APPLICATION OF THE SIX-SIGMA METHODOLOGY TO IMPROVE THE QUALITY OF THE PERFUMED SALICYLIC TALC SACHET PACKAGING AT PT NUSANTARA BETA FARMA

FINAL PROJECT REPORT

A report submitted in fulfillment of the requirement for the award of the degree of Bachelor in Department of Industrial Engineering, Faculty of Engineering, Andalas University

FERIO
1610931016

Supervisor :
Prof. Dr. Rika Ampuh Hadiguna

INDUSTRIAL ENGINEERING DEPARTEMENT
FACULTY OF ENGINEERING
ANDALAS UNIVERSITY
PADANG
2021

APPROVAL PAGE

The final project entitled "**Application of the Six-Sigma Methodology to Improve the Quality of the Perfumed Salicylic Talc Sachet Packaging at PT Nusantara Beta Farma**" prepared and submitted by **Ferio** in partial fulfillment of the requirement for degree of **Bachelor of Engineering** (Major in Industrial Engineering), has been examined and hereby recommended for approval and acceptance

Date: May 2021

Prof. Dr. Rika Ampuh Hadiguna
NIP. 19730723 199903 1 003
Supervisor

PANEL OF EXAMINERS
Approved by the Committee on Final Project Examination
17/03/2021
Final Project Examination Date

Eri Wirdianto, M.Sc
NIP. 19730921 199903 1 001
Chair

Taufik, M.T
NIP. 19680715 199412 1 001
Member

Accepted and approved in particular fulfillments for the degree of **Bachelor of Engineering** (Major in Industrial Engineering)

Reinny Patrisina, Ph.D
NIP. 19761002 200212 2 002
Chair of Industrial Engineering Undergraduate Program

Feri Afrinaldi, Ph.D
NIP. 19820920 200604 1 002
Chair of Industrial Engineering Department

ACKNOWLEDGEMENT

Author says Alhamdulillah to Allah SWT. because of his grace and guidance, author can complete this final project report with title "Application of the Six-Sigma Methodology to Improve the Quality of the Perfumed Salicylic Talc Sachet Packaging at PT Nusantara Beta Farma".

This final project report is certainly made with the help of many people. Therefore, the authors would like to thanks to:

1. Prof. Dr. Rika Ampuh Hadiguna as my supervisor of final project report, for the supervision, advice, and support that have been given.
2. Mr. Eri Wirdianto, M.Sc. and Mr Taufik, M.T. as my examiner of final project report for the advices and suggestions that have been given.
3. Mrs. Riri Ramadhani as my supervisor in PT Nusantara beta.
4. Lectures and all staff of Industrial Engineering Department in Andalas University.
5. My parents and family who has always encouragement and support in completing this final project report.
6. All friends who help and support me in completing the final project report.

The author hopes this report can provide benefits for authors and other people in need. As for the shortcomings contained in this report, the authors expect criticism and constructive suggestions for the refinement and improvement of further reports.

Padang, May 2021

Author

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

ABSTRACT

The global spending on medicines is increasing from year to year. This is resulting in the competition among the pharmaceutical companies become higher. In Indonesia, the chemical, pharmaceutical, and traditional medicine industries grew by 8.48% in 2019. To win the competition, the companies must have a good quality product. PT. Nusantara Beta Farma, the pharmaceutical industry, has a problem with their product: the quality of Perfumed Salicylic Talc. There are three type of defect, such as leak, unclear batch number, and no thread. The total damage several times exceeded the company's standard limit, and the common failure is a leak that more than 90% of all the failures. Improvement is necessarily needed to reduce the number of defective products.

This study aims to identify the causes of Perfumed Salicylic Talc's defective product and propose some improvement. Data collection in this study uses primary data and secondary data. Primary data obtained from interviews and questionnaires. Meanwhile, secondary data is obtained from the company that is data production, standard quality, and Perfumed Salicylic Talc's production flow. The DMAIC method uses to find the root cause of the failure and propose the improvement.

The main cause of leaks is in the batch number printing process. This is because the machine did not print the batch number correctly. This failure indicates a decrease in the reliability of the packaging machine. Decreased machine reliability relates to there is no maintenance schedule. Because there is no maintenance schedule, the machine is not well-maintained, which results in decreased reliability of the packaging machine.

Keywords: *Pharmaceutical, Quality, Six Sigma, DMAIC*

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

ABSTRAK

Konsumsi global untuk obat-obatan terus meningkat dari tahun ke tahun. Hal ini mengakibatkan persaingan antar perusahaan farmasi semakin tinggi. Di Indonesia, industri kimia, farmasi, dan obat tradisional tumbuh 8,48% pada 2019. Untuk memenangkan persaingan tersebut, perusahaan harus memiliki kualitas produk yang baik. PT. Nusantara Beta Farma, Industri selaku perusahaan farmasi memiliki permasalahan dengan kualitas produk Salisil Talk Wangi. Terdapat tiga tipe cacat, yaitu bocor, nomor batch *tidak jelas, dan tidak adanya benang. Total cacat beberapa kali melebihi batas standar perusahaan, dan kecacatan terbanyak adalah kebocoran yang lebih dari 90% dari semua kegagalan. Perbaikan diperlukan untuk mengurangi jumlah produk yang cacat.*

Penelitian ini bertujuan untuk mengetahui penyebab cacat produk Salisil Talk Wangi dan mengusulkan beberapa perbaikan. Pengumpulan data dalam penelitian ini menggunakan data primer dan data sekunder. Data primer diperoleh dari wawancara dan kuesioner. Sedangkan data sekunder diperoleh dari perusahaan yaitu data produksi, standar kualitas, dan alur produksi Salisil Talk Wangi. Metode DMAIC digunakan untuk menemukan akar penyebab kegagalan dan mengusulkan perbaikan.

Penyebab utama kebocoran adalah pada proses pencetakan nomor batch. Ini karena mesin tidak mencetak nomor batch dengan benar. Kegagalan ini menunjukkan adanya penurunan keandalan mesin pengemasan. penurunan Kehandalan mesin pengemasan berkaitan dengan tidak adanya jadwal perawatan. Karena tidak ada jadwal perawatan, mesin tidak terawat yang berakibat pada menurunnya kehandalan mesin pengemas.

Kata Kunci*: Farmasi, Kualitas, Six-Sigma, DMAIC*

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

TABLE OF CONTENT

TITLE PAGE

ACKNOWLEDGEMENT i

ABSTRACT ii

ABSTRAK iii

TABLE OF CONTENT iv

LIST OF TABLES vi

LIST OF FIGURES vii

LIST OF APPENDICES viii

CHAPTER I INTRODUCTION

1.1 Background 1

1.2 Problem Formulation 5

1.3 Research objective 6

1.4 Research Scope 6

1.5 Outline of Final Project Report 6

CAPTHER II LITERATURE REVIEW

2.1 Quality 8

2.1.1 Definition of Quality 8

2.1.2 Dimensions of Quality 9

2.2 Quality Control 10

2.3 Statistical Quality Control 11

2.3.1 Process Capability Analysis with Attribute Data 12

2.3.2 Sigma Level 12

2.4 Seven Basic Quality Tools 14

2.4.1 Pareto Diagram 14

2.4.2 Cause and Effect Diagram 15

2.4.3 Histogram 16

2.4.4 Control Charts 16

2.4.5 Scatter Diagram 19

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

2.4.6 Graphs 20
2.4.7 Check Sheet 20
2.5 Six Sigma DMAIC.....20
2.5.1 Define 21
2.5.2 Measure 22
2.5.3 Analyze 22
2.5.4. Improve.....23
2.5.5 Control 24
2.6 Failure Mode and Effect Analyze 24
2.7 Previous Research.....28

CHAPTER III RESEARCH METHODOLOGY
3.1 Preliminary Study 30
3.2 Data Collection 30
3.3 Data Processing.....31

CHARTER IV RESULT AND DISCUSSION
4.1 Data Collection 37
4.1.1 Production Flow of Perfumed Salicylic Talc 37
4.1.2 The Data Production of Perfumed Salicylic Talc.....39
4.1.3 Perfumed Salicylic Talc Packaging Standard.....39
4.2 Data Processing.....40
4.2.1 Define 40
4.2.2 Measure 43
4.2.3 Analyze 47
4.2.4 Improve.....55
4.2.5 Control 57

CHAPTER V CONCLUSSION
5.1 Conclusion 58
5.2 Recommendation 59

REFERENCES
APPENDICES

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

LIST OF TABLES

Table 2.1 Severity Ranking 25
Table 2.2 Occurrence Rate 26
Table 2.3 Detection Method 27
Table 2.4 Previous Research Result 29
Table 4.1 Type of Defect for Perfumed Salicylic Talc Packaging 42
Table 4.2 Example of a Questionnaire for Indicators of Severity 50
Table 4.3 Example of a Questionnaire for Indicators of Occurrence 51
Table 4.4 Example of a Questionnaire for Indicators of Detection 51
Table 4.5 Recapitulation of Expert Assessment for Severity 52
Table 4.6 Recapitulation of Expert Assessment for Occurrence 53
Table 4.7 Recapitulation of Expert Assessment for Detection 53
Table 4.8 The Value of Risk Priority Number 54

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

LIST OF FIGURES

Figure 1.1 Global Medicine Spending and Growth 2009-2023.....1
Figure 1.2 Analysis of Indonesia's Industrial Development 2
Figure 2.1 Failure Mode and Effect Analysis Cycle.....28
Figure 3.1 Flowchart of Research Methodology 36
Figure 4.1 P Control Chart.....45
Figure 4.2 Fishbone Diagram 49

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

LIST OF APPEDINCES

Appendix A Data Production of Yellow Salisil Talk Wangi

Appendix B Recapitulation of the P control Chart Calculation for Salisil Talk Wangi

Appendix C Sigma Level Conversion Table

Appendix D FMEA Questionnaire

Appendix E Standard Operating Procedure

Appendix F Check Sheet

Appendix G Form

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

CHAPTER I
INTRODUCTION

This chapter contains the research background, problem formulation, research objectives, research scopes, and outline of the final project report.

1.1 Background

UNIVERSITAS ANDALAS

The global spending on medicines is increasing from year to year. It can be seen from Global Medicine Spending and Growth 2009-2023, as shown in **Figure 1.1**.

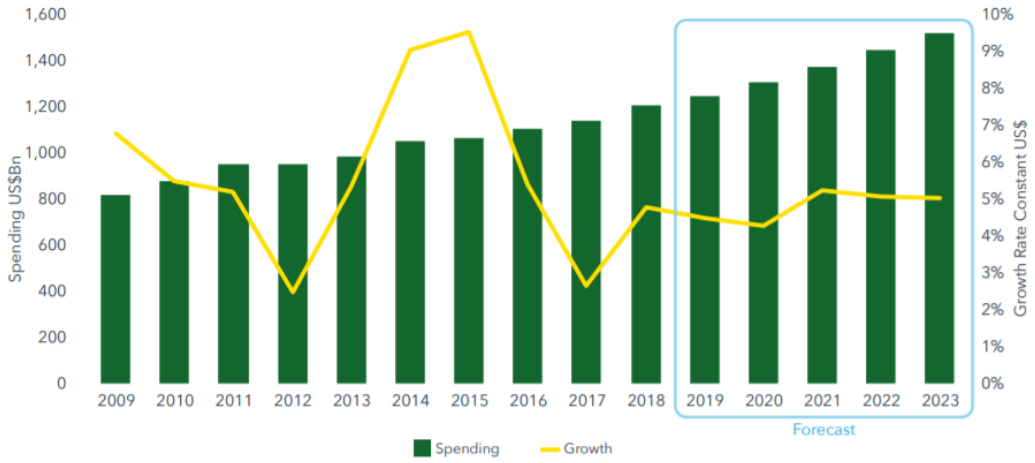


Figure 1.1 Global Medicine Spending and Growth 2009-2023 (IQVIA Institute, 2018)

The global pharmaceutical market will exceed $1.5 trillion by 2023, growing at a 3–6% compound annual growth rate over the next five years (IQVIA Institute, 2018). In Indonesia, the chemical, pharmaceutical, and traditional medicine industries grew by 8.48% in 2019. It can be seen from Analysis of Indonesia's Industrial Development, 1st Edition – 2020 as shown in **Figure 1.2**.

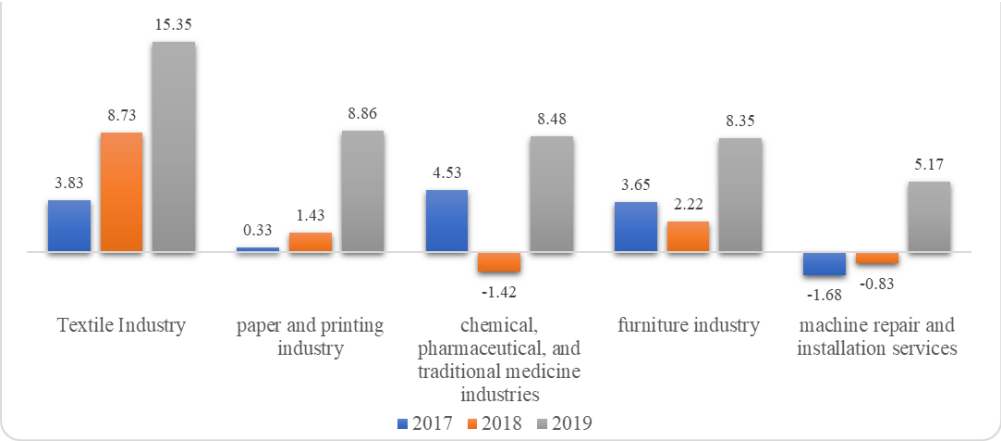


Figure 1.2 Analysis of Indonesia's Industrial Development, 1st Edition – 2020 (Ministry of Industry Republic of Indonesia, 2020)

Figure 1.2 shows that the pharmaceutical industry grew in 2019. This is resulting in the competition among the pharmaceutical companies become higher. The companies must have a competitive advantage to win the competition, one of the strategies is by fulfilling the customer needs, which provide the customer with good quality products.

PT. Nusantara Beta Farma is a pharmaceutical industry located in West Sumatra at Pasar Usang, Padang-Bukittinggi Roadway. PT. Nusantara Beta Farma produces medicines and cosmetics. Products manufactured by PT. Nusantara Beta Farma such as Obat Merah (Povidone Iodine), Obat Batuk Hitam (Cough Medicine), Beta Bethin Antiseptic Solution (Antiseptic), Beta Alcohol 70%, Chlorine, Borax Glycerin, and Salisil Talk Wangi (Perfumed Salicylic Talc).

PT. Nusantara Beta Farma, as a pharmaceutical company, has followed the standards set by the government. In Indonesia, every pharmaceutical company must implement Good Manufacturing Medicine Practices (GMMP) and Good Cosmetics Manufacturing Practices (GCMP) based on the Decree of the Minister of Health of the Republic of Indonesia No. 43 / MenKes / SK / II / 1988 and The Regulation of the Head of the Food and Drug Supervisory Agency Number HK.03.42.06.10.4556 of 2010.

One of the criteria for a product is defective if it does not meet the etiquette standards of PT Nusantara Beta Farma. The standard refers to GMMP and GCMP at PT Nusantara Beta Farma. The weight allowed by the company is 287 ± 287 x 5% grams. The value of 287 grams is the weight of 1 series of Perfumed Salicylic Talc products. So that the product weight allowed for the Perfumed Salicylic Talc product range is 273 grams - 301 grams, if the Perfumed Salicylic Talc product is outside the specified weight limit, the six sachets product will be refilled so that no serial product is out of control. Measurement of the weight value is carried out during Perfumed Salicylic Talc's production process for all available colors. This process is called In Process Control (IPC) which is done every 15 minutes during the production process. This is done to reduce the number of products outside the weight limit allowed.

PT. Nusantara Beta Farma sets 5% as the maximum proportion of defective products per day. Based on the results of interviews with the representative of the quality control division, it was found that the product that has many problems in its quality is Perfumed Salicylic Talc. Meanwhile, other products found few problems and did not require special handling.

Any defective products will cause additional costs and losses for the company. Also, defective products can harm consumers who use Perfumed Salicylic Talc products, thus causing Perfumed Salicylic Talc products not to sell in the market.

Perfumed Salicylic Talc product has four perfume variants, divided by color, which are red, blue, yellow, and green. Every day the company only produces a maximum of 2 types of perfume variants. Products with different colors will be produced after the first color product has been produced. This is done to avoid mixing the ingredients in each color in the Perfumed Salicylic Talc product.

The number of Perfumed Salicylic Talc products produced by PT Nusantara Betafarma varies every day. The amount of Perfumed Salicylic Talc produced

depends on market demand and differs for each type of perfume. PT Nusantara Beta Farma always maintains its powder quality. Before the powder is packaged, the quality staff will check the powder quality and ensure that it conforms to company standards. So, there is no problem with the powder content, and the failure can only happen in the packaging process.

Perfumed Salicylic Talc products manufactured at PT Nusantara Beta Farma produce several defective products that do not comply with the company's standards. There are three types of defects in Perfumed Salicylic Talc. The first is a leak, this type of defect when there is a hole or a path through which the package contents may escape or through which ambient materials from the environment may enter. The second is the unclear batch number, this type of error if the batch number difficult to read. The third is no thread. If there is no thread in the package, that makes the package bubble.

The number of defective products from Perfumed Salicylic Talc products varies every day. The most common type of damage is a leak. The percentage of leak type damage reached 91,58% of the total defect items of 14.316 sachets for all types of Perfumed Salicylic Talc. The total damage several times exceeded the company's standard limit so that it could cause losses to the company. So, handling is needed to reduce the number of defects per day so that the company does not experience losses in production.

Many industries implement the six-sigma concept to maintain their quality. Today, Six Sigma is one of the primary quality initiatives that have been billed as a critical business tool in the 21st century (Pepper and Spedding, 2010; Mader, 2008). Six Sigma helps industries improve organizational efficiencies and customer satisfaction and reduces operating costs, and increases profits (Laureani et al., 2013). Six Sigma's unique approach to continuous process and quality improvement is DMAIC methodology. DMAIC is an acronym from the words Define-Measure-Analyze-Improve-Control. This method is based on process improvement according to the Deming cycle. It is a process improvement of many different areas

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

in the enterprise. DMAIC cycle consists of five stages which are connected to each other (Sokovic et al., 2010; Sin et al., 2015)

Therefore, the method or approach DMAIC (Define, Measure, Analyze, and Improve) will be used to improve the quality of a product in this research. This method is used because it can eliminate defects and improve the quality of the observed process. At the measuring stage, the P control map is used because the data used in this study are attribute data. Meanwhile, the analysis stage is carried out using the Fishbone diagram and Failure Mode and Effect Analysis. The final output expected from this research is the provision of recommendations for the improvement of the quality of the production process on the Perfumed Salicylic Talc product. It is expected that later the cost of losses suffered by the company will be small by reducing the number of defective products that occur in Perfumed Salicylic Talc products.

1.2 Problem Formulation

Based on the data obtained when conducting the preliminary survey, it is known that there is data on the proportion of defects per day that exceed the limit set by the company. The limit set by the company per day is 5%. Meanwhile, Perfumed Salicylic Talc products were found a defect proportion that exceeds the stipulated limit. So, this causes the company that needs to rework the product to fix the quality. The company's rework process can increase production costs and require more time than usual. So, the formulation of the problem in this study is how to minimize the number of defective products of Perfumed Salicylic Talc in PT Nusantara Beta Farma using the DMAIC method.

1.3 Research Objective

The purpose of this research is as follows:

1. To identify the causes of the defective product of Perfumed Salicylic Talc
2. To provide some improvement on Perfumed Salicylic Talc Production

1.4 Research Scope

The scope of this research are as follows:

1. The product studied in this study was the yellow Perfumed Salicylic Talc Sachet.
2. This study is only focused on the quality packaging of Perfumed Salicylic Talc.

1.5 Outline of Final Project Report

This part contains the systematic writing of the final project report, which are as follows:

CHAPTER I INTRODUCTION

This chapter explains the background of the research, the problem formulation, the objectives of the research, the scope of the study, and the outline of the final project report.

CHAPTER II LITERATURE REVIEW

This chapter contains the theories used in this study, such as quality, quality control, statistical quality control, seven basic quality tools, Six Sigma DMAIC (Define Measure Analysis Improve Control), and Failure Mode and Effect Analysis (FMEA).

CHAPTER III RESEARCH METHODOLOGY

This chapter contains the procedures and methods used in conducting research.

CHAPTER IV RESULT AND DISCUSSION

This chapter contains an evaluation of the Perfumed Salicylic Talc production process that occurs at PT Nusantara Betafarma. This evaluation stage consists of define, measure, analyze, and improve (proposed improvements) for product quality that is not in accordance with specifications.

CHAPTER V CONCLUSIONS AND SUGGESTIONS

This chapter contains the conclusions of the research and the suggestions for further study.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

CHAPTER II
LITERATURE REVIEW

2.1 Quality

Quality is a complex and multifaceted concept. The definition of quality and the dimensions of quality are discussed in detail in the following sections.

