FINAL PROJECT – TI 184833

PRODUCTION MACHINE FAILURE MODE ANALYSIS IN MAYORA CHOCOLATE DIVISION USING FMEA METHOD

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Production Machine Failure Mode Analysis in Mayora Chocolate Division Using FMEA Method

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ABSTRACT

PT Mayora Indah tbk is a company that engaged in Fast Moving Consumer Goods (FMCG) field and one of its products is Choki-choki. The choki-choki packing line has several problems that cost the company for several years. This is caused by the lack of maintenance and management in the packaging line.This research will develop the failure mode identification through expert's judgement and then the failure mode will be evaluated by using FMEA Method. The FMEA method used to identify the potential failure modes, ranked each failure modes and maps it to categorize each risk. After that the mitigation strategy will be formulated for each risk at Mayora Chocolate Division.

The result is there are 27 identified failure modes in packaging lines of Choki-Choki. These 27 failure modes later categorized into 14 high risk (metal inside the product cannot be detected, codification not according to standards, scale cant detect product that weight over or below the limit, plastic doesn't shrink, seal not sticking, carton being cut off, cutting result not according to the standard, product misplaced, detected metal is not match with the real amount, misprint product code, plastic wrap shrivel up, cello shrivel up, scale number can't be stabilized and plastic got stuck), 5 medium risk (packaging torn or scratched, cannot set the pressure on filter regulator, product snagged, sensor cannot detect the product and cello deviate or tilted) and 8 low risk (Change occurred in the printed cello pattern, air leak from the filter regulator, registered mark can't be read, lack of wind pressure, plastic cut leftover moves to the wrong place, product not lifted, filter regulator cannot be dried and wind blower not working).

Keyword: Failure mode, FMEA, Packaging line

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PREFACE

The author would like to give gratitude towards God almighty for His grace and blessings towards helping this research entitled "Production Machine Failure Mode Analysis in Mayora Chocolate Division using FMEA Method" being completed as one of the requirements to complete the study at Department of Industrial Engineering ITS Surabaya.

In the process to finish the Final Project report, writer receive lots of help, suggestion, and motivation. Author wants to say thanks to:

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CHAPTER 1
BACKGROUND

This chapter will explain the reasons behind the topic and method chosen for this research and the expectation(s) to be solved in this research. Furthermore, there are explanations regarding the scope of this research and report outline of this research.

1.1 Background

The study of risk management began after World War II. Risk management has long been associated with the use of market insurance to protect individuals and companies from barious losses associated with the accidents. One very interesting book about this topic, "Against the Gods: The Remarkable Story of Risk," contends that the true dividing line between what we should call *ancient times* and *modern times* is mastering risk (Rhodes, 2015). In this book, Peter L. Bernstein contends that when people began to understand how to predict and manage risks, they also began to understand that the future did not just hold random events generated by the will of the gods or the whims of nature.

The goal of risk management is to create a reference framework that will allow companies to handle risk and uncertainty. Risks are present in nearly all of firms financial and economic activities. The risk identification, assessment and management process are part of companies' strategic development; it must be designed and planned at the highest level, namely the board of directors. An integrated risk management approach must evaluate, control, and monitor all risks and their dependences to which the company is exposed.

PT Mayora Indah Tbk is one of the largest Fast-Moving Consumer Goods (FMCG) in Indonesia. PT Mayora Indah Tbk was established in 1997 with the biscuit as its first product. Now mayora has more than 20 products and group it into 9 division which are Biscuit, Candy, Wafer, Chocolate, Cereal, coffee, Instant Noodle, Porridge, and drinks. One of the divisions is Mayora Chocolate Division, Mayora Chocolate Division focused on producing a chocolate-based product such

as choki-choki and chocolate that will be used by other product in Mayora Division.

Production capacity is defined as the maximum rate of output that a production facility (or production line, work center or group of work centers) is able to produce under a given set of assumed operating conditions (Groover, 2001). Machine that experience failure may affect the production capacity of a plant. The failure of a machine may cause a lot of problem. Therefore, risk management is crucial in the operation process of the machine. Risk management is defined as coordinated activities to direct and control an organization with regard to risk (ISO, 2009). Technical and operational risks in an organization must be assessed in order to encompass activity for a range of other (Cameron & Raman, 2005) these includes:

1. Risk assessment (analysis and evaluation);
2. Risk treatment (elimination, mitigation, transfer);
3. Risk acceptance (tolerability/acceptability criteria);
4. Risk communication (information sharing with stakeholders); and
5. Risk monitoring (auditing, evaluation, compliance).

Previously, the failure of the machine has caused Mayora Chocolate Division a lot of trouble. Packaging defect, metal can't be detected inside the food, barcode show wrong information or printed in the wrong place is several examples of machine failure that binder their fulfillment plan. Not only it affects the production plan but also affect the customer trust towards the brand. Therefore, Mayora Chocolate Division has issued to build a plan in order to prevent any accidents that might be occurred to the machine. Failure Mode and Effect Analysis (FMEA) will help to understand the processes in detail by highlighting the risks and mitigating the risks.

This research is done to design failure mode profile based on the production machineries of Mayora Chocolate Division. The method that will be used to solve this problem is Failure Mode, and Effect Analysis (FMEA) to develop the risk assessment.

1.2 Problem Formulation

The problem formulated in this research is to identify, assess, and evaluate the failure mode related to the multipack line.

1.3 Research Objectives

The objectives of this research are namely as follows:

1. To identify the failure mode caused by machine failure;
2. Create Risk Mapping based on Severity and Occurrence.
3. To recommend the action towards identified failure modes based on the available alternative.

1.4 Benefits

The benefits that can be obtained from this research are:

1. Identification of potential failure mode and effect analysis
2. Reference for the company when making decision to ensure and prevent any potential hazard. If it is occurred, the consequences are mitigated and solution(s) is/are proposed.

1.5 Limitation and Assumption

The limitations and assumptions of this research will be shown below.

1.5.1 Limitation

Limitation of this research are as follow:

1. The data used is limited on year 2019
2. The object for analysis is limited to only for multipack line

1.5.2 Assumption

Assumptions made in this research is there are no changes in production machineries during research conducted.

1.6 Report Outline

This chapter will give a brief description about the outline of the report that is used in this research.

CHAPTER 1 INTRODUCTION

This chapter elaborates the background of the research, problem formulation, research objectives, research benefits, research scope and report outline to give big picture of the report mechanism.

CHAPTER 2 LITERATURE REVIEW

This chapter consists of theoretical concept that is used as a foundation of the research derived from various literature studies to assist author in determining appropriate methods that fit with the research problem. The literature will review about Risk, Risk Management, Manufacturing System, Delphi method, Failure Mode, Effect, and Criticality Analysis, and Decision Making and Trial and Evaluation Laboratory.

CHAPTER 3 RESEARCH METHODOLOGY

This chapter explain about each step taken by author in order to conduct this research well-directed and systematic. The research methodology consists of preliminary phase, data collecting and data processing phase and analysis and conclusion phase.

CHAPTER 4 DATA COLLECTING AND PROCESSING

This chapter give explanation about what kind of data required to conduct this research, how the data is being collected and how it is processed according to the method that has been determined in Chapter 3.

CHAPTER 5 DATA ANALYSIS AND INTERPRETATIONS

This chapter explains the analysis of the data as the result of data processing in Chapter 4 and also the interpretation of the result.

CHAPTER 6 CONCLUSION AND RECOMMENDATION

This chapter give conclusion of the research and suggestion as the recommendation for the company and further research.

CHAPTER 2
LITERATURE REVIEW

This chapter will give a thorough explanation about theorem that will be used to solve the problem in this research. There are also several examples to provide a better understanding about the characteristic of the theorem.

2.1 Risk

Risk is more likely to be attributed with loss due to incident which may happen in certain period (Frosdick, 1997). That is why risk is often considered as a negative thing towards an individual or a person. Risk has two meaning; risk that has positive effect is called opportunity and; risk that has negative effect is called threat.

Risk also can be thought of as the effect of uncertainty on objectives (Green, 2016). However, risk can be defined as the chance of something happen that will have an impact on objectives (AS/NZS 4360:2004, 2004).

