including roads, bridges, irrigation, dams, etc. and 35% is building work. (Finance.com, 2018) Implementation of this infrastructure project is expected to be a driving force for the economy in Indonesia, when other sectors are weakened.

. Projects generally have a time limit, meaning that the project must be completed before or at the specified time (Artika, 2014). This is because the construction industry is considered an industry that has a high level of complexity. (Wirahadikusumah and Susilawati, 2006). Increased costs of implementation, delays, conflicts and disputes, are examples of problems that originate from fragmentation, until the construction industry is known as an inefficient industry (Tucker, et al, 2001).

Factors that influence productivity in the construction sector are: money, labor, materials, equipment and methods (Stone, 2017). Other factors that need to be considered in a project other than costs, quality, and time are human resources, communication, risk, procurement, auction, and environment.

Material needs is estimated reach 50%of the total material requirements of the total project cost. (Aditya and Sabihuddin, 2015). The success of a project can be influenced

by good material management. Often a project experiences delays, increased costs and claims due to the influence of material management ineffectiveness. Material management includes the planning, identification, procuring, storage, receiving and distribution of material. The responsibility of the Material Management department starts from the flow of material when it is ordered, received, stored and used during the construction period.

Supply Chain as a company or organization that is involved in a series of material activities starting from the stages of natural materials to become the final product (such as roads or buildings). The ability to manage an effective and efficient supply chain will provide a very high competitiveness in construction companies. Construction supply chain will contribute to the efficiency of a project implementation, so the construction supply chain has the potential to allow for an increase in the construction industry (Maddeppungeng, et al,2014). The competitive advantage of a construction service is largely determined by competitive advantage between supply chain networks. (Christopher, 1998). According to Bertelsen and Sven (2002) poor supply chain design can increase project costs by up to 10%. Tight competition in the industrial world and increasingly tight profit margins, companies must adopt strategies to operate efficiently (Adhitya, 2009). In each construction project material values can reach 30% to 70% of the total project needs (Donyavi, 2009). Smoothness in the supply of raw materials will affect the entire project (Sauer, 2016).

The construction of road infrastructure is one of the most important construction projects because it involves public infrastructure which is a means of supporting the economy and community life (Construction, 2010) The length of the Bali Provincial Road for National Roads and Provincial Roads covers a National Road totaling 629.39 km and Provincial Roads of 743.34 (Dinas PUPR Provinsi Bali, 2018). Road construction is a public need, so the government as the assignor must carry out supply chain management from upstream to downstream, related to the project to be assigned to the implementing contractor. Asphalt needs to meet national needs in road projects that are fulfilled by Pertamina as a partner provider of asphalt is believed to be able to meet asphalt needs of up to 45 to 50 percent which reaches 1.2 million to 1.4 million tons per year. Whereas Asphalt needs for Bali Province with a road length of 743 km for Fiscal Year 2018 for Road and Bridge Routine Rehabilitation / Maintenance Activities of 25,842 tons of asphalt (Bali Provincial Public Works Agency, 2018) and the need for asphalt quantity for Road and Bridge Improvement Work Packages in 2018 budget was 195,657.6 tons.

. Every project in practice will definitely experience risks and uncertainties. The construction industry faces greater risks and uncertainties than in other industries (Ahmed, 2004). This risk can occur from the beginning to the end of the project completion (Bhandari, 2014, Stone, 2017). There are no projects that are risk free at each stage of the project. The size of the risk varies from one project to another. Risks in the world of construction are the object of attention because they relate to the costs and time needed to complete the project (Akintoye, 1997). The most frequent risk in construction activities is the failure of the contractor to complete the project in accordance with the time, quality and predetermined costs (Al Bahar, 2000). There are various character risks that occur during the construction phase, namely risks that are predictable, identifiable or not visible risks. (Ahmed, 2004) Risks on construction projects can be classified into six categories such as: Nature factors, such as floods, storms; Physical risks such as workplace accidents, fire, equipment damage, supply chains, financial and economic risks such as rules and regulations, political and environmental risks such as regulatory changes, political uncertainty, design-related risks and risks associated with implementing construction such as design changes, productivity of work, etc. (Al Bahar, 2000). If the risk is not handled properly, it can lead to increased costs, delay and poor service levels. (Blackhurs, et al, 2005).