2.1.1 Definition of Quality

Quality is a characteristic of a product or service that aims to meet the needs and satisfaction of consumers. Quality has two definitions, namely the conventional definition and the strategic definition. Quality that describes the natural characteristics, such as performance, reliability, and ease of use, is called quality as a conventional definition. While the strategic definition of quality is anything that can meet the desires or needs of consumers and product excellence can be measured from customer satisfaction (Gaspersz, 2001)

According to Montgomery (2009), quality is one or more desirable characteristics that a product or service should possess. Quality has become one of the most important customer decision factors in selecting competing products and services. The phenomenon is widespread, regardless of whether the Customer is an individual, an industrial organization, a retail store, a bank or financial institution, or a military defense program. Consequently, understanding and improving quality are key factors leading to business success, growth, and enhanced competitiveness. There is a substantial return on investment from improved quality and from successfully employing quality as an integral part of overall business strategy (Khadka and Maharjan, 2017)

Lester (2017) defined quality as the totality of features and characteristics of a product, service, or facility that bear on its ability to satisfy a given need.

According to the American National Standards Institute (ANSI) or the American Society for Quality Control (ASQC), quality is defined as the overall features and characteristics of the products or services that demonstrate its ability in satisfying needs, whether stated explicitly or implicitly. The quality of the product is one of the basic decisions of customer satisfaction on the products they purchase by their needs and expectations. As a result, quality has become a key factor that brings success in business and enhances competitive position. The effective quality assurance program can increase market penetration, improve productivity and decrease the full manufacturing cost of goods and services (Besterfield, 2008).

2.1.2 Dimensions of Quality

According to Garvin (1987), the quality of a product can be described and evaluated several ways. The dimensions of quality are :

1. Performance. Potential customers usually evaluate a product to determine if it will perform certain specific functions and determine how well it performs to them.
2. Reliability. Complex products, such as many appliances, automobiles, or airplanes, will require some repair over their service life. For example, the Customer expects that an automobile will require occasional repair, but it is unreliable if the car requires frequent repair.
3. Durability. This is the useful service life of the product. Customers want products that perform satisfactorily over a long period. The automobile and major appliance industries are examples of businesses where this quality dimension is very important to most customers.
4. Serviceability. There are many industries in which the Customer's view of quality is directly influenced by how quickly and economically a repair or routine maintenance activity can be accomplished.
5. Aesthetics. This is the product's visual appeal, often taking into account factors such as style, color, shape, packaging alternatives, tactile characteristics, and other sensory features.

6. Features. Usually, customers associate the high quality with products that have added features; that is, those with features beyond the competition's basic performance.
7. Perceived Quality. In many cases, customers rely on the company's past reputation concerning the quality of its products. This reputation is directly influenced by failures of the product that are highly visible to the public or that require product recalls and by how the Customer is treated when a quality-related problem with the product is reported. Perceived quality, customer loyalty, and repeated purchase are closely interconnected.
8. Conformance to Standards. We usually think of a high-quality product as one that exactly appropriates the requirements placed on it. Manufactured parts that do not meet the designer's requirements can cause significant quality problems when used as the components of a more complex assembly.

2.2 Quality control

Quality control and improvement involve the set of activities used to ensure that the products and services meet requirements and are improved continuously. Since variability is often a major source of poor quality, statistical techniques, including SPC and designed experiments, are the major quality control tools and improvement. Quality improvement is often done on a project-by-project basis and involves teams led by personnel with specialized knowledge of statistical methods and experience in applying them. Projects should be selected so that they have a significant business impact and are linked with the overall business goals for quality identified during the planning process. The techniques in this book are integral to successful quality control and improvement (Montgomery, 2009).

Quality Control and supervision are activities carried out to ensure that production and operating activities are carried out in accordance with what is planned, and if deviations occur, then these deviations can be corrected so that what

is expected can be achieved (Assauri, 2008). According to Bakhtiar et al. (2013), quality control can be interpreted as "activities carried out to monitor activities and ensure actual performance." A good product must have good quality too. Quality control is needed to get a good quality product. Quality control is an effort made to achieve a quality product or production process in accordance with standards set by the company or outside the company.

2.3 Statistical Quality Control

Statistical Quality Control is a technique used to control and manage processes both in manufacturing and in services through statistical methods. Statistical quality control is a problem-solving technique that is used to control, monitor, analyze, manage and improve products and processes using statistical methods (Purnomo, 2004)

Statistical quality control applies probability theory in testing and examining samples. Statistical quality control is a statistical method in collecting and analyzing the results of the examination of samples. This is done by taking a sample from the population and drawing conclusions based on the characteristics of the sample statistically (statistical inference). The taking and use of this sample carries risks because there is a possibility that a sample does not have exactly the same characteristics as the whole sample (Handoko, 1984)

Statistics Quality Control is very impactful in a company as a quality control tool. Quality control includes monitoring the use of materials, so indirectly, Statistics Quality Control is useful for monitoring the level of efficiency in a company. So, Statistics Quality Control can be used as a tool to prevent damage by rejecting and accepting various products produced by machines (Prawirosentono, 2004).

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

2.3.1 Process Capability Analysis with Attribute Data

Often process performance is measured in terms of attribute data—that is, nonconforming units or defectives or nonconformities or defects. When a fraction nonconforming is the measure of performance, it is typical to use the parts per million (ppm) defectives as a measure of process capability. In some organizations, this ppm defective is converted to an equivalent sigma level. For example, a process producing 2,700 ppm defective would be equivalent to a three-sigma process (without the "usual" 1.5 s shift in the mean that many Six Sigma organizations employ in the calculations taken into account) (Montgomery, 2009).

When dealing with nonconformities or defects, a defects per unit (DPU) statistic is often used as a measure of capability, where

$$DPU = \frac{\text{Total number of defects}}{\text{total number of units}}$$

2.3.2 Sigma Level

Sigma is a letter in the Greek alphabet used to denote the standard deviation of a process. The term Six Sigma is derived from the field of statistics. Sigma quality level is sometimes used to describe the output of a process. A Six Sigma quality level is said to equate to 3.4 defects per million opportunities. However, the term in practice is used to denote more than simply counting defects. Six Sigma stands for six standard deviations from the mean. The Six Sigma methodology provides the techniques and tools to improve the capability and reduce the defects in any processes (Charantimath, 2017).

To achieve Six Sigma Quality, a process must produce no more that's 3.4 defects per million opportunities. An opportunity is defined as a chance for non-conformance or not meeting the required specifications. This means one needs to be nearly flawless in executing key processes. The process and culture are

conditioned for zero defects rather than being one that accepts that it is inevitable and acceptable that mistakes will occur.

Hence, Six Sigma delivers substantial cost reductions, enhanced efficiencies, sustainable improvement, and increased stakeholder value. A defect is defined as any part of a product or service that does not meet customer specifications or requirements or causes customer dissatisfaction, or does not fulfill the functional or physical requirements. It should be noted that the term customer refers to both internal and external customers. Opportunities are the total number of chances per unit to exhibit a defect. Each opportunity must be independent of other opportunities and must be measurable and observable. The final requirement of an opportunity is that it directly relates to the CTQ. The total count of opportunities indicates the complexity of a product or service. A unit is something that can be quantified by a customer. It is a measurable and observable output of the business process. It may manifest itself as a physical unit. In the case of a service, it may have specific start and stop points. Defects per unit (DPU) are defined as the number of defects in a given unit of product or process. The DPU measure does not directly take the complexity of the unit into account. A widely used way to do this is the defect per million opportunities (DPMO) measure (Charantimath, 2017).

$$DPMO = \frac{DPU\ x\ 1.000.000}{Opportunity\ for\ Error}$$

$$DPMO = \frac{Total\ Number\ of\ Defects}{Total\ Number\ of\ Unit\ x\ opportunity\ for\ error}\ x\ 1.000.000$$

Furthermore, the calculation of the sigma level of processes can be done using Sigma Conversion Table. Sigma Conversion Table can be seen in **Appendix C**.

2.4 Seven Basic Quality Tools

The seven QC tools used to solve quality problems are the Pareto diagram, cause and effect diagram, histogram, control charts, scatter diagrams, graphs, and check sheets. These are simple statistical tools used for problem-solving. These tools were developed in Japan and introduced by quality gurus such as Deming and Juran. In terms of importance, these are the most useful tools. Kaoru Ishikawa has stated that these tools can be used to solve 95% of all problems. They have been the foundation of Japan's astonishing industrial resurgence after World War II. These tools are used widely to monitor the overall operation and continuous process improvement while manufacturing products (Charantimath, 2017).

2.4.1 Pareto Diagram

The Pareto chart is also termed the Pareto diagram. A Pareto chart may be a weighted Pareto chart or a comparative Pareto chart. A Pareto chart is a special bar graph, the lengths of which represent frequency or cost (time or money) and are arranged with the longest bars on the left and the shortest to the right. Thus, the chart visually depicts the relative importance of problems or conditions. In 1950, Joseph M. Juran rephrased the theories of the Italian economist Vilfredo Pareto (1848–1923), which form the crux of the Pareto principle. These are often referred to as the 80–20 Rule. Pareto analysis is a statistical technique in decision-making that is used for the selection of a limited number of tasks that produce a significant overall effect.2 The Pareto effect also operates in the domain of quality improvement. According to the Pareto effect, 80 percent of the problems usually stem from 20 percent of the causes. This is also termed as the theory of the vital few and the trivial many (Charantimath, 2017).

The following steps can be used to construct a Pareto chart:

1. List the activities or causes in a table and their frequency of occurrence.
2. Place these in descending order of magnitude in the table.
3. Calculate the total for the whole list.

4. Calculate the percentage of the total that each cause represents.
5. Add a cumulative percentage column to the table.
6. Draw a Pareto chart plotting the causes on the X-axis and the cumulative percentage on the Y-axis. The cumulative percentage from all causes can be shown by drawing a cumulative curve.
7. On the same chart, plot a bar graph with the causes on the X-axis and the percentage frequency on the Y-axis.
8. Analyze the diagram. Look for the break-point on the cumulative percent graph. It can be identified by a marked change in the slope of the graph. This separates the significant few from the trivial many.

2.4.2 Cause and Effect Diagram

The cause-and-effect diagram, also termed the fishbone diagram or the Ishikawa diagram, was the brainchild of Kaoru Ishikawa. The fishbone diagram identifies many possible causes for a problem or an effect. It can be used to structure a brainstorming session. It immediately sorts ideas into useful categories. This diagram is used to explore all the potential or real causes (or inputs) that result in a single effect (or output). The causes are arranged according to their levels of importance or detail, resulting in a depiction of relationships and hierarchy of events. This diagram can also be used to search for root causes, identify areas where there may be problems, and compare the relative importance of different causes.

Steps in Constructing a Cause-and-effect Diagram

1. Write the issue (problem or process condition) on the center-right side of the cause-and-effect diagram.
2. Identify the major cause categories and write them in the four boxes on the cause and effect diagram. The causes may be summarized under various categories.
3. The potential causes of the problem need to be brainstormed. Decide where to place the possible causes on the cause-and-effect diagram. It is acceptable to list a possible cause under more than one major category.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

4. Review each major cause category. Circle the most likely causes on the diagram.
5. Review the causes that are circled and question, “why?” Asking “why” will help to get to the root of the problem.
6. Arrive at an agreement on the most probable cause(s).

2.4.3 Histogram

Histograms provide a simple graphical view of accumulated data, including its dispersion and central tendency. It is the most commonly used graph to show frequency distributions. In addition to the ease with which they can be constructed, histograms provide the easiest way to evaluate the distribution of data. A frequency distribution graph shows how often each different value in a set of data occurs. A histogram is a specialized type of bar chart. Individual data points are grouped together in classes so that one can get an idea of how frequently data in each class occur in the data set. High bars indicate more points in a class, and low bars indicate fewer points.

The strength of a histogram lies in the easy-to-read picture it projects of the location and variation in a data set. There are, however, two weaknesses of histograms that need to be understood. Histograms can be manipulated to show different pictures. It can prove to be misleading if too many or too few bars are used. This is an area that requires some judgment and perhaps some experimentation based on the analyst's experience.

2.4.4 Control Charts

A control chart is a fundamental tool of statistical process control (SPC), as it indicates the range of variability that is built into a system (known as common cause variation). Thus, it helps determine whether or not a process is operating consistently or if a special cause has occurred to change the process mean or variance. SPC is used to measure the performance of a process. It relates to the

application of statistical techniques to determine whether the output of a process conforms to the product or service design. All processes are subject to a certain degree of variability. Usually, variations are of two types that are natural variations and assignable variations.

Control charts are prepared to look at variation, seek assignable causes and track common causes. Assignable causes can be spotted using several tests such as one data point falling outside the control limits, six or more points in a row steadily increasing or decreasing, eight or more points in a row on one side of the central line, and 14 or more points alternating up and down. A control chart is a line chart with control limits. By mathematically constructing control limits at three standard deviations above and below the average, one can determine which variation is due to normal ongoing causes (common causes) and which is produced by unique events (assignable causes). Eliminating the assignable causes first and then reducing common causes can improve quality.

Attributes charts are generally not as informative as variables charts because there is typically more information in a numerical measurement than in merely classifying a unit as conforming or nonconforming. However, attribute charts do have important applications. They are particularly useful in services industries and in non-manufacturing or transactional business processes and quality improvement efforts because so many of the quality characteristics found in these environments are not easily measured on a numerical scale (Montgomery, 2009).

The fraction nonconforming is defined as the ratio of the number of nonconforming items in a population to the total number of items in that population. The items may have several quality characteristics that are examined simultaneously by the inspector. If the item does not conform to the standard on one or more of these characteristics, it is classified as nonconforming. We usually express the fraction nonconforming as a decimal, although occasionally, the percentage nonconforming (which is simply 100% times the fraction nonconforming) is used. When demonstrating or displaying the control chart to

production personnel or presenting results to management, the percentage nonconforming is often used, as it has a more intuitive appeal. Although it is customary to work with fraction nonconforming, we could also analyze the fraction conforming just as easily, resulting in a control chart on process yield. For example, many organizations operate a yield-management system at each stage of their manufacturing or fulfillment process, with the first-pass yield tracked on a control chart (Montgomery, 2009).

The statistical principles underlying the control chart for fraction nonconforming are based on the binomial distribution. Suppose the production process is operating in a stable manner, such that the probability that any unit will not conform to specifications is p and that successive units produced are independent. Then each unit produced is a realization of a Bernoulli random variable with parameter p. If a random sample of n units of a product is selected, and if D is the number of units of product that are nonconforming, then D has a binomial distribution with parameters n and p; that is,

$$P\{D = x\} = \binom{n}{x} p^x (1-p)^{n-x} \qquad x = 0,\ 1,\ \ldots,\ n$$

The sample fraction nonconforming is defined as the ratio of the number of nonconforming units in sample D to the sample size n—that is,

$$\hat{p} = \frac{D}{n}$$

When the process fraction nonconforming p is not known, then it must be estimated from observed data. The usual procedure is to select *m* preliminary samples, each of size *n*. As a general rule, *m* should be at least 20 or 25. Then if there are *Di* nonconforming units in sample *i*, we compute the fraction nonconforming in the *i*th sample as

$$\hat{p}_i = \frac{D_i}{n} \qquad i = 1,\ 2,\ \ldots,\ m$$

and the average of these individual sample fractions nonconforming is

$$\bar{p} = \frac{\sum_{i=1}^{m} D_i}{mn} = \frac{\sum_{i=1}^{m} \hat{p}_i}{m}$$

The statistic estimates the unknown fraction nonconforming p. The centerline and control limits of the control chart for fraction nonconforming are computed as follows

$$UCL = \bar{p} + 3\sqrt{\frac{\bar{p}\,(1-\bar{p})}{n}}$$

$$Center\ Line = \bar{p}$$

$$LCL = \bar{p} - 3\sqrt{\frac{\bar{p}\,(1-\bar{p})}{n}}$$

2.4.5 Scatter Diagrams

A scatter diagram is also termed the scatter plot or the X–Y graph. It is a quality tool used to display the type and degree of relationship between variables. If the variables are correlated, the points will fall along a line or curve. The better the correlation, the tighter the points will hug the line. The scatter diagram also shows the pattern of relationships between two variables. Some examples of relationships are cutting speed and tool life, breakdowns and equipment age, training and errors, speed and gas mileage, production speed, and the number of defective parts. Scatter diagrams are used to investigate a possible relationship between two variables that both relate to the same event. A straight line of best fit (using the least-squares method) is often included in this.

The following steps can be used to construct a scatter diagram:

1. Collect data on causes and effects for variables
2. Draw the causes on the X-axis
3. Draw the effect on the Y-axis

4. Plot the data pairs on the diagram by placing a dot at the intersection of the X and Y coordinates for each data pair
5. Interpret the scatter diagram for direction and strength

2.4.6 Graphs

Graphs are used depending on the shape desired and the purpose of analysis. Bar graphs compare values via parallel bars, while line graphs are used to illustrate variations over a period of time. Circle graphs indicate the categorical breakdown of values, and radar charts assist in the analysis of previously evaluated items.

2.4.7 Check Sheet

Check sheets are also termed defect concentration diagrams. A check sheet is a structured, prepared form for collecting and analyzing data. This is a generic tool that can be adapted for a wide variety of purposes. The function of a check sheet is to present information in an efficient, graphical format. This may be accomplished with a simple listing of items. However, the utility of check sheets may be significantly enhanced in some instances by incorporating a depiction of the system under analysis into the form.

2.5 Six Sigma DMAIC

Quality and process improvement occurs most effectively on a project-by-project basis. DMAIC (typically pronounced "duh-MAY-ick") is a structured five-step problem-solving procedure that can be used to successfully complete projects by proceeding through and implementing solutions that are designed to solve root causes of quality and process problems and to establish best practices to ensure that the solutions are permanent and can be replicated in other relevant business operations (Montgomery, 2012).

2.5.1 Define

The objective of the Define step of DMAIC is to identify the project opportunity and to verify or validate that it represents legitimate breakthrough potential. A project must be important to customers (voice of the Customer) and important to the business. Stakeholders who work in the process and its downstream customers need to agree on the potential usefulness of the project. One of the stages in defining is determining critical issues (Critical to Quality) for customers. This will relate to a description of a process and inspection of a product.

The stages in determining Critical to Quality are as follows:

1. Identify the Critical to Quality (CTQ).

CTQ are very important attributes to pay attention to because they are directly related to customer needs and satisfaction. CTQ is an element of a product, process, or other specification that is directly related to customer satisfaction. Before measuring the CTQ, it is necessary to evaluate the existing measurement system to ensure its effectiveness over time (Gaspersz, 2002).

2. Making Supplier, Input, Process, Output, and Customer (SIPOC) Diagram.

Identification of activity steps along with their descriptions in a related process can also use a process flowchart, which describes the process of a product and the inspections carried out. A useful and most widely used tool in process management and improvement is SIPOC, which describes:

a. The Suppliers are those who provide the information, material, or other items that are worked on in the process.
b. The Input is the information or material provided.
c. The process is the set of steps actually required to do the work.
d. The output is the product, service, or information sent to the Customer.
e. The Customer is either the external Customer or the next step in the internal business.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

2.5.2 Measure

The purpose of the Measure step is to evaluate and understand the current state of the process. This involves collecting data on measures of quality, cost, and throughput/cycle time. It is important to develop a list of all of the key process input variables (sometimes abbreviated KPIV) and the key process output variables (KPOV). The KPIV and KPOV may have been identified at least tentatively during the Define step, but they must be completely defined and measured during the Measure step. Important factors may be the time spent to perform various work activities and the time that work spends waiting for additional processing. Deciding what and how much data to collect are important tasks; there must be sufficient data to allow for a thorough analysis and understanding of current process performance with respect to the key metrics. The data collected during the Measure step may be displayed in various ways such as histograms, stem-and-leaf diagrams, run charts, scatter diagrams, and Pareto charts.

2.5.3 Analyze

In the Analyze step, the objective is to use the data from the Measure step to begin to determine the cause-and-effect relationships in the process and to understand the different sources of variability. In other words, in the Analyze step, we want to determine the potential causes of the defects, quality problems, customer issues, cycle time and throughput problems, or waste and inefficiency that motivated the project. It is important to separate the sources of variability into common causes and assignable causes.

There are many tools that are potentially useful in the Analyze step. Among these are control charts, which are useful in separating common cause variability from assignable cause variability; statistical hypothesis testing and confidence interval estimation, which can be used to determine if different conditions of operation produce statistically significantly different results and to provide information about the accuracy with which parameters of interest have been

estimated; and regression analysis, which allows models relating outcome variables of interest to independent input variables to be built.

The analysis tools are used with historical data or data that was collected in the Measure step. This data is often very useful in providing clues about potential causes of the problems that the process is experiencing. Sometimes these clues can lead to breakthroughs and actually identify specific improvements. In most cases, however, the purpose of the Analyze step is to explore and understand tentative relationships between and among process variables and to develop insight about potential process improvements. A list of specific opportunities and root causes that are targeted for action in the Improve step should be developed. Improvement strategies will be further developed and actually tested in the Improve step.

2.5.4 Improve

The objectives of the Improve step are to develop a solution to the problem and to pilot test the solution. A pilot test is a form of confirmation experiment: It evaluates and documents the solution and confirms that the solution attains the project goals. This may be an iterative activity, with the original solution being refined, revised, and improved several times as a result of the pilot test's outcome.