Quantitatively, risk can state as a result of multiplication of likelihood and consequences. Likelihood use historical data to estimate the probabilities and frequencies while consequences is the impact caused by an event that usually expressed as loss (AS/NZS, 2004).

2.1.1 Types of Risk

There are four types of risk that an organization may run into (Anityasari & Wessiani, 2011). Those are:

1. Operational Risk

   Risk related to operational activities in organization. He factors of undesirable risk are: failed functioning system, technology, human resource and others. There are four sections of operational risk, which will be explained as follow.

   a. Productivity Risk

Related to deviation from the result expected due to disparity of variables which affect productivity, such as technology, materials, tools, and human resources.

b. Technology Risk

Related to deviation from result expected caused by the technology is not accordance to the existing condition.

c. Innovation Risk

Result is not as expected due to innovation, modernization, or transformation in several business aspects.

d. System Risk

Part of process risk due to defect or incompatibility of system to organization operational activities.

2. Financial Risk

Risk related to the financial condition of an organization. It has four section namely as follows.

a. Finance Risk

Related to fluctuation on financial target due to uncertainty in macro-variables.

b. Liquidity Risk

Related to uncertainty or possibility of an organization do not fulfill short term debt or unexpected expenses.

c. Credit Risk

Related to possibility debtor and credits customer cannot pay their debt and fulfill their obligation as stated in the deal prior to the sales

d. Market Risk

Related to the potency of financial condition in the market caused by uncertainty in the market and the organization have to adjust their condition to the market (mark to market). These risks can be divided into interest risk, exchange rate risk, commodity risk, and equity risk.

e. Capital Risk

Related to probability that can't cover up the losses

3. External Risk

   Related to the possibility of unexpected result to corporation exposure and strategy. It may cause a business to be closed down. External risk can be categorized into four sections, namely as follows.

   a. Reputation Risk

      Related to the loss or destruction of an organization reputation due to low or none of environment acceptance to the business

   b. Environment Risk

      Related to the possibility the organization unable to manage the waste and pollution or the effect of waste management.

   c. Social Risk

      Related to the possibility of unexpected result since the organization failed to familiarize themselves to the community around.

   d. Law Risk

      Related to the possibility of unexpected result as the organization fail to follow the regulation.

4. Strategic Risk, is a risk related to organization's exposure as an effect of unsuitable strategic decision to the external and internal environment. There are 3 types of strategic risk namely as follows.

   a. Business Risk

      The possibility of unachieved targets in terms of value of the business, stocks, and finance, because the organization enter a certain business with unique industry environment and specific technology.

   b. Strategic Transaction Risk

      Related to the possibility of unachieved corporation and/or business targets because of strategic transaction

   c. Investor Relationship Risk

Related to the possibility of differences in financial target and exposure as the organization's imperfect relationship handling with investor, either stock-holder or creditor.

2.1.2 Risk Causes

There are two factors caused a risk to be considered, which are disaster and hazard.

1. Disaster is an activity that happened by natural causes, such as flood, earthquake, typhoon, etc.
2. Hazard is the background of loss. Hazard can be categorized into three categories.
    a. Physical hazard, is the physical aspect of the asset to risk. For example, a building which does not have fire equipment is in bigger risk than a building with fire equipment installed.
    b. Morale hazard is a hazard that may happen inflicted to careless attitude towards risk. For example, throwing away cigarettes butt randomly may cause fire.
    c. Legal Hazard, is the hazard happened because a fail action to follow regulation. For example, an operator who does not use personal protective equipment may cause accident fall onto him/her.

2.2 Manufacturing System

Manufacturing system is a collection of integrated equipment and human resources, whose function is to perform one or more processing and/or assembly operations on a starting raw material, part, or set of parts. The integrated equipment includes production machines and tools, material handling and work positioning devices, and computer systems. Human resources are required either full time or periodically to keep the system running. The manufacturing system is where the value-added work is accomplished on the part or product (Groover, 2001).

A manufacturing system consists of several components. These components usually include production machines and its tools, material handling system, computer systems to coordinate and/or control the above components, and human workers.

2.3 Failure Mode and Effect Analysis (FMEA)

Failure modes and effect analysis or FMEA is developed in 1940s by the U.S. Military. It is a method to identify all possible failures in a design, a manufacturing or assembly process, or a product or service. Failures are prioritized according to how serious their consequences are, how frequently they occur and how easily they can be detected (Quality, 2019).

The main purposes of FMEA is to take actions to eliminate or reduce failures. It also documented current knowledge and actions about risks of failures, for use in continuous improvement. FMEA used in initial stage to prevent design and it also used in later stage for control, before and during ongoing operation of the process.

2.3.1 Procedure of FMEA

there are ten steps need to be followed to conduct FMEA procedures (McDermott, et al., 2009), namely as follows

a. Review the Process

In the process of conducting FMEA, the team should review a detailed flowchart of the operation to ensure everyone on the team has the same understanding of the process. If the flowchart is not available, team should make the flowchart first, by physically walk through the process exactly as the process flows with the assistance of an expert.

b. Brainstorm Potential Failure Modes

After the process has been understood, team members can begin thinking about potential failure modes that could affect the process. Team members should come to the brainstorming meeting with a list of their idea. It is better to conduct a series brainstorming sessions, each focused on a different element. Then, the ideas should be organized by grouping it into

categories. It gives a chance to the team to consider if some failure modes should be combined due to similarity. After that, when appropriate, the list should be moved onto the FMEA worksheet.

c. List Potential Effects of Each Failure Mode

With failure modes listed on the FMEA worksheet, the team reviews each failure mode and identifies the potential effects of each failure should it occur.

d. Assign Severity, Occurrence, and Detection Ranking for Each Effect

Each of these ranking is based on a 10-point scale, 1 being the lowest ranking and 10 the highest. It is important to establish clear and concise description for the points on each of the scales, so all team members have the same understanding of the rankings. The scales should be established first before the ranking process begin. The more descriptive the team is when defining the ranking scale, the easier reach consensus during the ranking process. Below is the general scale for each ranking,

Table 2. 1 Generic Process FMEA Severity Evaluation Criteria

Effect	Criteria: Severity of Effect on Product	Rank	Effect	Criteria: Severity of Effect on Process
Failure to meet safety and/or regulatory requirements	Potental failure mode affects safe vehicle operation and/or involves noncompliance with government regulations without warning	1	Failure to meet safety and/or regulatory requirements	May endanger operator without warning
	Potental failure mode affects safe vehicle operation and/or involves noncompliance with government regulations with warning	2		May endanger operator with warning
Loss or degradation of primary function	Loss of primary function (vehicle inoperable, does not affect safe vehicle operation)	3	Major disruption	100% of product may have to be scrapped. Line shutdown or stop ship.
	Degradation of primary function (vehicle operable, but at reduced level of performance).	4	Significant disruption	A portion of the production run may have to be scrapped. Deviation from primary process including decreased line speed or added manpower.

