INTERNSHIP REPORT
AT PT DJARUM

ELIZABETH NATALIA GUNAWAN
15 14 08607

INTERNATIONAL INDUSTRIAL ENGINEERING PROGRAM
FAKULTAS TEKNOLOGI INDUSTRI
UNIVERSITAS ATMA JAYA YOGYAKARTA

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APPROVAL

The industrial practice report which is written based on the industrial practice at PT. Djarum SKM – Gribig during the period at December 18, 2017 until January 24, 2018 by:

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Study Program	: International Industrial Engineering
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has been approved.

Yogyakarta, May 14, 2018

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SURAT – KETERANGAN
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Yang bertanda tangan dibawah ini menerangkan bahwa :

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Telah selesai melakukan kerja praktek di perusahaan kami mulai dari Tanggal 18 Desember 2017 sampai dengan 24 Januari 2018 di perusahaan kami dengan hasil baik.

Demikian surat keterangan ini, harap dipergunakan sebagaimana mestinya.

Hormat kami,

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KUDUS - INDONESIA

Purwono Nugroho
Corporate Affairs

FOREWORD

Praise and gratitude to the God Almighty because of the blessing of His mercy and His power the writer able to complete the internship and the final report of the Internship in PT. Djarum.

The purpose of doing internship for the student is to introduce and learn about business activity in a company before graduating from Industrial Engineering Program, so hopefully the student can be ready for the real world. The author would like to thank:

1. God Almighty because of His blessing and mercy the author can finish all the activities related to the internship in PT. Djarum
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9. Author's classmate, TIKI'15, especially Giovani Natalia Widodo and Billa Oktina Trinugraheni who gave support to completing this internship report.
10. Surya Wijaya as a beloved partner who gave support and accompany the author in completing this internship report.
11. Others who involves in the internship activity in PT. Djarum SKM - Gribig and writing the internship report.

This report has been compiled as well as possible, but mistakes must be not being apart from this report, by this suggestion to improve the report is really welcomed. Lastly, this report is expected can be beneficially by giving the new knowledge to the readers

Yogyakarta, May 9th, 2018

Author

TABLE OF CONTENT

LIST OF TABLE

Page

LIST OF FIGURE

Page

LIST OF APPENDIX

CHAPTER 1
INTRODUCTION

This section discusses about background and purpose of the implementation of internship and an explanation of the place and time of internship.

1.1. Background

Industrial Engineering Program, Faculty of Industrial Technology, Atma Jaya University Yogyakarta (PSTI UAJY) requires all students to carry out internship in accordance with the Curriculum in PSTI UAJY. The UAJY PSTI sees internship as a vehicle or means for students to recognize the atmosphere in the industry as well as to grow, improve, and develop a professional work ethic as a candidate for Industrial Engineering graduate.

Internship can be said as a means of simulation of industrial engineering students profession. The paradigm that should be inculcated is that during the internship the students work in the company they choose. Work, in this case includes planning, design, repair, implementation and problem-solving activities. Therefore, in internship activities undertaken by students are:

a. Recognize the company's scope.
b. Following the work process in the company continuously.
c. Perform and perform tasks assigned by superiors, supervisors or field counselors.
d. Observe system behavior.
e. Compile reports in written form.
f. Carry out the internship exams.

Industrial Engineering is a branch of engineering that deals with the planning, design, improvement and installation of integrated systems comprising human, machinery, materials, information, energy, work methods and financial resources or briefly reviewing industrial systems. In particular, within the scope of Industrial Engineering it must be always realized that what is studied is the unity of the system elements consisting of Human, Machine, Material, Method, Money, Energy, Environment and Information. That is, in carrying out the activities under his responsibility, the Bachelor of Industrial Engineering should always view his activities within the framework of the system surrounding the activity.

Competencies held by students and Industrial Engineering graduates include:

1. System Design Work and Ergonomics.
2. Production Planning and Control.
3. Inventory / Inventory Management.
4. Quality Control System.
5. Material Handling System.
6. Logistics and Supply Chain Management.
7. Product Design and Development.
8. Occupational Safety and Health Techniques.
9. Design of Manufacturing Facility Layout.
10. Organizational Management.
11. Cost Analysis.
12. Industry Feasibility Analysis.
13. Process Design and CAD / CAM, and others.

1.2. Purpose

Things to be achieved through the implementation of this internship are:

a. Practice self-discipline.
b. Train the ability to interact with subordinates, coworkers, and bosses within the company.
c. Train the ability to adapt to the work environment.
d. Directly observe the company's activities in producing and running a business.
e. Complete the theory obtained in lectures with the actual state of existence in the factory.
f. Add insight into production systems and business systems.

1.3. Place and Time of Internship

This internship starts from 18th December 2017 until 24th January 2018 at PT. Djarum which is located in Jl. A. Yani No. 26 – 28, Kudus, Jawa Tengah, Indonesia. The author is assigned to the Pre-Process Material Preparation which has task to observe and work on the project related to the material preparation for the production process.

CHAPTER 2
COMPANY OVERVIEW

This section will discuss about the history, corporate organizational structure, and management team in PT. Djarum.

2.1. History of The Company

PT. Djarum is one of the tobacco companies in Indonesia. But first PT. DJarum is a private company. In the beginning, Oei Wie Gwan started a business in the production of fireworks, but because of the accident, Oei Wie Gwan ended his business. After that, Oei Wie Gwan decided to establish a cigarette business. Oei Wie Gwan pioneered the establishment of this cigarette company on August 23rd, 1950 and then on April 21st, 1951 Djarum business license as an individual business is given by the Minister of Finance.

Initially the company was only run by about 10 people on Jl. A. Yani No. 28. Oei Wie Gwan, a former Minak Djinggo cigarette agent in Jakarta, started his business by supplying cigarettes to the Army Service Department. In 1955, Djarum began to expand production and marketing. Production is greater after using a rolling machine and tobacco processing machine.

In 1969, Djarum began exporting its cigarette products abroad. In the same year, Djarum marketed Djarum Filter, the first brand manufactured using a machine, followed by Djarum Super brand introduced on April 21st, 1970. Djarum is currently headed by Victor Hartono, who is grandson of Oei Wie Gwan. Djarum launces a branded mild cigarette L.A. Lights on April 21st, 1999 and Djarum Black on April 21st, 2000. In 2012, Djarum issued cigarettes Djarum Super Mild or MLD and Djarum Black Mild.

In addition to the world of cigarettes, Djarum is also known actively involved in the world of badminton. Djarum has produced world-class players such as Liem Swie King and Alan Budi Kusuma. In addition, since 1998, Djarum company also controlled most of BCA’s shares. For community and environmental shares, Djarum has a special institution that is Djarum Foundation which is engaged in education, social, culture, and environment.

Currently, PT. Djarum is build an integrated plan in Gondangmanis Sub-district on Bae Sub-district. The integrated plant was built to centralize all activities at PT. Djarum.

2.1. Organizational Structures

Organizational structure is a structural relationship between people who are interconnected with each other in carrying out their functions and duties in a company.

Organizational structure is an important part in a company because without an organizational structure, a company will not be able to perform the function properly. Therefore, it is necessary to establish a good organizational structure that is by placing the right people in positions in accordance with the capabilities so that people can carry out their work properly.

There are various organizational structures used in the company. The organizational structure used by a company may differ from the organizational structure used by other companies. The organizational structure of an enterprise tailored to the needs of the company, the form of company and the size of the company.

The existing organizational structure in PT. Djarum Gribig is shown in Figure 2.1.

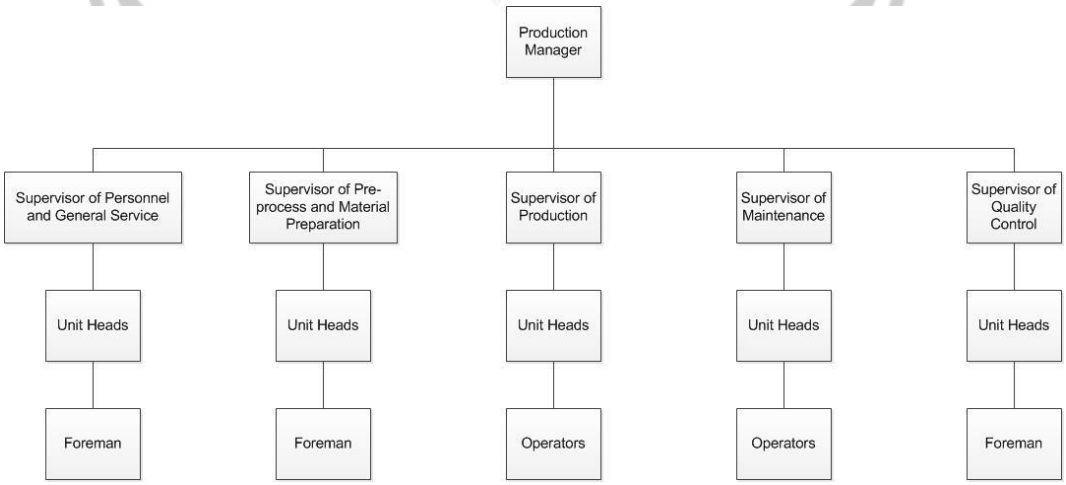

Figure 2.1. Organizational Structure PT. Djarum SKM Gribig

Duties, authority and position of the organizational structure of PT. Djarum SKM Gribig can be explained as follows:

1. Production Manager

His job is:

a. Carry out production policies in production or order.
b. Make product planning work.
c. Determining the production strategy
d. Determine the amount and material requirements needed for production.

2. Supervisor of Production

Main responsibility:

a. Responsible for direct supervision of the head of the underlying team (as well as being able to indirectly supervise all employees under his responsibility), this includes providing guidance / coaching to the subordinates in order to achieve the minimum level of skill required for his team and discipline his subordinates in accordance with the provisions / regulations that apply in the company.
b. Responsible in achieving the level of quantity (output), quality and production schedule and production utility level that has been predefined and mutually agreed.
c. Responsible in the fulfillment of quality standards of production in accordance with the level of customer needs & schedule delivery of production results in accordance PPIC schedule.
d. Responsible for work safety and environmental hygiene standards (regularity / tidiness of work environment).
e. Responsible for coordinating and fostering solid teamwork.
f. Responsible for reporting periodically to his / her supervisor for his / her work along with problem analysis, corrective actions on the matter and the time limit for the estimation of the problem resolution in a concise, concise and concrete manner.

Authority:

a. Authority in disciplining his subordinates in accordance with the rules / regulations applicable in the company.
b. The authority to stop and manage the operation of production machinery to achieve the production results in accordance with the needs of customers and the fulfillment of the production delivery deadline.

3. Supervisor of Quality Control

a. Control the machine-generated products
b. Check out the products 8x every shift

c. Conduct process control every 2 hours

d. Blocking defective products

4. Supervisor of Maintenance

Conducting preventive maintenance on Monday to Friday and cleaning (5S) on Saturday.

5. Supervisor of Personnel and General Service

Engage in personal activities, General Services, security, rejuvenation, and EHS.

6. Unit Head

a. Plan activities and costs

b. Carry out activities and costs

c. Controlling activities and costs

d. Fixed activity and cost

7. Supervisor of Pre-Process and Material Preparation

Conducting activities of supporting material production process (Foil, filter, sweet CTP and OPP) according to requirement of production process based on work plan

8. Foreman

Having the task of coordinating subordinate workers, controlling the course of duties, providing direction and guidance to workers, lowering consumer rejection and defective products in the process, and determining the cause of the problem and formulating corrective action. Responsible to Sub Division Production

9. Operators

Production operators have the authority to inform employee leadership in case of quality problems with the goods they produce. Responsible for achieving production targets. Filling the production report, perform production activities in accordance with the goods and quantities that have been determined

2.3. Company's Management

2.3.1. Company's Vision and Mission

a. Company Vision

Being the biggest in the value of sales and profitability in the Indonesian cigarette industry.

b. Company Mission

We are here to satisfy smokers' smoking needs.

c. Vision Description

Being the leadership in the market by producing high quality products consistently and innovatively to satisfy consumers. Creation of a strong positive image for our company and our products. Dedicated professional management and competent human resources.

d. Core Values

PT. Djarum has 5 core values in the development of the company. Those values are the focus on the customer, the professionalism, the learning organization, the family, and the social responsibility. Here is an explanation of these values:

i. Focus on the Customer

Customer is a very important part in the sustainability of a company, without any customers, without customer interest in the products that the company has produced will be mandatory. PT Djarum always prioritizes that customers are always satisfied with their products, by providing relatively low prices even though the profit is reduced, this is overcome by the increase of good results and the amount of sales. In addition, PT Djarum listen to customers and meet their needs in the best way that can be done.

ii. Professionalism

Professionals in building a company well, starting with the recruitment of potential employees (one of the elements of vitas for the excitement of a company's motion). The company's ability to innovate continuously as the demands, PT Djarum always provide an innovative response to consumers. Professionals in implementing strategies that have been designed with great optimism. With such professionalism everything can be achieved.

iii. Organizations that Continue to Learn

With the successes of innovative awards and products, PT Djarum is not satisfied, with that success, always learning that success. Not only always judge his own company. Share with other companies share their knowledge. This learning organization's attitude must be balanced with an attitude of openness and mutual trust so that people dare to make changes and experiments without feeling threatened.

iv. One Family

A sense of kinship is felt in the environment of PT Djarum, this is seen when at recess, sometimes the directors join the employees, share stories, joke, it creates fun for the employees. This is where the cohesiveness of all levels of management and employees. They work together to promote the company, with the support of a solid organization, and the hard work of all employees.

v. Social Responsibility

In terms of social responsibility, for employees, PT Djarum is very concerned about its employees by providing social security in the form of health insurance, annual prize, allowances, accident insurance, pension guarantee. PT Djarum also provides educational scholarships to children of employees so they can continue their education well. Social Responsibility given PT Djarum not only to its employees but also to the general public. To carry out this responsibility PT Djarum does Corporate Social Responsibility (CSR), which is very clear nowadays, namely: Djarum gives 30 billion fund in badminton field construction, GOR PT Djarum Bakti Bangsa, used to recruit world class badminton players. In the field of environment PT Djarum gives cumacuma trees for greening.

2.3.2. Employment

The current number of employees in PT Djarum is approximately 75000 people which spread over several departments in PT Djarum. Matters relating to employment in PT Djarum Gribig are regulated as follows:

a. Recruitment of Labor

The procedures and conditions stipulated in the recruitment of workers in PT Djarum include:

i. Form filling. Intended to obtain complete information and data from prospective employees.
ii. Following the psychotest.
iii. Interview. In this interview is usually assessed about appearance, speech, education and so forth.
iv. Medical examination. This is done to prevent the possibility of obtaining employees who suffer from a disease that can disrupt the work process.

b. Working Hours

The working hours of employees at PT Djarum company SKM Gribig have been regulated in accordance with government regulations. Here is the division of working hours PT Djarum SKM Gribig:

i. Shift 1: 06.00 - 14.00 WIB. Break time is set by the employee with a duration of rest for 1 hour.
ii. Shift 2: 14.00 - 22.00 WIB. Break time is set by the employee with a duration of rest for 1 hour.
iii. Shift 3: 22.00 - 06.00 WIB. Break time is set by the employee with a duration of rest for 1 hour.

For dinner, employees get catering and employees are not advised to leave the factory in order to maintain the security of each employee.

The working day of PT Djarum Gribig Kudus shift employees is Monday to Saturday. If the demand for cigarettes is low, it usually applies a mini shift with 5 working hours for each shift on Saturday with the following division:

i. Shift 1: 06.00 - 11.00 WIB. Break time is set by the employee with a duration of rest for 1 hour.
ii. Shift 2: 11.00 - 16.00 WIB. Break time is set by the employee with a duration of rest for 1 hour.
iii. Shift 3: 16.00 - 21.00 WIB. Break time is set by the employee with a duration of rest for 1 hour.

On Sundays shift employees may enter work depending on cigarette demand. Working hours on Sunday also apply a mini shift with 5 working hours for each shift.

For employees of non-shift working hours are as follows:

i. Monday - Friday: Working from 07.00 - 16.00 WIB with an hour break between 11.30 - 13.30 WIB.
ii. Saturday: Working from 07.00 - 12.00 WIB.

The working days of non-shift employees of PT Djarum Gribig Kudus are Monday-Saturday. On Sundays non-shift employees may enter work depending on cigarette demand. Working hours on Sundays are also applied starting at 07.00 - 12.00 WIB.

c. Employee Welfare

The Company provides a variety of useful facilities for employee benefits. This facility is provided with the aim of improving employee morale. The following are the facilities provided by the company:

i. Holiday allowances and other benefits

ii. Mess for employees
iii. Cafeteria
iv. Mosque
v. Car and motorcycle parking lot
vi. Bus for employee shuttle
vii. Etc.

Employee well-being is not only given in material form but also in the company's attention to the safety of its employees. This is a matter of great concern because the safety of work will affect the productivity and image of the company. PT Djarum has paid attention to the safety of its employees, this can be seen from the work equipment provided by the company to employees. Work equipment provided consists of masks, earplugs, gloves, safety shoes, safety helmet, etc. However, not all employees are given work equipment, only employees who have a high working risk are getting. In case of work accident, it will be seen first what the cause and for the cost will be borne by the company.