The tollgate review for the Improve step should involve the following:

1. Adequate documentation of how the problem solution was obtained
2. Documentation on alternative solutions that were considered
3. Complete results of the pilot test, including data displays, analysis, experiments, and simulation analyses
4. Plans to implement the pilot test results on a full-scale basis [This should include dealing with any regulatory requirements (FDA, OSHA, legal, for example), personnel concerns (such as additional training requirements), or impact on other business standard practices.]
5. Analysis of any risks of implementing the solution, and appropriate risk-management plans

2.5.5 Control

The objectives of the Control step are to complete all remaining work on the project and to hand off the improved process to the process owner along with a process control plan and other necessary procedures to ensure that the gains from the project will be institutionalized. That is, the goal is to ensure that the gains are of help in the process and, if possible, the improvements will be implemented in other similar processes in the business.

The process owner should be provided with before and after data on key process metrics, operations and training documents, and updated current process maps. The process control plan should be a system for monitoring the solution that has been implemented, including methods and metrics for periodic auditing. Control charts are an important statistical tool used in the Control step of DMAIC; many process control plans involve control charts on critical process metrics.

The transition plan for the process owner should include a validation check several months after project completion. It is important to ensure that the actual results are still in place and stable so that the positive financial impact will be sustained. It is not unusual to find that something has gone wrong in the transition to the improved process. The ability to respond rapidly to unanticipated failures should be factored into the plan.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

2.6 Failure Mode and Effect Analyze

Failure Mode and Effects Analysis (FMEA) is a structured procedure to identify and prevent as many failure modes as possible. FMEA is a set of systematic activities intended to identify and evaluate potential failures of the product/process and the impact of these failures, identify actions that can eliminate or reduce the likelihood of potential failures, and document the entire process (Automotive

Industry Action Group, 2001). FMEA is a structured procedure to identify and prevent as many failure modes as possible.

The analysis carried out on the FMEA method considers several variables. There are several calculation variables in FMEA, while the variables are (Puspitasari and Martanto, 2014):

1. Severity

Severity is an assessment of the seriousness of the effects caused. The point is that every failure that will appear is rated at its seriousness. Effects and severity have a direct relationship. For example, when the effect is classified as critical, the severity value will also be high, but if the effect that occurs is not a binding effect, the severity value will below. The severity ranking can be seen in Table 2.1.

Table 2.1 Severity Ranking

Ranking	Effects	Criteria
1	Without Effect	There is no effect
2	Very Minor	There is no effect, and the worker is aware of the Problem
3	Minor	There is no effect, and the worker is aware of the problem.
4	Very Low	Function changes, and many workers are aware of the problem
5	Low	Reducing the convenience of the use function
6	Medium	Loss of comfort of usage function
7	High	Reduction of the main function
8	Very High	Missing the main function
9	Dangerous, With Warning	Missing the main function and giving rise to warning
10	Dangerous, Without Warnings	Does not work at all

(Source: Gaspersz, 2013)

2. Occurrence rate

Occurrence indicates the likelihood that a cause will occur and results in a failure during product use. Occurrence is a rating that is adjusted to the estimated frequency or the cumulative number of possible failures. The occurrence ranking can be seen in

Table 2.2 Occurance Rate

Ranking	Failure Possibility	Failure Rate
10	Very High: Continuous failure occurs	≥ 100 out of 1000 equipment/items
9		50 out of 1000 equipment/items
8	High: Failure often occurs	20 out of 1000 equipment/items
7		10 out of 1000 equipment/items
6	Medium: Failure sometimes occurs	5 out of 1000 equipment/items
5		2 out of 1000 equipment/items
4	Low: a slight failure occurs	1 out of 1000 equipment/items
3		0.5 out of 1000 equipment/items
2	Almost no failure occurred	0.1 of 1000 equipment / items
1		≤ 0.01 of 1000 equipment / items

(Source: Gaspersz, 2013)

3. Detection method

The detection method is a measurement of the ability to control or control failures that might occur. The value of the detection method is associated with the current control. The detection ranking can be seen in

Table 2.3 Detection Method

Ranking	Detection	Criteria
1	Almost Certain	The ability of the control device to detect the shape and cause of failure is almost certain
2	Very High	The ability of the control device to detect the shape and cause of failure is very high
3	High	The ability of the control device to detect the shape and cause of failure is high
4	High Enough	The ability of the control device to detect the shape and cause of failure is quite high
5	Medium	The ability of the control device to detect the shape and cause of failure is moderate
6	Low	The ability of the control device to detect the shape and cause of failure is low
7	Very Low	The ability of the control device to detect the shape and cause of failure is very low
8	Small	Current control devices are difficult to detect the form and cause of failure
9	Very Small	Current control devices are very difficult to detect the form and cause of failure
10	Almost Impossible	There is no controller that can detect

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

4. Risk Priority Number (RPN)

The value of the RPN is the result of the multiplication between the severity, incidence rate, and detection rate. The RPN value determines the priority of failure. RPN is used as a ranking of potential process failures. The RPN value can be shown by the following equation:

RPN = Severity (S) x Occurrence (O) x Detection (D)

The FMEA method cycle can be seen in

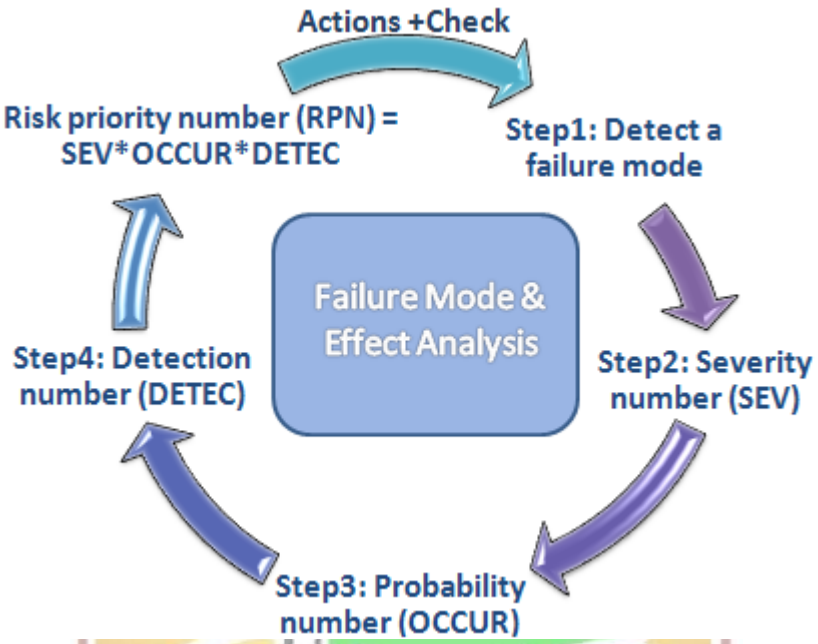


Figure 2.1 Failure Mode and Effect Analysis (FMEA) Cycle

(Source: George, 2002)

2.7 Previous Research

Review Previous research in this study was used as one of the references in conducting research. The previous studies related to the implementation of this study can be seen in **Table 2.4**.

Table 2.4 Previous Research Result

NO	Author	Title	Method	Result
1	K.Srinivasana, S.Muthu, S.R.Devadasan, C.Sugumaran (2014)	Enhancing the effectiveness of Shell and Tube Heat Exchanger through Six Sigma DMAIC phases	Six Sigma DMAIC	The sigma level was improved from1.34 to 2.01. The monetary savings was achieved about Rs.0.34 million per year.
2	Pavol Gejdoš (2015)	Continuous Quality Improvement by Statistical Process Control	Six Sigma DMAIC and Statistical Process Control	The results clearly show that the DMAIC model can systematically improve quality
3	J.P. Costa, I.S. Lopes, J. P. Brito (2019)	Six Sigma application for quality improvement of the pin insertion process	Six Sigma DMAIC	The use of some quality tools and the Six Sigma methodology proved to be extremely positive since this has led to significant improvements in the quality of the pin insertion process.
4	K.Srinivasan, S.Muthu, N.K.Prasad, G.Satheesh (2014)	Reduction of paint line defects in shock absorber through Six Sigma DMAIC phases	Six Sigma DMAIC and Taguchi robust design approach	The results obtained proved to be worthy that enhances sigma level from 3.31 to 4.5. These enhanced sigma levels lead to high quality and fewer variations.

UNIVERSITAS ANDALAS

CHAPTER III
RESEARCH METHODOLOGY

This chapter describes the steps and methods used in this research systematically. The research methodology in this study is as follows.

3.1 Preliminary Study

The preliminary study is the first step conducted to determine the actual situation that occurred in the company. The preliminary study is conducted in PT Nusantara Beta Farma, Padang, West Sumatra, related to its product quality. In the preliminary survey stage, data collection is carried out to support the research conducted. The preliminary survey was conducted by interviewing the Quality Control Division of PT Nusantara Beta Farma. Based on the interview results, it obtained information about the production process of Perfumed Salicylic Talc and company standard. Based on the preliminary survey results, Perfumed Salicylic Talc's quality data were obtained in August 2019 - July 2020.

3.2 Data Collection

Data collection is collected in two ways:

1. Observation

   The observations are to obtain data related to the production and quality of Perfumed Salicylic Talc, such as total production, total sampling, total defect, and type of defect of Perfumed Salicylic Talc products. The data used to determine the processing capability in the Perfumed Salicylic Talc production.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

2. Questionnaire

The questionnaire was used for failure mode and effect analysis (FMEA). The questionnaire was conducted to determine the level of critical risk faced during production and control of making Perfumed Salicylic Talc. The questionnaire was given to respondents who were directly involved in Perfumed Salicylic Talc production and control.

3.3 Data Processing

This final project research was conducted using the statistical quality control method using the DMAIC methodology. This method is used to achieve the research objectives, which are to reduce the number of defects that occur and provide suggestions for system improvements to the Perfumed Salicylic Talc product.

The stages of research carried out using the DMAIC approach are as follows:

1. Define

   The defined stage is the first stage carried out from the DMAIC process. The process of identifying an overview of system conditions is explained at this stage. The explanation of the defined stage can be described as follows:

   a. Identify the system overview.

      At this stage, identifying the Perfumed Salicylic Talc product's production process flow is carried out by determining the input, output, and parameters that must meet in each production process.

   b. Identify the Critical to Quality

      At this stage, identifying the types of defects that occur is carried out to see how much influence the resulting defect has and the appropriate handling to overcome the types of defects that occur.

2. Measure

The measuring stage is the second stage of the DMAIC process. This stage is carried out after data regarding the number and types of defects are obtained. Calculations and measurements regarding the company's existing systems are carried out at this stage. The processes carried out at the measuring stage are as follows:

a. Create the P Control Chart

This process is done by creating a P control chart to determine how much data is out of the upper control limit. The P control chart uses to know the proportion of items that do not meet the specified specifications categorized as defects. The steps in making a P control chart are as follows:

1) Collect the data production of Perfumed Salicylic Talc

2) Calculate the proportion of each subgroup

$$\hat{p}_i = \frac{D_i}{n}$$

Explanation:

$\hat{p}_i$ = proportion of non-conforming items in i the sample

D_i = number of non-conforming items in i the sample

n = sample size

3) Calculate the central line

$$CL_p = \bar{p} = \frac{\sum_{i=1}^{m} D_i}{mn}$$

Explanation:

CL_p = Center Line

$\bar{p}$ = unbiased estimator of p

D_i = number of non-conforming items in i th sample

n = sample size

m = numbers of samples

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

4) Calculate the lower control limit and upper control limit

$$UCL_p = \bar{p} + 3\sqrt{\frac{\bar{p}\,(1-\bar{p})}{n}}$$

Explanation:

UCL_p = Upper Control Limit

$\bar{p}$ = unbiased estimator of p

n = sample size

5) Plot all the data into graphic

b. Calculate the Capability Process

Measurement of process capability (Cp) is adjusted to the data used. This study uses attribute data, so the measurement of process capability has used the calculation of defects per unit (DPU). The formula used is as follows (Montgomery, 2013):

$$DPU = \frac{\text{Total number of defects}}{\text{total number of units}}$$

c. Calculate the sigma process level

Measurement of the sigma process level is preceded by the calculation of Defect per Million Opportunities (DPMO), which shows the amount of damage that occurred in one million opportunities. DPMO calculations can be done using the following formula (Montgomery, 2013):

$$DPMO = \frac{total\ defective\ x\ 1.000.000}{total\ product\ x\ opportunity}$$

Furthermore, the calculation of the sigma level of processes can be done using Sigma Conversion Table.

3. Analyze

Analyze stage is the third stage of the DMAIC process. This stage analyzes the causes of defective products, that based on the measurement stage. The method used at the analysis stage consists of a fishbone diagram and Failure Mode and Effect Analysis (FMEA). The steps taken at the analysis stage are as follows:

a. Make a fishbone diagram.

This fishbone diagram is designed to represent the relationship between effects and their causes. The steps in making a fishbone diagram are as follows:

1) Identify problems that occur in the system.
2) Identify the factors that cause the problems that occur
3) Make a fishbone diagram.

b. Make a Failure Mode and Effect Analysis (FMEA)

FMEA is used to see the risk of causing the highest failure from its effects. The root of the problem along the process is obtained from the fishbone diagram. The steps in making an FMEA are as follows:

1) Conducting recapitulation of the types of defects, causes of defects, and consequences of defects caused.
2) Assessing the severity, level of occurrence, and detection level based on filling out the questionnaire.
3) Calculating the RPN value based on the severity, occurrence, and detection values of the experts.
4) Ranking the priority causes of defects/failures based on the highest RPN value.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

4. Improve

The improvement stage is the fourth stage of the DMAIC process. At this stage, suggestions for improvements to the current system are given. This improvement proposal is based on the analysis results that have been carried out at the Analyze stage.

5. Control

The control stage is the fifth stage of the DMAIC process. At this stage, the document will design to control the process of Perfumed Salicylic Talc production.

The flowchart of the research methodology can see in **Figure 3.1**.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

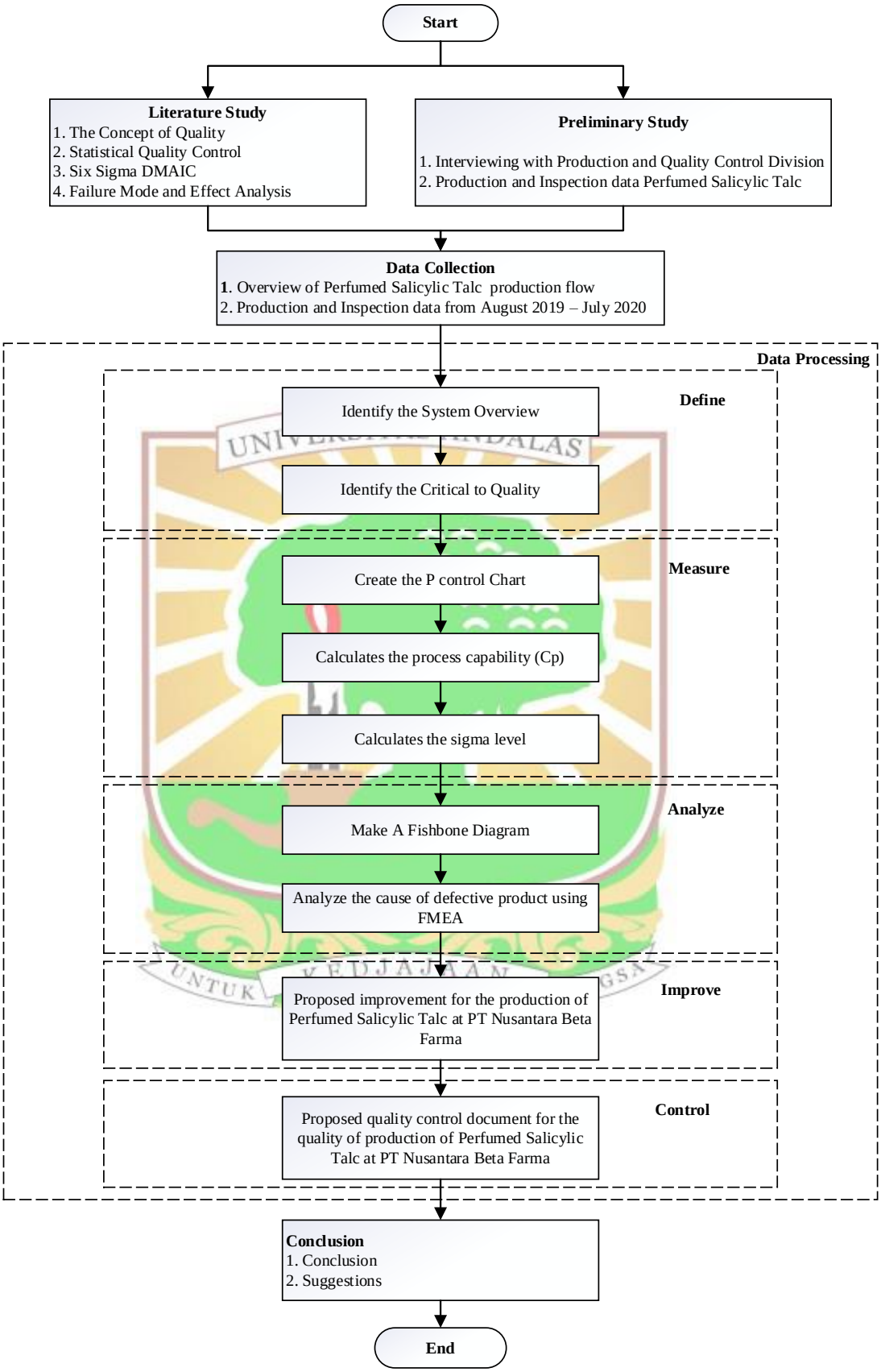


Figure 3.1 Flowchart of Research Methodology

CHAPTER IV
RESULT AND DISCUSSION

This chapter contains an evaluation of the Perfumed Salicylic Talc packaging process at PT Nusantara Beta Farma. This evaluation stage consists of Define, measure, analyze, improve, and control.

4.1 Data Collection

Data collection was carried out by direct observation to PT Nusantara Beta Farma. Data collected in the production process occurred in the Perfumed Salicylic Talc product and the number of total products, the number of defective products, and the number of samples examined by the quality control division during August 2019 - July 2020.

4.1.1 Production Flow of Perfumed Salicylic Talc

The process flow of making Perfumed Salicylic Talc at PT Nusantara Beta Farma is as follows:

1. Heating Talcum

The Talcum heating process is the first step in the production process of the Perfumed Salicylic Talc. This step to make sure there are no clumps in talcum after being stored in the warehouse. The machine used in Talcum heating is an oven machine.

2. Talcum and Salicylic Acid Sifting

Talcum and salicylic acid are sieved separately from storage. Sieving uses a sieve machine in the sieve chamber so that the powder does not spread into the air. The talcum sieving process starts from lifting the powdered material onto the

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

machine, sifting it, then collecting the sieve using a container. Meanwhile, the salicylic acid sifting process is the same as the talcum sifting process, but in a different sieve room.

3. Talcum, Salicylic Acid, and Perfume Weighing

Weighing is the next step after the sieving process. The talcum weighing process is carried out with a container capacity of 20 kg and needs sixteen containers per one production process. At the same time, weighing Salicylic Acid is carried out per formula of 6.88 kg. Meanwhile, in the perfume weighing process, the perfume is weighed as much as 1.27 kg.

4. Mixing

After weighing Talcum, Salicylic Acid, and Perfume, the three ingredients mix using a mixing machine. The results obtained from the powder mixing process are accommodated in a container with a capacity of 20 kg. The mixing of the three ingredients follows the Perfumed Salicylic Talc powder composition, such as 320 kg talcum, 6.88 kg salicylic acid, and 1.27 kg perfume.

5. Powder Quality check

The quality control staff checks that Salicylic Acid levels in the Perfumed Salicylic Talc powder have met the set standards. The standard set by the company is 1.9% - 2.1% levels of salicylic acid in the mixed powder. If the level is less than the standard determined, then the step taken is adding the salicylic acid to the mixture. If the level is greater than the predetermined standard, the step taken adds talcum to the mixture. Hence, it can be ascertained that the powder conforms to company standards.

6. Powder Filling and Packing

The filling and packaging of Perfumed Salicylic Talc powder are done using a packaging machine. This filling and packaging use plastic packaging with a capacity of 45 grams per sachet. The packaging used as a packaging material is roll packaging—the powder package in one sachet series. Each sachet series has six

sachets. In filling and packaging the Perfumed Salicylic Talc powder, every 15 minutes will do the In-Process Control. This aims to ensure the weight of each sachet complies with company standards.

7. Final Product Quality Check

The last step is a quality check. In this step, the product will leave for about three days in the warehouse. This is done to ensure no chemical reaction occurs. After three days, the quality control staff will take samples to check the product quality. The staff will check whether the packaging is leaking, there are no threads, or the batch number is difficult to read. If the defect proportion more than 5%, the company needs to rework the product to fix the quality.

4.1.2 The Data Production of Perfumed Salicylic Talc

Perfumed Salicylic Talc production data, such as the total number of products, the number of defective products, and the number of samples examined by the quality control division during August 2019 - July 2020. The production data can be seen in **Appendix A**.