Table 2. 2 Generic Process FMEA Severity Evaluation Criteria (con't)

Effect	Criteria: Severity of Effect on Product	Rank	Effect	Criteria: Severity of Effect on Process
Loss or degradation of secondary function	Loss of secondary function (vehicle inoperable but comfort/convenience functions inoperable)	5	Moderate disruption	100% of production run may have to be reworked off line and accepted
	Degradation of secondary function (vehicle inoperable, but comfort/convenience functions at reduced level of performance).	6		A portion of the production run may have to be reworked off line and accepted
Annoyance	Appearance or audible noise, vehicle operable, item does not conform and noticed by most customer (>75%)	7	Moderate disruption	100% of production run may have to be reworked in-station and accepted
	Appearance or audible noise, vehicle operable, item does not conform and noticed by many customer (50%)	8		A portion of the production run may have to be reworked in-station and accepted
	Appearance or audible noise, vehicle operable, item does not conform and noticed by discriminating customer (<25%)	9	Minor disruption	Slight inconvenience to the process, operation, or operator
No effect	No discemible effect	10	No effect	No discemible effect

Source: McDermott, et al., 2009

Table 2. 3 Generic Process FMEA Occurrence Evaluation Criteria

Likelihood of Failure	Occurrence of Causes – Incidents per item/vehicle	Rank
Very High	≥ 100 per thousand ≥ 1 in 10	10
High	50 per thousand 1 in 20	9
	20 per thousand 1 in 50	8
	10 per thousand 1 in 100	7
Moderate	2 per thousand 1 in 500	6
	0,5 per thousand 1 in 2000	5
	0,1 per thousand 1 in 10.000	4

Source: McDermott, et al., 2009

Table 2. 4 Generic Process FMEA Occurrence Evaluation Criteria (con't)

Likelihood of	Occurrence of Causes – Incidents per	Rank

Failure	item/vehicle	
Low	0,01 per thousand 1 in 100.000	3
	≤ 0,001 per thousand 1 in 1.000.000	2
Very Low	Failure is eliminated through preventive control	1

Table 2. 5 Generic Process FMEA Detection Evaluation Criteria

Opportunity for Detection	Criteria Likelihood of Detection by Process Control	Rank	Likelihood of Detection
No detection opportunity	No current process control; Cannot detect or is not analyzed	10	Almost impossible
Not like to detect at any stage	Failure Mode and/or Error (Cause) is not easily detected (e.g., random audits).	9	Very remote
Problem detection post processing	Failure Mode detection post-processing by operator through visual/tactile/audible means.	8	Remote
Problem detection at source	Failure Mode detection in-station by operator through visual/tactile/audible means or post-processing through use of attribute gauging (go/no-go, manual torque check/clicker wrench, etc.).	7	Very low
Problem detection post processing	Failure Mode detection post-processing by operator through use of variable gauging or in-station by operator through use of attribute gauging (go/no-go, manual torque check/clicker wrench, etc.).	6	Low
Problem detection at source	Failure Mode or Error (Cause) detection in-station by operator through the use of variable gauging or by automated controls in-station that will detect discrepant part and notify operator (light, buzzer, etc.). Gauging performed on setup and first-piece check (for set-up causes only)	5	Moderate
Problem detecting post processing	Failure Mode detection post-processing by automated controls that will detect discrepant part and lock part to prevent further processing.	4	Moderately high
Problem detection at source	Failure Mode detection in-station by automated controls that will detect discrepant part and automatically lock part in station to prevent further processing.	3	High

Table 2. 6 Generic Process FMEA Detection Evaluation Criteria (con't)

Opportunity for Detection	Criteria Likelihood of Detection by Process Control	Rank	Likelihood of Detection
Error detection and/or problem prevention	Error (Cause) detection in-station by automated controls that will detect error and prevent discrepant part from being	2	Very high

Opportunity for Detection	Criteria Likelihood of Detection by Process Control	Rank	Likelihood of Detection
	made.		
Detection not applicable; Error prevention	Error (Cause) prevention as a result of fixture design, not machine design or part design. Discrepant parts cannot be made because item has been error-proofed by process/product design.	1	Almost certain

Source: McDermott, et al., 2009

The best method for determining the occurrence ranking is to use actual data from the process, in the form of failure logs or even process capability data. If actual failure data are not available, the team must estimate how often a failure mode may occur.

Meanwhile, the detection ranking looks at how likely the team detect a failure or the effect of a failure. This step could be started by identifying current controls that may detect a failure or effect of a failure. If there are no current controls, the likelihood of detection will be low, and the item would receive a high ranking, such as 9 or 10.

e. Calculate the Risk Priority Number for Each Effect

The risk priority number (RPN) is simply calculated by multiplying the severity ranking times the occurrence ranking time the detection raking for each item.

$$Risk\ Priority\ Number = Severity \times Occurrence \times Detection \qquad (2.1)$$

The total RPN should be calculated by adding all of RPN. This number alone is meaningless because each FMEA has a different number of failure modes and effects. Nevertheless, it can serve as a gauge to compare the revised total RPN once the recommended actions have been instituted.

f. Prioritize the Failure Modes for Action

The failure modes can be prioritized by ranking them in order from the highest RPN to the lowest. Usually the rule 80/20 are applied with the RPNs as it does with other quality improvement opportunities.

The team must now decide which items to work on. It may help to set a cutoff RPN, where any failure modes with an RPN above that point are attender to, and the one below the cutoff are left alone for the time being.

g. Take Action to Eliminate or Reduce the High-Risk Failure Modes

In order to eliminate or reduce any high-risk failure, the team may use an organized problem-solving process. Ideally, the failure modes should be eliminated completely. When a failure mode has been eliminated completely, the new RPN approaches zero because the occurrence ranking become one. Often, the easiest approach for making a process improvement is to increase the detectability of the failure. However, these approaches are often costly and do not actually improve the process. Reducing severity is important, especially in situations that can lead to injuries. Nevertheless, the richest opportunity for improvement lies in reducing the likelihood of occurrence of the failure.

Table 2. 7 Specific Actions to Reduce Rankings

Severity	Occurrence	Detection
• Personal protective equipment (e.g., hardhats or bump caps, side shields on safety glasses, full face protection, cut-proof gloves, long gloves) • Safety stops/emergency shut-offs • Use different material, such as safety glass that will not cause as severe an injury should it fail.	• Increasing the Cpk through design of experiments and/or equipment modifications. • Focus on continuous improvement/problem-solving teams. • Engaging mechanism that must be activated for the product or process work (e.g., some lawn mowers have handles that must be squeezed in order for them to operate).	• Statistical process control (to monitor the process and identify when the process is going out • of control) • Ensure the measuring devices are accurate and regularly • calibrated. • Institute preventive maintenance to detect problems • before they occur. • Use coding such as colors and shapes to alert the user or worker that something is either right or wrong.

Source: McDermott, et al. 2009

h. Calculate the Resulting RPN as The Failure Modes are Reduced or Eliminated

Once action has been taken to improve the process, new rankings for severity, occurrence, and detection should be determined, resulting new

RPN calculated. The resulting RPNs can be organized on a Pareto diagram and compared with the original RPNs. The total RPNs of the before-and-after process also can be compared.

2.3.2 Advantage and Disadvantages of FMEA

As useful as FMEA method is, of course it has several advantages and disadvantages, too. According to Hodge (2014), FMEA is a logical, structured way to identify areas of concern while reducing time and cost. It is also an effective way to improve areas in which the performance is not great. Moreover, FMEA methods is able to early identification of single failure points and system problems that can hinder success and impact safety.

However, how good and complete the FMEA results are depending on the team behind it. Moreover, if one failure modes are forgotten to be listed, there is a high chance the risk will be ignored.

Another limitation is a function of FMEA's bases for prioritizing failures modes according to their risk. This will not eliminate the failure modes; thus, further actions must be taken. FMEA also must be regularly updated as new potential failure modes may appear.

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CHAPTER 3
RESEARCH METHODOLOGY

This chapter will describe in detail the sequence of conducting this research. These sequences are divided into three main phases, which are preliminary phase, data collecting and processing phase, and analysis and conclusion phase. Below is the flowchart of the research methodology.