In PT Djarum also provided medicines and beverages. For Panelists (master) is given a health injection every month. Panelists are the ones who are tasked with tasting cigarettes from the R & D department. For mothers the manual tobacco section is given cow's milk in order to neutralize tobacco that is inadvertently inhaled by the mothers and to improve health. There is also a company doctor for employees who are sick.

d. Facilities

PT. Djarum provided some facilities, which are:

1. Sports Venues

PT. Djarum provides badminton field facilities, volleyball court, tennis court, basketball court, fitness center, jogging track, etc.

2. Vehicles

For Manager, Senior Manager, and Director level get car service facility from PT Djarum during the position.

3. Education’s Scholarship

For employees of PT Djarum who have a family get scholarship’s right from PT Djarum for level of Elementary School until Senior High School for children who excel.

2.3.3. Marketing

PT Djarum's product marketing is not only domestically but has expanded abroad. For products marketed domestically, PT Djarum already has distributors spread across the western and central part of Indonesia. For products marketed abroad, PT Djarum has marketed to Malaysia, Singapore, Arab, India, America and Europe. PT Djarum also has a company in Brazil where some workers are Indonesians assigned to Brazil. In order to improve its services, PT Djarum already has branches throughout Indonesia whose branch of marketing office mostly located in Java Island.

CHAPTER 3
COMPANY'S SYSTEM OVERVIEW

3.1. Company's Business Process or Department

Business process is a series of activities between parts within a company. In the picture below presented business process owned by the company in general.

Company Business Process Generally can be seen in Figure 3.1.

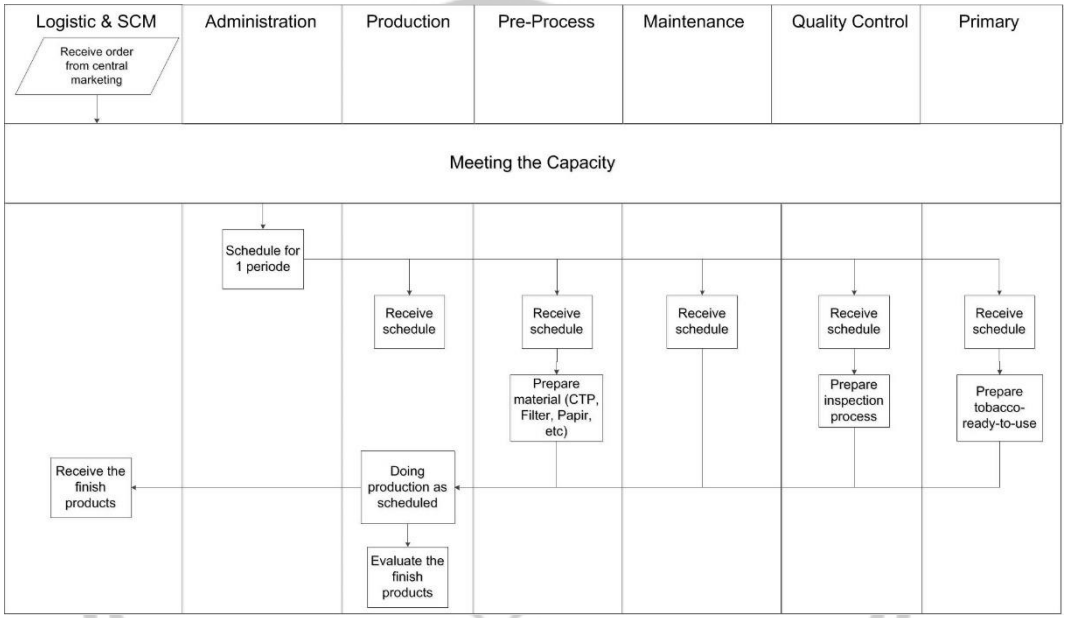

Figure 3.1. Company Business Process Generally

3.2. Operation Process Chart

The process of making a cigarette started with making its components, those are acetate tow, CTP (Cigarette Tipping Paper), and tobacco. Others are gained from supplier. When all of the three components are done then they enter to a maker machine to be processed become a cigarette, process happened here is like rolling the cigarette. After finish it enters to the packer machine.

PT. Djarum makes CTP (Cigarette Tipping Paper) and Acetate Tow on their own since all of those ingredients have specific material that already meets the customer's want. For tobacco, they get it from the farmer and in Primary plant they combined the tobacco with sauce (different for each types of cigarette). In Secondary then all of three main ingredients enter the maker machine in order to gain the cigarette rod. After that, the rod enter the packer machine to be packed as its type.

Operation Process Chart can be seen in Figure 3.2.

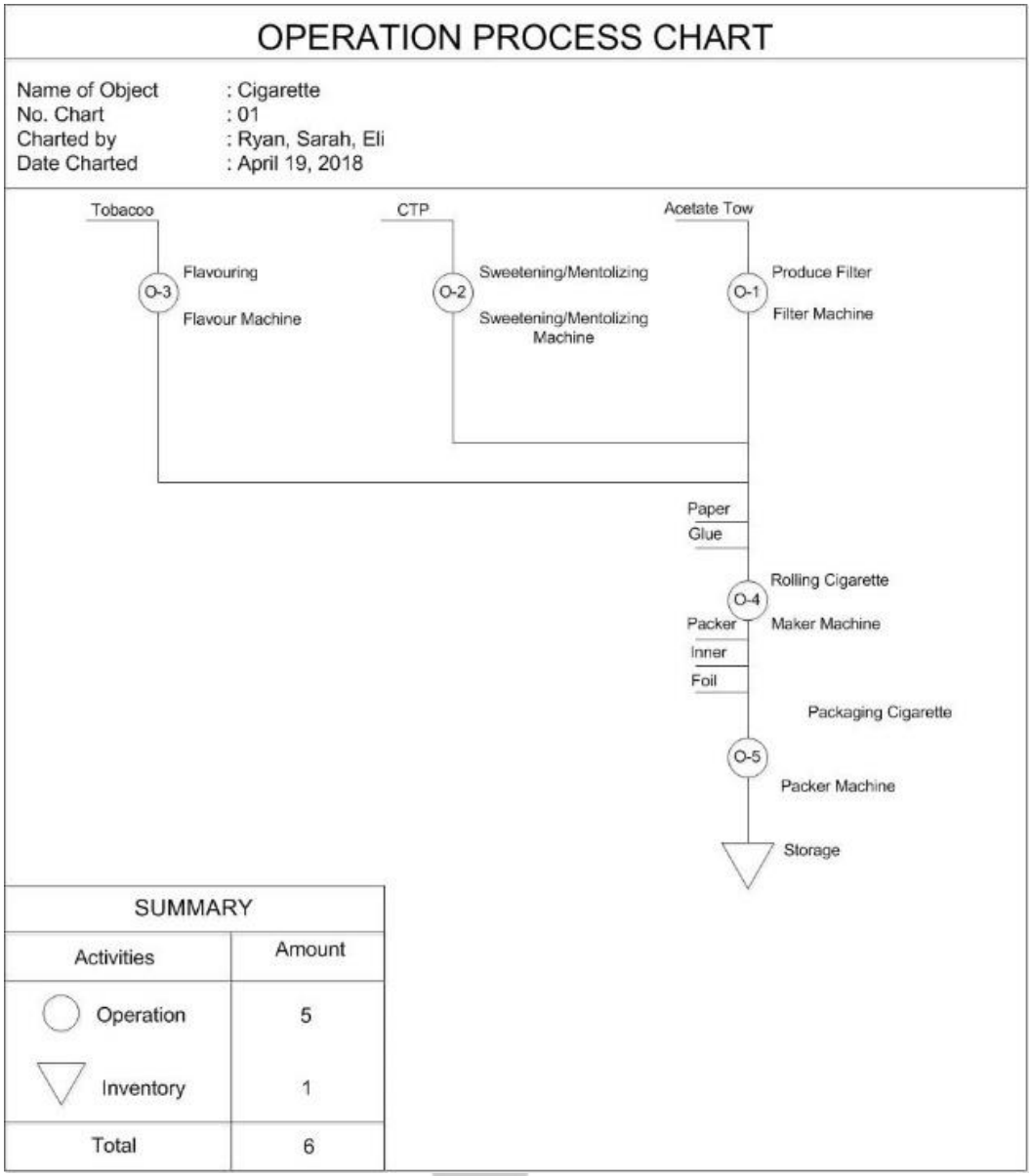

Figure 3.2. Operation Process Chart

3.3. Product Generated

Products that produced by PT Djarum Gribig is Cigarette. There are a lot of cigarette, such as LA Bold, Djarum Coklat, Super 16, MLD, etc. There also produced many kinds of cigarette for export product. The product that produced by PT Djarum can be seen in table 3.1.

Table 3.1. Product of PT Djarum

No.	Product Name	Product Picture
1	Djarum Super Mild	
2	Djarum Super 12	
3	LA Lights	

Table 3.2. Continuation

4	Djarum 76	
5	LA BOLD	

3.4. Production Process

3.4.1. Production Resources

The production process is a way or technique of creating something through the stages of the raw materials to be altered in a certain way in a sequential and systematic way to produce a product that has a particular function.

A production process involves the use of resources. Resources used are the main capital to start a production process. Resources needed in the production process that includes:

1. Material

The material includes all kinds of materials processed by machines and humans that become finished products that can be used by consumers.

2. Humans

Humans are an important component in the production process. Humans must plan and also become a supporting element in the occurrence of the production process because in PT Djarum QC part of this production process is almost all done by the machine. Humans act as planners, operators and mechanists in the production process in QC PT Djarum.

3. Methods

Methods are the means used to inspect a product (cigarette) both visually and with a QTM machine.

4. Money

The funds in question are the funds / money that will be spent to buy raw materials, research costs, paying manpower, paying for electricity, taxes, etc.

5. Machines

Machines are needed in the production process. Because in SKM PT Djarum, this production process is semi-automatic. Starting from bulb up to the process of sending filter to SKM department is done by machine (Automation).

3.4.2. Raw Materials

In material procurement, PT Djarum does not rely on one supplier only. The existing raw materials consist of finished blend raw materials, raw materials of cigarettes, and cigarette raw materials pack.

a. Filter Rod

Filters are made using a KDF engine that has a capacity of 395,000 stems / hour for the Gemini Rack if using a porous plug wrap. For non-porous plug wrap, KDF machines only produce 247,000 sticks / hour for Gemini Racks. New filters can be used four hours after production.

Raw materials in the manufacture of filters consist of acetate tow, hotmelt, triacetine, inner glue, and plug wrap. In the manufacture of filters produced waste paper, acetate tow decomposes, and filters that do not meet the specifications. Rejected paper and acetate tow can’t be used anymore, while non-compliant filters are sold to small cigarette manufacturers. The following is the raw material in making the filter in question:

1. Acetate Tow

Acetate tow in the form of fibers such as white cotton is very thin and unbroken in one roll. Acetate tow is the main raw material in making filter rod and roll filter. The roll filter is a roll-shaped filter. While the filter rod is a filter that has been cut into a bar. Acetate tow is imported from Japan, Germany, and USA.

2. Hotmelt

Hotmelt in the form of small pieces measuring approximately 7 mm. Hotmelt is boxy and yellowish. Hotmelt is used as a glue to glue the ends of the wrap plug.

3. Triacetine

Triacetine is a white solution. Triacetine is used to bloat and shake acetate tow.

4. Inner Glue

Inner glue is a solution used as a glue to glue acetate tow with plug wrap. Innerglue is made from a mixture of triacetine and acetate tow pieces.

5. Plug Wrap

Plug wrap is a filter wrapper, in the form of white paper. This wrap plug is stronger than paper. Plug wrap there are two kinds, namely porous and non-porous.

3.4.3. Cigarette Paper

Paper is a paper used to wrap tobacco finished blend. Each Cigarette Maker (CM) requires about 28 papers / day.

3.4.4. Cigarette Tipping Paper (CTP)

Cork Tipping Paper is a paper used to coat the connection between tobacco rods and filters, the CTP to be used must pass through the CTP sweetening process (in pre-process).

3.4.5. Sweetener Liquid

CTP tasteless and then sweetened by using a sweetener containing glucose and alcohol. The goal is to give a sweet taste to CTP.

3.4.6. Menthol (Optional)

Menthol is only used on LA Light Menthol and Djarum Black Menthol where the aluminum is done menthol application.

3.4.7. Glue

Glue is used for embedding paper, CTP paper, or to glue materials such as aluminum foil, inner frame paper, etiquette (blank), paper craft, and banderole. The use of glue is divided into two, namely:

a. The glue used in the process of making cigarettes (cigarette maker machines) includes cigarette / side seam glue, used to paste between two papers, and CTP glue used for gluing Cork Tipping.
b. Glue used in packaging process (on packer machine) that is glue 8065 which is used to glues etiquette (blank) and inner frame paper.

3.4.8. Ink

Ink is only used in the manufacture of Djarum Super products, where ink is used to create logos on Paper. In the manufacture of cigarette bars, also used auxiliary materials tape and tape garniture.

3.4.9. Production Facilities

Facility layout can be defined as the procedure of arranging factory facilities to support the smoothness of the production process. In the production of necessary equipment, equipment, machinery and production facilities. The entire facility must be arranged according to the needs of the production process so that the production can be produced with quantity and quality as expected, can be completed on time with minimal cost. Plant layout planning is the optimum selection of machinery and equipment, work place, storage and service facility, together with the determination of the factory building.

PT. Djarum set up its production facilities using product layout type. Product Layout Type is a factory layout that has high efficiency where the equipment is arranged based on the order of product making process. The flow of production that occurs is Flow Shop where the characteristics of Flow Shop as follows:

a. Material transfer flow is smooth and simple, and material handling cost is low.
b. Total time spent on production is relatively short.
c. The existence of an incentive system for the employee group will be able to provide motivation to improve work productivity.
d. Each production unit or work station requires a minimum area.
e. Production process control is easy to implement.

Any raw materials or components included in the production floor of PT. Djarum will experience some movement from one process to another. For example: paper which became one of the main raw materials of cigarettes. When arriving from the vendor it will be put first into the warehouse and then transferred to the pre-process department for processing. Any displacement that occurs must require a material handling or material handling.

Material handling system contained in PT. Djarum varies depending on the type and quantity of raw materials to be moved as well as the position of the raw materials are present. Method of moving raw materials and finished products in PT. Djarum can be divided into 3 types:

1. Manual Removal

Manual removal is done by the operator without the help of the machine. It is used when there is no special tool to handle and is a light job. For example, replacing CTP and papir paper manually. Manual removal is also done by the manual packing operator. Operator without the aid of special tools, put the ball into the box.

2. Removal by Machine

Displacement by machine without human assistance. This is used if it is not possible to do it manually. It is more efficient for heavy work. For example, in the production, ready-to-market cigarettes are transferred to manual packaging by conveyors. Especially for the M6 focke making machine for paperback and CTP paper replacements are performed automatically by a robotic arm equipped with sensors without human assistance. Similarly, on the machine packer focke F8 to take the carton press using the robot arm automatically without humans with the help of the sensor.

3. Transfer of mixed material

Manual transfer systems with the help of machines, usually used to move components from one department to another department. For example: to move the components from the manual packaging department to the warehouse using Forklift.

Material handling systems contained in parts of production vary, depending on the type of material to be moved. Most of the raw material transfer is done by human / operator. Material handling tools will be used if the material is heavy or large. Material handling in the production section include:

a. Forklift

Forklifts are used to remove raw materials and assist in removal of product components on the production floor. The maximum material that can be lifted by Forklift weighs 2 tons.

b. Hand Truck

Hand trucks are used to carry small materials in large quantities.

c. Pallet

Pallet is a wooden board that is used as a tool in the process of moving raw materials and finished products.

d. Pallet Jack

Pallet Jack is a special tool for moving pallets from department to department. Pallet Jack uses the hirdolik system to adjust the pallet cross-sectional height of the jack.

Implementation of quality control in PT. Djarum is handled by Quality Control (QC). Controlling the quality and quality of the products produced is very important to maintain the trust of consumers. Quality control at PT. Djarum consists of initial material inspection, inspection on every production process, inspection on manual packaging, and inspection on delivery. Raw materials that are not in accordance with the characteristics of raw materials ordered then the raw materials will be returned.

Each department contained in PT. Djarum implements a quality control system in every production process. In each production process the workers / operators check each other's work results so as to minimize the occurrence of defects to the final product.

CHAPTER 4
PROJECT REVIEW

This chapter explains an overview of student's internship project scope, background, objectives, analysis, countermeasures and implementation. During internship, most of internee activities are related with project accomplishment.