4.1.3 Perfumed Salicylic Talc Packaging Standard

PT Nusantara Beta Farma has set a product standard for Perfumed Salicylic Talc, consisting of 3 criteria. The first criterion is that the Perfumed Salicylic Talc sachet does not leak. The second criterion is that the Perfumed Salicylic Talc sachet has a precise batch number and is not difficult to read. The third criterion is that the Perfumed Salicylic Talc sachet must have a thread in its packaging.

The Perfumed Salicylic Talc sachet must not leak. A leak can reduce the amount of weight in the Perfumed Salicylic Talc packaging and reduce product

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

quality. Leaks can occur for several reasons, such as the machine not pressing the packaging properly or the pressure on the batch number printer that is too high.

The batch number on Perfumed Salicylic Talc must clear and easy to read. Unclear batch numbers can result in the product having an uncertain expiration date, which can harm consumers who buy this Perfumed Salicylic Talc product. This failure can happen because of the sensor misreading or the pressure on the batch number printer that is too low.

The Perfumed Salicylic Talc sachet must have a thread in its packaging. This is necessary so that the packaging does not bulge so that when the packaging process is carried out, there is no leak in the packaging. this happens because the operator does not check the availability of threads on the machine

4.2 Data Processing

Data processing in this study was carried out using the DMAIC method (Define, Measure, Analyze, Improvement, and Control).

4.2.1 Define

The first step of the DMAIC method is Define. This step will identify the system overview and identify the critical to quality.

4.2.1.1 Identify the System Overview

Identify the System Overview is carried out to determine the input, output, and parameters that must be achieved in each process in the making of Perfumed Salicylic Talc at PT Nusantara Beta Farma.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Step one, the process of making Perfumed Salicylic Talc, begins with heating talcum. The input in this process is talcum, and the output at this stage is in the form of heated talcum. The expected parameter at this stage is talcum free from lumps due to storage in the warehouse.

The next step in the making Perfumed Salicylic Talc is mixing the powder-making ingredients in a mixer machine. The input at this stage is in the form of Talcum, Salicylic Acid, and perfume. Meanwhile, the output of this process is a bulk product of Perfumed Salicylic Talc. This process's expected parameter is that the mixer machine's mixture has become a homogeneous mixture.

The next step in making Perfumed Salicylic Talc is weighing bulk products. The input of this process is the bulk product resulting from the mixing of the three starting materials. Meanwhile, the output produced from this process is bulk products that comply with standards. This process's expected parameter is that the bulk product produced contains salicylic acid with levels of 1.9% - 2.1%.

Before the powder is packaged, the quality staff will check the powder quality and ensure that it conforms to company standards. So, there is no problem with the powder content, and the failure can only happen in the packaging process. The next stage of making Perfumed Salicylic Talc is filling and packing. The input of this process is a powder that has been weighed. Meanwhile, the output produced is in Perfumed Salicylic Talc, which has been packaged in plastic packaging. This process's expected parameters are that the resulting product weighs between 273 grams - 301 grams for Perfumed Salicylic Talc's six sachets. The batch number on the product is visible, threads in the Perfumed Salicylic Talc packaging, and the packaging used meets the requirements. Standard of company etiquette.

4.2.1.2 Identify the Critical to Quality

Identifying product quality standards used at PT Nusantara Beta Farma was carried out to determine the standards set in Perfumed Salicylic Talc's manufacture.

Based on company regulations, the number of defective products allowed for each batch is 5% of the product samples examined.

Identify the Critical to Quality that occurs to determine the types of defects that may occur in Perfumed Salicylic Talc products at PT Nusantara Beta Farma. Critical to Quality (CTQ) are important attributes because they are directly related to the product produced. There are two Critical to Quality for Perfumed Salicylic Talc Packaging. First is the package should be able to cover the powder and make no chemical reaction. Second, all the information in the packaging should be clear and make no misleading information. The type of defect based on Critical to Quality (CTQ) in the Perfumed Salicylic Talc Packaging can be seen in **Table 4.1**.

Table 4.1 Type of Defect for Perfumed Salicylic Talc Packaging

No	Type of Defect	Explanation	Picture of defective products	Picture of Standardized product
1	Leak	Perfumed Salicylic Talc's contents came out of the package, and there was a hole in the package, which caused the contents of the Perfumed Salicylic Talc to come out and can cause a chemical reaction.		
2	Unclearly Batch number	The batch numbers on the packaging are not legible, making it difficult to determine the Perfumed Salicylic Talc packaging batch numbers.		

No	Type of Defect	Explanation	Picture of defective products	Picture of Standardized product
3	No thread	The thread is not included in the Perfumed Salicylic Talc package, causing the product to swell, which means there is a chemical reaction.		

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

4.2.2 Measures

The measure is the second step in DMAIC. This step consists of creating the P control chart, calculating the process capability and sigma process level of Perfumed Salicylic Talc.

4.2.2.1 Create the P Control Chart

The P control chart's function is to determine how much data is out of the upper control limit. The data used to create the P control chart is the data production of Perfumed Salicylic Talc. The steps in making a P control chart can be seen as follows.

a. Calculate the central line

$$CL_p = \bar{p} = \frac{\sum_{i=1}^{m} D_i}{mn}$$

$$= \frac{6918}{391 * 1152}$$

$$= 0.0153$$

b. Calculate the upper control limit

$$UCL_p = \bar{p} + 3\sqrt{\frac{\bar{p}\,(1-\bar{p})}{n}}$$

$$= 0.0153 + 3\sqrt{\frac{0.0153\,(1-0.0153)}{1152}}$$

$$= 0.0262$$

c. Calculate the proportion each subgroup

$$\hat{p}_i = \frac{D_i}{n}$$

Example

for i = 1

$D_i = 24 \quad ; \quad n = 1152$

$$\hat{p}_1 = \frac{24}{1152}$$

$$= 0.0208$$

for i = 2

$D_2 = 18 \quad ; \quad n = 1152$

$$\hat{p}_2 = \frac{18}{1152}$$

$$= 0.0156$$

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

The recapitulation of the P control chart calculation for Perfumed Salicylic Talc products can be seen in **Appendix B**. The P control chart can be seen in **Figure 4.1**.

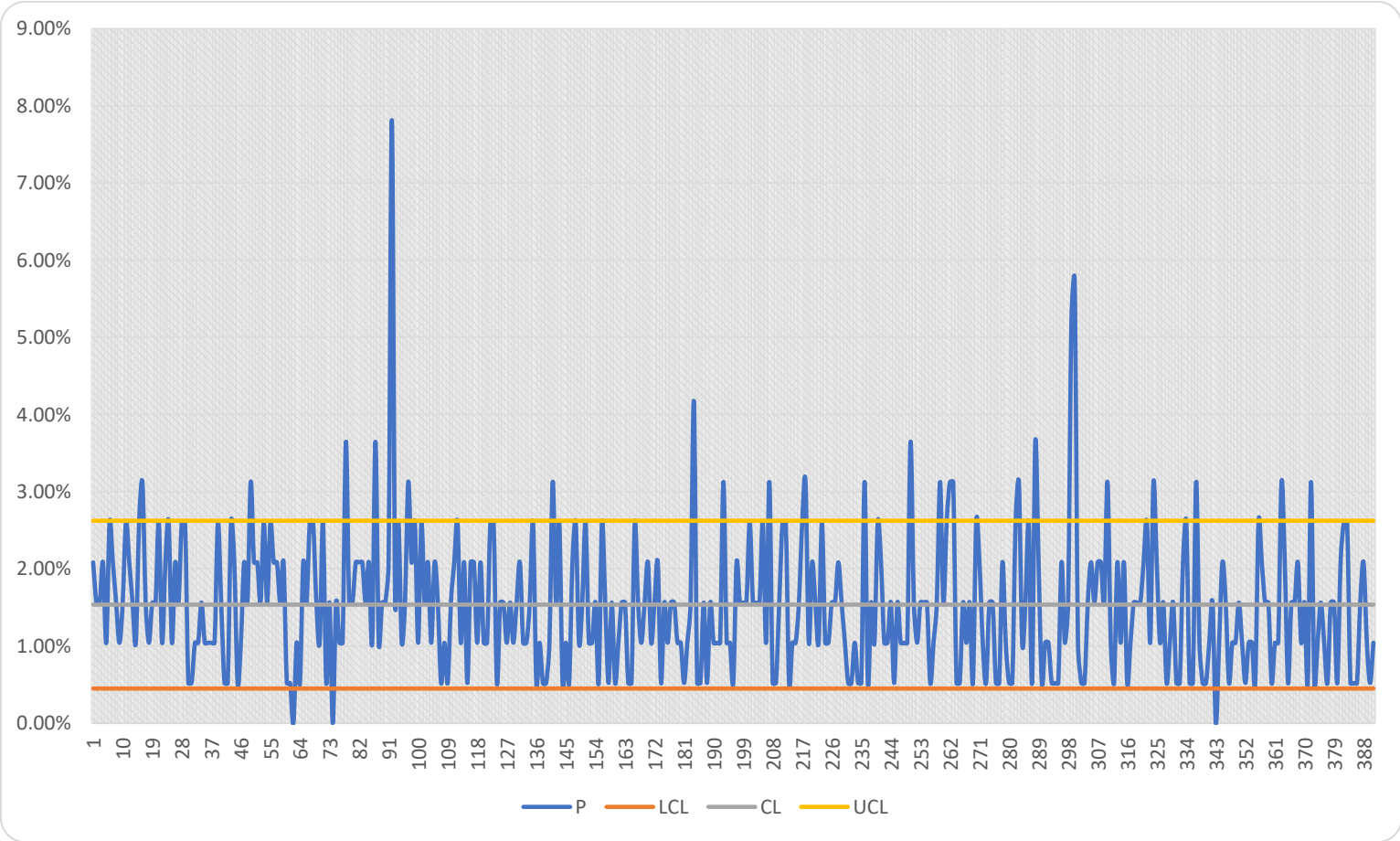


Figure 4.1. P Control Chart

Based on the P control chart, it is known that there are many defects per batch that exceed the UCL (Upper Control Limit) limit, which is 25 data. This means that Perfumed Salicylic Talc's production process has not been controlled because there is still a proportion of defects per day that exceed the upper control limit.

4.2.2.2 Calculates the Process Capability

Process capability is the ability to produce a product/service following consumer needs or expected specifications. The data used to calculate the process capability is the data production of Perfumed Salicylic Talc. The following is a measurement of the capability of the Perfumed Salicylic Talc production process.

$$DPU = \frac{total\ defective}{total\ product}$$

$$= \frac{6918}{450432}$$

$$= 0.0153$$

Based on the calculations, it can be concluded that Perfumed Salicylic Talc's production process at PT. Nusantara Beta Farma from August 2019 to July 2020, there was 0.0153 damage in one Perfumed Salicylic Talc production unit.

4.2.2.3 Calculates the Sigma Process Level

Measurement of the sigma process level is preceded by the calculation of Defect per Million Opportunities (DPMO), which shows the amount of damage that occurred in one million opportunities.

$$DPMO = \frac{total\ defective\ x\ 1.000.000}{total\ product\ x\ opportunity}$$

$$DPMO = \frac{6918\ x\ 1.000.000}{450432\ x\ 3}$$

$$DPMO = 5119.52$$

After knowing the value of DPMO, use the conversion table to get the sigma value. Based on the six-sigma conversion table, the Perfumed Salicylic Talc production process has a sigma level value of 4.0684. so, it can be concluded that the Perfumed Salicylic Talc Production process needs to be improved.

4.2.3 Analyze

This stage is the third step of the DMAIC method. This stage was carried out by making Fishbone Diagram and Failure Mode and Effect Analysis (FMEA) to determine the root cause of the problem in making Perfumed Salicylic Talc.

4.2.3.1 Make a Fishbone

A fishbone diagram consists of lines and symbols designed to represent relationships between effects and causes. The problem that occurs in making Perfumed Salicylic Talc is the proportion of products that exceed the company's standard limits. The cause-effect identification process is carried out with the quality control and engineer divisions at PT Nusantara Beta Farma. Based on the identification, three factors cause the failure mode, such as machine, man, and method.

a. Machine

PT Nusantara Beta Farma uses machines in the packaging process. Several errors have occurred with the machine. First, the machine does not press the packaging properly. This error makes the packaging does not vacuum and cause a leak. The company needs to rework the product to increase the operating cost and spend more time and energy. The machine does not press properly. Because there are parts that exhausted and the machine does not maintain regularly.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Second, the machine does not wind yarn properly. This error makes the packaging does not have a thread and will cause the packaging to become bloated. This happens because there is a tangled thread.

Third, the machine did not print the batch number correctly. These errors can spoil the packaging or blur the batch number. If the pressure is too high, then the printer will create holes in the packaging. If the pressure is too low, then the batch number becomes blurry. This happens because of some reason. The heater does not set up correctly, the batch number printer is exhausted, and wrong pressure setting.

Fourth, the sensor misreading. This error will send a false signal to the machine, so the machine will cut out of place and double print the batch number. The machine needs to shut off when the sensor has been fixing. This happened because dust covered the sensor.

b. Men

Operators have an essential role in the packaging process of Perfumed Salicylic Talc. Sometimes there is human error. First, the operator does not attach the batch number tape with precision. This causes the batch number not to comply with company standards. Second, the operator does not check the thread availability on the machine. This will cause the packaging to become bloated.

c. Method

PT Nusantara Beta Farma has no maintenance schedule. The machine will be maintained in case of an accident. This decreases the reliability of the machine. It will decrease the machine performance and machine capacity. Moreover, it can cause machine breakdown and increase maintenance costs. The Fishbone diagram for Perfumed Salicylic Talc products can be seen in **Figure 4.2.**

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

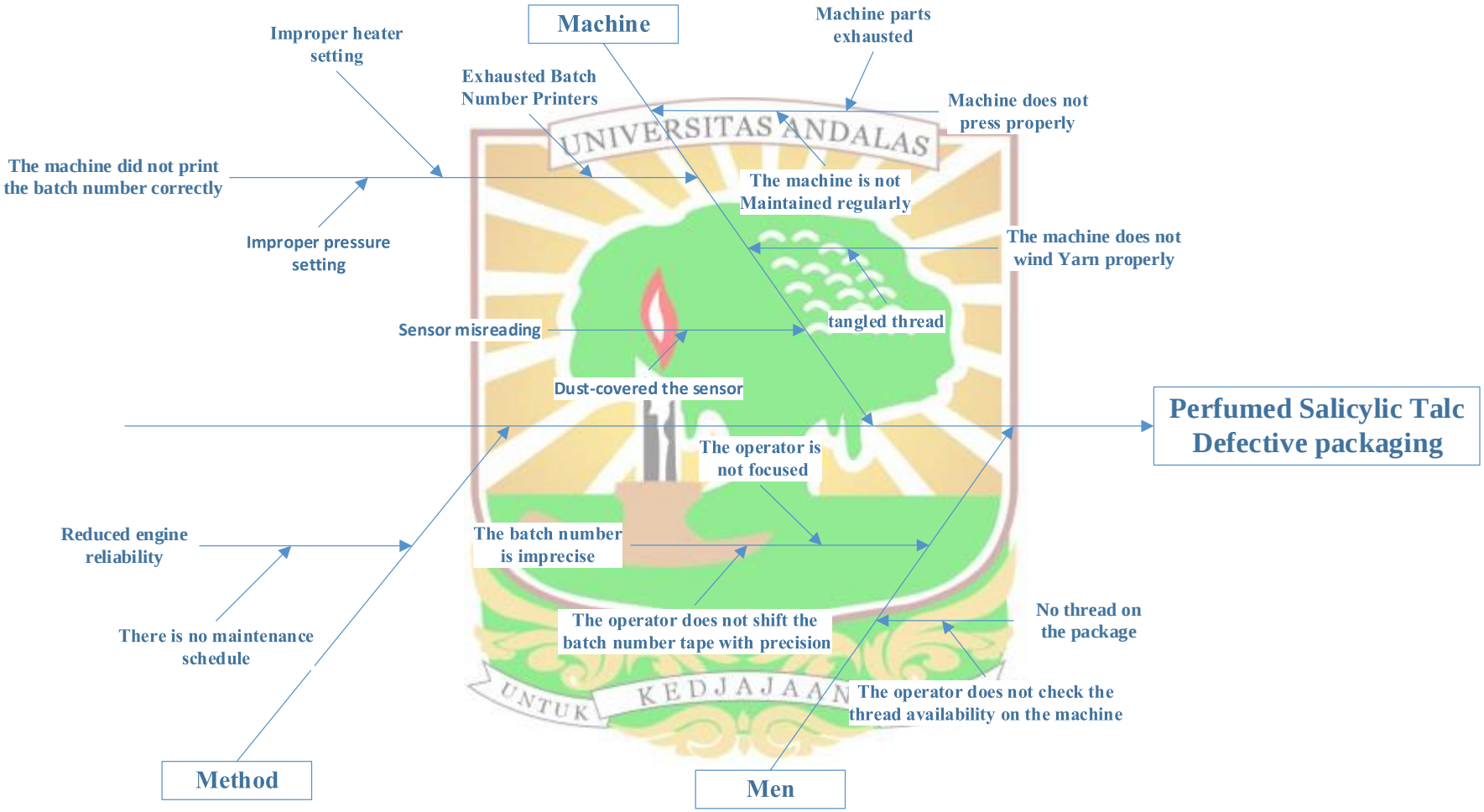


Figure 4.2. Fishbone Diagram

4.2.3.2 Make a Failure Mode and Effect Analysis

Failure mode and effect analysis (FMEA) is used to see the risk of the highest causes of failure and the effects it causes. The root of the problem along the process is obtained from the fishbone diagram. Then identified the impact caused by using FMEA. The fishbone diagram obtained previously has been validated by quality control staff.

The questionnaire was carried out based on the results of the problem identification using a fishbone diagram. Three indicators are Severity, Occurrence, and Detection.

a. Severity

An example of a questionnaire on severity indicators can be seen in **Table 4.2**.

Table 4.2 Example of a Questionnaire for Indicators of Severity

No	Factor	Cause of Failure	Effect of Failure	Ranking									
				1	2	3	4	5	6	7	8	9	10
2	Men	The operator does not check the thread	The packaging becomes bloated										
		The operator shifts the batch number tape incorrectly	The batch number does not comply with company standards										

b. Occurrence

An example of a questionnaire on occurrence indicators can be seen in **Table 4.3**.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Table 4.3 Example of a Questionnaire for Indicators of Occurrence

No	Factor	Cause of Failure	Ranking									
			1	2	3	4	5	6	7	8	9	10
1	Machine	Machine does not press properly										
		The machine does not wind Yarn properly										
		The machine did not print the batch number correctly										
		sensor misreading										

c. Detection

An example of a questionnaire on detection indicators can be seen in **Table 4.4**.

Tabel 4.4. Example of a questionnaire for indicators of Detection

No	Failure Mode	Control	Ranking									
			1	2	3	4	5	6	7	8	9	10
1	Leak	Check the product using the sampling method										
2	No Thread	Check the product using the sampling method										
3	Unclearly Batch Nur	Check the product using the sampling method										

The detection value will be used based on the cause of failure. the machine does not press properly, and there is no maintenance schedule that will use the detection value of the leak. The machine does not wind yarn properly, and the operator doesn't check the thread availability will use the detection value of no thread. The operator shifts the batch number tape incorrectly will use the unclear batch number. But, the machine did not print the batch number correctly, and sensor misreading will use Detection value-based the effect of failure, this because the cause of failure produces two types of defect. So, the batch number does not comply with company standards, and adjacent batch numbers use the detection value of the unclear batch number. Other effects of failure will use the detection value of the leak.

The complete questionnaire can be seen in **Appendix D**. Questionnaires were distributed to 5 experts who had more knowledge and understanding of the Perfumed Salicylic Talc production process and those directly involved in the Perfumed Salicylic Talc production process. Recapitulation of expert assessments can be seen in **Table 4.5** to **Table 4.7**.