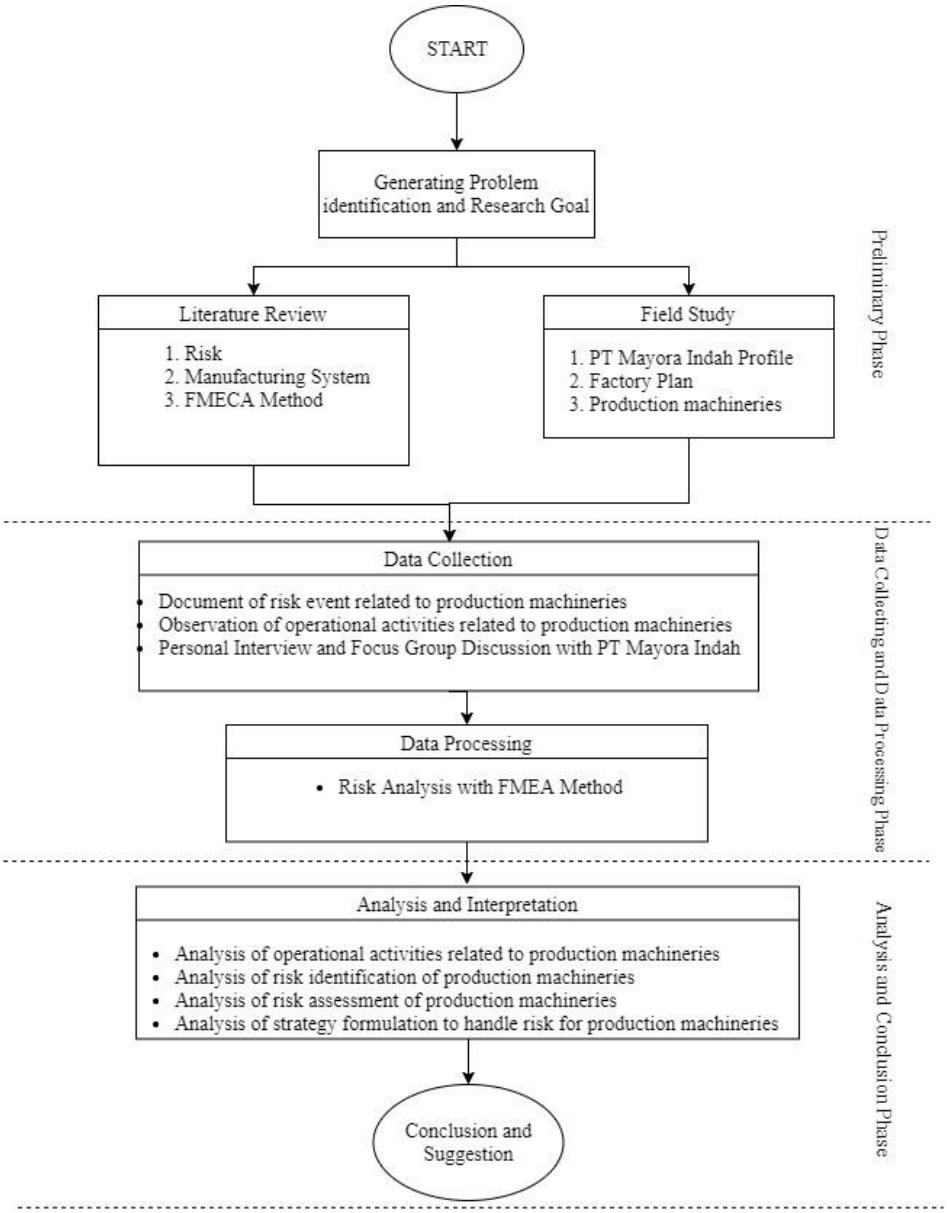

Figure 3. 1 Research flowchart

3.1 Preliminary Phase

This phase consists of identifying the existing risk management condition for the production machineries, problem formulation, research purposes and benefits determination, research scope, literature review, and field study.

3.2.1 Problem Identification and Research Goal

This stage is conducted by doing observation to the production machineries and discussion with manager and several staff of Mayora Chocolate Division. These are conducted to identify the existing condition of the risk management for production machineries. The problem that has been identified will be generated as the research objectives that have to be achieved. The result of these objectives will become the benefit of the research

3.2.2 Literature Review and Field Study

This stage is conducted by searching for related theories as references and guide to do the research. Literature about manufacturing system are taken from text book. Literature about FMEA is taken from books and journals provided from the website.

3.2 Data Collecting Phase

Direct observation, personal interview and using historical data will be used to collect operational activities of production machineries data. Identifying potential risk will be done by interview and focus group discussion. Assessing risk will be done using FMEA method through questionnaire where the risk will be scored based on three indicators which are potential effect (severity), risk cause(occurrence), and current control (detection).

3.3 Data Processing Phase

Data that has been collected in the previous stage will be processed at this stage. The processes are as follows.

3.3.1 Risk Evaluation

The results of questionnaires will be processed to become risk matrix and list of identified risk related to production machineries at Mayora Chocolate Division. The risk priority number (RPN) and the level of each risks then can be determined by calculating the occurrence and detection from the questionnaire.

3.3.2 Risk Mitigation

This stage will develop strategy and action towards risk to mitigate the risk in production machineries of Mayora Chocolate Division, and if it happened, understood how to handle any accident related to production machineries.

3.4 Analysis and Interpretation Phase

This phase consists of analyzing the result of data processing phase. The analysis of risk management implementation, analysis of operational activities related to the production machineries, analysis of risk identification and risk assessment, and analysis of strategy formulation to handle risk of production machine.

3.5 Conclusion and Recommendation Phase

This phase formulates the conclusion and suggestion to the related parties based on the result of analysis and interpretation phase. The conclusion will answer the research purposes while suggestion is formed towards the object, which in this case is Mayora Chocolate Division and for further research.

CHAPTER 4
DATA COLLECTING AND PROCESSING

This chapter will show the result of data collected from multipack line at Mayora Chocolate Division. Later the data will be processed into risk evaluation and risk mitigation.

4.1 Profile of Mayora Chocolate Division

PT Mayora Indah Tbk were established in 1977 as a Fast-moving Consumer Good (FMCG) Company. In 1990 PT Mayora Indah Tbk become a public listed company through Initial Public Offering (IPO) by listing its share on Jakarta Stock Exchange.

Until now there are 8 divisions at PT Mayora Indah Tbk where each division responsible for several products, there are: Cookies Division; Candies Division; Chocolates Division; Coffee Division; Beverages Division; Wafer Division; Instant Food Division and; Cereal Division.

One of its division is Mayora chocolate division is responsible to produce choki-choki, chocolate granule, and produce mung bean and chocolate that will be used for other divison(s). Mayora chocolate division is located at Jln. Yos Sudarso KM. 19, Batu Ceper, Tangerang.Banten.

4.1.1 Vision and Mission of PT Mayora Indah Tbk

The vision and mission of PT Mayora Indah Tbk are:

- To become a quality manufacturer of food and beverage products that is trusted by the consumers both domestic and international market, and control a significant market share in every category entered
- To provide added value to all the company stakeholder
- To provide a positive contribution to the environment, and the country where the company operates.

4.1.2 Organizational Structure

The organizational structure of Mayora Chocolate Division can be seen in the figure below.

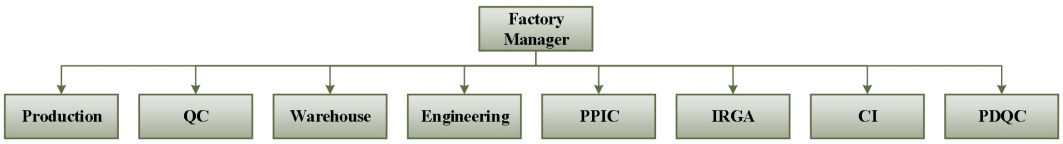

Figure 4. 1 Mayora Chocolate Division Organizational Structure

4.2 General Description of Multipack Line

Multipack line is one of many packaging lines in Mayora chocolate division. This multipack line is specialized for Choki-Choki Thailand 5gr. This multipack packaging line is used for packing choki-choki stick.

Figure 4. 2 Choki Choki packing

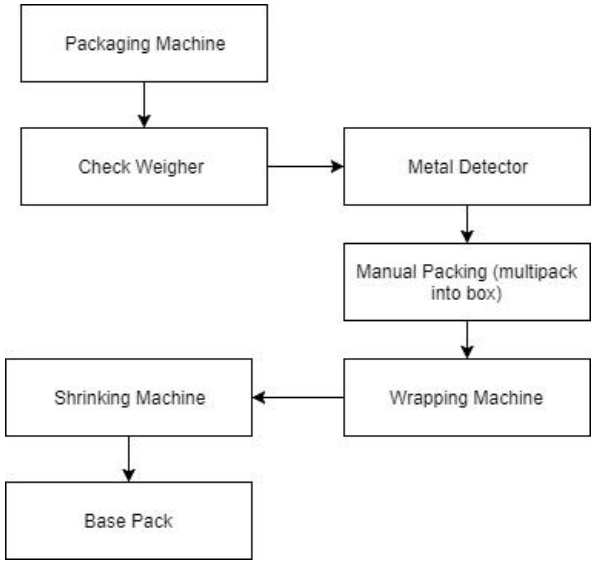

Figure 4. 3 Process in Multipack Line

.