Based on research by Hendricks and Singhal (2003), it is known that disruptions in the supply chain can have a negative long-term impact on companies and many companies are unable to recover quickly from these negative impacts. Linking all partners in the chain including the work units of a company and external partners

including suppliers, freight companies, and third-party companies including the risks faced in the supply chain is one of the objectives of supply chain risk management.

The risks associated with supply chains in road projects are very complex. Among them are risks related to the quantity, quality, time of delivery of material supplies, seasonal needs, weather, availability and adequacy of raw materials, environmental issues, quality, communication, finance and others (Hatmoko and Kistiani, 2017). The problems that occur in the supply chain certainly affect the project performance, especially on road infrastructure projects in Bali Province. Project performance related to this supply chain is the increasing cost, time and quality of the project that is declining. (Bali Post May 20, 2017) Whereas the things related to quality are the reduced age of road plans. One of the risk issues related to supply chain risk in the procurement of hot mix asphalt is in the form of external risks, namely the closure of unlicensed type C excavations in Selat village, Karangasem, Bali Province in accordance with Law number 23 of 2014, previously the authority was in road construction projects, both in terms of time and cost. Likewise, regarding the environment that is at risk and related to environmental sustainability and Regional Original Income (PAD) (Bali Post, 20 May 2017). Other risks faced by the asphalt concrete supply chain are the risk of accumulated demand, transportation risk, stock availability risk, weather risk, operational risk, financial risk, etc. All of the things mentioned above are risks that are likely to occur in the supply chain that affect project performance. In this study, each risk at the stage of supply chain activities is identified for its potential risks and how much risk is generated. So that the supply chain risk is known to be mitigated. From this research, it is expected that supply chain risk issues can be identified, evaluated and mitigated so that the road supply chain can contribute significantly to the success of the project.

1.1 Problem Formulation

From the background above, the formulation of the problem is made as follows:

1. Identify what Production and management stage will be faced in the supply chain in the construction based on SIPOC process
2. Identify the risk faced by production and management stages of the AMP unit industrial

1.2 Objectives and Benefits

The objective to be achieved from conducting research is to investigate and to identify as well as to find out the mitigation carried out in the supply chain so that the risks can be prevented and minimized.

While some of the benefits expected to be obtained from this research namely:

1. Identify each management stage faced riskbased on SIPOC on production and management
2. Identify risks that can occur in the supply chain based on production, demand and management activity

2. Research Method

This research is a qualitative research method. The implementation of data collection was carried out through library research, field surveys, interviews and using semi-structured interviews. After the data is known, data analysis is carried out both through library research, interviews and field surveys to the competence's ones. The research involve person that involve in hot mix industry. The reason for using interviews in field surveys is to develop, improve and create the depth of the results obtained through library research and field studies. Interviews were conducted with field people who were experienced in the field. With this interview the expected issues can be analyzed by collaborating with library data from library research.

3. Literature Review

3.1 Definition of Risk

The definition of the supply chain term referred to in this research is the project environmental supply chain, namely the flow of material, information, finance and others.

According to the Unabridged Indonesian Dictionary the risk is a result that is less pleasant than an act. According to the human-social view it is stated that risk is an unwanted realization force where the consequences are contrary to human survival, health, property and the environment. Risk as quoted from Sinha (2004) means a function of the degree of uncertainty and influence of an event. The definition of risk according to the Australian / New Zealand Standard Risk Management (AS / NZ Standard), stating risk is the possibility of things happening that can have both negative and positive impacts on certain goals to be achieved.

From the picture it can be seen that environmental factors and internal organizations are a source of risk to the entire supply network while the relationship between networks affects the risk of the entire network. In some industries, RM is still understood as a specific part of a company, Ju€Ttner, *et al* (2003) states that only a few understand that the risk concerns all supply chains.

Chopra and Sodhi (2004) classify the risk of SC in 9 categories, namely: disruption, delay, system, forecasting, intellectual property, procurement, receipt, inventory and capacity.