4.1. Project Scope

Students are place in the Secondary Engineering which is consist of Maker and Packer Process. The students are given right to used pre-process and material preparation office. The layout is as follows:

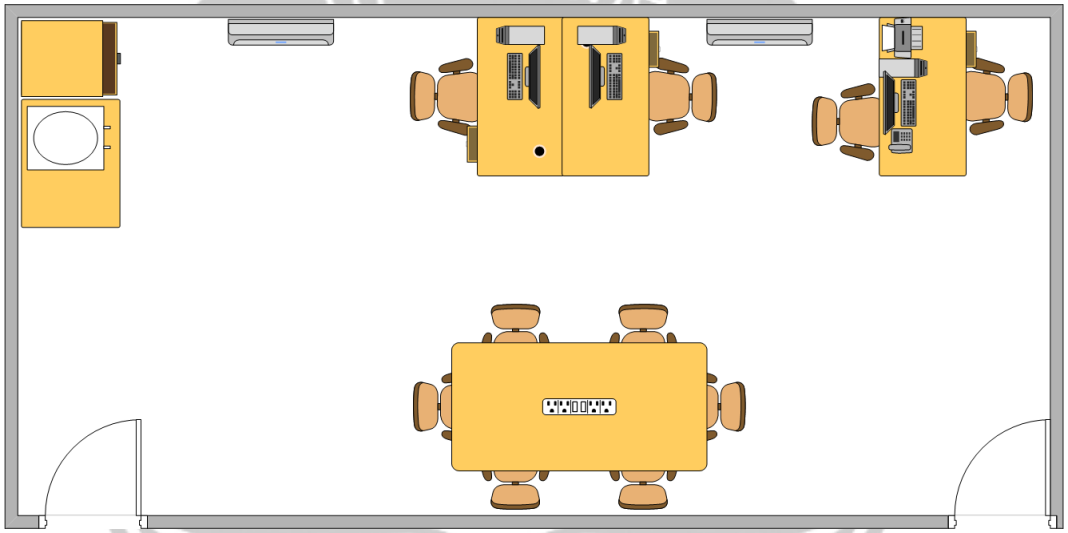

Figure 4.1. Pre-Process and Material Preparation Office

Student worked from 07.00 – 16.00 WIB in Monday – Friday and 07.00 – 12.00 WIB in Saturday. Student worked in Pre-Process and Material Preparation. This department is used to prepare all the materials needed to support maker and packer process. In addition, PT. Djarum also has a process of making raw material of cigarette maker, commonly called Pre-Process, which is making filter and CTP (Cigarette Tipping Paper) process.

Student had task to make a determination of the amount of material requirement for raw material of filter of LA Bold and Super and do workload analysis as consideration to determine the number of workers for machine KDF-M/14 and KDF2/04. For this task, student was helped and led by Mrs. Christy as the Pre-Process and Material Preparation's supervisor with Mr. Nugi, Mr. Paad and Mr.

Wawan as her Unit Heads. The working hours for doing the observation was in shift 1, shift 2 and shift 3. This observation doing in different day and different shift is to know the difference of the productivity of the workers between those three shifts.

4.2. Rights and Responsibilities

During 29 days of worked, student had rights as follow:

a. Student was permitted to enter all the production room and learn about the production process.
b. Student was permitted to observe all the manufacturing process and communicate with the supervisors, unit heads, operators, and workers.
c. Student are allowed to retrieve the necessary data on weekdays with notes to not annoy the workers and not spreading any form of data out of the company.
d. Student are allowed to use the pre-process and material preparation department room to complete the report.

While the responsibilities given as the following:

a. Student should do the observation and report the result to the unit head and supervisor.
b. Student should give suggestion to the result.
c. At the last day, student should do a presentation in front of the production manager, supervisors, and unit heads in the Secondary Engineering of PT. Djarum SKM Gribig.

4.3. Methodology to Complete Assignment

4.3.1. Determination of The Amount of Material Requirement for Raw Material of Filter Of LA Bold and Super

a. Research Design

The research design used is descriptive analysis. The method used is Statistics Method.

b. Types and Sources of Data

The type of data used is quantitative data (data in the form of numbers), including:

i. Standard data for the use of raw materials to produce filters in December 2017.
ii. Actual data on filter raw material use in December 2017.

The data source used is the data "Pre-Process Data Input - Filter Maker Gribig" owned by Unit Head in the pre-process building.

c. Method of collecting data

The data collection method used is by viewing and checking documents in the pre-process office. The data is used to analyze the determination of the amount of safety stock and material requirement needed.

d. Research Steps

The steps taken in conducting this research are as follows:

i. Field Studies

Field studies were conducted to obtain information on the general picture and actual company conditions.

ii. Literature Review

Literature study is conducted to obtain and better understanding about the theories related to problem solving. Sources of literature comes from books, journals, and studies of labs that have been done before.

iii. Formulation of The Problem

Based on literature studies and field studies, will be known the problems that are being studied.

iv. Determination of Research Objectives

Determination of research objectives is used to explain what goals to be achieved with research.

v. Collecting the Data

The data collected for this study includes secondary data obtained from archives, textbooks, and journals related with this research.

vi. Data Processing

Data processing conducted in this research are:

1. Calculating the actual amount of filter material use
2. Calculate the standard number of filter's raw materials use
3. Calculate the average use of raw materials per day
4. Calculate standard deviation of raw materials
5. Determining service level and standard deviation
6. Calculate the amount of safety stock of raw material maker LA Bold and Super brand filter.
7. Calculate the amount of material needed for the manufacture of LA Bold and Super brand filters.

vii. Analysis and Conclusion

The analysis and conclusion of this research is to analyze and determine the amount of optimum material needed to make filter of brand LA Bold and Super.

4.3.2. Workload Analysis as Consideration to Determine the Number of Workers for KDF-M/14 and KDF2/04 Machines

a. Research Design

The research design used is descriptive analysis. The method used is Workload Analysis (WLA)

b. Types and Sources of Data

The type of data used is quantitative data (data in the form of numbers), including:

i. Data of total productive and non-productive activities undertaken by operators and helpers on KDF-M / 14 and KDF2 / 04 machines.
ii. Data of Performance Rating (Westinghouse System)
iii. Data of allowance factor table

The sources of data used are data obtained from the observations made by the student herself as well as archives of practicum during lectures related to research.

c. Method of collecting data

Methods used in data collection are:

i. Observation

The data obtained by doing a direct observation of the object under study to obtain accurate data.

ii. Interview

Data obtained by conducting question and answer directly. Question and answer activities are conducted by asking the parties concerned in the research activities.

iii. Fill Out the Observation Sheet

Data obtained from observations are recorded in the observation sheet.

d. Research Steps

The steps taken in conducting this research are as follows:

i. Field Studies

Field studies were conducted to obtain information on the general picture and actual company conditions.

ii. Literature Review

Literature study is conducted to obtain and better understanding about the theories related to problem solving. Sources of literature comes from books, journals, and studies of labs that have been done before.

iii. Formulation of The Problem

Based on literature studies and field studies, will be known the problems that are being studied.

iv. Determination of Research Objectives

Determination of research objectives is used to explain what goals to be achieved with research.

v. Prepare for Data Collection

Before conducting the research, determine the work elements of the worker to determine the random number to be used and create an observation sheet.

The observation sheet is shown in Figure 4.2.

LEMBAR PENGAMATAN SAMPLING PEKERJAAN di GEDUNG KDF													
Nama Pengamat :	Elizabeth Natalia Gunawan												
Posisi :	PKL												
Hari, tanggal :	Rabu, 3 Januari 2018												
Nama Pekerja :												Jenis Mesin:	
Jenis Kelamin :													
Umur :													
Posisi :													
			Produktif						Non Produktif				
No	RN	Waktu Pengamatan	Pemeriksaan Awal	*Set up* benda kerja	*Material Handling*	*Quality Control*	*Error Checking*	Pemeriksaan Akhir	*Personal Times*	*Fatigue*	*Waiting*	*Not Available*	Mencari *tools* /Peralatan lain
1	0	6:00											
2	1	6:06											
3	2	6:12											
4	4	6:24											
5	5	6:30											
6	6	6:36											
7	11	7:07											
8	12	7:13											
9	13	7:19											
10	14	7:25											
11	15	7:32											
12	17	7:44											
13	19	7:56											
14	23	8:21											
15	24	8:27											
16	25	8:33											
17	28	8:51											
18	29	8:57											
19	32	9:16											

Figure 4.2. Observation Sheet

vi. Collecting the Data

The data collected for this research includes both primary and secondary data obtained directly from observations and from archives, textbooks, and journal related of this research.

vii. Data Processing

Data processing conducted in this research are:

1. Count the number of productive and non-productive activities of operators and helpers of each observation.
2. Calculate the percentage of productive and non-productive activities

3. Perform test data adequacy.
4. Conduct uniform test data of each operator and helper.
5. Determining performance rating with Westinghouse System method.
6. Determine allowance by using the allowance table.
7. Calculating workload by WLA method.
8. Calculate the number of workers of each machine based on the workload.
9. Determining the number of workers.

viii. Analysis and Conclusion

The analysis and conclusion of this research are:

1. Analyze the amount of productive and non-productive percentages of each operator and helpers.
2. Analyze workload conditions related to the cause of the high workload.
3. The analysis is related to the number of workers who will compare the number of current workers with the number of workers based on their workload.
4. Drawing conclusions

4.4. Result of Internship Assignment

In this sub-section will be explained about the observation's result.

4.4.1. Determination of The Amount of Material Requirement for Raw Material of Filter of LA Bold and Super

In this case, the authors only calculate the Safety Stock for the raw material of the LA Bold and Super brand-specific filters because based on December production data, every day the machine produces the LA Bold and Super brands in large quantities and is continuous. As for the manufacture of other brand filters tend to be rare and the number is small. The raw material for making LA Bold and Super filters tend to be the same. Which distinguishes only on the Wrap Plug used. The LA Bold brand filter uses Porous Plug Wrap, while Super brand filters use Non-Porous Plug Wrap. For acetate tow needs are separated according to the machine because the acetate tow can't be divided into other machines.

In determining the average requirement per day, calculated by summing material requirements divided by the number of days. To determine the amount of safety stock required data actual use of raw materials and raw material usage plans. Safety Stock calculation is done by looking at and considering the deviations that occur between the estimated use of raw materials with the actual use. After

knowing the standard deviation of each day, it will be determined the amount of deviation analysis. Having known the number of safety stock, then the material needs can be calculated by summing the average needs of raw materials per day plus the amount of safety stock. To determine the needs of this material, it is assumed that all machines operate daily.

a. Data

The following is data of actual usage and standard usage of each raw material to produce filter of LA Bold and Super

The actual usage of raw materials in December 2017 is shown in Table 4.1. The standard usage of raw materials in December 2017 is shown in Table 4.2.

Table 4.1. Actual Usage of Raw Materials in December 2017

Date	Machine Type	Acetate Tow (Kg)	Hotmelt (Kg)	Triacetine (Kg)	Inner Glue (Kg)	Plug Wrap (Roll)
4/12/2017	FM14-LB	3080.00	25.00	229.1	10	57.8
4/12/2017	FM04-SP	737.00	4.00	59	3.5	23.6
5/12/2017	FM04-SP	1699.00	9.00	166.6	8	52
5/12/2017	FM05-LB	1512.00	13.00	90	6	57.9
5/12/2017	FM14-LB	4073.00	24.00	297	13	75
6/12/2017	FM04-SP	1846.10	12.50	178.1	10	55.6
6/12/2017	FM05-LB	1390.00	6.00	90	3	49
6/12/2017	FM06-SP	878.00	4.00	80	8	27.2
6/12/2017	FM14-LB	4538.30	27.00	321.6	13	81.3
7/12/2017	FM04-SP	2006.90	10.50	193.4	8.5	60
7/12/2017	FM05-LB	1682.40	9.00	120	6	60.7
7/12/2017	FM06-SP	968.30	5.00	85	4	29.8
7/12/2017	FM14-LB	3686.40	21.00	252.5	12	63.9
8/12/2017	FM04-SP	909.00	5.50	88.1	4	27.3
8/12/2017	FM05-LB	2466.60	13.00	185	8	92.2
8/12/2017	FM06-SP	1008.60	3.50	30	5	29.9
8/12/2017	FM14-LB	3594.30	20.00	254.7	11	64.4
11/12/2017	FM04-SP	1753.70	9.50	171.6	10.5	53.4
11/12/2017	FM05-LB	2358.00	12.50	180	10	91.9
11/12/2017	FM14-LB	2665.00	14.00	187	8	47.8
12/12/2017	FM04-SP	2479.90	13.00	242.6	12.5	75.3
12/12/2017	FM05-LB	2633.20	11.00	200	9	97.6
12/12/2017	FM14-LB	2387.50	14.00	163	8	41.1
13/12/2017	FM04-SP	2607.20	14.50	256.4	12	79.7
13/12/2017	FM05-LB	1639.80	10.00	115	5	61.5

Table 4.1. Continuation

13/12/2017	FM06-SP	1007.60	4.50	85	5	30
13/12/2017	FM14-LB	3552.50	20.00	256	11	64.5
14/12/2017	FM04-SP	1386.70	10.50	136.1	5.5	42.3
14/12/2017	FM14-LB	3986.80	22.00	280	12	70.6
15/12/2017	FM04-SP	1811.30	8.00	171.6	8	53.3
15/12/2017	FM14-LB	3107.80	18.00	216	10	54.5
18/12/2017	FM04-SP	2758.00	14.00	264.3	14	82.1
18/12/2017	FM05-LB	1278.70	0.50	85	4	45.3
18/12/2017	FM14-LB	2763.00	16.00	192	10	48.5
19/12/2017	FM04-SP	2599.60	15.00	252.5	12	78.8
19/12/2017	FM05-LB	800.60	4.50	55	3	28.8
19/12/2017	FM14-LB	2442.80	14.00	169	9	42.8
20/12/2017	FM04-SP	2543.10	14.00	244.5	12	76.2
20/12/2017	FM05-LB	1614.10	8.00	120	5	59.6
20/12/2017	FM14-LB	3454.30	20.00	241	12	60.8
21/12/2017	FM04-SP	1790.60	11.50	171.8	8	53.5
21/12/2017	FM05-LB	820.70	5.50	65	3	34.1
21/12/2017	FM14-LB	3280.70	19.00	229	12	57.9
22/12/2017	FM04-SP	2811.20	14.50	269.2	13.5	83.6
22/12/2017	FM05-LB	1850.90	9.50	130	7	66.3
22/12/2017	FM06-SP	1637.30	7.00	145	8	48.3
22/12/2017	FM14-LB	2389.30	14.00	166	9	41.9
27/12/2017	FM04-SP	1979.60	15.00	191.8	10	59.6
27/12/2017	FM05-LB	1741.90	8.00	125	5	62.7
27/12/2017	FM14-LB	2002.00	12.00	140	7	36
28/12/2017	FM04-SP	2661.00	13.50	245.6	17	77.8
28/12/2017	FM05-LB	1386.70	9.00	95	6	49.2
28/12/2017	FM14-LB	4035.20	24.00	282	14	71.2
29/12/2017	FM04-SP	1289.40	8.00	123.6	6.5	38.9
29/12/2017	FM05-LB	1655.50	7.00	115	5	58.8
29/12/2017	FM14-LB	4369.80	26.00	306	15	77.2
30/12/2017	FM04-SP	2455.90	14.50	235.6	12.5	73.6
30/12/2017	FM05-LB	2447.30	15.00	185	7	90.2
30/12/2017	FM06-LB	658.20	4.00	43	3	21.7
30/12/2017	FM14-LB	4046.70	24.00	283	14	71.8
Total		134816.70	760.50	10491.30	523.00	3468.30

Table 4.2. Standard Usage of Raw Materials in December 2017

Date	Machine Type	Acetate Tow (Kg)	Hotmelt (Kg)	Triacetine (Kg)	Inner Glue (Kg)	Plug Wrap (Roll)
4/12/2017	FM14-LB	3151.00	15	229	10	57
4/12/2017	FM04-SP	738.00	4	59	3	23
5/12/2017	FM04-SP	1659.00	9	152	6	51
5/12/2017	FM05-LB	1594.00	8	120	4	55
5/12/2017	FM14-LB	4085.00	20	297	12	74
6/12/2017	FM04-SP	1777.00	10	163	7	54
6/12/2017	FM05-LB	1374.00	7	103	3	48
6/12/2017	FM06-SP	880.00	5	81	3	27
6/12/2017	FM14-LB	4423.00	21	322	13	80
7/12/2017	FM04-SP	1925.00	11	176	7	59
7/12/2017	FM05-LB	1748.00	9	131	4	61
7/12/2017	FM06-SP	954.00	6	87	4	29
7/12/2017	FM14-LB	3472.00	17	253	11	63
8/12/2017	FM04-SP	867.00	5	79	3	26
8/12/2017	FM05-LB	2573.00	13	193	7	89
8/12/2017	FM06-SP	959.00	6	88	4	29
8/12/2017	FM14-LB	3502.00	17	255	11	64
11/12/2017	FM04-SP	1695.00	9	155	6	52
11/12/2017	FM05-LB	2622.00	14	197	7	91
11/12/2017	FM14-LB	2574.00	12	187	8	47
12/12/2017	FM04-SP	2375.00	13	218	9	73
12/12/2017	FM05-LB	2748.00	14	207	7	95
12/12/2017	FM14-LB	2241.00	11	163	7	41
13/12/2017	FM04-SP	2504.00	14	229	10	76
13/12/2017	FM05-LB	1736.00	9	130	4	60
13/12/2017	FM06-SP	977.00	6	90	4	30
13/12/2017	FM14-LB	3516.00	17	256	11	64
14/12/2017	FM04-SP	1413.00	8	129	5	43
14/12/2017	FM14-LB	3853.00	19	280	12	70
15/12/2017	FM04-SP	1694.00	9	155	6	52
15/12/2017	FM14-LB	2966.00	14	216	9	54
18/12/2017	FM04-SP	2591.00	14	237	10	79
18/12/2017	FM05-LB	1273.00	7	96	3	44
18/12/2017	FM14-LB	2642.00	13	192	8	48
19/12/2017	FM04-SP	2545.00	14	233	10	78
19/12/2017	FM05-LB	813.00	4	61	2	28
19/12/2017	FM14-LB	2334.00	11	170	7	42
20/12/2017	FM04-SP	2387.00	13	219	9	73
20/12/2017	FM05-LB	1695.00	9	127	4	59

Table 4.2. Continuation

20/12/2017	FM14-LB	3322.00	16	242	10	60
21/12/2017	FM04-SP	1704.00	9	156	7	52
21/12/2017	FM05-LB	934.00	5	70	2	32
21/12/2017	FM14-LB	3153.00	15	229	10	57
22/12/2017	FM04-SP	2665.00	15	244	10	81
22/12/2017	FM05-LB	1789.00	9	134	5	62
22/12/2017	FM06-SP	1572.00	10	144	6	48
22/12/2017	FM14-LB	2287.00	11	166	7	42
27/12/2017	FM04-SP	1891.00	10	173	7	58
27/12/2017	FM05-LB	1760.00	9	132	4	61
27/12/2017	FM14-LB	1926.00	9	140	6	35
28/12/2017	FM04-SP	2469.00	14	226	9	75
28/12/2017	FM05-LB	1386.00	7	104	4	48
28/12/2017	FM14-LB	3888.00	19	283	12	71
29/12/2017	FM04-SP	1145.00	6	105	4	35
29/12/2017	FM05-LB	1687.00	9	127	4	59
29/12/2017	FM14-LB	4213.00	20	306	13	77
30/12/2017	FM04-SP	2320.00	13	212	9	71
30/12/2017	FM05-LB	2569.00	13	193	7	89
30/12/2017	FM06-LB	610.00	3	46	2	21
30/12/2017	FM14-LB	3907.00	19	284	12	71
Total		134816.70	132072.00	678.00	10392.00	420.00

b. Data Processing

i. Material Needs of Acetate Tow for Machine KDF-M / 14 (Brand LA Bold)

The calculation for material needs of acetate tow for machine KDF-M / 14 (Brand LA Bold) is shown in Table 4.3.