Table 4.5 Recapitulation of Expert Assessment for Severity

No	Factor	Cause of Failure	Effect of Failure	Expert					Average
				1	2	3	4	5	
1	Machine	Machine does not press properly	The packaging is not vacuum	7	6	7	7	6	6.6
			waste of time and energy	7	7	5	5	7	6.2
			Operating costs are increasing	4	4	5	5	4	4.4
		The machine does not wind Yarn properly	The packaging becomes bloated	7	5	7	7	5	6.2
		The machine did not print the batch number correctly	The batch number does not comply with company standards	4	7	4	4	7	5.2
			Batch number prints damage the packaging	7	5	7	7	7	6.6
		sensor misreading	The packaging is cut out of place	7	8	8	9	8	8.0
			Machine breakdown	7	7	7	7	6	6.8
			Adjacent batch number	4	5	5	5	5	4.8
2	Man	The operator does not check the thread	The packaging becomes bloated	7	5	7	7	5	6.2
		The operator shifts the batch number tape incorrectly	The batch number does not comply with company standards	4	7	4	4	7	5.2
3	Method	There is no maintenance schedule	decreased performance rate	5	6	8	8	4	6.2
			Production capacity decreased	6	6	6	6	4	5.6
			Machine breakdown	7	6	8	8	6	7.0
			Maintenance costs are increasing	4	6	7	7	6	6.0

The following calculations carry out the determination of the severity value for each effect of failure:

$$Severity\ Value = \frac{Expert\ 1 + Expert\ 2 + Expert\ 3 + Expert\ 4 + Expert\ 5}{n}$$

An example for the packaging is not vacuum:

$$Severity\ Value = \frac{7 + 6 + 7 + 7 + 6}{5}$$

$$Severity\ Value = 6.6$$

$$Severity\ Value\ \approx 7$$

Table 4.6 Recapitulation of Expert Assessment for Occurrence

No	Factor	Cause of Failure	Expert					Average
			1	2	3	4	5	
1	Machine	Machine does not press properly	6	7	4	4	5	5.2
		The machine does not wind Yarn properly	6	6	4	4	5	5.0
		The machine did not print the batch number correctly	6	5	7	6	7	6.2
		sensor misreading	8	6	3	2	8	5.4
2	Man	The operator does not check the thread	3	3	3	3	7	3.8
		The operator shifts the batch number tape incorrectly	2	1	2	1	6	2.4
3	Method	There is no maintenance schedule	6	7	6	6	7	6.4

The following calculations carry out the determination of the Occurrence value for each cause of failure:

$$Occurrence\ Value = \frac{Expert\ 1 + Expert\ 2 + Expert\ 3 + Expert\ 4 + Expert\ 5}{n}$$

Example for the machine does not press properly:

$$Occurrence\ Value = \frac{6 + 7 + 4 + 4 + 5}{5}$$

$$Occurrence\ Value = 5.2$$

$$Occurrence\ Value \approx 5$$

Table 4.7 Recapitulation of Expert Assessment for Detection

No	Failure Mode	Control	Expert					Average
			1	2	3	4	5	
1	Leak	Check the product using the sampling method	2	2	3	4	2	2,6
2	No Thread	Check the product using the sampling method	2	2	3	4	3	2,8
3	Unclearly Batch Nu	Check the product using the sampling method	2	2	3	4	2	2,6

The following calculations carry out the determination of the Occurrence value for each failure mode:

$$Detection\ Value = \frac{Expert\ 1 + Expert\ 2 + Expert\ 3 + Expert\ 4 + Expert\ 5}{n}$$

Example for the unclearly batch number:

$$Detection\ Value = \frac{2+2+3+4+2}{5}$$

$$Detection\ Value = 2.6$$

$$Detection\ Value \approx 3$$

4.2.3.3 Calculate Risk Priority Number (RPN)

The Risk Priority Number (RPN) value determines the priority of failure. RPN is used as a ranking of potential process failures Risk Priority Number (RPN). The value of the RPN is the result of the multiplication between the severity, incidence rate, and detection rate. Based on the calculation, several failure modes are obtained that have the highest risk value. Calculation of the value of the Risk Priority Number (RPN) can be seen in **Table 4.8**.

Table 4.8 The Value of Risk Priority Number

No	Factor	Cause of Failure	Effect of Failure	O	S	D	RPN	Rank
1	Machine	Machine does not press properly	The packaging is not vacuum	5	7	3	105	7
			waste of time and energy		6		90	9
			Operating costs are increasing		4		60	14
		The machine does not wind Yarn properly	The packaging becomes bloated	5	6	3	90	9
		The machine did not print the batch number correctly	The batch number does not comply with company standards	6	5	3	90	9
			Batch number prints damage the packaging		7	3	126	1
		sensor misreading	The packaging is cut out of place	5	8	3	120	3
			Machine breakdown		7		105	7
			Adjacent batch number		5	3	75	12
2	Man	The operator does not check the thread	The packaging becomes bloated	4	6	3	72	13
		The operator shifts the batch number tape incorrectly	The batch number does not comply with company standards	2	5	3	30	15
3	Method	There is no maintenance schedule	decreased performance rate	6	6	3	108	4
			Production capacity decreased		6		108	4
			Machine breakdown		7		126	1
			Maintenance costs are increasing		6		108	4

Based on the analysis on the Failure Mode and Effect Analysis (FMEA) method and the Risk Priority Number (RPN) assessment that has been carried out, it can be seen that the type of defect that has the highest RPN value in the production process of Perfumed Salicylic Talc at PT. Nusantara Beta Farma is the batch number prints that damage the packaging and machine breakdown. The third highest RPN is the packaging cut out of place.

4.2.4 Improve

Improve is the fourth step in DMAIC. This step is carried out after the sources and root causes of quality problems have been identified. The improvement given in this final project focuses on three leading causes of failure to the packaging of Perfumed Salicylic Talc as the machine did not print the batch number correctly, there is no maintenance schedule, and sensor misreading.

4.2.4.1 Proposed improvements for as the machine did not print the batch number correctly

Printing machines can cause damage to the packaging. This can be happened because of some reason. First, the machine is set with an incorrect temperature. This will make the batch number hard to read or the batch number printer cut off. Second, the machine is set with an incorrect pressure setting. This will make a hole in the packaging. Third, the batch number printer is exhausted. This will make the batch number difficult to read.

The problem can be avoided if the machine is set up correctly and regularly check by the operator. The improvement proposal for this problem is a standard operating procedure to check and record the machine condition. The standard operating procedure to check machine conditions can be seen in **Appendix E**.

This improvement makes the operator aware of the machine's condition and increases the understanding of the phenomena or signs when the machine will produce defective packaging. Furthermore, the data can use to analyze the machine behavior and predictable machine error.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

4.2.4.2 Proposed improvements for there is no maintenance schedule.

Based on the head of the engineering department, there is no record of the maintenance. This makes the maintenance schedule difficult to determine. So, the improved proposal for this problem is a big picture of preventive maintenance that needed to be implemented to achieve better productivity in the future. However, the initial preventive maintenance schedule will be set once a month, based on the head of the engineering department's decision. The preventive maintenance procedure can be seen in **Appendix E**.

This improvement's primary purpose is to record all the data about the machine, such as performance, common error, and machine parts lifetime. All of this data can be useful to predict the following error that can be occurs and decrease the cost of maintenance. If the machine is maintained effectively, it will increase the machine performance to the highest productivity. In other words, it will increase the income of the company by producing more products in the same amount of time with fewer defective products.

4.2.4.3 Proposed improvements for sensor misreading

The sensor will send a signal to the printer and cutter if sensor misreading causes a false signal. This false signal will cause the printer to print multiple batch numbers and cut them out of place. The packaging machine needs to be stopped to fix the sensor.

In PT Nusantara Betafarma, there is no regular schedule to clean the sensor. As the company produces powder, it is a possible thing that makes the sensor quickly get some dirt on it. Improvement proposals for sensor misreading need to be cleaned regularly, so it is crucial to set a schedule for it. The schedule is done by an interview with the engineering department. Based on the head of the engineering

department, the company set the schedule two times a day, such as in the morning and in the break time.

4.2.5 Control

Control is the last step in DMAIC. This step provides several documents to improve quality control in the Perfumed Salicylic Talc production process. There are two types of documents such as check sheets and form.

First, the check sheet uses to help the operator to check the machine's condition. This check sheet is a document for the standard operating procedure to check machine conditions. This document is designed together with the head of the engineering department. The operator will use the check sheet, and all the data will be used to better understand the phenomena or signs when the machine will produce defective packaging. The design of the machine condition check sheet can be seen in **Appendix F**.

Second, forms are used to collect the information. In this case, the information that will be collected, such as the failure/error, the item/part that fails/error, and others. The technician will fill the form when their machine is repair or maintenance. All the data that has been recorded will be used to make a preventive maintenance schedule. The complete design of the machine maintenance/repair form can be seen in **Appendix G**. This form design with the engineering department and the form uses for the preventive maintenance procedure.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

CHAPTER V
CONCLUSION

This chapter contains the conclusions of the research results and the recommendation for further research.

5.1 Conclusion

The conclusions of this research are:

The most common defect in Perfumed Salicylic Talc packaging is a leak. The main cause of leaks is in the batch number printing process. This is because the machine did not print the batch number correctly. This failure indicates a decrease in the reliability of the packaging machine. Decreased machine reliability is closely related to there is no maintenance schedule. Because there is no maintenance schedule, the machine is not well-maintained, which results in decreased reliability of the packaging machine. Besides that, there is no schedule for cleaning the sensor in the packaging machine. This causes a misread on the sensor, which results in the packaging cut out of place.

The proposed suggestions in this research are the procedure for preventive maintenance, checking machine condition, and setting a schedule for cleaning the sensor. For the procedure, there are documents as tools such as check sheets and form. The company will use the data that had been recorded in the check sheet and form to make a proper preventive maintenance schedule so the PT. Nusantara Beta Farma can increase machine reliability.

5.2 Recommendation

Recommendations that can give for further research are:

Further research can be conducted by making the preventive maintenance schedule and determine the spare part lifetime for the Packaging machine. so, the company can increase and maintain the machine reliability of the Packaging machine. the stable reliability of the machine will make the production process run smoothly.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

REFERENCES

Assauri, S. (2008). *Manajemen Produksi dan Operasi*. Jakarta: Universitas Indonesia.

Automotive Industry Action Group (2001). *Potential Failure Mode and Effects Analysis.* (Ed. Ketiga). Michigan: AIAG

Bakhtiar, S. Tahir, S. dan Hasni, R.A. (2013). Analisa pengendalian kualitas dengan menggunakan metode statistical quality control (SQC). *Malikussaleh Industrial Engineering Journal*. 2(1). 29-36.

Besterfield, D.H. (2008). *Quality Control*. United State of Amerika: Pearson.

Charantimath, P. M. (2017). *Total Quality Management.* (Ed. 3). India: Pearson India Education Services Pvt.

Costa J.P. Lopes I.S. dan Brito J. P. (2019). Six Sigma application for quality improvement of the pin insertion process. *Procedia Manufacturing*. 38. 1592–1599.

Garvin, D. A. (1987). *Managing Quality*. New York: The Free Press.

Gaspersz, V. (2001). *Total Quality Management*. Jakarta: PT Gramedia Pustaka Utama.

Gaspersz, V. (2002). *Pedoman Implementasi Program Six Sigma Terintegrasi Dengan ISO 9001: 2000, MBNQA, dan HACCP*. Bogor: Gramedia Pustaka Utama.

Gasperz, V. (2013). *All in One 150 Keys Performance Indicator and Balanced Scorecard, Malcom Baldrige, Lean Six Sigma Supply Chain Management*. Bogor: Tri-Al-Bros Publishing.

Gejdoš, P. (2015). Continuous Quality Improvement by Statistical Process Control. *Procedia Economics and Finance*. 34. 565 – 572.

George. (2002). *Lean Six Sigma for Service*. New York: MC Graw Hill.

Handoko, T.H. (1984). *Dasar-Dasar Manajemen Peroduksi dan Operasi*. Yogyakarta: BPFE.

Institute for Human Data Science. (2019). *The Global Use of Medicine in 2019 and Outlook to 2023.* USA.

Khadka, K. dan Maharjan, S. (2017). *Customer satisfaction and customer loyalty*. Thesis. Centria University Date of Applied Sciences.

Laureani, A. Brady, M. dan Antony, J. (2013). Applications of Lean Six Sigma in an Irish Hospital. *Leadership in Health Service*. 26(4). 322-337.

Lester, A. (2017). "Quality Management," in *Project Management, Planning and Control*. (7th ed). United Kingdom: Butterworth-Heinemann, 85–98.

Mader, D.P. (2008). Lean Six Sigma's Evolution. *Quality Progress.* 41(1). 40-48.

Montgomery, D. C. (2009). *Introduction to Statistical Quality Control*. (Ed 6). United States: Jhon Wiley and Sons, Inc.

Montgomery, D. C. (2009). *Statistical Quality Control: A Modern Introduction*. (Ed 7). United States: Jhon Wiley and Sons, Inc.

Montgomery, D. C. (2012). Statistical Quality Control. USA: Wiley.

Pepper, M.P.J. dan Spedding, T.A. (2010). The Evolution of Lean Six Sigma. *Int. J. of Quality and Reliability Management*. 27 (2). 138-155.

Peraturan Kepala Badan Pengawas Obat dan Makanan Nomor HK.03.42.06.10.4556 tahun 2010.

Peraturan Menteri Kesehatan RI No. 43/MenKes/SK/II/1988.

Peraturan Menteri Kesehatan RI No. 1799/Menkes/Per/XII/2010.

Prawirosentono, S. (2004). *Filosofi Baru Tentang Manajemen Mutu Terpadu Total Quality Management Abad 21 (Studi dan Kasus)*. (Ed 2). Jakarta: Bumi Aksara.

Purnomo, Hari. (2004). *Pengantar Teknik Industri*. (Ed 2). Yogyakarta: Graha Ilmu.

Puspitasari, N. B. dan Arif, M. 2014. *Penggunaan FMEA Dalam Mengidentifikasi Resiko Kegagalan Proses Produksi Sarung Atm (Alat Tenun Mesin): Studi Kasus Pt. Asaputex Jaya Tegal*. *Jurnal Teknik Industri*. 9(2).

Smętkowska, M. dan Mrugalska, B. (2018). Using Six Sigma DMAIC to improve the quality of the production process: a case study. *Procedia - Social and Behavioral Sciences*. 238. 590 – 596.

Sokovic, M. Pavletic, D. dan Pipan, K. K. (2010). Quality improvement methodologies - PDCA cycle, RADAR matrix, DMAIC and DFSS. *Journal of Achievements in Materials and Manufacturing Engineering*. 43(1). 476-483.

Sin, A. B. Zailani, S. Iranmanesh, M. dan Ramayah, T. (2015). Structural equation modelling on knowledge creation in Six Sigma DMAIC project and its impact on organizational performance. *International Journal of Production Economics*. 168. 105-117.

Srinivasana, K. Muthu S. Devadasan S.R. dan Sugumaran, C. (2014). Enhancing effectiveness of Shell and Tube Heat Exchanger through Six Sigma DMAIC phases. *Procedia Engineering*. 97. 2064 – 2071.

Srinivasana, K. Muthu S. Prasadc N.K. dan Satheeshd, G. (2014). Reduction of paint line defects in shock absorber through Six Sigma DMAIC phases. *Procedia Engineering*. 97. 1755 – 1764.

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

APPENDIX

APPENDIX A

(Data Production of Yellow Salisil Talk Wangi)