The multipack line is consisting of several machines, there are packaging machine, check weigher, metal detector, wrapping machine, shrinking machine and base pack.

4.2.1 Packaging machine

Packaging machine is made of infeed conveyor, former box, celo roller, registered mark sensor, center sealer, end sealer cutter, and printing. Infeed conveyor is used to deliver product, former box is used to create shape of packing made out of celo. Celo roller is used to set the celo in the right direction, while registered mark sensor is used to read the registered mark to let the machine know where to cut the celo. Center sealer is used to make the pre-seal of the packaging and end sealer cutter is for sealing the packaging and cutting it. The printing machine is used to print the production code into the packaging.

4.2.2 Check Weigher

Check weigher is consist of air blast, weighing unit, weighing conveyor and photo sensor. Air blast is used to blow the product out of the conveyor, weighing unit is used to weighing the product, weighing conveyor is used to deliver the product and photo sensor is used to detect the product that will be weighed.

4.2.3 Metal Detector

Metal detector is consisting of metal detector and conveyor. The metal detector is used to detect the amount of metal contained in a product, if it gets past the limit then the product will be rejected.

4.2.4 Wrapping Machine

Wrapping machine consisting of plastic roller, sealer and conveyor. Plastic roller is used to set direction of the plastic that will be used as a base to wrap the product, sealer is used to create seal around the plastic that has wrapped around the product.

4.2.5 Shrinking Machine

Shrinking machine is consist of heater and conveyor. The heater is used to create the heat at a certain degree to shrink the plastic that has been wrapped around the product.

4.2.6 Base pack

Base pack is consisting of printing and tape cutter. Printing is used to print the codification of the product into the base pack while tape cutter is used to cut the tape after sealing the base pack.

4.3 Failure Mode Identification

The identification of failure mode is using focus group discussion. The member of the focus group discussion will be shown in the table below.

Table 4. 1 List of Respondent

Name	Position	Graduates
Ade Agung Laksono	Unit Head	S1 Electrical Engineering
Akhmad Misbahnun	Staff	Vocational High School (Electrical Engineering)
Yoyok Kristiyono	Staff	Vocational High School (Mechanical Engineering)

Source: Author's document

The discussion goes through a series of questions regarding the failure modes happen in the packaging machineries. The result of the discussion can be seen in the table below.

Table 4. 2 Failure Mode Identification

Machine	Code	Item	FM Code	Potential Failure Mode
Packaging Machine	A1	Infeed Conveyor	R1	Product not lifted
			R2	Product snagged
	A2	Former box	R3	packaging torn or scratched
	A3	celo roller	R4	celo deviate or tilted
	A4	Registered Mark Sensor	R5	Change occurred in the printed cello pattern
			R6	Registered mark can't be read
	A5	Center Sealer	R7	Seal not sticking
			R8	Cello shrivel up
	A6	End Sealer Cutter	R9	Seal not sticking
			R10	Cello shrivel up
			R11	Cutting result not according to the standard
	A7	Printing	R12	Misprint product code
			R13	Codification not according to standards

Table 4. 3 Failure Mode Identification (con't)

Machine	Code	Item	FM Code	Potential Failure Mode
Check Weigher	B1	Solenoid Valve Unit	R14	Wind blower not working
			R15	Lack of wind pressure
	B2	Weighing unit	R16	scale number can't be stabilized
			R17	Scale can't detect product that weighed over or below the limit
	B3	Weighing conveyor	R18	Product not lifted
	B4	Photo Sensor	R19	sensor cannot detect the product
	B5	Filter Regulator	R20	Cannot set the pressure on filter regulator
			R21	Air leak from the filter regulator
			R22	Filter regulator cannot be dried
Metal Detector	C1	Metal detector	R23	Metal inside the product cannot be detected
			R24	Detected metal is not match with the real amount
	C2	Conveyor	R25	Product not lifted
			R26	Product snagged

Wrapping	D1	Plastic Roller	R27	Plastic snagged
			R28	plastic cut leftover moves to the w4ong place
	D2	Sealer	R29	Seal not sticking
			R30	Product misplaced
			R31	Cello shrivel up
	D3	Conveyor	R32	Product not lifted
Shrinking	E1	heater	R33	Plastic doesn't shrink
			R34	Plastic wrap shrivel up
	E2	Conveyor	R35	Product not lifted
Basepack	F1	Printing	R36	Misprint product code
			R37	Codification not according to standards
	F2	Tape cutter	R38	Carton being cut off

Source: Author's document

4.4 Failure Mode Analysis using FMEA Method

The failure mode analysis begins with identifying the potential effect and risk cause identification to know the severity, occurrence and detection score in every potential failure mode. This needs to be conducted to identify the prioritized potential risk based on Risk Priority Number (RPN)

4.4.1 Potential Effect and Risk Cause Identification

This process is conducted to identify the level of severity, probability of an accident occurred, and existing control level. The process of identification is done by observation, interview, and discussion with the respondent.

Table 4. 4 Potential Effect and Risk Cause Identification

FM Code	Potential Failure Mode	Potential Effect	Risk Cause
R1	Product not lifted	product is not inside the packaging	Different size attachment
R2	Product snagged	product is not inside the packaging	Incorrect conveyor speed
R3	packaging torn or scratched	lipatan tidak terbentuk	ukuran former tidak tepat
R4	celo deviate or tilted	packaging not according to standard	sudut entry celo salah
R5	Change occurred in the printed cello pattern	packaging not according to standard	Posisi sensor registered mark kurang tepat
R6	Registered mark can't be read	Celo not cut off	sensor tidak dapat membaca register mark
R7	Seal not sticking	Air leak	heater temperature too low, sealing point not parallel with central point
R8	Cello shrivel up	packaging not according to standard	heater temperature too high
R9	Seal not sticking	Air leak	heater temperature too low, sealing point not parallel with central point
R10	Cello shrivel up	packaging not according to standard	heater temperature too high
R11	Cutting result not according to the standard	Packaging scratched	Pisau kurang tajam, tingkat kecepatan pemotongan
R12	Misprint product code	Code position not according to standard	Incorrect printer position
R13	Codification not according to standards	Code position not according to standard	
R14	Wind blower not working	Defect product cannot be blown out of the conveyor	Wind pressure is too low
R15	Lack of wind pressure	Defect product cannot be blown out of the conveyor	Compressor capacity is not enough
R16	scale number can't be stabilized	Product cannot be weighed	loose bolt, choose a wrong program

Table 4. 5 Potential Effect and Risk Cause Identification (con't)

FM Code	Potential Failure Mode	Potential Effect	Risk Cause
R17	Scale can't detect product that weighed over or below the limit	Product cannot be weighed	Weghing unit defect
R18	Product not lifted	Product cannot be weighed	timing belt defect
R19	sensor cannot detect the product	Product cannot be weighed	Incorrect sensor position
R20	Cannot set the pressure on filter regulator	Defect product cannot be blown out of the conveyor	adjustment spring or valve spring is defect
R21	Air leak from the filter regulator	Defect product cannot be blown out of the conveyor	gasket or O-ring is damaged
R22	Filter regulator cannot be dried	Defect product cannot be blown out of the conveyor	Outlet of the drain cock is clogged with solid foreign objects
R23	Metal inside the product cannot be detected	Defect product cannot be detected	defect metal detector
R24	Detected metal is not match with the real amount	Defect product cannot be detected	skala metal detector tidak berfungsi dengan baik
R25	Product not lifted	Product cannot enter the process	Motor drive defect
R26	Product snagged	Product cannot be delivered to the next process	Incorrect conveyor speed
R27	Plastic snagged	Product cannot be wrapped	Wrong entry angle
R28	plastic cut leftover moves to the w4ong place	Impede the running machine	Roller position is incorrect
R29	Seal not sticking	Easy to be torn off	Temperature too low
R30	Product misplaced	Product cut off	
R31	Cello shrivel up	Product not according to standard	Temperature too high
R32	Product not lifted	Product cannot be wrapped	timing belt defect
R33	Plastic doesn't shrink	Product not according to standard	Temperature too low
R34	Plastic wrap shrivel up	packaging not according to standard	Temperature too high
R35	Product not lifted	Product cannot enter the process	Motor drive defect
R36	Misprint product code	Code position not according to standard	Incorrect printer position
R37	Codification not according to standards		
R38	Carton being cut off	Carton has defect	Cutters are not apropriately set

4.4.2 Severity, Occurrence and Detection Scoring

To determine the scores of severity, occurrence, and detection, questionnaire is given to three persons which are Engineering Unit Head, and 2 Engineering staff.