Wagner (2008) divides the risk of SC in 2 classes and 5 categories, namely:
Internal: .1 Demand side, 2. Supply side,
External: 3. Regulations, permits and bureaucracy, 4. Infrastructure and 5. catastrophic.
Goh, et al (2007) states that there are two types of supply chain risk in terms of the source, namely risks arising from supply chain internal networks and risks arising from external factors. While (Tang, 2006) classifies the risk of supply chain based on operational risk and the risk due to a disturbance. Operational risk is associated with uncertainty in the supply chain including demand, supply and uncertainty of costs. Likewise, Christopher and Peck (2004) categorize risk into 3 categories and then divide it into 5 sub categories namely:

1. Internal for the Company
   - o Process
   - o Control
2. External for companies but internal to supply chain networks
   - o Demand
   - o Supply
3. External to supply chain networks
   - o Environment

3.2. Risk Management Strategy

Strategy in risk management is defined as an understanding of the concept, which is done by in-depth discussion of risk management to make the best decisions whenever there is uncertainty or risk (Muka, 2015) A good strategy will provide the objectives set according to plan. Strategy can be seen as a process that connects an organization with management and external relations with suppliers, customers and competitors, who take certain responsibilities from the economic and social environment in which the company is located.

Risk management consists of 3 stages of Wagnerand Bode (2009); Kleindorfer and Saad (2005) Tang (2006) namely:

1. Risk identification
2. Risk Evaluation
3. Risk Mitigation

But in some literature, researchers separate the risk evaluation phase into two, namely risk measurement and risk assessment. This risk assessment is based on predictions and uncertainties about the future. This risk assessment, due to the influence of time, risks must always be monitored, updated and revised.

Whereas Chen, et al (2013) conducted a research that is developing collaboration as a risk mitigation strategy. There are three types of risks, namely supplier risk, demand risk and process risk related to three types of collaboration, namely: supplier collaboration, customer collaboration and internal collaboration as a mechanism

to mitigate these risks. This research is to model data collected from 203 factories. The results show that collaborative areas can effectively reduce supply chain risk but only mitigate processes and demand that directly affect supply chain performance.

3.3 Supply Chain

A supply chain is a system where organizations distribute production goods and services to their customers and work together to increase value for their customers (Lu, 2011). This chain is also a network of various interconnected organizations that have the same goal, namely as best as possible to organize the procurement or distribution of these items. Supply Chain is also said to be a logistics network.

Supply chain is a network organization of suppliers, production machines, warehouses, distributed from raw materials to finished materials, and then distributed to consumers. Supply chain planning includes network configuration, number, location, capacity and technology, then planning the material needs of the purchase, processing, and distribution. (Santoso, et al, 2014). The most important component in planning manufacturing activities is to efficiently design and operate supply chain.

Although largely dominated by logistical problems, the concept of contemporary supply chain management includes more than just logistical problems (Lambert and Cooper, 2000).

An understanding of the definition of supply chain management must begin with an understanding of the supply chain concept. According to Mentzer, et al. (2001), as quoted in Bakri (2015) supply chain is defined as a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finance, and / or information from one source to customers. The supply chain includes all activities related to the flow and transformation of goods from the raw material stage to the end user, and information flows related to Handfield and Nichols, 1999, cited in Presutti, 2003). Meanwhile, according to Chopra and Meindl (2007: 20), the supply chain has a dynamic nature but involving three constant flow are: the flow of information, products and money. Besides that, Chopra and Meindl also explained that the main goal of each supply chain is to meet consumer needs and generate profits.

Meanwhile, Ling Li (2007: 3) explained that supply chains put more emphasis on all activities in meeting consumer needs in which there is a flow and transformation of goods ranging from raw materials to end consumers and accompanied by a flow of information and money. In this connection, there are several parties which are companies that have the same interests, namely:

1. Suppliers;
2. Manufacture;
3. Distribution
4. Retail outlets;
5.Customer

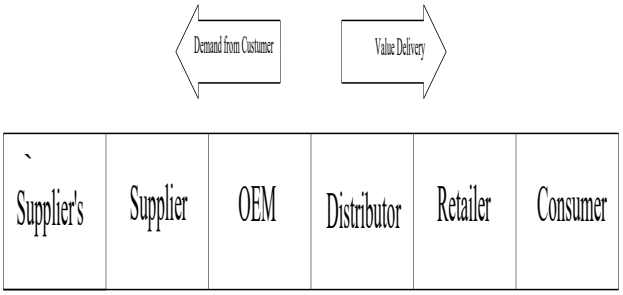

Figure Basic Model of Supply Chain, Source (Tjipto S, 2014).