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
August	1	079329	51	4	0	7392	1152	18	6	0	no bets menutupi barcode
August	1	079331	51	2	0	7368	1152	18	0	0	
August	1	079333	51	8	0	7440	1152	18	0	0	
August	1	079335	51	0	0	7344	1152	24	0	0	
August	2	079337	50	7	0	7284	1152	12	0	0	
August	3	089339	52	0	0	7488	1152	30	0	0	
August	5	089341	51	10	0	7464	1152	18	6	0	no bets menutupi bpom NA
August	6	089345	52	8	0	7584	1152	18	0	0	
August	6	089347	50	0	0	7200	1152	12	0	0	
August	8	089349	52	0	0	7488	1152	18	0	0	
August	8	089351	51	4	0	7392	1152	30	0	0	
August	8	089353	51	3	0	7380	1152	24	0	0	
August	16	089355	50	8	0	7296	1152	18	0	0	
August	16	089357	51	0	0	7344	1152	12	0	0	
August	19	089359	51	1	0	7356	1152	30	0	0	
August	20	089361	50	0	0	7200	1152	6	30	0	no bets menutupi barcode
August	20	089363	50	2	0	7224	1152	18	0	0	
August	21	089365	51	2	0	7368	1152	12	0	0	
August	21	089367	50	8	0	7296	1152	6	12	0	bocor d no bets
August	21	089369	51	0	0	7344	1152	18	0	0	
August	21	089371	50	2	0	7224	1152	18	12	0	no bets menutupi bpom NA
August	22	089373	51	5	0	7404	1152	12	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
August	22	089375	50	8	0	7296	1152	24	0	0	
August	23	089377	50	0	0	7200	1152	24	6	0	no bets menutupi bpom NA
August	23	089379	51	0	0	7344	1152	12	0	0	
August	24	089381	51	7	0	7428	1152	24	0	0	
August	24	089383	50	9	0	7308	1152	18	0	0	
August	26	089385	51	5	0	7404	1152	24	6	0	no bets menutupi bpom NA
August	26	089387	50	8	0	7296	1152	30	0	0	
August	27	089389	49	11	0	7188	1152	6	0	0	
August	27	089391	50	10	0	7320	1152	6	0	0	
August	28	089393	51	4	0	7392	1152	12	0	0	
August	28	089395	52	2	0	7512	1152	12	0	0	
August	29	089397	50	10	0	7320	1152	18	0	0	
August	30	089401	51	6	0	7416	1152	12	0	0	
August	31	089403	51	7	0	7428	1152	12	0	0	
August	31	089405	51	1	0	7356	1152	12	0	0	
September	2	089407	50	11	0	7332	1152	12	0	0	
September	2	089409	50	4	0	7248	1152	30	0	0	
September	3	089411	50	8	0	7296	1152	18	0	0	
September	5	099413	50	9	0	7308	1152	6	0	0	
September	5	099415	51	4	0	7392	1152	6	0	0	
September	6	099417	50	9	0	7308	1152	30	0	0	
September	6	099419	51	7	0	7428	1152	24	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
September	6	099421	51	7	0	7428	1152	6	0	0	
September	7	099423	52	1	0	7500	1152	12	0	0	
September	7	099425	50	8	0	7296	1152	24	0	0	
September	9	099427	51	0	0	7344	1152	18	0	0	
September	9	099429	51	11	0	7476	1152	18	18	0	no bets menutupi bpom NA
September	10	099431	50	0	0	7200	1152	24	0	0	
September	10	099433	50	11	0	7332	1152	24	0	0	
September	11	099435	50	11	0	7332	1152	18	0	0	
September	11	099437	50	9	0	7308	1152	12	18	0	bocor d no bets
September	12	099439	50	5	0	7260	1152	18	0	0	
September	12	099441	50	7	0	7284	1152	30	0	0	
September	13	099443	51	6	0	7416	1152	12	12	0	no bets menutupi barcode
September	13	099445	51	1	0	7356	1152	24	0	0	
September	14	099447	51	6	0	7416	1152	18	0	0	
September	14	099449	51	1	0	7356	1152	24	0	0	
September	16	099451	49	9	0	7164	1152	6	0	0	
September	16	099453	52	1	0	7500	1152	6	0	0	
September	17	099455	51	5	0	7404	1152	0	0	0	
September	17	099457	50	3	0	7236	1152	12	0	0	
September	18	099459	50	10	0	7320	1152	6	0	0	
September	19	099461	49	11	0	7188	1152	24	0	0	
September	19	099463	51	5	0	7404	1152	18	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
September	20	099465	50	6	0	7272	1152	30	0	0	
September	20	099467	51	10	0	7464	1152	30	0	0	
September	21	099469	51	0	0	7344	1152	18	0	0	
September	21	099471	51	5	0	7404	1152	12	0	0	
September	23	099473	51	1	0	7356	1152	30	0	0	
September	23	099475	52	1	0	7500	1152	6	0	0	
October	2	099477	51	6	0	7416	1152	18	0	0	
October	2	099479	52	10	0	7608	1152	0	0	0	
October	3	099481	52	6	0	7560	1152	18	0	0	
October	3	099483	51	10	0	7464	1152	12	0	0	
October	4	099485	51	9	0	7452	1152	12	0	0	
October	4	099487	51	2	0	7368	1152	18	24	0	no bets menutupi bpom NA
October	5	109489	50	4	0	7248	1152	18	0	0	
October	5	109491	50	10	0	7320	1152	18	0	0	
October	7	109493	50	8	0	7296	1152	24	0	0	
October	7	109495	50	7	0	7284	1152	24	0	0	
October	8	109497	50	7	0	7284	1152	24	0	0	
October	10	109499	51	3	0	7380	1152	18	0	0	
October	11	109501	51	10	0	7464	1152	24	0	0	
October	11	109503	50	10	0	7320	1152	12	0	0	
October	12	109505	50	2	0	7224	1152	6	36	0	bocor d no bets
October	14	109507	52	2	0	7512	1152	12	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
October	15	109509	51	2	0	7368	1152	18	0	0	
October	16	109511	50	6	0	7272	1152	18	0	0	
October	16	109513	50	3	0	7236	1152	24	0	0	
October	17	109515	50	6	0	7272	1152	18	72	0	no bets menutupi barcode
October	17	109517	50	3	0	7236	1152	18	0	0	
October	18	109519	51	5	0	7404	1152	30	0	0	
October	19	109521	51	6	0	7416	1152	12	0	0	bocor d no bets
October	19	109523	50	7	0	7284	1152	6	12	0	
October	21	109525	50	7	0	7284	1152	36	0	0	
October	22	109527	50	1	0	7212	1152	24	0	0	
October	22	109529	51	3	0	7380	1152	30	0	0	
October	22	109531	51	2	0	7368	1152	12	0	0	
November	6	119533	51	5	0	7404	1152	30	0	0	
November	7	119535	50	2	0	7224	1152	18	0	0	
November	8	119537	50	4	0	7248	1152	24	0	0	
November	8	119539	52	6	0	7560	1152	12	0	0	
November	11	119541	51	0	0	7344	1152	24	0	0	
November	11	119543	50	10	0	7320	1152	18	0	0	
November	12	119545	50	7	0	7284	1152	6	0	0	
November	12	119547	50	3	0	7236	1152	12	0	0	
November	12	119549	50	6	0	7272	1152	6	0	0	
November	14	119551	51	2	0	7368	1152	18	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
November	15	119553	53	0	0	7632	1152	24	0	0	
November	15	119555	50	4	0	7248	1152	30	0	0	
November	15	119557	51	4	0	7392	1152	12	0	0	
November	18	119559	50	7	0	7284	1152	24	0	0	
November	19	119561	51	0	0	7344	1152	6	0	0	
November	21	119563	49	3	0	7092	1152	18	6	0	bocor d no bets
November	21	119565	51	0	0	7344	1152	24	0	0	
November	21	119567	50	0	0	7200	1152	12	0	0	
November	22	119569	51	4	0	7392	1152	24	0	0	
November	22	119571	51	3	0	7380	1152	12	0	0	
November	23	119573	50	7	0	7284	1152	12	0	0	
November	25	119575	50	8	0	7296	1152	30	0	0	
November	26	119577	52	0	0	7488	1152	30	0	0	
November	26	119579	51	3	0	7380	1152	6	0	0	
November	27	119581	50	9	0	7308	1152	18	0	0	
November	27	119583	51	1	0	7356	1152	18	0	0	
November	27	119585	51	8	0	7440	1152	12	0	0	
November	28	119587	50	7	0	7284	1152	18	0	0	
November	28	119589	50	9	0	7308	1152	12	0	0	
November	29	119591	50	4	0	7248	1152	18	0	0	
November	29	119593	51	3	0	7380	1152	24	0	0	
November	29	119595	50	6	0	7272	1152	12	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
November	30	119597	51	4	0	7392	1152	12	0	0	
December	2	119599	51	0	0	7344	1152	18	0	0	
December	2	119601	51	1	0	7356	1152	30	0	0	
December	3	119603	50	11	0	7332	1152	6	0	0	
December	3	119605	50	6	0	7272	1152	12	0	0	
December	4	119607	51	2	0	7368	1152	6	0	0	
December	5	119609	51	2	0	7368	1152	6	0	0	
December	5	119611	51	1	0	7356	1152	12	0	0	
December	5	119613	50	5	0	7260	1152	36	0	0	
December	16	129615	51	2	0	7368	1152	18	0	0	
December	17	129617	50	10	0	7320	1152	18	12	0	no bets menutupi bpom NA
December	17	129619	51	2	0	7368	1152	6	0	0	
December	18	129621	51	5	0	7404	1152	12	0	0	
December	18	129623	50	6	0	7272	1152	6	0	0	
December	19	129625	51	0	0	7344	1152	24	0	0	
December	19	129627	50	0	0	7200	1152	30	0	0	
December	19	129629	51	1	0	7356	1152	12	0	0	
December	20	129631	51	0	0	7344	1152	18	0	0	
December	20	129633	50	9	0	7308	1152	18	12	0	no bets menutupi bpom NA
December	21	129635	50	7	0	7284	1152	12	0	0	
December	21	129637	50	7	0	7284	1152	12	0	0	
December	23	129639	50	10	0	7320	1152	18	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
December	23	129641	50	3	0	7236	1152	6	0	0	
December	24	129643	51	5	0	7404	1152	30	0	0	
December	24	129645	50	7	0	7284	1152	18	0	0	
December	26	129647	51	0	0	7344	1152	6	0	0	
December	26	129649	50	9	0	7308	1152	12	6	0	no bets menutupi bpom NA
December	27	129651	50	7	0	7284	1152	6	0	0	
December	27	129653	51	7	0	7428	1152	12	0	0	
December	28	129655	50	10	0	7320	1152	18	0	0	
December	28	129657	51	0	0	7344	1152	18	0	0	
December	28	129659	51	3	0	7380	1152	6	0	0	
December	30	129661	50	10	0	7320	1152	6	0	0	
December	30	129663	50	0	0	7200	1152	30	0	0	
December	30	129665	50	0	0	7200	1152	12	6	0	bocor d no bets
December	31	129667	50	8	0	7296	1152	12	0	0	
December	31	129669	50	3	0	7236	1152	18	0	0	
January	11	010001	50	0	0	7200	1152	24	0	0	
January	13	010003	51	6	0	7416	1152	12	0	0	
January	13	010005	49	3	0	7092	1152	18	0	0	
January	14	010007	51	0	0	7344	1152	24	0	0	
January	14	010009	51	6	0	7416	1152	6	0	0	
January	15	010011	50	4	0	7248	1152	18	0	0	
January	15	010013	50	6	0	7272	1152	12	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
January	29	010015	49	8	0	7152	1152	18	0	0	
January	29	010017	50	7	0	7284	1152	18	0	0	
January	30	010019	50	2	0	7224	1152	12	0	0	
January	30	010021	49	11	0	7188	1152	12	0	0	
February	6	020023	53	0	0	7632	1152	6	0	0	
February	6	020025	52	0	0	7488	1152	12	0	0	
February	6	020027	50	8	0	7296	1152	18	0	0	
February	7	020029	50	0	0	7200	1152	30	18	0	bocor d no bets
February	7	020031	50	8	0	7296	1152	6	0	0	
February	7	020033	50	9	0	7308	1152	6	0	0	
February	8	020035	51	5	0	7404	1152	18	0	0	
February	8	020037	51	0	0	7344	1152	6	0	0	
February	8	020039	50	10	0	7320	1152	18	0	0	
February	10	020041	50	10	0	7320	1152	12	0	0	
February	11	020043	51	7	0	7428	1152	12	0	0	
February	11	020045	50	0	0	7200	1152	12	0	0	
February	12	020047	51	1	0	7356	1152	30	6	0	bocor d no bets
February	12	020049	50	10	0	7320	1152	12	0	0	
February	12	020051	51	7	0	7428	1152	12	0	0	
February	12	020053	50	10	0	7320	1152	6	0	0	
February	13	020055	50	3	0	7236	1152	24	0	0	
February	13	020057	50	0	0	7200	1152	18	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
February	13	020059	50	10	0	7320	1152	18	0	0	
February	14	020061	50	4	0	7248	1152	18	0	0	
February	14	020063	50	0	0	7200	1152	30	0	0	
February	14	020065	50	10	0	7320	1152	18	0	0	
February	15	020067	50	10	0	7320	1152	18	0	0	
February	15	020069	50	10	0	7320	1152	12	6	0	no bets menutupi barcode
February	15	020071	50	6	0	7272	1152	30	0	0	
February	17	020073	50	8	0	7296	1152	12	0	0	
February	18	020075	50	8	0	7296	1152	36	0	0	
February	18	020077	51	4	0	7392	1152	6	0	0	
February	19	020079	51	2	0	7368	1152	6	0	0	
February	20	020081	51	3	0	7380	1152	18	0	0	
February	20	020083	52	4	0	7536	1152	30	0	0	
February	21	020085	51	6	0	7416	1152	24	6	0	no bets menutupi bpom NA
February	26	020087	51	5	0	7404	1152	6	0	0	
February	27	020089	50	7	0	7284	1152	12	0	0	
February	28	020091	49	0	0	7056	1152	12	0	0	
February	29	020093	51	9	0	7452	1152	18	0	0	
February	29	020095	51	9	0	7452	1152	30	0	0	
March	2	020097	50	7	0	7284	1152	36	0	0	
March	3	020099	51	4	0	7392	1152	12	0	0	
March	3	020101	51	5	0	7404	1152	24	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet												
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect				
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
March	4	020103	51	1	0	7356	1152	18	0	0	
March	4	020105	50	4	0	7248	1152	12	0	0	
March	5	030107	51	4	0	7392	1152	30	0	0	
March	6	030109	50	5	0	7260	1152	12	0	0	
March	6	030111	50	4	0	7248	1152	12	0	0	
March	7	030113	51	0	0	7344	1152	12	6	0	no bets menutupi barcode
March	9	030115	50	0	0	7200	1152	18	0	0	
March	10	030117	51	0	0	7344	1152	24	0	0	
March	11	030119	49	8	0	7152	1152	18	0	0	
March	12	030121	50	0	0	7200	1152	12	0	0	
March	12	030123	50	7	0	7284	1152	6	0	0	
March	13	030125	50	5	0	7260	1152	6	0	0	
March	14	030127	50	11	0	7332	1152	12	0	0	
March	14	030129	51	1	0	7356	1152	6	0	0	
March	16	030131	51	7	0	7428	1152	6	0	0	
March	16	030133	50	0	0	7200	1152	12	24	0	no bets menutupi bpom NA
March	17	030135	50	8	0	7296	1152	6	0	0	
March	17	030137	50	0	0	7200	1152	18	0	0	
March	18	030139	49	9	0	7164	1152	12	0	0	
March	19	030141	51	2	0	7368	1152	30	0	0	
March	20	030143	50	4	0	7248	1152	24	0	0	
March	20	030145	50	0	0	7200	1152	12	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
March	21	030147	50	10	0	7320	1152	12	0	0	
March	23	030149	50	5	0	7260	1152	18	0	0	
March	24	030151	50	0	0	7200	1152	6	0	0	
March	25	030153	52	0	0	7488	1152	18	0	0	
March	26	030155	51	1	0	7356	1152	12	0	0	
March	27	030157	50	9	0	7308	1152	12	0	0	
March	30	030159	51	0	0	7344	1152	12	0	0	
March	31	030161	51	0	0	7344	1152	24	18	0	no bets menutupi barcode
April	1	030163	50	6	0	7272	1152	18	0	0	
April	1	030165	50	11	0	7332	1152	12	0	0	
April	3	030167	50	8	0	7296	1152	18	0	0	
April	3	030169	49	0	0	7056	1152	18	0	0	
April	4	030171	50	10	0	7320	1152	18	0	0	
April	7	030173	50	0	0	7200	1152	6	0	0	
April	8	030175	52	0	0	7488	1152	12	0	0	
April	9	040177	51	8	0	7440	1152	18	0	0	
April	9	040179	51	7	0	7428	1152	24	12	0	no bets menutupi barcode
April	10	040181	51	6	0	7416	1152	18	0	0	
April	13	040183	50	2	0	7224	1152	30	0	0	
April	14	040185	50	0	0	7200	1152	36	0	0	
April	15	040187	50	7	0	7284	1152	36	0	0	
April	15	040189	50	0	0	7200	1152	6	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet												
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect				
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
April	16	040191	50	7	0	7284	1152	6	0	0	
April	16	040193	51	0	0	7344	1152	18	0	0	
April	17	040195	50	2	0	7224	1152	12	0	0	
April	17	040197	50	7	0	7284	1152	18	0	0	
April	18	040199	51	0	0	7344	1152	6	0	0	
April	20	040201	51	5	0	7404	1152	30	0	0	
April	21	040203	51	7	0	7428	1152	24	0	0	
April	21	040205	51	1	0	7356	1152	12	0	0	
April	22	040207	50	0	0	7200	1152	6	0	0	
April	23	040209	50	7	0	7284	1152	12	6	0	no bets menutupi barcode
April	23	040211	50	6	0	7272	1152	18	0	0	
April	24	040213	50	0	0	7200	1152	6	0	0	
April	29	040215	50	8	0	7296	1152	6	0	0	
April	29	040217	51	0	0	7344	1152	24	0	0	
April	29	040219	50	5	0	7260	1152	12	0	0	
April	30	040221	50	1	0	7212	1152	6	0	0	
April	30	040223	51	0	0	7344	1152	6	0	0	
April	30	040225	51	3	0	7380	1152	12	18	0	no bets menutupi bpom NA
May	1	040227	50	5	0	7260	1152	36	0	0	
May	1	040229	50	9	0	7308	1152	12	0	0	
May	4	040231	51	5	0	7404	1152	18	0	0	
May	4	040233	50	7	0	7284	1152	30	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
May	5	040235	50	8	0	7296	1152	6	0	0	
May	5	040237	51	6	0	7416	1152	18	24	0	no bets menutupi barcode
May	5	040239	51	5	0	7404	1152	24	0	0	
May	6	050241	50	10	0	7320	1152	6	0	0	
May	6	050243	51	10	0	7464	1152	12	0	0	
May	6	050245	51	7	0	7428	1152	12	0	0	
May	6	050247	50	0	0	7200	1152	6	0	0	
May	8	050249	50	0	0	7200	1152	6	0	0	
May	8	050251	51	4	0	7392	1152	6	0	0	
May	8	050253	50	6	0	7272	1152	24	0	0	
May	9	050255	51	2	0	7368	1152	12	0	0	
May	9	050257	51	8	0	7440	1152	18	0	0	
May	11	050259	50	0	0	7200	1152	24	36	0	bocor d no bets
May	12	050261	51	0	0	7344	1152	36	30	0	bocor d no bets
May	18	050263	51	2	0	7368	1152	12	0	0	
May	18	050265	51	0	0	7344	1152	6	0	0	
May	19	050267	50	3	0	7236	1152	6	0	0	
May	19	050269	51	0	0	7344	1152	18	0	0	
May	19	050271	51	1	0	7356	1152	24	0	0	
May	20	050273	50	4	0	7248	1152	18	0	0	
May	28	050275	51	5	0	7404	1152	24	0	0	
May	28	050277	51	0	0	7344	1152	24	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
May	30	050279	50	0	0	7200	1152	18	0	0	
May	30	050281	50	4	0	7248	1152	6	30	0	no bets menutupi bpom NA
June	2	050283	51	4	0	7392	1152	12	0	0	
June	2	050285	50	4	0	7248	1152	6	0	0	
June	3	050287	50	10	0	7320	1152	24	0	0	
June	3	050289	50	8	0	7296	1152	12	0	0	
June	4	050291	50	4	0	7248	1152	24	0	0	
June	4	060293	50	0	0	7200	1152	6	0	0	
June	5	060295	50	0	0	7200	1152	12	0	0	
June	5	060297	51	0	0	7344	1152	18	0	0	
June	6	060299	50	2	0	7224	1152	18	0	0	
June	6	060301	50	7	0	7284	1152	18	0	0	
June	8	060303	51	0	0	7344	1152	24	0	0	
June	8	060305	51	0	0	7344	1152	30	0	0	
June	8	060307	50	3	0	7236	1152	12	0	0	
June	9	060309	50	0	0	7200	1152	18	18	0	no bets menutupi bpom NA
June	9	060311	50	8	0	7296	1152	24	0	0	
June	10	060313	50	6	0	7272	1152	12	0	0	
June	10	060315	51	0	0	7344	1152	18	0	0	
June	11	060317	51	0	0	7344	1152	6	0	0	
June	11	060319	50	9	0	7308	1152	12	0	0	
June	11	060321	51	6	0	7416	1152	18	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet												
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect				
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
June	12	060323	51	0	0	7344	1152	6	0	0	
June	12	060325	50	0	0	7200	1152	6	0	0	
June	13	060327	51	0	0	7344	1152	24	0	0	
June	13	060329	50	2	0	7224	1152	30	0	0	
June	13	060331	50	4	0	7248	1152	6	0	0	
June	15	060333	50	7	0	7284	1152	6	0	0	
June	15	060335	52	0	0	7488	1152	24	12	0	no bets menutupi bpom NA
June	16	060337	51	4	0	7392	1152	6	6	0	no bets menutupi bpom NA
June	16	060339	51	0	0	7344	1152	6	0	0	
June	16	060341	51	5	0	7404	1152	6	0	0	
June	17	060343	52	0	0	7488	1152	12	0	0	
June	17	060345	51	4	0	7392	1152	18	0	0	
June	18	060347	52	0	0	7488	1152	0	0	0	
June	18	060349	51	6	0	7416	1152	12	0	0	
June	18	060351	51	4	0	7392	1152	24	0	0	
June	19	060353	51	0	0	7344	1152	18	0	0	
June	19	060355	50	11	0	7332	1152	6	0	0	
June	20	060357	50	3	0	7236	1152	12	0	0	
June	20	060359	50	3	0	7236	1152	12	0	0	
June	20	060361	50	1	0	7212	1152	18	0	0	
June	22	060363	50	1	0	7212	1152	12	0	0	
June	23	060365	50	3	0	7236	1152	6	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
June	23	060367	50	2	0	7224	1152	12	0	0	
June	24	060369	50	7	0	7284	1152	6	6	0	no bets menutupi barcode
June	24	060371	51	0	0	7344	1152	6	0	0	
June	25	060373	50	1	0	7212	1152	30	0	0	
June	25	060375	50	3	0	7236	1152	24	0	0	
June	30	060377	49	9	0	7164	1152	18	0	0	
July	1	060379	50	10	0	7320	1152	18	0	0	
July	1	060381	51	3	0	7380	1152	6	0	0	
July	2	060383	50	10	0	7320	1152	12	0	0	
July	2	060385	51	2	0	7368	1152	12	0	0	
July	3	070387	50	11	0	7332	1152	36	0	0	
July	3	070389	51	3	0	7380	1152	24	0	0	
July	4	070391	51	8	0	7440	1152	6	0	0	
July	4	070393	50	3	0	7236	1152	18	0	0	
July	6	070395	50	7	0	7284	1152	18	0	0	
July	6	070397	51	0	0	7344	1152	24	0	0	
July	7	070399	50	9	0	7308	1152	12	0	0	
July	8	070401	50	0	0	7200	1152	18	0	0	
July	8	070403	50	6	0	7272	1152	6	0	0	
July	9	070405	50	7	0	7284	1152	24	12	0	no bets menutupi bpom NA
July	11	070407	51	0	0	7344	1152	6	0	0	
July	22	070409	50	3	0	7236	1152	12	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

Data Production of yellow Salisil Talk Wangi sachet											
Month	Date	No. Batch	Total Production			Total Production (sachet)	Total Sample (sachet)	Product Defect			
			Box	Dozen	Sachet			Leak	Unclear No. Batch	No Thread	Note
July	22	070411	50	7	0	7284	1152	18	0	0	
July	23	070413	50	7	0	7284	1152	12	0	0	
July	23	070415	50	7	0	7284	1152	6	0	0	
July	23	070417	50	2	0	7224	1152	18	0	0	
July	24	070419	50	2	0	7224	1152	18	0	0	
July	24	070421	50	1	0	7212	1152	6	0	0	
July	25	070423	50	1	0	7212	1152	24	0	0	
July	25	070425	50	1	0	7212	1152	12	18	0	no bets menutupi barcode
July	27	070427	51	1	0	7356	1152	30	0	0	
July	27	070429	50	11	0	7332	1152	6	0	0	
July	27	070431	50	1	0	7212	1152	6	0	0	
July	28	070433	50	11	0	7332	1152	6	0	0	
July	29	070435	50	5	0	7260	1152	18	0	0	
July	29	070437	50	9	0	7308	1152	24	0	0	
July	29	070439	51	2	0	7368	1152	12	0	0	
July	30	070441	51	2	0	7368	1152	6	0	0	
July	30	070443	51	6	0	7416	1152	12	0	0	

Appendix A. Data Production of Yellow Salisil Talk Wangi

APPENDIX B

(Recapitulation of the P control chart calculation for Salisil Talk Wangi)

i	D_i	P_i	i	D_i	P_i	i	D_i	P_i
1	24	0,0208	**37**	12	0,0104	**73**	18	0,0156
2	18	0,0156	**38**	12	0,0104	**74**	0	0,0000
3	18	0,0156	**39**	30	0,0260	**75**	18	0,0156
4	24	0,0208	**40**	18	0,0156	**76**	12	0,0104
5	12	0,0104	**41**	6	0,0052	**77**	12	0,0104
6	30	0,0260	**42**	6	0,0052	**78**	42	0,0365
7	24	0,0208	**43**	30	0,0260	**79**	18	0,0156
8	18	0,0156	**44**	24	0,0208	**80**	18	0,0156
9	12	0,0104	**45**	6	0,0052	**81**	24	0,0208
10	18	0,0156	**46**	12	0,0104	**82**	24	0,0208
11	30	0,0260	**47**	24	0,0208	**83**	24	0,0208
12	24	0,0208	**48**	18	0,0156	**84**	18	0,0156
13	18	0,0156	**49**	36	0,0313	**85**	24	0,0208
14	12	0,0104	**50**	24	0,0208	**86**	12	0,0104
15	30	0,0260	**51**	24	0,0208	**87**	42	0,0365
16	36	0,0313	**52**	18	0,0156	**88**	12	0,0104
17	18	0,0156	**53**	30	0,0260	**89**	18	0,0156
18	12	0,0104	**54**	18	0,0156	**90**	18	0,0156
19	18	0,0156	**55**	30	0,0260	**91**	24	0,0208
20	18	0,0156	**56**	24	0,0208	**92**	90	0,0781
21	30	0,0260	**57**	24	0,0208	**93**	18	0,0156
22	12	0,0104	**58**	18	0,0156	**94**	30	0,0260
23	24	0,0208	**59**	24	0,0208	**95**	12	0,0104
24	30	0,0260	**60**	6	0,0052	**96**	18	0,0156
25	12	0,0104	**61**	6	0,0052	**97**	36	0,0313
26	24	0,0208	**62**	0	0,0000	**98**	24	0,0208
27	18	0,0156	**63**	12	0,0104	**99**	30	0,0260
28	30	0,0260	**64**	6	0,0052	**100**	12	0,0104
29	30	0,0260	**65**	24	0,0208	**101**	30	0,0260
30	6	0,0052	**66**	18	0,0156	**102**	18	0,0156
31	6	0,0052	**67**	30	0,0260	**103**	24	0,0208
32	12	0,0104	**68**	30	0,0260	**104**	12	0,0104
33	12	0,0104	**69**	18	0,0156	**105**	24	0,0208
34	18	0,0156	**70**	12	0,0104	**106**	18	0,0156
35	12	0,0104	**71**	30	0,0260	**107**	6	0,0052
36	12	0,0104	**72**	6	0,0052	**108**	12	0,0104