Table 4. 6 Severity, Occurrence and Detection Value

FM Code	Potential Failure Mode	Severity	Occurrence	Detection
R1	Product not lifted	2	2	4
R2	Product snagged	3	5	5
R3	packaging torn or scratched	3	4	7
R4	celo deviate or tilted	3	4	3
R5	Change occurred in the printed cello pattern	8	1	5
R6	Registered mark can't be read	2	4	3
R7	Seal not sticking	7	5	4
R8	Cello shrivel up	7	5	3
R9	Cutting result not according to the standard	7	6	3
R10	Misprint product code	6	4	5
R11	Codification not according to standards	8	6	5
R12	Wind blower not working	2	2	3
R13	Lack of wind pressure	2	2	5
R14	scale number can't be stabilized	5	5	3
R15	Scale can't detect product that weighed over or below the limit	5	6	7
R16	sensor cannot detect the product	5	3	5
R17	Cannot set the pressure on filter regulator	6	2	7
R18	Air leak from the filter regulator	2	2	7
R19	Filter regulator cannot be dried	2	1	7
R20	Metal inside the product cannot be detected	7	7	5
R21	Detected metal is not match with the real amount	5	5	5
R22	Plastic got stuck	6	4	3
R23	plastic cut leftover moves to the w4ong place	2	3	3
R24	Product misplaced	7	6	3
R25	Plastic wrap shrivel up	7	4	4
R26	Plastic doesn't shrink	5	7	5
R27	Carton being cut off	5	4	7

4.4.3 Risk Priority Number (RPN) Score Calculation

To calculate Risk Priority Number, severity, occurrence, and detection score from the questionnaires will be multiplied. From RPN score, the critical risk will be known. Below is the example calculation of Risk Priority Number for Risk 1.

$$\begin{aligned} \text{RPN} &= 2 \times 2 \times 4 \\ &= 16 \end{aligned}$$

Table 4. 7 RPN of each Risk

FM Code	Potential Failure Mode	RPN
R1	Product not lifted	16
R2	Product snagged	75
R3	packaging torn or scratched	84
R4	celo deviate or tilted	36
R5	Change occurred in the printed cello pattern	40
R6	Registered mark can't be read	24
R7	Seal not sticking	140
R8	Cello shrivel up	105
R9	Cutting result not according to the standard	126
R10	Misprint product code	120
R11	Codification not according to standards	240
R12	Wind blower not working	12
R13	Lack of wind pressure	20
R14	scale number can't be stabilized	75
R15	Scale can't detect product that weighed over or below the limit	210
R16	sensor cannot detect the product	75
R17	Cannot set the pressure on filter regulator	84
R18	Air leak from the filter regulator	28
R19	Filter regulator cannot be dried	14
R20	Metal inside the product cannot be detected	245
R21	Detected metal is not match with the real amount	125
R22	Plastic got stuck	72
R23	plastic cut leftover moves to the w4ong place	18
R24	Product misplaced	126
R25	Plastic wrap shrivel up	112
R26	Plastic doesn't shrink	175
R27	Carton being cut off	140

4.5 Risk Evaluation

4.5.1 Risk Ranking Determination

The rank of risks will be determined based on the calculation of Risk Priority Number of each risk. The risk ranking determination will be used to see which risks should be handled first. The higher the RPN, the higher the chance for the risk to be identified as highly urgent mitigated.

Table 4. 8 Risk Ranking based on the highest RPN

FM Code	Potential Failure Mode	RPN
R20	Metal inside the product cannot be detected	245
R11	Codification not according to standards	240
R15	Scale can't detect product that weighed over or below the limit	210
R26	Plastic doesn't shrink	175
R07	Seal not sticking	140
R27	Carton being cut off	140
R09	Cutting result not according to the standard	126
R24	Product misplaced	126
R21	Detected metal is not match with the real amount	125
R10	Misprint product code	120
R25	Plastic wrap shrivel up	112
R08	Cello shrivel up	105
R03	packaging torn or scratched	84
R17	Cannot set the pressure on filter regulator	84
R02	Product snagged	75
R14	scale number can't be stabilized	75
R16	sensor cannot detect the product	75
R22	Plastic got stuck	72
R05	Change occurred in the printed cello pattern	40
R04	cello deviate or tilted	36
R18	Air leak from the filter regulator	28
R06	Registered mark can't be read	24
R13	Lack of wind pressure	20
R23	plastic cut leftover moves to the wrong place	18
R01	Product not lifted	16
R19	Filter regulator cannot be dried	14
R12	Wind blower not working	12

4.5.2 Risk Mapping

The result of risk scoring which is based on the criteria of severity, occurrence, and detection in the sub chapter will be used as the input for the risk mapping, considering two scoring criteria, which are severity as the x-axis and occurrence as the y-axis.

Table 4. 9 Risk Mapping

Risk Consequences Level										
10										
9										
8	R05					R11				
7				R25	R7,R8	R9,R24	R20			
6		R17		R10,R22						
5			R16	R27	R14,R21	R15	R26			
4										
3				R03,R04	R02					
2		R01, R12, R13,R18	R23	R06						
1	R19									
	1	2	3	4	5	6	7	8	9	10

Risk Likelihood Level

Table 4. 10 Risk Mapping result

FM Code	Potential Failure Mode	RPN	Risk Category
R20	Metal inside the product cannot be detected	245	High
R11	Codification not according to standards	240	High
R15	Scale can't detect product that weighed over or below the limit	210	High
R26	Plastic doesn't shrink	175	High
R7	Seal not sticking	140	High
R27	Carton being cut off	140	High
R9	Cutting result not according to the standard	126	High
R24	Product misplaced	126	High
R21	Detected metal is not match with the real amount	125	High
R10	Misprint product code	120	High
R25	Plastic wrap shrivel up	112	High
R8	Cello shrivel up	105	High
R3	packaging torn or scratched	84	Medium

Table 4. 11 Risk Mapping result (con't)

FM Code	Potential Failure Mode	RPN	Risk Category
R17	Cannot set the pressure on filter regulator	84	Medium
R2	Product snagged	75	Medium
R14	scale number can't be stabilized	75	High
R16	sensor cannot detect the product	75	Medium
R22	Plastic got stuck	72	High
R5	Change occurred in the printed cello pattern	40	Low
R4	cello deviate or tilted	36	Medium
R18	Air leak from the filter regulator	28	Low
R6	Registered mark can't be read	24	Low
R13	Lack of wind pressure	20	Low
R23	plastic cut leftover moves to the wrong place	18	Low
R1	Product not lifted	16	Low
R19	Filter regulator cannot be dried	14	Low
R12	Wind blower not working	12	Low

4.6 Risk Mitigation Formulation

In order to determine the strategy of handling the risks, author design a plan to handle all of the risks. But, the priority to the risk is needed to be considered since not all risks can be mitigated with the best way to minimize cost. Risk that fall in the orange zone (high risk) in the risk mapping. The risk that is mapped in the orange area, or high risk, these risks are prioritized to be mitigated due to the result of multiplication between occurrence, severity, and detection score.