Figure 2.3 shows the relationship between supply chains is directly related to the complete cycle of raw materials from suppliers to production, to warehouses and then to end users. As for those who include players in the industry, including raw material suppliers, or suppliers of components and parts, or intermediate goods suppliers (sub assembly suppliers), manufacturers of products and services, distributors and end with

end consumers. Each of these actors is connected to a chain of cooperation in supporting industrial activities, resulting in a product or service that can be enjoyed by end consumers. The chain of activities is called the supply chain (Tjipto S, 2014).

3.4 Asphalt Mixing Plant Supply Chain Pattern

Supply chain is a concept that was originally used in manufacturing industry, where this concept was adopted in the construction industry to achieve quality efficiency, time and cost to increase productivity in the implementation of construction work, as well as customer

Supply Chain Structure in construction projects is an arrangement of activities or cooperation networks for the procurement of goods and services that work together and engage with each other to produce and distribute products in the form of goods or services. The supply chain according to Harland (1996) in (Maulani Febriana, 2014) is a management arrangement of business networks involved in providing the final packages of products and services needed by consumers.

In the companies studied, the process is not the same as other companies, in other words that each company has a different structure. Each company will have different processes and suppliers in developing their products. Therefore, a company must integrate different suppliers. The stages of designing supply chain networks according to (Febriana, 2014) begin from identifying supply chain members, namely actors from a partnership (supply chain on a road project such as a main contractor, supplier, vendors, subcontractor manufacturers and others).

The design stages in road construction in Bali Province are starting from the procurement of projects, payment systems, employment contracts and interactions with the main contractors. In general, the picture of the supply chain in the Asphalt Concrete Procurement can be seen as an example in the Asphal Mixing Plant.

3.5 Supply Chain Integration

Coordination between raw material companies, factories, retailers and third-party logistics providers is key to increasing corporate flexibility in rapidly changing market conditions. Integration and supply chain coordination are processes in planning, implementing and monitoring activities among members of the supply chain to create value for consumers.

Supply chain integration can be divided into 8 dimensions, namely:

1. Consumer relationship management
2. Consumer service management
3. Demand management
4. Fulfillment of demand
5. Production flow management
6. Management of relationships between suppliers
7. Product development and commercialization
8. Return Management

3.6 *Asphalt* Mixing Plant

Asphalt mixing plant is a company that manufactures asphalt concrete which consists of a series of components of equipment / machines to process sandstone and asphalt material into hot mix products of varying types according to jobmix with the design according to the requirements of the type

Hotmix asphalt is a mixture of fine aggregate with coarse aggregate and filler with asphalt binder in high temperature conditions with a composition that has been adjusted and examined its specifications (PT Prayoga, 2012).

Asphalt mixing plant is a set of mechanical and electronic equipment in which aggregates (raw materials) are heated, dried and mixed with asphalt to produce hot asphalt mixes that meet certain requirements. The asphalt mixing plant (AMP) industry as an industry that produces hotmix asphalt is one of the supporting factors in the construction sector. As long as the construction activities in the construction sector are launched, during that time the AMP processing business will run.

In the mixing process, the aggregate is in the form of sand and stone after going through the heating process, and weighed with certain mixtures and then mixed with asphalt until the hot mix is produced or concrete asphalt is ready to fit into the dump truck and then sent to the project location.

Types of AMP

1. AMP of batch type * scales
2. Continuous AMP type
3. AMP of tie drum mix

   Source (Umum, 2005)

   Scale-type AMP has scales for aggregates, for fillers, and for asphalt. The hot aggregate, filler and asphalt that have been scaled are then inserted and stirred in the pug mill. In continuous AMP the mixture gradation is obtained by setting the output of the hot bin aggregate mixed with asphalt content which is regulated by setting the asphalt pump speed.

   In drum type AMP, the aggregate dried and heated in the drum is also mixed with asphalt by adjusting the speed of the asphalt pump. The project leader must conduct an inspection of AMP installed at the location of the asphalt mixture production unit and ready to operate according to the specifications provided.