Table 4.3. Material Needs of Acetate Tow for Machine KDF-M / 14

Date	Machine Type	Actual Usage (X)	Standard Usage (Y)	$(X-Y)$	$(X-Y)^2$
4/12/2017	FM14-LB	3080.00	3151.00	-71.00	5041.00
5/12/2017	FM14-LB	4073.00	4085.00	-12.00	144.00
6/12/2017	FM14-LB	4538.30	4423.00	115.30	13294.09
7/12/2017	FM14-LB	3686.40	3472.00	214.40	45967.36
8/12/2017	FM14-LB	3594.30	3502.00	92.30	8519.29
11/12/2017	FM14-LB	2665.00	2574.00	91.00	8281.00
12/12/2017	FM14-LB	2387.50	2241.00	146.50	21462.25
13/12/2017	FM14-LB	3552.50	3516.00	36.50	1332.25
14/12/2017	FM14-LB	3986.80	3853.00	133.80	17902.44

Table 4.3. Continuation

15/12/2017	FM14-LB	3107.80	2966.00	141.80	20107.24
18/12/2017	FM14-LB	2763.00	2642.00	121.00	14641.00
19/12/2017	FM14-LB	2442.80	2334.00	108.80	11837.44
20/12/2017	FM14-LB	3454.30	3322.00	132.30	17503.29
21/12/2017	FM14-LB	3280.70	3153.00	127.70	16307.29
22/12/2017	FM14-LB	2389.30	2287.00	102.30	10465.29
27/12/2017	FM14-LB	2002.00	1926.00	76.00	5776.00
28/12/2017	FM14-LB	4035.20	3888.00	147.20	21667.84
29/12/2017	FM14-LB	4369.80	4213.00	156.80	24586.24
30/12/2017	FM14-LB	4046.70	3907.00	139.70	19516.09
		63455.40	61455.00	2000.40	284351.40

$$Average\ Usage\ per\ day = \frac{63455.4\ kg}{19}$$

$$Average\ Usage\ per\ day = 3339.76\ kg$$

$$SD = \frac{\sqrt{\Sigma(x - \bar{x})^2}}{n}$$

$$SD = \sqrt{\frac{284351.4}{19}}$$

$$SD = \sqrt{14965.86} = 122.34\ kg$$

Based on previous studies, assuming the company management chose 5% deviation standard, so that Z obtained with standard deviation table of 1.65 (can be seen in appendix 1).

$$Safety\ Stock = Z \times SD$$

$$Safety\ Stock = 122.34 \times 1.65$$

$$Safety\ Stock = 202\ \text{kg}$$

$$Material\ Needs = 3339.76\ \text{kg} + 202\ \text{kg}$$

$$Material\ Needs = \frac{3541.76\ \text{kg}}{550\ kg/bale} = 6.44\ \text{bale} = 7\ \text{bale}$$

From the data processing above, the standard deviation for the Acetate Tow raw material for the KDF-M / 14 machine of December 2017 is 122.34 kg. Based on previous studies, that with management assumption, the company chose standard deviation of 5%, so that Z obtained with standard deviation table of 1.65. Then the calculation of safety stock for Acetate Tow raw material is done by multiplying the value of Z and standard deviation, that is 122.34 x 1.65 = 202 kg. As for the average

per day, KDF-M / 14 machine requires acetate tow approximately 3339.76 kg. Then the material requirement per day is determined by summing the average use of material per day plus the amount of safety stock, which is 3339.76 kg + 202 kg = 3541.76 kg. But for raw materials Acetate Tow, material orders made in the form of bale that has an average weight of 550 kg in one bale. Then the number of safety stock Acetate Tow that is 3541.76 / 550 = 6.44 bale or rounded up to equal 7 bale. However, since the KDF-M / 14 machine is a double track machine, the safety stock must be a multiple of 2 because the stock acetate tow of both tracks will run out at the same time. So, it is not possible if this machine only runs for one track. It must be added 1 bale for the number to be even. Therefore, the average requirement of acetate tow per day for KDF-M / 14 machine is 8 bale.

ii. Material Needs of Acetate Tow for Machine KDF2 / 04 (Brand Super)

The calculation for material needs of acetate tow for machine KDF2 / 04 (Brand Super) is shown in Table 4.4.

Table 4.4. Material Needs of Acetate Tow for Machine KDF2 / 04

Date	Machine Type	Actual Usage (X)	Standard Usage (Y)	$(X-Y)$	$(X-Y)^2$
4/12/2017	FM04-SP	737.00	738.00	-1.00	1.00
5/12/2017	FM04-SP	1699.00	1659.00	40.00	1600.00
6/12/2017	FM04-SP	1846.10	1777.00	69.10	4774.81
7/12/2017	FM04-SP	2006.90	1925.00	81.90	6707.61
8/12/2017	FM04-SP	909.00	867.00	42.00	1764.00
11/12/2017	FM04-SP	1753.70	1695.00	58.70	3445.69
12/12/2017	FM04-SP	2479.90	2375.00	104.90	11004.01
13/12/2017	FM04-SP	2607.20	2504.00	103.20	10650.24
14/12/2017	FM04-SP	1386.70	1413.00	-26.30	691.69
15/12/2017	FM04-SP	1811.30	1694.00	117.30	13759.29
18/12/2017	FM04-SP	2758.00	2591.00	167.00	27889.00
19/12/2017	FM04-SP	2599.60	2545.00	54.60	2981.16
20/12/2017	FM04-SP	2543.10	2387.00	156.10	24367.21
21/12/2017	FM04-SP	1790.60	1704.00	86.60	7499.56
22/12/2017	FM04-SP	2811.20	2665.00	146.20	21374.44
27/12/2017	FM04-SP	1979.60	1891.00	88.60	7849.96
28/12/2017	FM04-SP	2661.00	2469.00	192.00	36864.00
29/12/2017	FM04-SP	1289.40	1145.00	144.40	20851.36
30/12/2017	FM04-SP	2455.90	2320.00	135.90	18468.81
Total		38125.20	36364.00	1761.20	222543.84

$$Average\ Usage\ per\ day = \frac{38125.20\ kg}{19}$$

$$Average\ Usage\ per\ day = 2006.59\ kg$$

$$SD = \frac{\sqrt{\Sigma(x - \bar{x})^2}}{n}$$

$$SD = \sqrt{\frac{222543.84}{19}}$$

$$SD = \sqrt{11712.83} = 108.23\ kg$$

Based on previous studies, assuming the company management chose 5% deviation standard, so that Z obtained with standard deviation table of 1.65 (can be seen in appendix 1).

$$Safety\ Stock = Z \times SD$$

$$Safety\ Stock = 108.23 \times 1.65$$

$$Safety\ Stock = 179\ \text{kg}$$

$$Material\ Needs = 2006.59\ \text{kg} + 179\ \text{kg}$$

$$Material\ Needs = \frac{2185.59\ \text{kg}}{550\ kg/bale} = 3.97\ \text{bale} = 4\ \text{bale}$$

From data processing above, it can be seen that the standard deviation for Acetate Tow raw material for KDF2 / 04 engine in December of 2017 is 108.23. Based on previous studies, that with management assumption, the company chose standard deviation of 5%, so that Z obtained with standard deviation table of 1.65. Then the calculation of safety stock for Acetate Tow raw material is done by multiplying the value of Z and standard deviation, that is 108.23 x 1.65 = 179 kg. As for the average per day, KDF2 / 04 engine requires acetate tow approximately 2006.59 kg. Then the material requirement per day is determined by summing the average use of material per day plus the amount of safety stock, that is 2006.59 kg + 179 kg = 2185.59 kg. But for raw materials Acetate Tow, reservations made in the form of bale that has an average weight of 550 kg in one bale. Then the amount of Acetate Tow material needs is 2185.59 / 550 = 3.97 bale or rounded up to 4 bale. Therefore, the average requirement of acetate tow per day for KDF2 / 04 machines is 4 bale.

iii. Material Needs of Acetate Tow for Machine KDF2 / 05 (Brand LA Bold)

The calculation for material needs of acetate tow for machine KDF2 / 05 (Brand LA Bold) is shown in Table 4.5.

Table 4.5. Material Needs of Acetate Tow for Machine KDF2 / 05

Date	Machine Type	Actual Usage (X)	Standard Usage (Y)	$(X-Y)$	$(X-Y)^2$
5/12/2017	FM05-LB	1512.00	1594.00	-82.00	6724.00
6/12/2017	FM05-LB	1390.00	1374.00	16.00	256.00
7/12/2017	FM05-LB	1682.40	1748.00	-65.60	4303.36
8/12/2017	FM05-LB	2466.60	2573.00	-106.40	11320.96
11/12/2017	FM05-LB	2358.00	2622.00	-264.00	69696.00
12/12/2017	FM05-LB	2633.20	2748.00	-114.80	13179.04
13/12/2017	FM05-LB	1639.80	1736.00	-96.20	9254.44
18/12/2017	FM05-LB	1278.70	1273.00	5.70	32.49
19/12/2017	FM05-LB	800.60	813.00	-12.40	153.76
20/12/2017	FM05-LB	1614.10	1695.00	-80.90	6544.81
21/12/2017	FM05-LB	820.70	934.00	-113.30	12836.89
22/12/2017	FM05-LB	1850.90	1789.00	61.90	3831.61
27/12/2017	FM05-LB	1741.90	1760.00	-18.10	327.61
28/12/2017	FM05-LB	1386.70	1386.00	0.70	0.49
29/12/2017	FM05-LB	1655.50	1687.00	-31.50	992.25
30/12/2017	FM05-LB	2447.30	2569.00	-121.70	14810.89
Total		27278.40	28301.00	-1022.60	154264.60

$$Average\ Usage\ per\ day = \frac{27278.40\ kg}{16}$$

$$Average\ Usage\ per\ day = 1704.9\ kg$$

$$SD = \frac{\sqrt{\Sigma(x-\bar{x})^2}}{n}$$

$$SD = \sqrt{\frac{154264.60}{16}}$$

$$SD = \sqrt{9641.54} = 98.19\ kg$$

Based on previous studies, assuming the company management chose 5% deviation standard, so that Z obtained with standard deviation table of 1.65 (can be seen in appendix 1).

$$Safety\ Stock = Z \times SD$$

$$Safety\ Stock = 98.19 \times 1.65$$

$$Safety\ Stock = 162\ \text{kg}$$

$$Material\ Needs = 1704.9\ \text{kg} + 162\ \text{kg}$$

$$Material\ Needs = \frac{1866.9\ \text{kg}}{550\ kg/bale} = 3.39\ \text{bale} = 4\ \text{bale}$$

From the data processing above, it can be seen that the standard deviation for Acetate Tow raw material for KDF2 / 05 engine in December of 2017 is 98.19. Based on previous studies, that with management assumption, the company chose standard deviation of 5%, so that Z obtained with standard deviation table of 1.65. Then the calculation of safety stock for Acetate Tow raw material is done by multiplying the value of Z and standard deviation, that is 98.19 x 1.65 = 162 kg. As for the average per day, KDF2 / 05 engine requires acetate tow approximately 1704.9 kg. Then the material requirement per day is determined by summing the average use of material per day plus the amount of safety stock, that is 1704.9 kg + 162 kg = 1866.9 kg. But for raw materials Acetate Tow, reservations made in the form of bale that has an average weight of 550 kg in one bale. Then the amount of Acetate Tow material needs is 1866.9 / 550 = 3.39 bale or rounded up to 4 bale. Therefore, the average requirement of acetate tow per day for KDF2 / 05 machines is 4 bale.

iv. Material Needs of Acetate Tow for Machine KDF2 / 06 (Brand LA Bold and Super)

The calculation for material needs of acetate tow for machine KDF2 / 06 (Brand LA Bold and Super) is shown in Table 4.6.

Table 4.6. Material Needs of Acetate Tow for Machine KDF2 / 06

Date	Machine Type	Actual Usage (X)	Standard Usage (Y)	$(X-Y)$	$(X-Y)^2$
6/12/2017	FM06-SP	878.00	880.00	-2.00	4.00
7/12/2017	FM06-SP	968.30	954.00	14.30	204.49
8/12/2017	FM06-SP	1008.60	959.00	49.60	2460.16
13/12/2017	FM06-SP	1007.60	977.00	30.60	936.36
22/12/2017	FM06-SP	1637.30	1572.00	65.30	4264.09
30/12/2017	FM06-LB	658.20	610.00	48.20	2323.24
Total		6158.00	5952.00	206.00	10192.34

$$Average\ Usage\ per\ day = \frac{6158\ kg}{6}$$

$$Average\ Usage\ per\ day = 1026.33\ kg$$

$$SD = \frac{\sqrt{\Sigma(x-\bar{x})^2}}{n}$$

$$SD = \sqrt{\frac{10192.34}{6}}$$

$SD = \sqrt{1698.72} = 41.22\ kg$

Based on previous studies, assuming the company management chose 5% deviation standard, so that Z obtained with standard deviation table of 1.65 (can be seen in appendix 1).

$Safety\ Stock = Z \times SD$

$Safety\ Stock = 41.22 \times 1.65$

$Safety\ Stock = 68\ \text{kg}$

$Material\ Needs = 1026.33\ \text{kg} + 68\ \text{kg}$

$$Material\ Needs = \frac{1094.33\ \text{kg}}{550\ kg/bale} = 1.99\ \text{bale} = 2\ \text{bale}$$

From the data processing above, it can be seen that the standard deviation for Acetate Tow raw material for KDF2 / 06 engine in December of 2017 is 41.22. Based on previous studies, that with management assumption, the company chose standard deviation of 5%, so that Z obtained with standard deviation table of 1.65. Then the calculation of safety stock for Acetate Tow raw material is done by multiplying the value of Z and standard deviation, that is 41.22 x 1.65 = 68 kg. As for the average per day, KDF2 / 06 engine requires acetate tow approximately 1026.33 kg. Then the material requirement per day is determined by summing the average use of material per day plus the amount of safety stock, that is 1026.33 kg + 68 kg = 1094.33 kg. But for raw materials Acetate Tow, reservations made in the form of bale that has an average weight of 550 kg in one bale. Then the amount of Acetate Tow material requirement is 1094.33 / 550 = 1.99 bale or rounded up to equal to 2 bale. Therefore, the average requirement of acetate tow per day for KDF2 / 04 machines is 2 bale.

v. Material Needs of Hotmelt (Brand LA Bold and Super)

The calculation for material needs of Hotmelt is shown in Table 4.7.