Appendix B. Recapitulation of The P Control Chart Calculation for Salisil Talk Wangi

i	D_i	P_i
109	6	0,0052
110	18	0,0156
111	24	0,0208
112	30	0,0260
113	12	0,0104
114	24	0,0208
115	6	0,0052
116	24	0,0208
117	24	0,0208
118	12	0,0104
119	24	0,0208
120	12	0,0104
121	12	0,0104
122	30	0,0260
123	30	0,0260
124	6	0,0052
125	18	0,0156
126	18	0,0156
127	12	0,0104
128	18	0,0156
129	12	0,0104
130	18	0,0156
131	24	0,0208
132	12	0,0104
133	12	0,0104
134	18	0,0156
135	30	0,0260
136	6	0,0052
137	12	0,0104
138	6	0,0052
139	6	0,0052
140	12	0,0104
141	36	0,0313
142	18	0,0156
143	30	0,0260
144	6	0,0052

i	D_i	P_i
145	12	0,0104
146	6	0,0052
147	24	0,0208
148	30	0,0260
149	12	0,0104
150	18	0,0156
151	30	0,0260
152	12	0,0104
153	12	0,0104
154	18	0,0156
155	6	0,0052
156	30	0,0260
157	18	0,0156
158	6	0,0052
159	18	0,0156
160	6	0,0052
161	12	0,0104
162	18	0,0156
163	18	0,0156
164	6	0,0052
165	6	0,0052
166	30	0,0260
167	18	0,0156
168	12	0,0104
169	18	0,0156
170	24	0,0208
171	12	0,0104
172	18	0,0156
173	24	0,0208
174	6	0,0052
175	18	0,0156
176	12	0,0104
177	18	0,0156
178	18	0,0156
179	12	0,0104
180	12	0,0104

i	D_i	P_i
181	6	0,0052
182	12	0,0104
183	18	0,0156
184	48	0,0417
185	6	0,0052
186	6	0,0052
187	18	0,0156
188	6	0,0052
189	18	0,0156
190	12	0,0104
191	12	0,0104
192	12	0,0104
193	36	0,0313
194	12	0,0104
195	12	0,0104
196	6	0,0052
197	24	0,0208
198	18	0,0156
199	18	0,0156
200	18	0,0156
201	30	0,0260
202	18	0,0156
203	18	0,0156
204	18	0,0156
205	30	0,0260
206	12	0,0104
207	36	0,0313
208	6	0,0052
209	6	0,0052
210	18	0,0156
211	30	0,0260
212	30	0,0260
213	6	0,0052
214	12	0,0104
215	12	0,0104
216	18	0,0156

Appendix B. Recapitulation of The P Control Chart Calculation for Salisil Talk Wangi

i	D_i	P_i
217	30	0,0260
218	36	0,0313
219	12	0,0104
220	24	0,0208
221	18	0,0156
222	12	0,0104
223	30	0,0260
224	12	0,0104
225	12	0,0104
226	18	0,0156
227	18	0,0156
228	24	0,0208
229	18	0,0156
230	12	0,0104
231	6	0,0052
232	6	0,0052
233	12	0,0104
234	6	0,0052
235	6	0,0052
236	36	0,0313
237	6	0,0052
238	18	0,0156
239	12	0,0104
240	30	0,0260
241	24	0,0208
242	12	0,0104
243	12	0,0104
244	18	0,0156
245	6	0,0052
246	18	0,0156
247	12	0,0104
248	12	0,0104
249	12	0,0104
250	42	0,0365
251	18	0,0156
252	12	0,0104

i	D_i	P_i
253	18	0,0156
254	18	0,0156
255	18	0,0156
256	6	0,0052
257	12	0,0104
258	18	0,0156
259	36	0,0313
260	18	0,0156
261	30	0,0260
262	36	0,0313
263	36	0,0313
264	6	0,0052
265	6	0,0052
266	18	0,0156
267	12	0,0104
268	18	0,0156
269	6	0,0052
270	30	0,0260
271	24	0,0208
272	12	0,0104
273	6	0,0052
274	18	0,0156
275	18	0,0156
276	6	0,0052
277	6	0,0052
278	24	0,0208
279	12	0,0104
280	6	0,0052
281	6	0,0052
282	30	0,0260
283	36	0,0313
284	12	0,0104
285	18	0,0156
286	30	0,0260
287	6	0,0052
288	42	0,0365

i	D_i	P_i
289	24	0,0208
290	6	0,0052
291	12	0,0104
292	12	0,0104
293	6	0,0052
294	6	0,0052
295	6	0,0052
296	24	0,0208
297	12	0,0104
298	18	0,0156
299	60	0,0521
300	66	0,0573
301	12	0,0104
302	6	0,0052
303	6	0,0052
304	18	0,0156
305	24	0,0208
306	18	0,0156
307	24	0,0208
308	24	0,0208
309	18	0,0156
310	36	0,0313
311	12	0,0104
312	6	0,0052
313	24	0,0208
314	12	0,0104
315	24	0,0208
316	6	0,0052
317	12	0,0104
318	18	0,0156
319	18	0,0156
320	18	0,0156
321	24	0,0208
322	30	0,0260
323	12	0,0104
324	36	0,0313

Appendix B. Recapitulation of The P Control Chart Calculation for Salisil Talk Wangi

i	D_i	P_i
325	24	0,0208
326	12	0,0104
327	18	0,0156
328	6	0,0052
329	12	0,0104
330	18	0,0156
331	6	0,0052
332	6	0,0052
333	24	0,0208
334	30	0,0260
335	6	0,0052
336	6	0,0052
337	36	0,0313
338	12	0,0104
339	6	0,0052
340	6	0,0052
341	12	0,0104
342	18	0,0156
343	0	0,0000
344	12	0,0104
345	24	0,0208
346	18	0,0156
347	6	0,0052
348	12	0,0104
349	12	0,0104
350	18	0,0156
351	12	0,0104
352	6	0,0052
353	12	0,0104
354	12	0,0104
355	6	0,0052
356	30	0,0260
357	24	0,0208
358	18	0,0156
359	18	0,0156
360	6	0,0052

i	D_i	P_i
361	12	0,0104
362	12	0,0104
363	36	0,0313
364	24	0,0208
365	6	0,0052
366	18	0,0156
367	18	0,0156
368	24	0,0208
369	12	0,0104
370	18	0,0156
371	6	0,0052
372	36	0,0313
373	6	0,0052
374	12	0,0104
375	18	0,0156
376	12	0,0104
377	6	0,0052
378	18	0,0156
379	18	0,0156
380	6	0,0052
381	24	0,0208
382	30	0,0260
383	30	0,0260
384	6	0,0052
385	6	0,0052
386	6	0,0052
387	18	0,0156
388	24	0,0208
389	12	0,0104
390	6	0,0052
391	12	0,0104

Appendix B. Recapitulation of The P Control Chart Calculation for Salisil Talk Wangi

APPENDIX C

(Sigma Level Conversion Table)

Table C. Sixma Level Conversion Table

Nilai Sigma	DPMO	Nilai Sigma	DPMO	Nilai Sigma	DPMO	Nilai Sigma	DPMO
0,00	933.193	0,51	838.913	1,02	684.386	1,53	488.033
0,01	931.888	0,52	836.457	1,03	680.822	1,54	484.047
0,02	930.563	0,53	833.977	1,04	677.242	1,55	480.061
0,03	929.219	0,54	831.472	1,05	673.645	1,56	476.078
0,04	927.855	0,55	828.944	1,06	670.031	1,57	472.097
0,05	926.471	0,56	826.391	1,07	666.402	1,58	468.119
0,06	925.066	0,57	823.814	1,08	662.757	1,59	464.144
0,07	923.641	0,58	821.214	1,09	659.097	1,60	460.172
0,08	922.196	0,59	818.589	1,10	655.422	1,61	456.205
0,09	920.730	0,60	815.940	1,11	651.732	1,62	452.242
0,10	919.243	0,61	813.267	1,12	648.027	1,63	448.283
0,11	917.736	0,62	810.570	1,13	644.309	1,64	444.330
0,12	916.207	0,63	807.850	1,14	640.576	1,65	440.382
0,13	914.656	0,64	805.106	1,15	636.831	1,66	436.441
0,14	913.085	0,65	802.338	1,16	633.072	1,67	432.505
0,15	911.492	0,66	799.546	1,17	629.300	1,68	428.576
0,16	909.877	0,67	796.731	1,18	625.516	1,69	424.655
0,17	908.241	0,68	793.892	1,19	621.719	1,70	420.740
0,18	906.582	0,69	791.030	1,20	617.911	1,71	416.834
0,19	904.902	0,70	788.145	1,21	614.092	1,72	412.936
0,20	903.199	0,71	785.236	1,22	610.261	1,73	409.046
0,21	901.475	0,72	782.305	1,23	606.420	1,74	405.165
0,22	899.727	0,73	779.350	1,24	602.568	1,75	401.294
0,23	897.958	0,74	776.373	1,25	598.706	1,76	397.432
0,24	896.165	0,75	773.373	1,26	594.835	1,77	393.580
0,25	894.350	0,76	770.350	1,27	590.954	1,78	389.739
0,26	892.512	0,77	767.305	1,28	587.064	1,79	385.908
0,27	890.651	0,78	764.238	1,29	583.166	1,80	382.089
0,28	888.767	0,79	761.148	1,30	579.260	1,81	378.281
0,29	886.860	0,80	758.036	1,31	575.345	1,82	374.484
0,30	884.930	0,81	754.903	1,32	571.424	1,83	370.700
0,31	882.977	0,82	751.748	1,33	567.495	1,84	366.928
0,32	881.000	0,83	748.571	1,34	563.559	1,85	363.169
0,33	878.999	0,84	745.373	1,35	559.618	1,86	359.424
0,34	876.976	0,85	742.154	1,36	555.670	1,87	355.691
0,35	874.928	0,86	738.914	1,37	551.717	1,88	351.973
0,36	872.857	0,87	735.653	1,38	547.758	1,89	348.268
0,37	870.762	0,88	732.371	1,39	543.795	1,90	344.578
0,38	868.643	0,89	729.069	1,40	539.828	1,91	340.903
0,39	866.500	0,90	725.747	1,41	535.856	1,92	337.243
0,40	864.334	0,91	722.405	1,42	531.881	1,93	333.598
0,41	862.143	0,92	719.043	1,43	527.903	1,94	329.969
0,42	859.929	0,93	715.661	1,44	523.922	1,95	326.355
0,43	857.690	0,94	712.260	1,45	519.939	1,96	322.758
0,44	855.428	0,95	708.840	1,46	515.953	1,97	319.178
0,45	853.141	0,96	705.402	1,47	511.967	1,98	315.614
0,46	850.830	0,97	701.944	1,48	507.978	1,99	312.067
0,47	848.495	0,98	698.468	1,49	503.989	2,00	308.538
0,48	846.136	0,99	694.974	1,50	500.000	2,01	305.026
0,49	843.752	1,00	691.462	1,51	496.011	2,02	301.532
0,50	841.345	1,01	687.933	1,52	492.022	2,03	298.056

Table C. Sixma Level Conversion Table

Nilai Sigma	DPMO	Nilai Sigma	DPMO	Nilai Sigma	DPMO	Nilai Sigma	DPMO
2,04	294.598	2,55	146.859	3,06	59.380	3,57	19.226
2,05	291.160	2,56	144.572	3,07	58.208	3,58	18.763
2,06	287.740	2,57	142.310	3,08	57.053	3,59	18.309
2,07	284.339	2,58	140.071	3,09	55.917	3,60	17.864
2,08	280.957	2,59	137.857	3,10	54.799	3,61	17.429
2,09	277.595	2,60	135.666	3,11	53.699	3,62	17.003
2,10	274.253	2,61	133.500	3,12	52.616	3,63	16.586
2,11	270.931	2,62	131.357	3,13	51.551	3,64	16.177
2,12	267.629	2,63	129.238	3,14	50.503	3,65	15.778
2,13	264.347	2,64	127.143	3,15	49.471	3,66	15.386
2,14	261.086	2,65	125.072	3,16	48.457	3,67	15.003
2,15	257.846	2,66	123.024	3,17	47.460	3,68	14.629
2,16	254.627	2,67	121.001	3,18	46.479	3,69	16.262
2,17	251.429	2,68	119.000	3,19	45.514	3,70	13.903
2,18	248.252	2,69	117.023	3,20	44.565	3,71	13.553
2,19	245.097	2,70	115.070	3,21	43.633	3,72	13.209
2,20	241.964	2,71	113.140	3,22	42.716	3,73	12.874
2,21	238.852	2,72	111.233	3,23	41.815	3,74	12.545
2,22	235.762	2,73	109.349	3,24	40.929	3,75	12.224
2,23	232.695	2,74	107.488	3,25	40.059	3,76	11.911
2,24	229.650	2,75	105.650	3,26	39.204	3,77	11.604
2,25	226.627	2,76	103.835	3,27	38.364	3,78	11.304
2,26	223.627	2,77	102.042	3,28	37.538	3,79	11.011
2,27	220.650	2,78	100.273	3,29	36.727	3,80	10.724
2,28	217.695	2,79	98.525	3,30	35.930	3,81	10.444
2,29	214.764	2,80	96.801	3,31	35.148	3,82	10.170
2,30	211.855	2,81	95.098	3,32	34.379	3,83	9.903
2,31	208.970	2,82	93.418	3,33	33.625	3,84	9.642
2,32	206.108	2,83	91.759	3,34	32.884	3,85	9.387
2,33	203.269	2,84	90.123	3,35	32.157	3,86	9.137
2,34	200.454	2,85	88.508	3,36	31.443	3,87	8.894
2,35	197.662	2,86	86.915	3,37	30.742	3,88	8.656
2,36	194.894	2,87	85.344	3,38	30.054	3,89	8.424
2,37	192.150	2,88	83.793	3,39	29.379	3,90	8.198
2,38	189.430	2,89	82.264	3,40	28.716	3,91	7.976
2,39	186.733	2,90	80.757	3,41	28.067	3,92	7.760
2,40	184.060	2,91	79.270	3,42	27.429	3,93	7.549
2,41	181.411	2,92	77.804	3,43	26.803	3,94	7.344
2,42	178.786	2,93	76.359	3,44	26.190	3,95	7.143
2,43	176.186	2,94	74.934	3,45	25.588	3,96	6.947
2,44	173.609	2,95	73.529	3,46	24.998	3,97	6.756
2,45	171.056	2,96	72.145	3,47	24.419	3,98	6.569
2,46	168.528	2,97	70.781	3,48	23.852	3,99	6.387
2,47	166.023	2,98	69.437	3,49	23.295	4,00	6.210
2,48	163.543	2,99	68.112	3,50	22.750	4,01	6.037
2,49	161.087	3,00	66.807	3,51	22.215	4,02	5.868
2,50	158.655	3,01	65.522	3,52	21.692	4,03	5.703
2,51	156.248	3,02	64.256	3,53	21.178	4,04	5.543
2,52	153.864	3,03	63.008	3,54	20.675	4,05	5.386
2,53	151.505	3,04	61.780	3,55	20.182	4,06	5.234
2,54	149.170	3,05	60.571	3,56	19.699	4,07	5.085

Table C. Sixma Level Conversion Table

Nilai Sigma	DPMO	Nilai Sigma	DPMO	Nilai Sigma	DPMO	Nilai Sigma	DPMO
4,08	4.940	4,59	1.001	5,10	159	5,61	20
4,09	4.799	4,60	968	5,11	153	5,62	19
4,10	4.661	4,61	936	5,12	147	5,63	18
4,11	4.527	4,62	904	5,13	142	5,64	17
4,12	4.397	4,63	874	5,14	136	5,65	17
4,13	4.269	4,64	845	5,15	131	5,66	16
4,14	4.145	4,65	816	5,16	126	5,67	15
4,15	4.025	4,66	789	5,17	121	5,68	15
4,16	3.907	4,67	762	5,18	117	5,69	14
4,17	3.793	4,68	736	5,19	112	5,70	13
4,18	3.681	4,69	711	5,20	108	5,71	13
4,19	3.573	4,70	687	5,21	104	5,72	12
4,20	3.467	4,71	664	5,22	100	5,73	12
4,21	3.364	4,72	641	5,23	96	5,74	11
4,22	3.264	4,73	619	5,24	92	5,75	11
4,23	3.167	4,74	598	5,25	88	5,76	10
4,24	3.072	4,75	577	5,26	85	5,77	10
4,25	2.980	4,76	557	5,27	82	5,78	9
4,26	2.890	4,77	538	5,28	78	5,79	9
4,27	2.803	4,78	519	5,29	75	5,80	9
4,28	2.718	4,79	501	5,30	72	5,81	8
4,29	2.635	4,80	483	5,31	70	5,82	8
4,30	2.555	4,81	467	5,32	67	5,83	7
4,31	2.477	4,82	450	5,33	64	5,84	7
4,32	2.401	4,83	434	5,34	62	5,85	7
4,33	2.327	4,84	419	5,35	59	5,86	7
4,34	2.256	4,85	404	5,36	57	5,87	6
4,35	2.186	4,86	390	5,37	54	5,88	6
4,36	2.118	4,87	376	5,38	52	5,89	6
4,37	2.052	4,88	362	5,39	50	5,90	5
4,38	1.988	4,89	350	5,40	48	5,91	5
4,39	1.926	4,90	337	5,41	46	5,92	5
4,40	1.866	4,91	325	5,42	44	5,93	5
4,41	1.807	4,92	313	5,43	42	5,94	5
4,42	1.750	4,93	302	5,44	41	5,95	4
4,43	1.695	4,94	291	5,45	39	5,96	4
4,44	1.641	4,95	280	5,46	37	5,97	4
4,45	1.589	4,96	270	5,47	36	5,98	4
4,46	1.538	4,97	260	5,48	34	5,99	4
4,47	1.489	4,98	251	5,49	33	6,00	3
4,48	1.441	4,99	242	5,50	32		
4,49	1.395	5,00	233	5,51	30		
4,50	1.350	5,01	224	5,52	29		
4,51	1.306	5,02	216	5,53	28		
4,52	1.264	5,03	208	5,54	27		
4,53	1.223	5,04	200	5,55	26		
4,54	1.183	5,05	193	5,56	25		
4,55	1.144	5,06	185	5,57	24		
4,56	1.107	5,07	179	5,58	23		
4,57	1.070	5,08	172	5,59	22		
4,58	1.035	5,09	165	5,60	21		

Catatan: Tabel konversi ini Mencakup pengeseran 1,5-sigma untuk semua nilai Z

APPENDIX D

(FMEA Questionnaire)

Kuesioner Penelitian

Penerapan Metodologi *Six Sigma* dalam Pengemasan Salisil Talk Wangi (PT Nusantara Beta Farma)

Jurusan Teknik Industri
Fakultas Teknik
Universitas Andalas
Padang

Dengan Hormat,

Pertama sekali saya ucapkan terimakasih kepada Bapak/Ibu yang bersedia menjadi responden pada penelitian yang sedang saya lakukan. Kuesioner ini semata-mata untuk tujuan akademik yaitu menyelesaikan Tugas Akhir di Jurusan Teknik Industri Fakultas Teknik Universitas Andalas. Kuesioner ini digunakan untuk mendapatkan data *input* yang digunakan dalam pengolahan data metode FMEA (*Failure Mode and Effect Analysis*).

Kuesioner ini berisikan tentang kemungkinan yang menyebabkan cacat produk (*potensial cause*), kemungkinan akibat yang ditimbulkan oleh cacat produk (*potensial effect*), dan kontrol yang dilakukan dalam mencegah atau mengurangi cacat produk (*detection method*) PT Nusantara Beta Farma. Kuesioner ini bertujuan untuk mengetahui nilai indikator penilaian dalam metode FMEA (*severity*, *occurance*, dan *detection*). Oleh karena itu, jawaban yang Bapak/Ibu berikan sangat membantu dalam penelitian ini, serta kerahasiaannya akan dijamin sepenuhnya. Atas partisipasi dan kerjasama yang Bapak/Ibu berikan, saya mengucapkan terima kasih.

Padang, Januari 2020
Hormat Saya

Ferio

A. Identitas Responden

Mohon untuk mengisi identitas berikut ini:

1. Nama :
2. Jenis Kelamin :
3. Usia :
4. Pendidikan terakhir :
5. Pekerjaan/Jabatan :

Penilaian terhadap nilai kemunculan (*occurance*), tingkat keparahan (*severity*), dan deteksi (*detection*) berdasarkan cacat produk yang terjadi pada proses pengemasan Salisil Talk Wangi. Penilaian terhadap nilai ini dilakukan terhadap tiga faktor yang mempengaruhi proses pengemasan, yaitu *Men*, *Machine*, dan *Methods*. Penilaian cacat produk dilihat berdasarkan tabel kemunculan (*occurance*), tabel tingkat keparahan (*severity*), dan tabel deteksi (*detection*).