   Main part of Batch-type AMP, and Continuous-type AMP

4. Results

Before identifying the risk occurs in business and production, firstly the process and activities on AMP activity must be identified**.** To find out the risk, at this stage the approach is based on the Business and Production Stage in the AMP Supply Chain industry

4.1 Production activities Order and Diagrams

Production activities start from identifying the work network at AMP business an management which starts from the aggregate supplier of raw materials then the goods are stored in the warehouse before use. Furthermore, if there is a shipping schedule, the raw materials will be produced at the processing plant. Goods will be sent to consumers to be ready to be spread out. Before the concrete asphalt was sent, the specimen was sent. Figure 1 shows the flow diagram of concrete asphalt production in the AMP basecamp. Starting from the level of need and then entering the production management stage in general

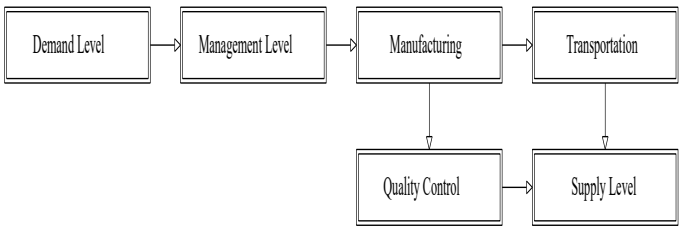

Figure 1 Supply chain networks for AMP

4.2 Demand Management Order in AMP

The business process in AMP starts from the process of goods / services produced and then sold by the company. This process starts from the logistics department, namely the department that manages the preparation of goods / products until they are ready to sell. The stages of this process can be identified as a sales order management, namely the processing of orders and sales of goods produced by the production process. Generally, the results of this production are stored and sent directly to the custome or to the project.

1. Order of goods, that is, orders for goods from customers are documented in sales orders
2. Availability check at this stage, SO that has been issued will be used to check the availability of goods in the Warehouse

3. Outbound delivery, at this stage the goods that are ready will be scheduled for delivery
4. Select transportation and packaging, at this stage, what transportation will be used and how to treat the goods during transportation to the consumers
5. Picking or preparing items to be sent to consumers
6. Good issue, namely the process of removing goods from the Warehouse. At this stage a delivery document will be issued, then the goods will be delivered and sent to consumers.
7. Material process through plant unit includes: raw material cleaning, aggregate mixture, aggregate heating, aggregate screening, aggregate weighing, dust collector, last step is Mixturing aggregate, asphalt and other material to become the Hotmix
8. The next step is to test the Hotmix mixture production in the laboratorium
9. The hotmix transport into the customer
10. Billing is the stage of making bills to consumers. Bills are made based on SO and DO that have been made and billed to consumers
11. Payment after the bill adjustment is complete, the consumer will make payment for the goods.

Eleven stages of order management process in the activities of AMP industry causing risk are as can be seen on Figure 2 and Figure 3 describe the list of the order of the production process on Asphalt Mixing Plant Unit.

4.3 Risk Identification on AMP Industry

The second step of this research is to identify the risk occurs during the step and stage of the production process. The identification is based on interview to the competence people in the industry and literature review. The quissionare were held to the competence people of the production and the management of the AMP. From the literature review and the field, the risk can be summarized as in Table 1

Table 1 AMP Risk Identification

Risk Sources	**Risk Factor**
Quarry/Logistic	Capacity Risk
	Environment Risk
	Continuity Risk
Demand	Over capacity Demand Risk
	Competition risk
	Price bids risk
Quality Control	QC risk
Production stage	Risk of Plant failure Maintenance of plant Risk Lack of Human Resource in plant Risk Lack of human resource training risk
Production	Production risk
Transportasi	Lack Transportation risk Late Transportation risk Price risk
Environment	Environment damage Risk Legality Risk
Politic	Political Risk
Management	Management Risk