Table 4.7. Material Needs of Hotmelt

Date	Machine Type	Actual Usage (X)	Standard Usage (Y)	$(X-Y)$	$(X-Y)^2$
4/12/2017	FM14-LB	25.00	15	10.00	100.00
4/12/2017	FM04-SP	4.00	4	0.00	0.00
5/12/2017	FM04-SP	9.00	9	0.00	0.00
5/12/2017	FM05-LB	13.00	8	5.00	25.00
5/12/2017	FM14-LB	24.00	20	4.00	16.00

Table 4.7. Continuation

6/12/2017	FM04-SP	12.50	10	2.50	6.25
6/12/2017	FM05-LB	6.00	7	-1.00	1.00
6/12/2017	FM06-SP	4.00	5	-1.00	1.00
6/12/2017	FM14-LB	27.00	21	6.00	36.00
7/12/2017	FM04-SP	10.50	11	-0.50	0.25
7/12/2017	FM05-LB	9.00	9	0.00	0.00
7/12/2017	FM06-SP	5.00	6	-1.00	1.00
7/12/2017	FM14-LB	21.00	17	4.00	16.00
8/12/2017	FM04-SP	5.50	5	0.50	0.25
8/12/2017	FM05-LB	13.00	13	0.00	0.00
8/12/2017	FM06-SP	3.50	6	-2.50	6.25
8/12/2017	FM14-LB	20.00	17	3.00	9.00
11/12/2017	FM04-SP	9.50	9	0.50	0.25
11/12/2017	FM05-LB	12.50	14	-1.50	2.25
11/12/2017	FM14-LB	14.00	12	2.00	4.00
12/12/2017	FM04-SP	13.00	13	0.00	0.00
12/12/2017	FM05-LB	11.00	14	-3.00	9.00
12/12/2017	FM14-LB	14.00	11	3.00	9.00
13/12/2017	FM04-SP	14.50	14	0.50	0.25
13/12/2017	FM05-LB	10.00	9	1.00	1.00
13/12/2017	FM06-SP	4.50	6	-1.50	2.25
13/12/2017	FM14-LB	20.00	17	3.00	9.00
14/12/2017	FM04-SP	10.50	8	2.50	6.25
14/12/2017	FM14-LB	22.00	19	3.00	9.00
15/12/2017	FM04-SP	8.00	9	-1.00	1.00
15/12/2017	FM14-LB	18.00	14	4.00	16.00
18/12/2017	FM04-SP	14.00	14	0.00	0.00
18/12/2017	FM05-LB	0.50	7	-6.50	42.25
18/12/2017	FM14-LB	16.00	13	3.00	9.00
19/12/2017	FM04-SP	15.00	14	1.00	1.00
19/12/2017	FM05-LB	4.50	4	0.50	0.25
19/12/2017	FM14-LB	14.00	11	3.00	9.00
20/12/2017	FM04-SP	14.00	13	1.00	1.00
20/12/2017	FM05-LB	8.00	9	-1.00	1.00
20/12/2017	FM14-LB	20.00	16	4.00	16.00
21/12/2017	FM04-SP	11.50	9	2.50	6.25
21/12/2017	FM05-LB	5.50	5	0.50	0.25
21/12/2017	FM14-LB	19.00	15	4.00	16.00
22/12/2017	FM04-SP	14.50	15	-0.50	0.25
22/12/2017	FM05-LB	9.50	9	0.50	0.25
22/12/2017	FM06-SP	7.00	10	-3.00	9.00

Table 4.7. Continuation

22/12/2017	FM14-LB	14.00	11	3.00	9.00
27/12/2017	FM04-SP	15.00	10	5.00	25.00
27/12/2017	FM05-LB	8.00	9	-1.00	1.00
27/12/2017	FM14-LB	12.00	9	3.00	9.00
28/12/2017	FM04-SP	13.50	14	-0.50	0.25
28/12/2017	FM05-LB	9.00	7	2.00	4.00
28/12/2017	FM14-LB	24.00	19	5.00	25.00
29/12/2017	FM04-SP	8.00	6	2.00	4.00
29/12/2017	FM05-LB	7.00	9	-2.00	4.00
29/12/2017	FM14-LB	26.00	20	6.00	36.00
30/12/2017	FM04-SP	14.50	13	1.50	2.25
30/12/2017	FM05-LB	15.00	13	2.00	4.00
30/12/2017	FM06-LB	4.00	3	1.00	1.00
30/12/2017	FM14-LB	24.00	19	5.00	25.00
Total		760.50	678.00	82.50	548.25

$$Average\ Usage\ per\ day = \frac{760.50\ kg}{19}$$

$$Average\ Usage\ per\ day = 40.03\ kg$$

$$SD = \frac{\sqrt{\Sigma(x - \bar{x})^2}}{n}$$

$$SD = \sqrt{\frac{548.25}{19}}$$

$$SD = \sqrt{28.86} = 5.37\ kg$$

Based on previous studies, assuming the company management chose 5% deviation standard, so that Z obtained with standard deviation table of 1.65 (can be seen in appendix 1).

$$Safety\ Stock = Z \times SD$$

$$Safety\ Stock = 5.37 \times 1.65$$

$$Safety\ Stock = 8.9\ \text{kg}$$

$$Material\ Needs = \frac{40.03\ kg + 8.9\ \text{kg}}{25\ kg\ /\ sack} = 1.96\ \text{sacks} = 2\ \text{sacks}$$

From the data processing above, it can be seen that the magnitude of standard deviation for Hotmelt raw material in December of 2017 is 5.37. Based on previous studies, that with management assumption, the company chose standard deviation of 5%, so that Z obtained with standard deviation table of 1.65. Then the calculation of safety stock for Hotmelt raw material is done by multiplying the value of Z and

standard deviation, which is 5.37 x 1.65 = 8.9 kg. As for the average per day, the production process requires hotmelt approximately 40.03 kg. Then the material requirement per day is determined by summing the average use of material per day plus the amount of safety stock, which is 40.03 kg + 8.9 kg = 48.93 kg. But for Hotmelt raw materials, the order is made in the form of a sack that weighs 25 kg in one sack. So, the amount of material needs Hotmelt is 48.93 / 25 = 1.96 sacks or rounded upwards with 2 sacks. Therefore, the average requirement of Hotmelt per day is 2 sacks.

vi. Material Needs of Triacetine (Brand LA Bold and Super)

The calculation for material needs of Triacetine is shown in Table 4.8.

Table 4.8. Material Needs of Triacetine

Date	Machine Type	Actual Usage (X)	Standard Usage (Y)	$(X-Y)$	$(X-Y)^2$
4/12/2017	FM14-LB	229.1	229	0.10	0.01
4/12/2017	FM04-SP	59	59	0.00	0.00
5/12/2017	FM04-SP	166.6	152	14.60	213.16
5/12/2017	FM05-LB	90	120	-30.00	900.00
5/12/2017	FM14-LB	297	297	0.00	0.00
6/12/2017	FM04-SP	178.1	163	15.10	228.01
6/12/2017	FM05-LB	90	103	-13.00	169.00
6/12/2017	FM06-SP	80	81	-1.00	1.00
6/12/2017	FM14-LB	321.6	322	-0.40	0.16
7/12/2017	FM04-SP	193.4	176	17.40	302.76
7/12/2017	FM05-LB	120	131	-11.00	121.00
7/12/2017	FM06-SP	85	87	-2.00	4.00
7/12/2017	FM14-LB	252.5	253	-0.50	0.25
8/12/2017	FM04-SP	88.1	79	9.10	82.81
8/12/2017	FM05-LB	185	193	-8.00	64.00
8/12/2017	FM06-SP	30	88	-58.00	3364.00
8/12/2017	FM14-LB	254.7	255	-0.30	0.09
11/12/2017	FM04-SP	171.6	155	16.60	275.56
11/12/2017	FM05-LB	180	197	-17.00	289.00
11/12/2017	FM14-LB	187	187	0.00	0.00
12/12/2017	FM04-SP	242.6	218	24.60	605.16
12/12/2017	FM05-LB	200	207	-7.00	49.00
12/12/2017	FM14-LB	163	163	0.00	0.00
13/12/2017	FM04-SP	256.4	229	27.40	750.76
13/12/2017	FM05-LB	115	130	-15.00	225.00
13/12/2017	FM06-SP	85	90	-5.00	25.00

Table 4.8. Continuation

13/12/2017	FM14-LB	256	256	0.00	0.00
14/12/2017	FM04-SP	136.1	129	7.10	50.41
14/12/2017	FM14-LB	280	280	0.00	0.00
15/12/2017	FM04-SP	171.6	155	16.60	275.56
15/12/2017	FM14-LB	216	216	0.00	0.00
18/12/2017	FM04-SP	264.3	237	27.30	745.29
18/12/2017	FM05-LB	85	96	-11.00	121.00
18/12/2017	FM14-LB	192	192	0.00	0.00
19/12/2017	FM04-SP	252.5	233	19.50	380.25
19/12/2017	FM05-LB	55	61	-6.00	36.00
19/12/2017	FM14-LB	169	170	-1.00	1.00
20/12/2017	FM04-SP	244.5	219	25.50	650.25
20/12/2017	FM05-LB	120	127	-7.00	49.00
20/12/2017	FM14-LB	241	242	-1.00	1.00
21/12/2017	FM04-SP	171.8	156	15.80	249.64
21/12/2017	FM05-LB	65	70	-5.00	25.00
21/12/2017	FM14-LB	229	229	0.00	0.00
22/12/2017	FM04-SP	269.2	244	25.20	635.04
22/12/2017	FM05-LB	130	134	-4.00	16.00
22/12/2017	FM06-SP	145	144	1.00	1.00
22/12/2017	FM14-LB	166	166	0.00	0.00
27/12/2017	FM04-SP	191.8	173	18.80	353.44
27/12/2017	FM05-LB	125	132	-7.00	49.00
27/12/2017	FM14-LB	140	140	0.00	0.00
28/12/2017	FM04-SP	245.6	226	19.60	384.16
28/12/2017	FM05-LB	95	104	-9.00	81.00
28/12/2017	FM14-LB	282	283	-1.00	1.00
29/12/2017	FM04-SP	123.6	105	18.60	345.96
29/12/2017	FM05-LB	115	127	-12.00	144.00
29/12/2017	FM14-LB	306	306	0.00	0.00
30/12/2017	FM04-SP	235.6	212	23.60	556.96
30/12/2017	FM05-LB	185	193	-8.00	64.00
30/12/2017	FM06-LB	43	46	-3.00	9.00
30/12/2017	FM14-LB	283	284	-1.00	1.00
Total		10491.30	10392.00	99.30	12895.69

$$Average\ Usage\ per\ day = \frac{10491.3\ kg}{19}$$

$$Average\ Usage\ per\ day = 552.17\ kg$$

$$SD = \frac{\sqrt{\Sigma(x - \bar{x})^2}}{n}$$

$$SD = \sqrt{\frac{12895.69}{19}}$$

$$SD = \sqrt{678.72} = 26.05\ kg$$

Based on previous studies, assuming the company management chose 5% deviation standard, so that Z obtained with standard deviation table of 1.65 (can be seen in appendix 1).

$$Safety\ Stock = Z \times SD$$

$$Safety\ Stock = 26.05 \times 1.65$$

$$Safety\ Stock = 42.98\ \text{kg} = 43\ \text{kg}$$

$$Material\ Needs = \frac{552.17\ kg + 43\ \text{kg}}{230\ kg\ /\ drum} = 2.59\ \text{drum} = 3\ \text{drum}$$

From the data processing above, it can be seen that the magnitude of standard deviation for Triacetine raw materials in December 2017 is 26.05. Based on previous studies, that with management assumption, the company chose standard deviation of 5%, so that Z obtained with standard deviation table of 1.65. Then the calculation of safety stock for Triacetine raw material is done by multiplying the value of Z and standard deviation, which is 26.05 x 1.65 = 43 kg. As for the average per day, the production process requires Triacetine approximately 552.17 kg. Then the material requirement per day is determined by summing the average use of material per day plus the amount of safety stock, which is 552.17 kg + 43 kg = 595.17 kg. But for Triacetine raw materials, the ordering is done in the form of drums that weighs 230 kg in one drum. Then the amount of material needs Triacetine is 595.17 / 230 = 2.59 drums or rounded up to the same as 3 drums. Therefore, the average requirement of Triacetine per day is 3 drums.

vii. Material Needs of Inner Glue (Brand LA Bold and Super)

The calculation for material needs of Inner Glue is shown in Table 4.9.

Table 4.9. Material Needs of Inner Glue

Date	Machine Type	Actual Usage (X)	Standard Usage (Y)	$(X-Y)$	$(X-Y)^2$
4/12/2017	FM14-LB	10	10	0.00	0.00
4/12/2017	FM04-SP	3.5	3	0.50	0.25
5/12/2017	FM04-SP	8	6	2.00	4.00
5/12/2017	FM05-LB	6	4	2.00	4.00
5/12/2017	FM14-LB	13	12	1.00	1.00
6/12/2017	FM04-SP	10	7	3.00	9.00

Table 4.9. Continuation

6/12/2017	FM05-LB	3	3	0.00	0.00
6/12/2017	FM06-SP	8	3	5.00	25.00
6/12/2017	FM14-LB	13	13	0.00	0.00
7/12/2017	FM04-SP	8.5	7	1.50	2.25
7/12/2017	FM05-LB	6	4	2.00	4.00
7/12/2017	FM06-SP	4	4	0.00	0.00
7/12/2017	FM14-LB	12	11	1.00	1.00
8/12/2017	FM04-SP	4	3	1.00	1.00
8/12/2017	FM05-LB	8	7	1.00	1.00
8/12/2017	FM06-SP	5	4	1.00	1.00
8/12/2017	FM14-LB	11	11	0.00	0.00
11/12/2017	FM04-SP	10.5	6	4.50	20.25
11/12/2017	FM05-LB	10	7	3.00	9.00
11/12/2017	FM14-LB	8	8	0.00	0.00
12/12/2017	FM04-SP	12.5	9	3.50	12.25
12/12/2017	FM05-LB	9	7	2.00	4.00
12/12/2017	FM14-LB	8	7	1.00	1.00
13/12/2017	FM04-SP	12	10	2.00	4.00
13/12/2017	FM05-LB	5	4	1.00	1.00
13/12/2017	FM06-SP	5	4	1.00	1.00
13/12/2017	FM14-LB	11	11	0.00	0.00
14/12/2017	FM04-SP	5.5	5	0.50	0.25
14/12/2017	FM14-LB	12	12	0.00	0.00
15/12/2017	FM04-SP	8	6	2.00	4.00
15/12/2017	FM14-LB	10	9	1.00	1.00
18/12/2017	FM04-SP	14	10	4.00	16.00
18/12/2017	FM05-LB	4	3	1.00	1.00
18/12/2017	FM14-LB	10	8	2.00	4.00
19/12/2017	FM04-SP	12	10	2.00	4.00
19/12/2017	FM05-LB	3	2	1.00	1.00
19/12/2017	FM14-LB	9	7	2.00	4.00
20/12/2017	FM04-SP	12	9	3.00	9.00
20/12/2017	FM05-LB	5	4	1.00	1.00
20/12/2017	FM14-LB	12	10	2.00	4.00
21/12/2017	FM04-SP	8	7	1.00	1.00
21/12/2017	FM05-LB	3	2	1.00	1.00
21/12/2017	FM14-LB	12	10	2.00	4.00
22/12/2017	FM04-SP	13.5	10	3.50	12.25
22/12/2017	FM05-LB	7	5	2.00	4.00
22/12/2017	FM06-SP	8	6	2.00	4.00
22/12/2017	FM14-LB	9	7	2.00	4.00
27/12/2017	FM04-SP	10	7	3.00	9.00

Table 4.9. Continuation

27/12/2017	FM05-LB	5	4	1.00	1.00
27/12/2017	FM14-LB	7	6	1.00	1.00
28/12/2017	FM04-SP	17	9	8.00	64.00
28/12/2017	FM05-LB	6	4	2.00	4.00
28/12/2017	FM14-LB	14	12	2.00	4.00
29/12/2017	FM04-SP	6.5	4	2.50	6.25
29/12/2017	FM05-LB	5	4	1.00	1.00
29/12/2017	FM14-LB	15	13	2.00	4.00
30/12/2017	FM04-SP	12.5	9	3.50	12.25
30/12/2017	FM05-LB	7	7	0.00	0.00
30/12/2017	FM06-LB	3	2	1.00	1.00
30/12/2017	FM14-LB	14	12	2.00	4.00
Total		523.00	420.00	103.00	297.00

$$Average\ Usage\ per\ day = \frac{523}{19}$$

$$Average\ Usage\ per\ day = 27.5\ kg$$

$$Average\ Usage\ per\ month = 27.5\ kg \times 30\ hari = \ 825\ kg$$

$$SD = \frac{\sqrt{\Sigma(x - \bar{x})^2}}{n}$$

$$SD = \sqrt{\frac{297}{19}}$$

$$SD = \sqrt{15.63} = \ 3.95\ kg$$

Based on previous studies, assuming the company management chose 5% deviation standard, so that Z obtained with standard deviation table of 1.65 (can be seen in appendix 1).

$$Safety\ Stock = Z\ \times SD$$

$$Safety\ Stock = 3.95 \times 1.65$$

$$Safety\ Stock = 6.5\ \text{kg x}\ 30\ \text{hari}\ =\ 195.5\ \text{kg}$$

$$Material\ Needs = \frac{825\ \text{kg} + 195.5\ \text{kg}}{23\ kg/jerigen} = 44.37\ jerry\ cans = 45\ jerry\ cans$$

From the data processing above, it can be seen that the standard deviation for Inner Glue in December of 2017 is 3.95. Based on previous studies, that with management assumption, the company chose standard deviation of 5%, so that Z obtained with standard deviation table of 1.65. Then the calculation of safety stock for Inner Glue raw material is done by multiplying the value of Z and standard

deviation is 3.95 x 1.65 = 6.5 kg. But for ordering Inner Glue can't be done daily because it depends on the stock on the parent-house. Thus, material orders are made with a monthly cycle. Thus, the safety stock for Inner Glue material per month is 6.5 x 30 days = 195.5 kg. As for the average per month, the production process requires Inner Glue approximately 825 kg. Then the material requirement per month is determined by summing the average use of material per month plus the amount of safety stock, which is 825 kg + 195.5 kg = 1020.5 kg. But for Inner Glue raw materials, reservations are made in the form of jerry cans that weigh 23 kg in one jerry can. Then the amount of material needs Inner Glue is 1020.50 / 230 = 44.37 jerry cans or rounded up to the same as 45 jerry cans. Therefore, the average requirement of Inner Glue per month is 45 jerry cans.

viii. Material Needs of Plug Wrap Porous for KDF-M / 14 (Brand LA Bold)

The calculation for material needs of plug wrap porous for KDF-M / 14 (Brand LA Bold) is shown in Table 4.10.