Table 4. 12 High Priority Failure Mode

FM Code	Potential Failure Mode	Risk Category
R07	Seal not sticking	High
R08	Cello shrivel up	High
R09	Cutting result not according to the standard	High
R10	Misprint product code	High
R11	Codification not according to standards	High
R14	scale number can't be stabilized	High
R15	Scale can't detect product that weighed over or below the limit	High

FM Code	Potential Failure Mode	Risk Category
R20	Metal inside the product cannot be detected	High
R21	Detected metal is not match with the real amount	High
R22	Plastic got stuck	High
R24	Product misplaced	High
R25	Plastic wrap shrivel up	High
R26	Plastic doesn't shrink	High
R27	Carton being cut off	High

Table 4. 13 Failure Mode Mitigation

FM Code	Potential Failure Mode	Risk Mitigation			
		Accept	Avoid	Transfer	Mitigate
R07	Seal not sticking	Manual check by operator			Periodic temperature check
R08	Cello shrivel up	manual check by operator			
R09	Cutting result not according to the standard	Manual check by operator			
R10	Misprint product code	Manual check by operator			
R11	Codification not according to standards	Manual check by operator			
R14	scale number can't be stabilized		prepare a reserve scale in the production area		Periodic checking
R15	Scale can't detect product that weighed over or below the limit				
R20	Metal inside the product cannot be detected		Prepare a reserve metal detector in the production area		Periodic checking
R21	Detected metal is not match with the real amount				Periodic checking
R22	Plastic got stuck	Manual check by operator			
R24	Product misplaced	Manual check by operator			

FM Code	Potential Failure Mode	Risk Mitigation			
		Accept	Avoid	Transfer	Mitigate
R25	Plastic wrap shrivel up	Manual check by operator			Periodic temperature check
R26	Plastic doesn't shrink	Manual check by operator			
R27	Carton being cut off		change sensor periodically		Make sure the position of the knife is correct and sensor has no problem detecting the carton

CHAPTER 5
DATA ANALYSIS AND INTERPRETATION

This chapter will give thorough explanations and analysis about the potential risk of packaging machineries and the strategy formulation for the potential risk in the packaging machineries.

5.1. Risk Identification Analysis Related to Packaging Machineries

The process of risk identification is conducted through direct interview and observation. In this case, risk can be categorized as any event that led to packaging machineries stopped working or doesn't have the function as it intended. There are 3 respondents being asked about the risk identification of packaging machineries. The respondents are the unit head of the engineering department in choki-choki and 2 staffs also from engineering department. The respondent is selected based on their job description as engineering department because it handles all the problems related to machineries in the factory therefore this department has the experience and knowledge to help and understand the process of risk identification.

The problem when doing risk identification is the working time of the staff engineering department as the staff work in different shift everyday therefore it is hard to find the time to meet with the staff. Based on the results of the interview and observation, there are 27 risk identified on the packaging machineries.

5.2. Analysis of Potential Risk Related to Packaging Machineries

The next step is to identify the severity, occurrence and detection of each risk as there are uncertainty about when the event will be triggered and if it is triggered it will cause the production activities to be ceased immediately. This process is important to understand how severe a risk when it occurred, how often this risk occurred and the easiness to detect it when it occurred.

The identification process is conducted through questionnaire where the unit head of the engineering department and 2 staffs from the engineering

department are selected as respondents. The questionnaires help to identify the potential effect and risk cause in the packaging machineries.

5.3. Analysis of Potential Risk Scoring for Packaging machineries

The score of severity, occurrence and detection are also determined by the unit head of engineering department and 2 staff from engineering department. Severity is used to measure the loss if it occurred, the higher the score of severity means higher loss. The scale is from 1 to 10 where 1 is no effect when the risk is occurred and 10 is could endanger operator without any warning. The highest rated number is 8 which means it is a major disruption and it is scored for R5 change in the printed cello pattern and R11 the product codification not according to standard. The average score is 5 means there are moderate consequences when the risk is occurred therefore the risk need to be handled.

Occurrence is used to measure the possibility of a risk occurred, the higher the score of occurrence means higher likelihood of the risk to be occurred. The occurrence use scale from 1 to 10 where 1 means the probability is very low while 10 means the probability is very high. The highest score for occurrence is 7 which means the probability is high and it is scored for R20 cannot detect metal inside the product and R26 plastic doesn't shrivel up.

Detection is used to measure the possibility of a risk being detected before it occurred, the higher detection score means the possibility of the risk not being detected right away is higher. The detection use scale 1 to 10 where 1 is error prevention while 10 is no detection opportunity. Based on the results, the highest score for detection is 7 which means it is detected at the source by operator using visual and it is scored for R3 packaging torn or scratched, R15 scale cannot detect product that has weight over or under the limit, R17 cannot set the pressure on filter regulator, R18 Air leak from the filter regulator, R19 filter regulator cannot be dried up and R27 carton being cut off.

Risk Priority Number (RPN) can be calculated by using the score of severity, occurrence and detection by multiplying its respective value for each risk. The score in RPN show the priority of handling the risk. The highest RPN number

is 245 for R20 metal inside the product cannot be detected, followed by 240 for R11 codification not according to standards and 210 for R15 scale cannot detect product that weighed over or below the limit.

The priority of handling the risk is also determined by risk mapping. Risk mapping categorized risk into low, medium, and high. Risk mapping is done by using the score of severity and occurrence. Based on this category, there are 14 high risk, 5 medium risk and 8 low risk.

`

5.4.Analysis of Strategy Formulation for Packaging Machineries

The strategy formulation in handling the risk for packaging machineries. The priority of the risk is based on the orange area in the risk mapping. There are 14 risks categorized as high risk, which formulated by brainstorming and discussion with the engineering department of Mayora Chocolate Division. There are four treatment for a risk which are acceptance (accept potential risk and keep operate the process or implement a control method to reduce risk level to an accepted level), avoidance (avoid risk by eliminate the cause of risk or the consequences), transfer (transfer risk to other parties) and mitigation (find alternatives action to reduce the probability or consequences of the risk).

There are 9 acceptance risk treatment, 5 avoidance risk treatment and 10 mitigation risk treatment. The highest treatment is mitigation because the packaging machineries is a sequential operational activity so when there is a problem in the first stage then the second stage cannot be proceeded. The avoidance and acceptance risk treatment are conducted because the risk is seen as a risk that can be handled if the activity is conducted according to the standard operational procedure.

CHAPTER 6
CONCLUSION AND SUGGESTION

6.1. Conclusion

1. The risk is identified by using experts' judgements with total of 27 potential risk identified in focus group discussion. The risk scoring is done by using FMEA methodology. Potential effect, risk cause, and current control is identified to get accurate RPN. There are 14 failure modes that are categorized as high risk (metal inside the product cannot be detected, codification not according to standards, scale cant detect product that weight over or below the limit, plastic doesn't shrink, seal not sticking, carton being cut off, cutting result not according to the standard, product misplaced, detected metal is not match with the real amount, misprint product code, plastic wrap shrivel up, cello shrivel up, scale number can't be stabilized and plastic got stuck), 5 failure modes categorized as medium risk (packaging torn or scratched, cannot set the pressure on filter regulator, product snagged, sensor cannot detect the product and cello deviate or tilted) and 8 failure modes categorized as low risk (Change occurred in the printed cello pattern, air leak from the filter regulator, registered mark can't be read, lack of wind pressure, plastic cut leftover moves to the wrong place, product not lifted, filter regulator cannot be dried and wind blower not working).
2. The risk mapping is created based on risk priority number and the score of severity and occurrence. There are total 4 areas; which are critical risk; high risk; medium risk; and low risk.
3. The action towards potential risks is formulated based on the risk priority number, its current control, and the potential effect. The risk priority is based on the category of risk and the correlation of the risk.

6.2. Suggestion

1. Mayora chocolate division should put their potential risk and mitigation accessible by the employee

2. Mayora chocolate division should implement risk management to help their plants

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ATTACHMENT

ATTACHMENT A

List of Questions for Failure Mode Identification

1. What are the machineries used in packaging line?
2. What are the problems that occurred in the past for each machine?
3. What are the risk potentials of each machine?

ATTACHMENT B

Failure Mode Assessment based on Severity Occurrence and Detection

Kriteria penilaian dilakukan berdasarkan 3 kategori yaitu *severity, occurrence,* dan *detection*. Kriteria penilaian dapat dilihat pada table dibawah ini:

1. *Severity*

Berikut merupakan skala penilaian terhadap *severity*.