Customer	Risk of unsatisfied customer Risk of failure payment by customer

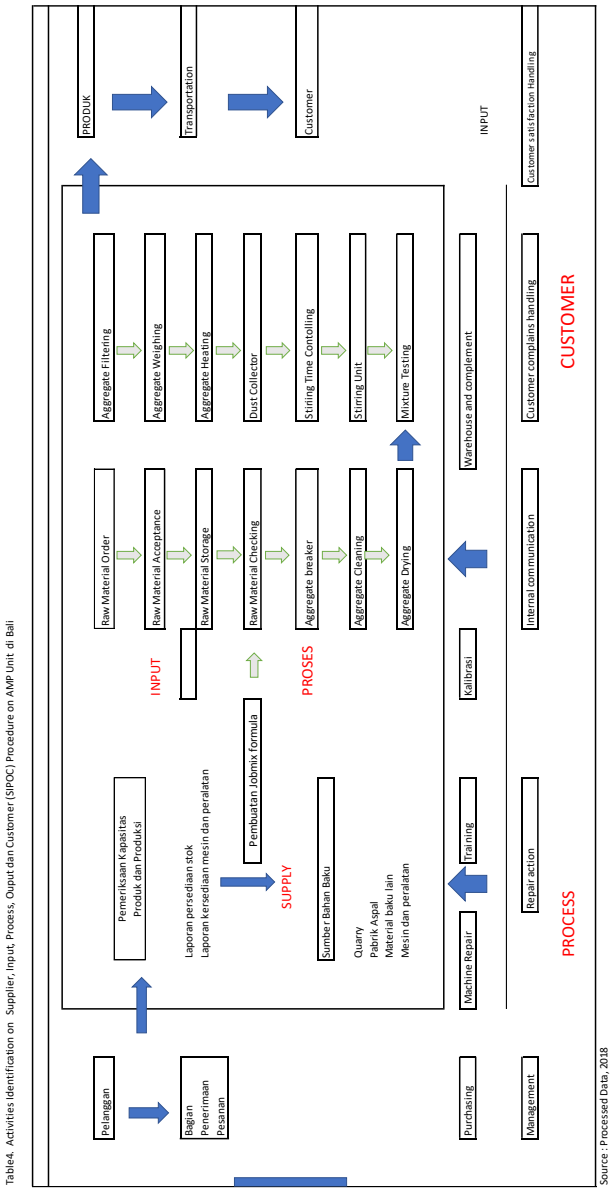

Figure 2 Production Order in AMP industry

4. Research Gap and Recommendations

There are many possibilities that can be researched and developed in this study. After the risks are identified, the risks need to be analyzed by using various existing risk assessment methods such as Hazard, Impact probability methods, etc. In the end, the risk can be mitigated.

Because AMP has an important role in the success of road projects in Bali, it is necessary to carry out serious mitigation efforts, both by AMP owners, contractors and stakeholders, namely project owners in this case the government. With the existence of mitigation efforts against identified risks, it is expected that the project can run in a timely, cost and quality manner.

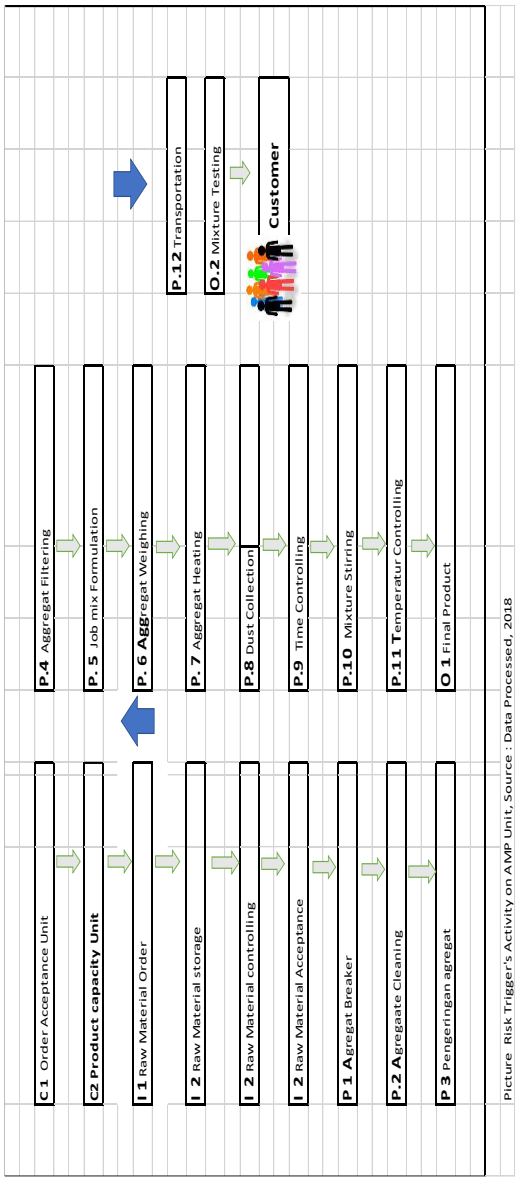

Figure 2 Production Step Figure 2 Production Order in AMP industry in AMP industry

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