Table 4.10. Material Needs of Plug Wrap Porous for KDF-M / 14

Date	Machine Type	Actual Usage (X)	Standard Usage (Y)	$(X-Y)$	$(X-Y)^2$
4/12/2017	FM14-LB	57.8	57	0.80	0.64
5/12/2017	FM14-LB	75	74	1.00	1.00
6/12/2017	FM14-LB	81.3	80	1.30	1.69
7/12/2017	FM14-LB	63.9	63	0.90	0.81
8/12/2017	FM14-LB	64.4	64	0.40	0.16
11/12/2017	FM14-LB	47.8	47	0.80	0.64
12/12/2017	FM14-LB	41.1	41	0.10	0.01
13/12/2017	FM14-LB	64.5	64	0.50	0.25
14/12/2017	FM14-LB	70.6	70	0.60	0.36
15/12/2017	FM14-LB	54.5	54	0.50	0.25
18/12/2017	FM14-LB	48.5	48	0.50	0.25
19/12/2017	FM14-LB	42.8	42	0.80	0.64
20/12/2017	FM14-LB	60.8	60	0.80	0.64
21/12/2017	FM14-LB	57.9	57	0.90	0.81
22/12/2017	FM14-LB	41.9	42	-0.10	0.01
27/12/2017	FM14-LB	36	35	1.00	1.00
28/12/2017	FM14-LB	71.2	71	0.20	0.04
29/12/2017	FM14-LB	77.2	77	0.20	0.04
30/12/2017	FM14-LB	71.8	71	0.80	0.64
Total		1129	1117	12	9.88

$$Average\ Usage\ per\ day = \frac{1129}{19}$$

$$Average\ Usage\ per\ day = 59.42\ rolls = 60\ rolls$$

$$SD = \frac{\sqrt{\Sigma(x - \bar{x})^2}}{n}$$

$$SD = \sqrt{\frac{9.88}{19}}$$

$$SD = \sqrt{0.52} = 0.72\ rolls$$

Based on previous studies, assuming the company management chose 5% deviation standard, so that Z obtained with standard deviation table of 1.65 (can be seen in appendix 1).

$$Safety\ Stock = Z \times SD$$

$$Safety\ Stock = 0.72 \times 1.65$$

$$Safety\ Stock = 1.19 = 2\ \text{rolls}$$

$$Material\ Needs = 60\ \text{rolls} + 2\ \text{rolls} = 62\ \text{rolls}$$

From the data processing above, it can be seen that the magnitude of the standard deviation for raw materials Porous Plug Wrap special KDF-M / 14 machine for the LA Bold brand in December of 2017 was 0.72. Based on previous studies, that with management assumption, the company chose standard deviation of 5%, so that Z obtained with standard deviation table of 1.65. Then the calculation of safety stock for raw materials Plug Wrap for LA Bold brand is done by multiplying the value of Z and standard deviation, that is 0.72 x 1.65 = 1.19 roll, or equal to 2 rolls. As for the average per day, KDF-M / 14 machine requires Porous Plug Wrap approximately 60 rolls. Then the material requirement per day is determined by summing the average use of material per day plus the amount of safety stock, which is 60 roll + 2 rolls = 62 rolls. Therefore, the average requirement of a porous plug wrap per day for a KDF-M / 14 machine is 62 rolls.

ix. Material Needs of Plug Wrap Porous for KDF2 (Brand LA Bold)

The calculation for material needs of plug wrap porous for KDF2 / 04 (Brand LA Bold) is shown in Table 4.11.

Table 4.11. Material Needs of Plug Wrap Porous for KDF2

Date	Machine Type	Actual Usage (X)	Standard Usage (Y)	$(X - Y)$	$(X - Y)^2$
5/12/2017	FM05-LB	57.9	55	2.90	8.41

Table 4.11. Continuation

6/12/2017	FM05-LB	49	48	1.00	1.00
7/12/2017	FM05-LB	60.7	61	-0.30	0.09
8/12/2017	FM05-LB	92.2	89	3.20	10.24
11/12/2017	FM05-LB	91.9	91	0.90	0.81
12/12/2017	FM05-LB	97.6	95	2.60	6.76
13/12/2017	FM05-LB	61.5	60	1.50	2.25
18/12/2017	FM05-LB	45.3	44	1.30	1.69
19/12/2017	FM05-LB	28.8	28	0.80	0.64
20/12/2017	FM05-LB	59.6	59	0.60	0.36
21/12/2017	FM05-LB	34.1	32	2.10	4.41
22/12/2017	FM05-LB	66.3	62	4.30	18.49
27/12/2017	FM05-LB	62.7	61	1.70	2.89
28/12/2017	FM05-LB	49.2	48	1.20	1.44
29/12/2017	FM05-LB	58.8	59	-0.20	0.04
30/12/2017	FM05-LB	90.2	89	1.20	1.44
30/12/2017	FM06-LB	21.7	21	0.70	0.49
Total		1027.5	1002	25.5	61.45

$$Average\ Usage\ per\ day = \frac{1027.5}{17}$$

$$Average\ Usage\ per\ day = 60.44\ rolls = 61\ rolls$$

$$SD = \frac{\sqrt{\Sigma(x - \bar{x})^2}}{n}$$

$$SD = \sqrt{\frac{61.45}{17}}$$

$$SD = \sqrt{3.61} = 1.9\ rolls$$

Based on previous studies, assuming the company management chose 5% deviation standard, so that Z obtained with standard deviation table of 1.65.

$$Safety\ Stock = Z \times SD$$

$$Safety\ Stock = 1.9 \times 1.65$$

$$Safety\ Stock = 3.14 = 4\ \text{rolls}$$

$$Material\ Needs = 61\ \text{rolls} + 4\ \text{rolls} = 65\ \text{rolls}$$

From the data processing above, it can be seen that the standard deviation for raw materials Porous Plug Wrap special for KDF2 machine for LA Bold brand in December of 2017 is 1.9. Based on previous studies, that with management assumption, the company chose standard deviation of 5%, so that Z obtained with standard deviation table of 1.65. Then the calculation of safety stock for raw

material Plug Wrap for LA Bold brand is done by multiplying the value of Z and standard deviation, that is 1.9 x 1.65 = 3.14 roll, or equal to 4 rolls. As for the average per day, KDF2 machine requires Porous Plug Wrap approximately 61 rolls. Then the material requirement per day is determined by summing the average use of material per day plus the amount of safety stock, which is 61 rolls + 4 rolls = 65 rolls. Therefore, the average requirement of a porous plug wrap per day for a KDF-M / 14 machine is 65 rolls.

x. Material Needs of Plug Wrap Non - Porous (Brand Super)

The calculation for material needs of plug wrap non - porous (Brand Super) is shown in Table 4.12.

Table 4.12. Material Needs of Plug Wrap Non - Porous

Date	Machine Type	Actual Usage (X)	Standard Usage (Y)	$(X-Y)$	$(X-Y)^2$
4/12/2017	FM04-SP	23.6	23	0.60	0.36
5/12/2017	FM04-SP	52	51	1.00	1.00
6/12/2017	FM04-SP	55.6	54	1.60	2.56
6/12/2017	FM06-SP	27.2	27	0.20	0.04
7/12/2017	FM04-SP	60	59	1.00	1.00
7/12/2017	FM06-SP	29.8	29	0.80	0.64
8/12/2017	FM04-SP	27.3	26	1.30	1.69
8/12/2017	FM06-SP	29.9	29	0.90	0.81
11/12/2017	FM04-SP	53.4	52	1.40	1.96
12/12/2017	FM04-SP	75.3	73	2.30	5.29
13/12/2017	FM04-SP	79.7	76	3.70	13.69
13/12/2017	FM06-SP	30	30	0.00	0.00
14/12/2017	FM04-SP	42.3	43	-0.70	0.49
15/12/2017	FM04-SP	53.3	52	1.30	1.69
18/12/2017	FM04-SP	82.1	79	3.10	9.61
19/12/2017	FM04-SP	78.8	78	0.80	0.64
20/12/2017	FM04-SP	76.2	73	3.20	10.24
21/12/2017	FM04-SP	53.5	52	1.50	2.25
22/12/2017	FM04-SP	83.6	81	2.60	6.76
22/12/2017	FM06-SP	48.3	48	0.30	0.09
27/12/2017	FM04-SP	59.6	58	1.60	2.56
28/12/2017	FM04-SP	77.8	75	2.80	7.84
29/12/2017	FM04-SP	38.9	35	3.90	15.21
30/12/2017	FM04-SP	73.6	71	2.60	6.76
Total		1311.80	1274.00	37.80	93.18

$$Average\ Usage\ per\ day = \frac{1311.80\ roll}{19}$$

$$Average\ Usage\ per\ day = 69.04\ roll = 70\ rolls$$

$$SD = \frac{\sqrt{\Sigma(x - \bar{x})^2}}{n}$$

$$SD = \sqrt{\frac{93.18}{19}}$$

$$SD = \sqrt{4.9} = 2.21\ rolls$$

Based on previous studies, assuming the company management chose 5% deviation standard, so that Z obtained with standard deviation table of 1.65 (can be seen in appendix 1).

$$Safety\ Stock = Z \times SD$$

$$Safety\ Stock = 2.21 \times 1.65$$

$$Safety\ Stock = 3.64 = 4\ rolls$$

$$Material\ Needs = 70\ \text{rolls} + 4\ \text{rolls} = 74\ \text{rolls}$$

From the data processing above, it can be seen that the standard deviation for raw materials Plug Wrap for Super brand in December of 2017 is 2.21. Based on previous studies, that with management assumption, the company chose standard deviation of 5%, so that Z obtained with standard deviation table of 1.65. Then the calculation of safety stock for raw material Plug Wrap for Super brand is done by multiplying the value of Z and standard deviation, that is 2.21 x 1.65 = 3.64 roll, or equal to 4 rolls. As for the average per day, KDF2 machine requires Plug Wrap Non-Porous approximately 70 rolls. Then the material requirement per day is determined by summing the average use of material per day plus the amount of safety stock, which is 70 rolls + 4 rolls = 74 rolls. Therefore, the average requirement of a porous plug wrap per day for a KDF-M / 14 machine is 74 rolls.

c. Summary

The summary of all material needs is shown in Table 4.13.

Table 4.13. Summary of Material Needs

Material Type	The needs every cycle	Safety Stock	Material Needs			Order Cycle
Acetate Tow KDF-M/14	3339.76 kg	202 kg	3541.76 kg	7 + 1 bale = 8 bales	18 bales	Daily
Acetate Tow KDF2 /04	2006.59 kg	179 kg	2185.59 kg	4 bales		Daily
Acetate Tow KDF2/05	1704.90 kg	162 kg	1866.90 kg	4 bales		Daily
Acetate Tow KDF2/06	1026.33 kg	68 kg	1094.33 kg	2 bales		Daily
Triacetine	552.17 kg	43 kg	595.17 kg	3 drums	1 palette	Daily
Hotmelt	40.03 kg	8.9 kg	48.93 kg	2 sacks		Daily
Inner Glue	825.00 kg	195.5 kg	1020.50 kg	45 jerry cans		Monthly
Plug Wrap Porous KDF-M/14	60 rolls	2 rolls	62 rolls		1 palette	Daily
Plug Wrap Porous KDF2	61 rolls	4 rolls	65 rolls		1 palette	Daily
Plug Wrap Non Porous	70 rolls	4 rolls	74 rolls		1 palette	Daily

Based on the data processing, the number of material requirements per order cycle for each material is as follows: Acetate Tow for KDF-M / 14 machine is 3541.76 kg, Acetate Tow for KDF2 / 04 machine is 2185.59 kg, Acetate Tow for KDF2 / 05 machine is 1866.9 kg, Acetate Tow for KDF2 / 06 machine is 595.17 kg, Hotmelt 1020.5 kg, Triacetine 48.93 kg, Inner Glue 195.5 kg, Plug Wrap Porous for KDF-M / 14 machine is 62 roll, Plug Wrap Porous for machine KDF2 is 65 roll and Plug Wrap Non Porous is 74 roll.

4.4.2. Workload Analysis as Consideration to Determine the Number of Workers for KDF-M/14 and KDF2/04 Machines

In this section will be explained on the analysis of workload of operators and helper operators in KDF-M / 14 machines and KDF2 / 04 engines. This is done because

both machines work every day but have different production capacity. KDF-M / 14 machine is more automatic and has a high production capacity and engine speed, while the KDF2 / 04 engine is still semi-automatic and its production capacity and engine speed is still low. Despite these differences, the number of workers on each machine is the same.

a. Data and Data Processing

i. Productive and Non-Productive Activities Operators and Helpers of KDF-M / 14 and KDF2 / 04 Machine

Definition of non-earning activities is activities that do not generate added value on improving process quality and speed of task completion. While productive activity is an activity in accordance with the job description that has been determined and this activity is done to create a product or service. Productive activities are divided into 6 categories and each has a job description. As for non-productive work activities are divided into 4 categories and each also has a job description. Table 4.14. indicates the productive activity of the operator and the helper operator. While table 4.15. indicates non-earning activity from operator and helpers.

Table 4.14. Productive Activities

No	Category	Job Descriptions
1	Set up (S)	Folded carton
		Create a production date and *freshness*
		Cut the *freshness' label*
		Operating the panel machine
		Turn on the machine
2	Material Handling (MH)	Move the material
		Placing the material
		Watching the proses
		Watching the machine
		Move the filters from machine to rack
		Put the filters to the carton
		Keep an eye on material availability
3	Quality Control (QC)	Spot Check
		Observe and monitor filter conformity

Table 4.14. Continuation

4	Error Checking (EC)	Fix the error occurs
		Check the cause of error
		Monitor the occurrence of errors
5	Cleaning (C)	Cleaning working area
		Cleaning machine
		Cleaning work equipment
6	Fill out the Worksheet (FO)	Fill out the filter production code check sheet
		Fill out the Operation Sheet
		Fill out the Picking List
		Fill in the Production Book

Table 4.15. Non-Productive Activities

No	Category	Job Descriptions
1	Personal Times (PT)	Go to the toilet
		Talking with friends
		Smoking
		Eating
		Drinking
		Praying
		Calling
		Playing Mobile Phone
		Make up
		Sleeping on working area (not during recess)
2	Waiting (W)	Waiting for the material comes
		Waiting for other workers to operate the machine
		Waiting for other workers to fix the error occur
		Waiting for other workers to check the material

Table 4.15. Continuation

3	Not Available (NA)	Leave the work area
4	Find the tools (FT)	Find the tools needed

ii. Determining Work Elements

The work element is determined based on the productive activity of the worker on the KDF-M / 14 machine and KDF2 / 04 machine which is divided into 6 elements: Setup, Material Handling, Quality Control, Error Checking, Cleaning, and Fill out the Worksheet. Measurement time of each element is done by using stopwatch at the time of operator and operator helper conducting or executing the activity.

The work elements are shown in Figure 4.3.

No	Elemen Kerja	Waktu(detik)
1	Set up	900
2	Material Handling	30
3	Quality Control	20
4	Error Checking	180
5	Cleaning	900
6	Fill out the Worksheet	180
	Total	2210
	Observation Unit	368
	Maximum Random Number	78

Figure 4.3. Work Elements

iii. Number of Productive and Non-Productive Activities Operators and Helpers of KDF-M / 14 and KDF2 / 04 Machine

The productive and non-productive amounts of each operator and operator helper are determined from the author's observation based on a predetermined number of random numbers. But for the total data obtained every day obtained from the total data minus the maximum data when the operator or the helper rest. This is because the break time is not included in the worker's productive hours.