Effect	Criteria: Severity of Effect on Product	Rank
Gagal mmnuhi peraturan dan/atau persyaratan keselamatan	Potensial mode kegagalan mempengaruhi operasi mesin yang aman dan / atau melibatkan ketidakpatuhan terhadap peraturan pemerintah tanpa peringatan	10
	Mode kegagalan potensial mempengaruhi operasi mesin yang aman dan / atau melibatkan ketidakpatuhan terhadap peraturan pemerintah dengan peringatan	9
Kehilangan atau penurunan fungsi utama	Kehilangan fungsi utama (mesin tidak bisa dioperasikan, tidak mempengaruhi operasi mesin yang aman)	8
	Degradasi fungsi utama (mesin dapat dioperasikan, tetapi pada tingkat kinerja yang lebih rendah).	7
Kehilangan atau penurunan fungsi sekunder	Kehilangan fungsi sekunder (mesin tidak dapat dioperasikan tetapi fungsi kenyamanan / kenyamanan tidak bisa dioperasikan)	6
	Degradasi fungsi sekunder (mesin tidak dapat dioperasikan, tetapi fungsi kenyamanan / kemudahan pada tingkat kinerja yang lebih rendah).	5
Gangguan	Penampilan atau kebisingan yang dapat didengar, mesin dapat dioperasikan, barang tidak sesuai dan diperhatikan oleh sebagian besar pelanggan (> 75%)	4
	Penampilan atau kebisingan yang dapat didengar, mesin dapat dioperasikan, barang tidak sesuai dan diperhatikan oleh banyak pelanggan (50%)	3
	Penampilan atau kebisingan yang dapat didengar,mesin dapat dioperasikan, barang tidak sesuai dan diperhatikan oleh pelanggan yang melakukan diskriminasi (<25%)	2
Tidak ada pengaruh	Tidak ada efek yang terlihat	1

2. *Occurrence*

Berikut merupakan skala penilaian terhadap *occurrence*.

Likelihood of Failure	Occurrence of Causes – Incidents per item/vehicle	Rank
Sangat Tinggi	≥ 100 per Seribu ≥ 1 Dalam 10	10
Tinggi	50 per Seribu 1 Dalam 20	9
	20 per Seribu 1 Dalam 50	8
	10 per Seribu 1 Dalam 100	7
Sedang	2 per Seribu 1 Dalam 500	6
	0,5 per Seribu 1 Dalam 2000	5
	0,1 per Seribu 1 Dalam 10.000	4
Rendah	0,01 per Seribu 1 Dalam 100.000	3
	≤ 0,001 per Seribu 1 Dalam 1.000.000	2
Sangat Rendah	Kegagalan dapat dieliminasi dengan tindakan preventif	1

3. *Detection*

Berikut merupakan skala penilaian terhadap *detection*.

Opportunity for Detection	Criteria Likelihood of Detection by Process Control	Rank	Likelihood of Detection
Tidak ada peluang deteksi	Tidak ada kontrol proses saat ini; Tidak dapat mendeteksi atau tidak dianalisis saat ini	10	Hampir tidak mungkin
Sulit terdeteksi pada tahap apapun	Mode Kegagalan dan / atau Kesalahan (Penyebab) tidak mudah terdeteksi (mis., Audit acak).	9	Sangat jauh

Opportunity for Detection	Criteria Likelihood of Detection by Process Control	Rank	Likelihood of Detection
Masalah terdeteksi setelah proses	Deteksi Mode Kegagalan pasca pemrosesan oleh operator melalui sarana visual / tactile / audible.	8	Jauh
Masalah terdeteksi pada sumber	Deteksi Mode Kegagalan di-stasiun oleh operator melalui sarana visual / tactile / audible atau pasca-pemrosesan melalui penggunaan pengukuran atribut (go / no-go, cek torsi manual / kunci pas klik, dll.).	7	Sangat rendah
Masalah terdeteksi setelah proses	Deteksi Mode Kegagalan pasca-pemrosesan oleh operator melalui penggunaan pengukuran variabel atau in-station oleh operator melalui penggunaan atribut pengukuran (go / no-go, cek torsi manual / kunci pas klik, dll.).	6	Rendah
Masalah terdeteksi pada sumber	Mode Kegagalan atau Kesalahan (Penyebab) deteksi di-stasiun oleh operator melalui penggunaan pengukur variabel atau dengan kontrol otomatis di-stasiun yang akan mendeteksi bagian yang tidak sesuai dan memberi tahu operator (cahaya, bel, dll.). Pengukuran dilakukan pada pengaturan dan pemeriksaan potongan pertama (hanya untuk penyebab pengaturan)	5	Sedang
Masalah terdeteksi setelah proses	Deteksi Mode Kegagalan pasca pemrosesan dengan kontrol otomatis yang akan mendeteksi bagian yang tidak sesuai dan mengunci bagian untuk mencegah pemrosesan lebih lanjut.	4	Cukup Tinggi
Masalah terdeteksi pada sumber	Deteksi Mode Kegagalan di stasiun dengan kontrol otomatis yang akan mendeteksi bagian yang tidak sesuai dan secara otomatis mengunci bagian di stasiun untuk mencegah pemrosesan lebih lanjut.	3	Tinggi
Deteksi kesalahan dan / atau pencegahan masalah	Deteksi kesalahan (Penyebab) di-stasiun oleh kontrol otomatis yang akan mendeteksi kesalahan dan mencegah bagian yang tidak sesuai dibuat.	2	Sangat tinggi
Pencegahan kesalahan	Pencegahan kesalahan (Penyebab) sebagai akibat dari desain fixture, bukan desain mesin atau desain bagian. Komponen yang tidak sesuai tidak dapat dibuat karena barang telah dibuktikan kesalahannya oleh proses / desain produk.	1	Hampir pasti

Petunjuk Pengisian : Bapak/Ibu dimohon untuk menilai daftar risiko dengan skala 1-10 sesuai dengan kriteria penilaian yang telah dijelaskan.

Code	Item	FM Code	Potential Failure Mode	S	O	D
A1	Infeed Conveyor	R1	Produk tidak terangkut			
		R2	Produk tersangkut			
A2	Former box	R3	packaging hancur			
A3	celo roller	R4	celo menyimpang			
A4	Registered Mark Sensor	R5	perubahan pola celo yang dicetak			
		R6	Registered mark tidak terbaca			
A5	Center Sealer	R7	Seal tidak rapat			
		R8	celo meleleh			
A6	End Sealer Cutter	R9	Seal tidak rapat			
		R10	celo meleleh			
		R11	Hasil potongan tidak sesuai standar			
A7	Printing	R12	salah tempat pencetakan kode produk			
		R13	kodifikasi tidak tercetak dengan baik			
B1	Solenoid Valve Unit	R14	tidak dapat mengeluarkan angin			
		R15	Angin yang dikeluarkan kurang kencang			
B2	Weighing unit	R16	angka timbangan tidak dapat stabil			
		R17	Angka timbangan tidak berubah			
B3	Weighing conveyor	R18	Produk tidak terangkut			
B4	Photo Sensor	R19	sensor tidak dapat mendeteksi barang			
B5	Filter Regulator	R20	Tidak dapat mengatur tekanan pada filter regulator			
		R21	Udara bocor dari filter regulator			
		R22	Filter regulator tidak dapat dikeringkan			
C1	Metal detector	R23	Tidak dapat mendeteksi metal di dalam produk			
		R24	Jumlah metal yang terdeteksi tidak akurat			
C2	Conveyor	R25	Produk tidak terangkut			
		R26	Produk tersangkut			
D1	Plastic	R27	plastik tersangkut			

Code	Item	FM Code	Potential Failure Mode	S	O	D
	Roller	R28	Sisa potongan plastik tidak terbuang pada tempatnya			
D2	Sealer	R29	Seal tidak rapat			
		R30	Letak produk kurang tepat			
		R31	Plastik meleleh			
D3	Conveyor	R32	Produk tidak terangkut			
E1	heater	R33	plastik tidak mengalami penyusutan			
		R34	Plastik meleleh			
E2	Conveyor	R35	Produk tidak terangkut			
F1	Printing	R36	salah tempat pencetakan kode produk			
		R37	kodifikasi tidak tercetak dengan baik			
F2	Tape cutter	R38	Karton terpotong			