B. Kuesioner Penilaian Peringkat Kemunculan (*Occurance*)

Petunjuk pengisian:

Dalam kuesioner ini Bapak/Ibu diminta untuk menentukan peringkat dari kemungkinan yang menyebabkan cacat produk. Berikut ini merupakan tabel penilaian kemunculan (*occurance*) dalam menentukan peringkat yang sesuai.

Peringkat	Kriteria	Kemungkinan Terjadinya Penyebab Cacat Per 1000 Siklus Produksi atau Operasi	Deteksi
1	Kemungkinan terjadinya penyebab cacat produk hampir tidak pernah	<0,00058	Hampir Tidak Pernah
2	Kemungkinan terjadinya penyebab cacat produk sangat jarang	0,0068	Kecil
3	Kemungkinan terjadinya penyebab cacat produk sangat sedikit	0,0063	Sangat Sedikit
4	Kemungkinan terjadinya penyebab cacat produk sedikit	0,46	Sedikit
5	Kemungkinan terjadinya penyebab cacat produk rendah	2,7	Rendah
6	Kemungkinan terjadinya penyebab cacat produk sedang	12,4	Sedang

Peringkat	Kriteria	Kemungkinan Terjadinya Penyebab Cacat Per 1000 Siklus Produksi atau Operasi	Deteksi
7	Kemungkinan terjadinya penyebab cacat produk cukup tinggi	46	Cukup Tinggi
8	Kemungkinan terjadinya penyebab cacat produk tinggi	134	Tinggi
9	Kemungkinan terjadinya penyebab cacat produk sangat tinggi	316	Sangat Tinggi
10	Kemungkinan terjadinya penyebab cacat produk hampir pasti terjadi	>316	Hampir Selalu

(Sumber: Stamatis, 2003)

Contoh pengisian kuisioner:

Ceklislah antara peringkat 1-10 pada kolom penilaian kemunculan penyebab dari cacat produk sesuai dengan pendapat Bapak/Ibu. Dalam contoh, penilaian dilakukan pada faktor mesin.

1. Jika Bapak/Ibu menceklis **peringkat 1**, maka artinya peringkat kemunculan "Mesin tidak mempress dengan benar" **Hampir Tidak Pernah.** Berikut contoh pengisian kuesioner :

No	Faktor	Penyebab	Ranking									
			1	2	3	4	5	6	7	8	9	10
1	Mesin	Mesin tidak mempress dengan benar	✓									

2. Jika Bapak/Ibu menceklis **peringkat 2**, maka artinya peringkat kemunculan "Mesin tidak mencetak No batch dengan benar" **Kecil.** Berikut contoh pengisian kuesioner:

No	Faktor	Penyebab	Ranking									
			1	2	3	4	5	6	7	8	9	10
1	Mesin	Mesin tidak mencetak No batch dengan benar		✓								

3. Jika Bapak/Ibu menceklis **peringkat 3**, maka artinya peringkat kemunculan "Mesin tidak menggulung benang dengan benar" **Sangat Sedikit.** Berikut contoh pengisian kuesioner :

No	Faktor	Penyebab	Ranking									
			1	2	3	4	5	6	7	8	9	10
1	Mesin	Mesin tidak menggulung benang dengan benar			✓							

KUESIONER PENELITIAN

A. Kuesioner Peringkat *Occurance*

No	Faktor	Penyebab	Ranking									
			1	2	3	4	5	6	7	8	9	10
1	Mesin	Mesin tidak mempress dengan benar										
		Mesin tidak menggulung benang dengan benar										
		Mesin tidak mencetak No batch dengan benar										
		Sensor tidak membaca dengan benar										

No	Faktor	Penyebab	Ranking									
			1	2	3	4	5	6	7	8	9	10
2	Manusia	Operator tidak menchek ketersedian benang										
		Operator tidak memasang pita no batch dengan presisi										

No	Faktor	Penyebab	Ranking									
			1	2	3	4	5	6	7	8	9	10
3	Metode	Tidak terjadwalnya maintanance mesin										

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

C. Kuesioner Penilaian Peringkat Tingkat Keparahan (*Severity*)

Petunjuk pengisian:

Dalam kuesioner ini Bapak/Ibu diminta untuk menentukan peringkat keparahan akibat yang ditimbulkan oleh cacat produk. Berikut ini merupakan tabel penilaian tingkat keparahan (*severity*) dalam menentukan peringkat yang sesuai.

Peringkat	Kriteria	Efek
1	Tingkat keparahan dari efek yang ditimbulkan oleh cacat produk tidak ada	Tidak Ada Efek
2	Cacat memberikan efek sangat ringan terhadap fungsi atau mutu produk; kadang terjadi gangguan terhadap proses namun bersifat non vital; konsumen tidak menyadari efek tersebut	Efek Sangat Kecil
3	Cacat memberikan efek ringan terhadap fungsi atau mutu produk; gangguan non vital terhadap proses sering terjadi; konsumen agak sedikit terganggu	Efek Kecil
4	Cacat memberikan efek minor terhadap fungsi atau mutu produk; gangguan non vital terhadap proses selalu terjadi namun tidak membutuhkan perbaikan berarti; konsumen merasakan gangguan minor pada fungsi produk	Efek Minor
5	Cacat memberikan efek sedang terhadap fungsi atau mutu produk; gangguan non vital terhadap proses membutuhkan perbaikan; konsumen merasakan sedikit ketidakpuasan	Efek Sedang
6	Cacat menyebabkan fungsi atau mutu produk menurun tapi masih bisa difungsikan; gangguan menyebabkan proses terganggu; konsumen merasakan keluhan	Efek Signifikan
7	Cacat menyebabkan produk harus diperbaiki karna mempengaruhi fungsi atau mutu produk; gangguan menyebabkan proses terhenti; konsumen merasakan ketidakpuasan	Efek Mayor
8	Produk tidak berfungsi, gangguan menyebabkan sistem berhenti; kadang peralatan mengalami kerusakan; konsumen sangat tidak puas	Efek Ekstrem
9	Cacat menyebabkan produk gagal, menghentikan proses, cacat memberikan potensi bahaya	Efek Serius
10	Cacat memberikan efek berbahaya, bisa berakibat proses berhenti tiba-tiba; konsumen dapat terancam dari bahaya yang ditimbulkan	Efek Berbahaya

(Sumber: Stamatis, 2003)

Contoh pengisian kuisioner:

Ceklislah antara peringkat 1-10 pada kolom penilaian tingkat keparahan efek dari cacat produk sesuai dengan pendapat Bapak/Ibu. Dalam contoh, penilaian dilakukan pada **potensi akibat kegagalan** terhadap **faktor mesin**.

1. Jika Bapak/Ibu menceklis **peringkat 2**, maka artinya tingkat keparahan dari "Mesin tidak mempress dengan benar" adalah efek sangat kecil. Berikut contoh pengisian kuesioner :

No	Faktor	Penyebab	Potensi Akibat Kegagalan	Ranking									
				1	2	3	4	5	6	7	8	9	10
1	Mesin	Mesin tidak mempress dengan benar	Kemasan tidak tertutup dengan rapat		✓								

2. Jika Bapak/Ibu menceklis **peringkat 4**, maka artinya tingkat keparahan dari "Terjadi wasting pada waktu, tenaga dan energi" adalah efek minor. Berikut contoh pengisian kuesioner :

No	Faktor	Penyebab	Potensi Akibat Kegagalan	Ranking									
				1	2	3	4	5	6	7	8	9	10
1	Mesin	Mesin tidak mempress dengan benar	Terjadi wasting pada waktu, tenaga dan energi				✓						

3. Jika Bapak/Ibu menceklis **peringkat 2**, maka artinya tingkat keparahan dari "Biaya operational meningkat" adalah efek sangat kecil. Berikut contoh pengisian kuesioner :

No	Faktor	Penyebab	Potensi Akibat Kegagalan	Ranking									
				1	2	3	4	5	6	7	8	9	10
1	Mesin	Mesin tidak mempress dengan benar	Biaya operational meningkat		✓								

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

KUESIONER PENELITIAN

B. Kuesioner Peringkat *Severity*

No	Faktor	Penyebab	Potensi Akibat Kegagalan	Ranking									
				1	2	3	4	5	6	7	8	9	10
1	Mesin	Mesin tidak mempress dengan benar	Kemasan tidak tertutup dengan rapat										
			Terjadi wasting pada waktu, tenaga dan energi										
			Biaya operational meningkat										
		Mesin tidak menggulung benang dengan benar	Kemasan menjadi gembung										
		Mesin tidak mencetak No batch dengan benar	No batch tidak tercetak sesuai standar perusahaan										
			cetakan no batch merusak kemasan										
		Sensor tidak membaca dengan benar	Kemasan terpotong tidak pada tempatnya										
			terjadi breakdown mesin										
			No batch berdempetan										

No	Faktor	Penyebab	Potensi Akibat Kegagalan	Ranking									
				1	2	3	4	5	6	7	8	9	10
2	Manusia	Operator tidak menchek ketersedian benang	Kemasan menjadi gembung										
		Operator tidak memasang pita no batch dengan presisi	No batch tidak tercetak sesuai standar perusahaan										

No	Faktor	Penyebab	Potensi Akibat Kegagalan	Ranking									
				1	2	3	4	5	6	7	8	9	10
3	Metode	Tidak terjadwalnya maintanance mesin	performance rate menurun										
			Kapasitas produksi menurun										
			Dapat mengakibatkan engine breakdown										
			Biaya maintanance menjadi meningkat										

D. Kuesioner Penilaian Peringkat Deteksi (Detection)

Petunjuk pengisian:

Dalam kuesioner ini Bapak/Ibu diminta untuk menentukan peringkat kontrol yang dilakukan dalam mendeteksi cacat produk. Berikut ini merupakan tabel penilaian deteksi (detection) dalam menentukan peringkat yang sesuai. Istilah "kontrol" diartikan sebagai pengendalian yang dilakukan dalam mendeteksi cacat produk.

Peringkat	Kriteria	Deteksi
1	Kontrol saat ini hampir selalu bisa mendeteksi cacat, kontrol sudah bersifat standar dan dapat diterapkan diproses yang sama	Hampir Pasti
2	Kemungkinannya sangat besar kontrol saat ini dalam mendeteksi cacat	Sangat Tinggi
3	Kemungkinannya besar kontrol saat ini dalam mendeteksi cacat	Tinggi
4	Kemungkinannya agak besar kontrol saat ini dalam mendeteksi cacat	Cukup Tinggi
5	Kemungkinannya cukup (*medium*) kontrol saat ini dalam mendeteksi cacat	Sedang
6	Kemungkinannya rendah kontrol saat ini dalam mendeteksi cacat	Rendah
7	Kemungkinannya sedikit kontrol saat ini dalam mendeteksi cacat	Sedikit
8	Kemungkinannya sangat sedikit kontrol saat ini dalam mendeteksi cacat	Sangat Sedikit
9	Kemungkinannya jarang kontrol saat ini dalam mendeteksi cacat	Jarang
10	Tidak ada kontrol yang dapat mendeteksi cacat produk	Hampir Tidak Mungkin

(Sumber: Stamatis, 2003)

Contoh pengisian kuisioner:

Ceklislah antara peringkat 1-10 pada kolom penilaian kontrol yang dilakukan dalam mendeteksi cacat produk sesuai dengan pendapat Bapak/Ibu. Dalam contoh, Pengecheckan kecacatan kemasan salisil talk wangi yang dilakukan dengan pendekatan sampling.

1. Jika Bapak/Ibu menceklis **peringkat 1**, maka artinya kontrol yang dilakukan saat ini kemungkinan hampir pasti dalam mendeteksi cacat produk. Berikut contoh

No	Failure Mode	Kontrol	Ranking									
			1	2	3	4	5	6	7	8	9	10
1	Kebocoran	Melakukan pengecheckan pada produk	✓									

2. Jika Bapak/Ibu menceklis **peringkat 3**, maka artinya Kemungkinannya besar kontrol saat ini dalam mendeteksi cacat. Berikut contoh

No	Failure Mode	Kontrol	Ranking									
			1	2	3	4	5	6	7	8	9	10
1	Kebocoran	Melakukan pengecheckan pada produk			✓							

3. Jika Bapak/Ibu menceklis **peringkat 5**, maka artinya kontrol yang dilakukan saat ini Kemungkinannya cukup (medium) kontrol saat ini dalam mendeteksi cacat. Berikut contoh

No	Failure Mode	Kontrol	Ranking									
			1	2	3	4	5	6	7	8	9	10
1	Kebocoran	Melakukan pengecheckan pada produk					✓					

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

KUESIONER PENELITIAN

C. Kuesioner Peringkat *Detection*

No	Failure Mode	Kontrol	Ranking									
			1	2	3	4	5	6	7	8	9	10
1	Kebocoran	Melakukan pengecheckan pada produk menggunakan metode sampling										
2	Tidak ada Benang	Melakukan pengecheckan pada produk menggunakan metode sampling										
3	No Batch tidak Jelas	Melakukan pengecheckan pada produk menggunakan metode sampling										

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

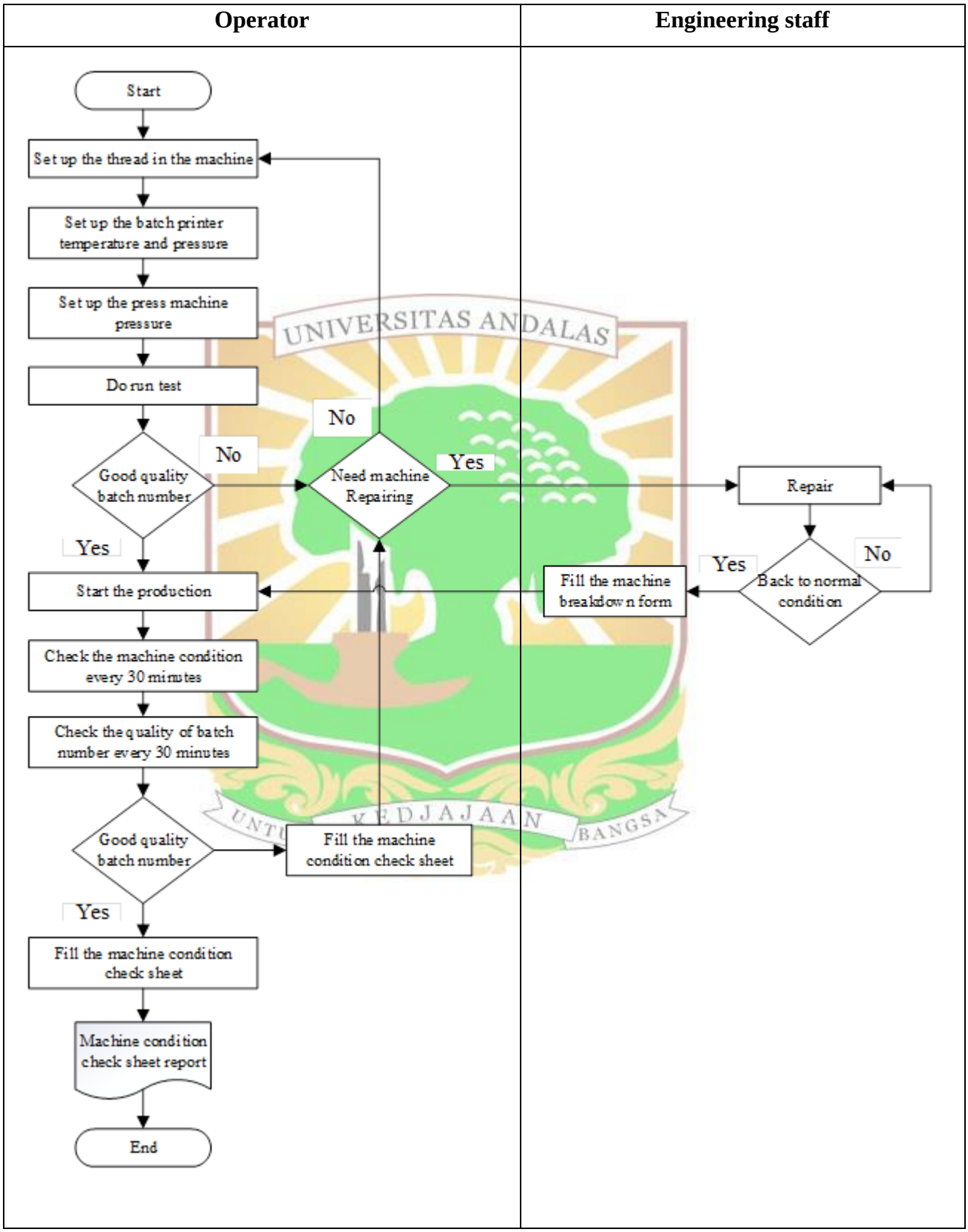
Padang Pariaman, Januari 2020
Tanda Tangan,

_____

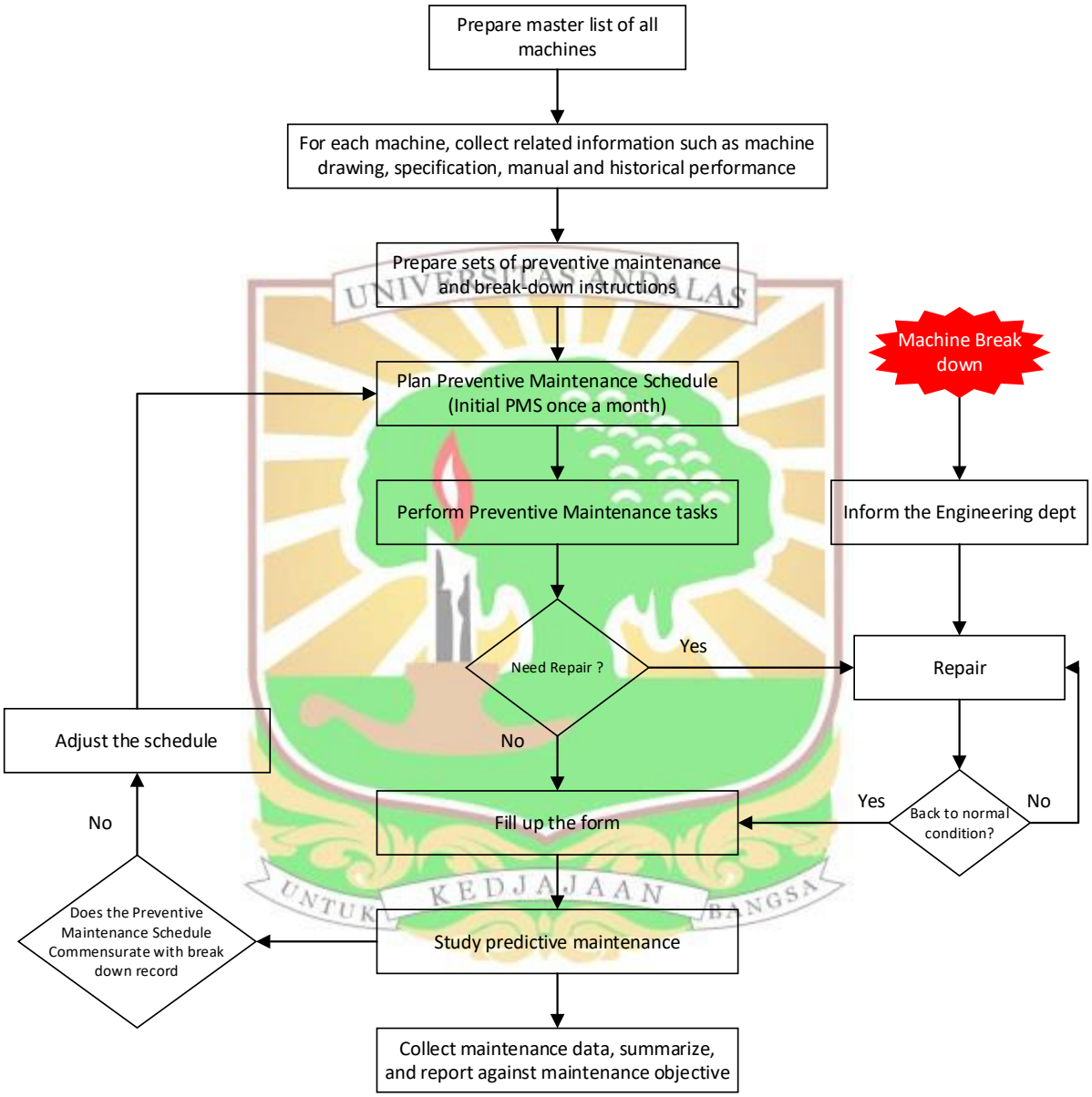
APPENDIX E

(Standard Operating Procedure)

STANDARD OPERATING PROCEDURE (SOP)
CHECK MACHINE CONDITION



PREVENTIVE MAINTENANCE PROCEDURE



APPENDIX F

(Check Sheet)

CHECK SHEET	Machine Condition	Logo perusahaan

Month :
Year :
No Machine :

Date / Shift	Time	Sensor Cleaning	Pressure	Heater	Thread	Note

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA

APPENDIX G

(Form)

FORM	MACHINE MAINTAINANCE / REPAIR	Logo perusahaan

Date :

Technician :	Machine Number :
Supervisor :	Maintenance / Repair *Select one

Report Failure :

Detail of Repairing

No	Item name / Failure Part	Replaced / Repaired	Job Complete (Yes/No)	Description of job

UNIVERSITAS ANDALAS
UNTUK KEDJAJAAN BANGSA