Table 4.16. shows the number of productive and non-productive activities operators and helpers

Table 4.16. Number of Productive and Non-Productive Activities Operators and Helpers

KDF-M/14		Productive						Non-Productive						
		S	***MH***	***QC***	***EC***	***C***	**FO**	***PT***	***W***	***NA***	**FT**	**∑P**	**∑NP**	***Total***
Wed 3/1/18	Operator	2	2	4	11	1	1	11	0	1	0	21	12	33
	Helper 1	1	13	0	4	1	0	7	3	2	2	19	14	33
	Helper 2	4	7	0	4	2	0	7	6	3	0	17	16	33
Thu 4/1/18	Operator	1	0	3	6	4	3	7	0	6	0	17	13	30
	Helper 1	0	9	0	0	3	0	7	8	3	0	12	18	30
	Helper 2	0	7	0	1	3	0	5	6	8	0	11	19	30
Fri 5/1/18	Operator	1	4	3	6	0	1	18	0	2	0	15	20	35
	Helper 1	1	14	0	0	0	0	8	5	7	0	15	20	35
	Helper 2	0	17	0	0	2	0	10	5	1	0	19	16	35
Tue 9/1/18	Operator	3	7	6	14	8	5	18	0	3	0	43	21	64
	Helper 1	0	36	0	0	2	0	3	18	5	0	38	26	64
	Helper 2	1	33	0	0	5	0	8	15	2	0	39	25	64
Wed 10/1/18	Operator	1	9	7	16	8	6	17	0	2	0	47	19	66
	Helper 1	0	36	0	0	2	0	5	20	3	0	38	28	66

Table 4.16. Continuation

	Helper 2	5	27	0	1	3	0	12	14	4	0	36	30	66
Thu 11/1/18	Operator	2	3	9	15	8	4	19	0	5	0	41	24	65
	Helper 1	0	32	0	0	3	0	3	24	3	0	35	30	65
	Helper 2	3	32	2	1	3	0	4	15	5	0	41	24	65
Fri 12/1/18	Operator	3	7	6	16	11	3	14	1	2	0	46	17	63
	Helper 1	0	27	0	0	8	0	5	21	2	0	35	28	63
	Helper 2	1	26	1	0	10	0	10	14	1	0	38	25	63
Total	Operator	13	32	38	84	40	23	104	1	21	0	230	126	356
	Helper 1	2	167	0	4	19	0	38	99	25	2	192	164	356
	Helper 2	14	149	3	7	28	0	56	75	24	0	201	155	356
KDF2/04														
Wed 3/1/18	Operator	2	8	7	5	3	3	3	0	2	0	28	5	33
	Helper 1	2	20	0	1	2	0	3	5	0	0	25	8	33
	Helper 2	2	15	1	3	2	0	3	2	5	0	23	10	33
Thu 4/1/18	Operator	6	6	2	10	3	2	1	0	0	0	29	1	30
	Helper 1	0	14	1	2	4	0	4	1	4	0	21	9	30
	Helper 2	4	14	0	1	1	0	3	2	4	1	20	10	30

Table 4.16. Continuation

Fri 5/1/18	Operator	4	7	7	6	3	3	1	0	4	0	30	5	35
	Helper 1	5	14	1	3	3	0	4	2	2	1	26	9	35
	Helper 2	3	22	0	1	2	0	2	3	2	0	28	7	35
Tue 9/1/18	Operator	11	16	14	5	3	3	5	0	5	2	52	12	64
	Helper 1	10	32	2	4	3	0	4	9	0	0	51	13	64
	Helper 2	6	34	1	1	4	0	3	8	7	0	46	18	64
Wed 10/1/18	Operator	6	12	10	9	8	6	0	14	0	1	51	15	66
	Helper 1	4	30	2	3	2	0	2	15	8	0	41	25	66
	Helper 2	8	30	1	1	6	0	4	14	2	0	46	20	66
Thu 11/1/18	Operator	2	19	19	6	9	6	2	0	0	2	61	4	65
	Helper 1	6	36	2	3	7	0	0	6	5	0	54	11	65
	Helper 2	9	37	2	4	8	0	2	3	0	0	60	5	65
Fri 12/1/18	Operator	9	12	15	9	12	5	0	0	1	0	62	1	63
	Helper 1	7	36	2	2	4	0	7	2	3	0	51	12	63
	Helper 2	7	29	4	4	11	0	3	2	3	0	55	8	63
Total	Operator	40	80	74	50	41	28	12	14	12	5	313	43	356
	Helper 1	34	182	10	18	25	0	24	40	22	1	269	87	356
	Helper 2	39	181	9	15	34	0	20	34	23	1	278	78	356

Based on the observations made, the sequence of productive activities of KDF-M / 14 machine operators are Error Checking, Cleaning, Quality Control, Material Handling, Fill out the Worksheet and Setup.

As for the sequence of productive activities for helper 1 KDF-M / 14 machine is Material Handling, Cleaning, Error Checking, Setup, Quality Control, and Fill out the Worksheet. The sequence of productive activities of helper 2 KDF-M / 14 machine are Material Handling, Cleaning, Setup, Error Checking, Quality Control, Fill out the Worksheet.

Based on the data above, the helper should not be able to perform Error Checking, Quality Control and Fill out the worksheet because the task can only be performed by the operator. However, at the time of data retrieval and error occurs, the operator is not in working area. So, helpers try to review the occurrence of errors on the machine and perform Quality Control. However, the helpers can't still fill out the worksheet because the information and production calculations that must be done is understood only by the operator.

For machine operator of KDF2 / 04, the sequence of productive activities is Material Handling, Quality Control, Error Checking, Cleaning, Setup, Fill out the Worksheet. This can happen because the operator often changes the raw material and move the filter because the machine is error. And machine error in KDF2 / 04 machine tends to be more frequent compared to KDF-M / 14 machine. Therefore, operators should more often do Quality Control to maintain the quality of filter that can change due to error machine.

For helper 1 and helper 2 KDF2 / 04 machines, both have the same earning sequence values, which are Material Handling, Setup, Cleaning, Error Checking, Quality Control, Fill out the Worksheet. This could be due to the helper task on the KDF2 / 04 machine is to make the carton, move the box, cut the freshness label, paste the freshness label, move the rack, move the filter into the box and move the filter to the rack. In addition, the helper on this machine can replace operator tasks for Error Checking and Quality Control when the operator leaves the work area or is performing other activities such as filling out the worksheet or replacing the raw material with the new one.

iv. Test Data Adequacy

Test data adequacy is done to know the number of observations that must be done in work sampling. The formula is as follows:

$$N' = \frac{k^2(1-p)}{s^2 p}$$

with: N' = adequacy data

k = confidence interval

s = accuracy interval

In this data adequacy test, the authors used 10% accuracy which means the author allows the average measurement results to deviate as far as 10% from the actual average and 95% confidence level which indicates the author's belief that the results obtained meet the conditions of accuracy set. With a 95% confidence level, the value of k is 2. The value of k was defined from the confidence interval, 95% has k equal to two, bellow 68% is 1 and 99% of confidence interval has k equal to 3. So, it has 1 as k value.

The data of confidence level and accuracy rate can be seen in table 4.17 while the results of the test data adequacy can be seen in table 4.18.

Table 4.17. Confidence Level and Accuracy Rate

Confidence Level	0.95
Accuracy Rate	0.1
k	2
Total Data (N)	356

Table 4.18. Data Adequacy Test

KDF-M/14	Total Productive	Total Non-Productive	p	N'	Information
Operator	230	126	65%	219	N>N', sufficient
Helper 1	192	164	54%	342	N>N', sufficient
Helper 2	201	155	56%	308	N>N', sufficient
KDF2/04	Total Productive	Total Non-Productive	P'	N'	Information
Operator	313	43	12%	55	N>N', sufficient
Helper 1	269	87	24%	129	N>N', sufficient
Helper 2	278	78	22%	112	N>N', sufficient

The p value is determined by dividing the total earning value by the data obtained per day. For example: machine operator of KDF-M / 14 total productive activities

are 230 and data obtained per day as much as 356 data, so it got p value that is 65%.

Thus N 'or the amount of data that should be observed is 219. Thus, if the value of N (amount of data) is greater than the value of N' (the amount of data that should be observed), the observed data is sufficient. And according to the calculation, the amount of data obtained for all workers is sufficient.

a. Uniformity Data Test

The data uniformity test is performed to determine whether the data obtained is uniform and does not exceed the upper control limit (UCL) and the lower control limit (LCL) that has been determined. The data uniformity test is done by using formula:

$$UCL = p + k\sqrt{\frac{p(1-p)}{n}}$$

$$LCL = p - k\sqrt{\frac{p(1-p)}{n}}$$

with:

p = percent productivity

k = confidence level

n = number inspected in a subgroup

UCL = upper control limit

LCL = lower control limit

i. Operator Machine KDF-M/14

The upper limit and lower limit can be seen in table 4.19 while the result of uniformity data test for operator machine KDF-M / 14 can be seen in table 4.20.

Table 4.19. Upper Limit and Lower Limit

p	0.65
n	50.86
UCL	0.78
LCL	0.49

Table 4.20. Uniformity Data Test for Operator Machine KDF-M/14

Hari	Date	P-Percentage	UCL	LCL	Info
Wednesday	January 3rd 18	64%	79.76%	49.45%	Uniform
Thursday	January 4th 18	60%	79.76%	49.45%	Uniform
Friday	January 5th 18	60%	79.76%	49.45%	Uniform
Tuesday	January 9th 18	67%	79.76%	49.45%	Uniform
Wednesday	January 10th 18	65%	79.76%	49.45%	Uniform
Thursday	January 11st 18	63%	79.76%	49.45%	Uniform
Friday	January 12nd 18	68%	79.76%	49.45%	Uniform

The uniformity data test graph for operator machine KDF-M / 14 is shown in Figure 4.4.

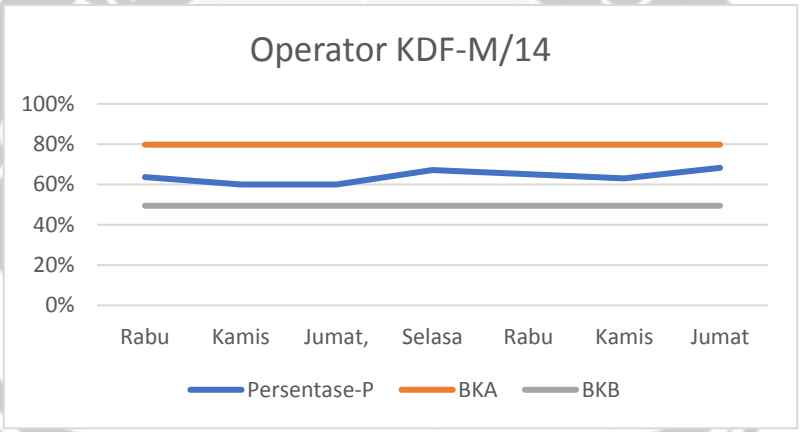

Figure 4.4. Uniformity Data Test Graph for Operator Machine KDF-M/14

ii. Helper 1 Machine KDF-M/14

The upper limit and lower limit can be seen in table 4.21 while the result of uniformity data test for helper 1 machine KDF-M / 14 can be seen in table 4.22.

Table 4.21. Upper Limit and Lower Limit

p	0.54
n	50.86
UCL	0.62
LCL	0.46

Table 4.22. Uniformity Data Test for Helper 1 Machine KDF-M/14

Hari	Date	P-Percentage	UCL	LCL	Info
Wednesday	January 3rd 18	55%	61.80%	46.07%	Uniform
Thursday	January 4th 18	53%	61.80%	46.07%	Uniform
Friday	January 5th 18	51%	61.80%	46.07%	Uniform
Tuesday	January 9th 18	55%	61.80%	46.07%	Uniform
Wednesday	January 10th 18	55%	61.80%	46.07%	Uniform
Thursday	January 11st 18	54%	61.80%	46.07%	Uniform
Friday	January 12nd 18	54%	61.80%	46.07%	Uniform

The uniformity data test graph for helper 1 machine KDF-M / 14 is shown in Figure 4.5.

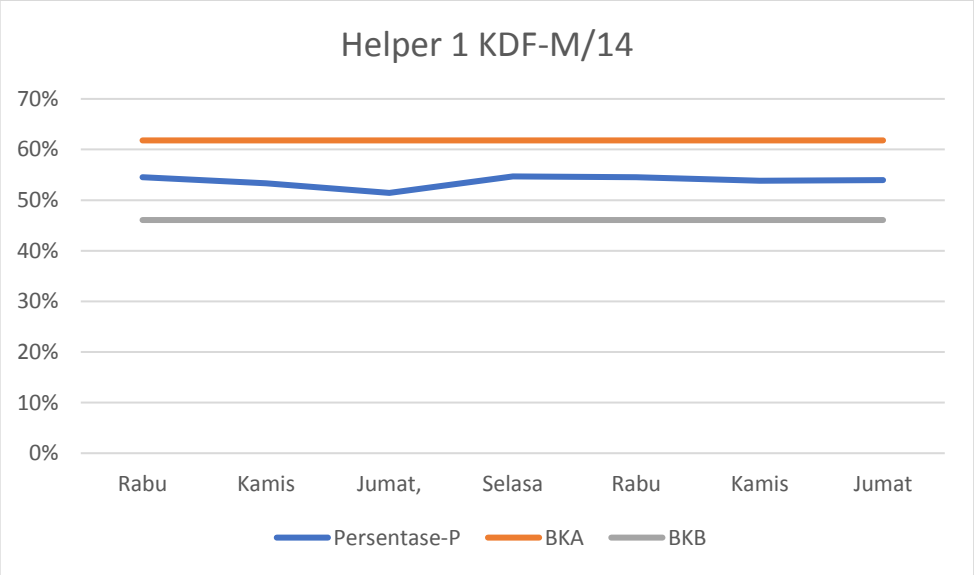

Figure 4.5. Uniformity Data Test Graph for Helper 1 Machine KDF-M/14

iii. Helper 2 Machine KDF-M/14

The upper limit and lower limit can be seen in table 4.23. while the result of uniformity data test for helper 2 machine KDF-M / 14 can be seen in table 4.24.

Table 4.23. Upper Limit and Lower Limit

p	0.56
n	50.86
UCL	0.67
LCL	0.46

Table 4.24. Uniformity Data Test for Helper 2 Machine KDF-M/14

Day	Date	P-Percentage	UCL	LCL	Info
Wednesday	January 3rd 18	55%	66.54%	46.38%	Uniform
Thursday	January 4th 18	53%	66.54%	46.38%	Uniform
Friday	January 5th 18	54%	66.54%	46.38%	Uniform
Tuesday	January 9th 18	58%	66.54%	46.38%	Uniform
Wednesday	January 10th 18	55%	66.54%	46.38%	Uniform
Thursday	January 11st 18	58%	66.54%	46.38%	Uniform
Friday	January 12nd 18	59%	66.54%	46.38%	Uniform

The uniformity data test graph for helper 2 machine KDF-M / 14 is shown in Figure 4.6.

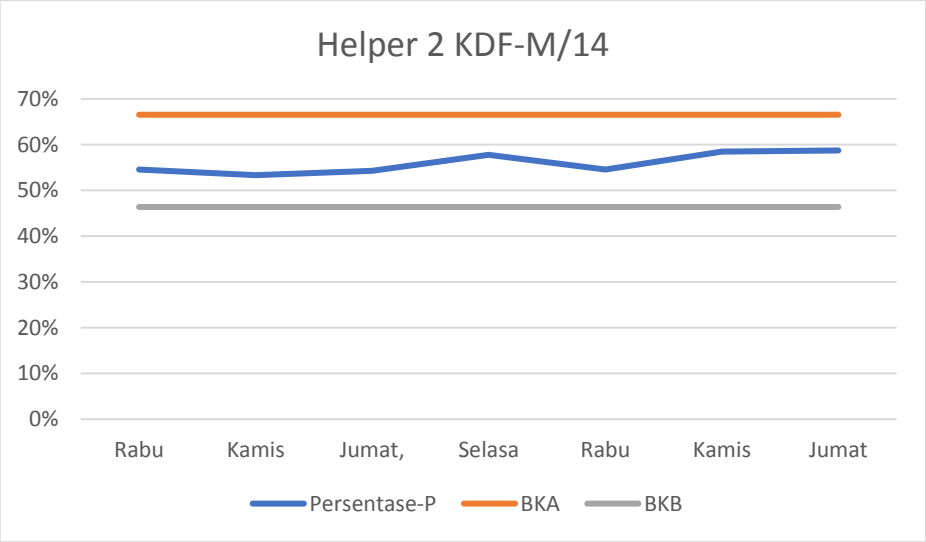

Figure 4.6. Uniformity Data Test Graph for Helper 2 Machine KDF-M/14

iv. Operator Machine KDF2/04

The upper limit and lower limit can be seen in table 4.25. while the result of uniformity data test for operator machine KDF2 / 04 can be seen in table 4.26.

Table 4.25. Upper Limit and Lower Limit

p	0.88
n	50.86
UCL	1.12
LCL	0.64

Table 4.26. Uniformity Data Test for Operator Machine KDF2/04

Day	Date	P-Percentage	UCL	LCL	Info
Wednesday	January 3rd 18	85%	112.35%	63.50%	Uniform
Thursday	January 4th 18	93%	112.35%	63.50%	Uniform
Friday	January 5th 18	86%	112.35%	63.50%	Uniform
Tuesday	January 9th 18	83%	112.35%	63.50%	Uniform
Wednesday	January 10th 18	80%	112.35%	63.50%	Uniform
Thursday	January 11st 18	94%	112.35%	63.50%	Uniform
Friday	January 12nd 18	95%	112.35%	63.50%	Uniform

The uniformity data test graph for operator machine KDF2 / 04 is shown in Figure 4.7.

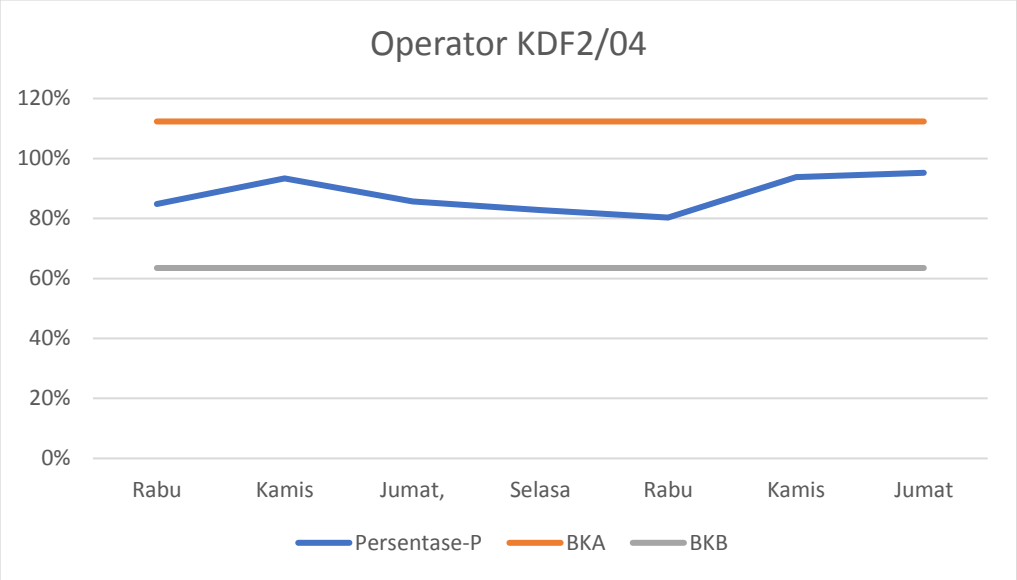

Figure 4.7. Uniformity Data Test Graph for Operator Machine KDF2/04

v. Helper 1 Machine KDF2/04

The upper limit and lower limit can be seen in table 4.27. while the result of uniformity data test for helper 1 machine KDF2 / 04 can be seen in table 4.28.

Table 4.27. Upper Limit and Lower Limit

p	0.76
n	50.86
UCL	0.96
LCL	0.56

Table 4.28. Data Uniformity Test for Helper 1 Machine KDF2/04

Day	Date	P-Percentage	UCL	LCL	Info
Wednesday	January 3rd 18	76%	95.61%	55.51%	Uniform
Thursday	January 4th 18	70%	95.61%	55.51%	Uniform
Friday	January 5th 18	74%	95.61%	55.51%	Uniform
Tuesday	January 9th 18	77%	95.61%	55.51%	Uniform
Wednesday	January 10th 18	68%	95.61%	55.51%	Uniform
Thursday	January 11st 18	80%	95.61%	55.51%	Uniform
Friday	January 12nd 18	81%	95.61%	55.51%	Uniform

The uniformity data test graph for helper 1 machine KDF2 / 04 is shown in Figure 4.7.

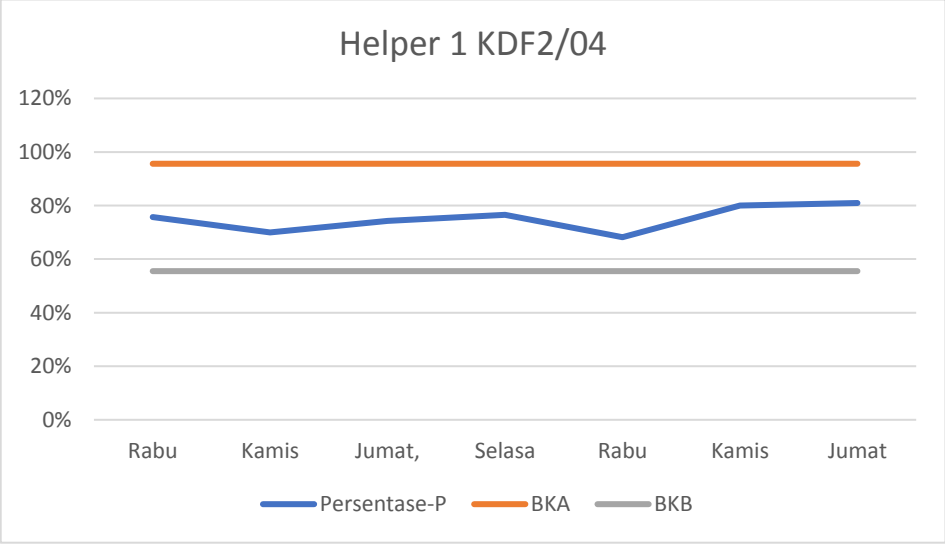

Figure 4.8. Uniformity Data Test Graph for Helper 1 Machine KDF2/04

vi. Helper 2 Machine KDF2/04

The upper limit and lower limit can be seen in table 4.29. while the result of uniformity data test for helper 2 machine KDF2 / 04 can be seen in table 4.30.

Table 4.29. Upper Limit and Lower Limit

p	0.78
n	50.86
UCL	0.99
LCL	0.57

Table 4.30. Data Uniformity Test for Helper 2 Machine KDF2/04

Day	Date	P-Percentage	UCL	LCL	Info
Wednesday	January 3rd 18	73%	99.11%	57.07%	Uniform
Thursday	January 4th 18	73%	99.11%	57.07%	Uniform
Friday	January 5th 18	80%	99.11%	57.07%	Uniform
Tuesday	January 9th 18	73%	99.11%	57.07%	Uniform
Wednesday	January 10th 18	71%	99.11%	57.07%	Uniform
Thursday	January 11st 18	86%	99.11%	57.07%	Uniform
Friday	January 12nd 18	86%	99.11%	57.07%	Uniform

The uniformity data test graph for helper 2 machine KDF2 / 04 is shown in Figure 4.8.

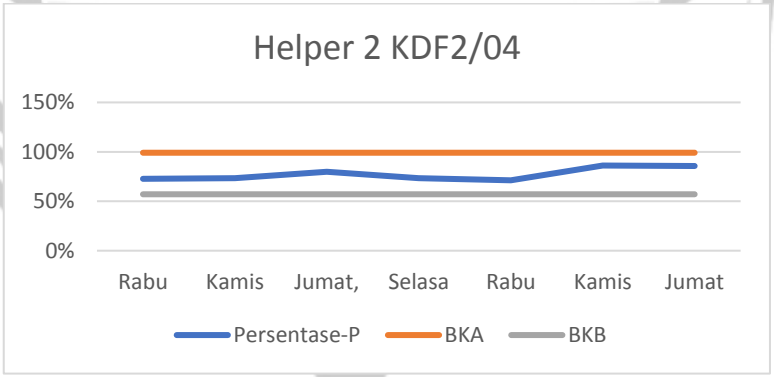

Figure 4.9. Uniformity Data Test Graph for Helper 2 Machine KDF2/04

b. Workload

The Percentage of Productive and Non-Productive Each Work Element is shown in Table 4.31.

Table 4.31. Percentage of Productive and Non-Productive for Each Work Element

		Productive						Non-Productive					
KDF-M/14		Set up	Material Handling	Quality Control	Error Checking	Cleaning	Fill out the Worksheet	Personal Times	Waiting	Not Available	Find the tools	∑P	∑NP
∑	Operator	13	32	38	84	40	23	104	1	21	0	230	126
	Helper 1	2	167	0	4	19	0	38	99	25	2	192	164
	Helper 2	14	149	3	7	28	0	56	75	24	0	201	155
%	Operator	4%	9%	11%	24%	11%	6%	29%	0%	6%	0%	65%	35%
	Helper 1	1%	47%	0%	1%	5%	0%	11%	28%	7%	1%	54%	46%
	Helper 2	4%	42%	1%	2%	8%	0%	16%	21%	7%	0%	56%	44%
KDF2/04													
∑	Operator	40	80	74	50	41	28	12	14	12	5	313	43
	Helper 1	34	182	10	18	25	0	24	40	22	1	269	87
	Helper 2	39	181	9	15	34	0	20	34	23	1	278	78
%	Operator	11%	22%	21%	14%	12%	8%	3%	4%	3%	1%	88%	12%
	Helper 1	10%	51%	3%	5%	7%	0%	7%	11%	6%	0%	76%	24%
	Helper 2	11%	51%	3%	4%	10%	0%	6%	10%	6%	0%	78%	22%

c. Performance Rating Determination

Performance Rating is determined by the formula:

$$Performance\ rating = 1 + rating\ factor$$

The value of the adjustment factor is usually denoted by p where p has the following values and meanings:

a. p > 1 or p > 100% means that the operator is working too fast or is above the normal limit

b. p = 1 or p = 100% means that the operator is working normally or reasonably

c. p < 1 or p < 100% means that the operator works too slowly or is below normal limits

The performance ratings are shown in Table 4.32.

Table 4.32. Performance Ratings

	Worker	Westinghouse System				Performance Rating	Info.
		Skill	Effort	Condition	Consistency		
KDF-M/14	Operator	D=0	D=0	D=0	D=0	1	Average/ Normal
	Helper 1	D=0	D=0	D=0	D=0	1	Average/ Normal
	Helper 2	D=0	D=0	D=0	D=0	1	Average/ Normal
KDF2/04	Operator	D=0	D=0	D=0	D=0	1	Average/ Normal
	Helper 1	D=0	D=0	D=0	D=0	1	Average/ Normal
	Helper 2	D=0	D=0	D=0	D=0	1	Average/ Normal

Based on the activity that the author has observed, all operator and helpers have moderate or normal skills, effort, working conditions, and consistency. Then all values are worth 0. So, the result of performance rating for all workers is 1.

Each factor has its own category such as superskill, excellent, good, average, fair and poor. It will be described in figure 4.10.

FAKTOR	KELAS	LAMBANG	PENYESUAIAN
KETERAMPILAN	Superskill	A1	+ 0,15
		A2	+ 0,13
	Excellent	B1	+ 0,11
		B2	+ 0,08
	Good	C1	+ 0,06
		C2	+ 0,03
	Average	D	0,00
	Fair	E1	- 0,05
		E2	- 0,10
	Poor	F1	- 0,16
		F2	- 0,22
USAHA	Excessive	A1	+ 0,13
		A2	+ 0,12
	Excellent	B1	+ 0,10
		B2	+ 0,08
	Good	C1	+ 0,05
		C2	+ 0,02
	Average	D	0,00
	Fair	E1	- 0,04
		E2	- 0,08
	Poor	F1	- 0,12
		F2	- 0,17
KONDISI KERJA	Ideal	A	+ 0,06
	Excellenty	B	+ 0,04
	Good	C	+ 0,02
	Average	D	0,00
	Fair	E	- 0,03
	Poor	F	- 0,07
KONSISTENSI	Perfect	A	+ 0,04
	Excellenty	B	+ 0,03
	Good	C	+ 0,01
	Average	D	0,00
	Fair	E	- 0,02
	Poor	F	- 0,04

Figure 4.10. Table of Westinghouse System

d. Allowance Determination

The allowance determination for operators and helpers is based on the allowance table. Allowance factor for all workers is the same because the level of work and workplace environment of all workers are the same.

Figure 4.11. is allowance table from ILO:

Factor	Job Example	Equivalent Load	Allowance	
A. Energy released			Male	Female
1. Can be ignored	Working at the desk, sitting down	No load	0.0-6.0	0.0-6.0
2. Very light	Work at the table, stand up	0.00-2.25 kg	6.0-7.5	6.0-7.5
3. Lightweight	Shoved lightly	2.25-9.00	7.5-12.0	7.5-16.0
4. Medium	Hoeing	9.00-18.00	12.0-19.0	16.0-30
5. Weight	Swinging a heavy hammer	18.00-27.00	19.0-30.0	
6. Very heavy	Shouldering loads	27.00-50.00	30.0-50.0	
7. Unbelievably heavy	Bear heavy sacks	Above 50 kg		
B. Work attitude				
1. Sit down	Working sit, light		0.00-1.0	
2. Stand on two legs	Body upright, supported by two legs		1.0-2.5	
3. Stand on one leg	One leg working on the controller		2.5-4.0	
4. Lie down	On the side, back or front of the body		2.5-4.0	
5. Bending	The body is bent on both legs		4.0-10.0	
C. Work Motion				
1. Normal	Swinging a heavy hammer		0	
2. A bit limited	Limited swing from the hammer		0-5	
3. Hard	Carry heavy loads with one hand		0-5	
4. Only for limited limbs	Working with hands overhead		5-10	
5. All limbs are limited	Working in mines		10-15	
D. Eyestrain			Good Lights	Bad Lights
1. Dijointed view	Read measuring instrument		0	1
2. Almost continuous view	Meticulous work		2	2
3. Continuous view with changing focus	Check for defects on the fabric		2	5
4. Constant view with fixed focus	A very thorough examination		4	8
E. Workplace temperature conditions	(temperature degree celcius)		Normal Fatigue	Excessive
1. Frozen	Below 0		Above 10	Above 12
2. Low	0-13		10-0	12-5
3. Medium	13-22		5-0	8-0
4. Normal	22-28		0-5	0-8
5. High	28-38		5-40	8-100
6. Very high	Above 38		Above 40	Above 100
F. Atmosphere				
1. Good	Well ventilated room		0	
2. Enough	Bad ventilation, odors		0-5	
3. Not good	Toxic dust, or non-toxic but numerous		5-10	
4. Bad	Harmful odors that require to use breathing apparatus		10-20	
G. Good environmental conditions				
1. Clean, healthy, bright with low noise			0	
2. The work cycle repeatedly between 5-10 seconds			0-1	
3. Repetitive work cycle between 0-5 seconds			1-3	
4. Very noisy			0-5	
5. If influencing factors can degrade quality			0-5	
6. Feel the vibration of the floor			5-10	
7. Exceptional circumstances (sound, cleanliness, etc.)			5-15	

Figure 4.11. Allowance Table from ILO

Based on the table above, we can determine the allowance for the workers. The energy consuming is included into a very light factor or got score 7 (average score of 6-7.5) for A factor. The toughest worker's attitude is to stand on two legs, so the B score is 2 (the average of the score is 1-2.5). Because the maximum work movement is normal, so the score of C factor is 0. Eye fatigue for the job is a disjointed view, because the work performed does not require a high focus, so the score of D factor is 3 (the average of the score 0-6) with good lighting levels. Workplace temperature conditions categorized as normal (22-28 degrees Celsius), so the score for E factor is 3 (average score of 0-5) with normal fatigue level. The workplace environment is very noisy, then the score of G factor is 3 (average score

of 0-5). The allowance value of all workers is the same which is 17% derived from summing the predetermined A-G factor score. Table 4.33. shows the allowance.

Table 4.33. Allowance

	Worker	Category of Allowance							∑%
		A	B	C	D	E	F	G	
KDF-M/14	Operator	7%	2%	0%	3%	3%	0%	3%	17%
	Helper 1	7%	2%	0%	3%	3%	0%	3%	17%
	Helper 2	7%	2%	0%	3%	3%	0%	3%	17%
KDF2/04	Operator	7%	2%	0%	3%	3%	0%	3%	17%
	Helper 1	7%	2%	0%	3%	3%	0%	3%	17%
	Helper 2	7%	2%	0%	3%	3%	0%	3%	17%

e. Workload Analysis

According to Anggara (2011), the good workload should be close to 100% or under normal conditions. The 100% workload means that for 8 hours the worker is able to work continuously in normal conditions.

Work load is calculated by the formula:

$$Workload = (\%produktif \times Performance\ Rating) \times (1 + allowance)$$

Table 4.34. shows the workload calculation result.

Table 4.34. Workload Calculation Result

Workload Calculation Result		
KDF-M/14	Operator	75%
	Helper 1	63%
	Helper 2	66%
KDF2/04	Operator	102%
	Helper 1	88%
	Helper 2	91%

Based on the formula, the result of work load for KDF-M machine operator is 75%, KDF-M machine helper 1 is 63%, KDF-M machine helper 2 is 66%, 102% KDF2 / 04 machine operator, KDF2 / 04 machine helper 1 is 88%, and KDF2 / 04 machine

helper 2 is 91%. This difference workload can be caused by the machine used and the work performed.

The KDF-M / 14 machine tends to be more automated and its filter placement is already on the rack. While the KDF2 / 04 machine is still semi-automatic and filter placement more often using the box, so the maid should prepare for its box. In addition, the helpers on the KDF2 / 04 machine can replace the operator's task when the operator is leaving the work area or is working on another job. For Error Checking, the KDF-M / 14 machine can only be handled by the operator, while the KDF2 / 04 engine can be performed by the operator and the helper.

f. Calculation of Number of Workers in accordance with Workload

The following is the formula for calculating the number of workers required based on the workload:

$$Average\ Workload\ (existing) = \frac{total\ workload}{number\ of\ existing\ worker}$$

$$Average\ Workload\ (recommended) = \frac{total\ workload}{number\ of\ worker\ rocommendation}$$

The calculation of workers on KDF-M / 14 machine can't be combined because the helpers can't replace the operator's task. While on the KDF2 / 04 engine, the helpers can replace the operator's task so that the workload can be divided equally. Table 4.35. shows the workload calculation result.

Table 4.35. Calculation of Number of Workers in accordance with Workload

	Worker	Total Workload	Number of Existing Worker	Average of Existing Workload	Number of Workers Recommendation	Average of Recommended Workload
KDF-M/14	Operator	75%	1	75%	1	75%
	Helpers	129%	2	64%	2	64%
KDF2/04	Operator + Helpers	281%	3	94%	4	70%

After the calculation by dividing the total workload with the number of existing workers, the average received by the operator and the two helpers on the KDF-M

/ 14 machine and KDF2 / 04 machine is under the maximum condition of the worker's workload which is 100%. With an average workload of 64%, helpers on KDF-M / 14 machines tend to produce large non-productive activities. However, if the number of helper is reduced, will cause a high workload on one helper. Thus, on KDF-M / 14 machines, there is no additional workers is required.

However, the average workload of the operator and the helpers on the KDF2 / 04 machine tends to be heavier than the workers in the KDF-M / 14 machine because the value is close to 100%. Thus, if the number of workers on a KDF2 / 04 machine plus 1 person, then the average workload of each worker becomes 70% or close to the same workers on the KDF-M / 14 machine.

CHAPTER 5
CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions

Based on the internship project on PT. Djarum, conclusions drawn from this project internship activities are as follows:

a. Based on the data processing, the number of material requirements per order cycle for each material is as follows: Acetate Tow for KDF-M / 14 machine is 3541.76 kg, Acetate Tow for KDF2 / 04 machine is 2185.59 kg, Acetate Tow for KDF2 / 05 machine is 1866.9 kg, Acetate Tow for KDF2 / 06 machine is 595.17 kg, Hotmelt 1020.5 kg, Triacetine 48.93 kg, Inner Glue 195.5 kg, Plug Wrap Porous for KDF-M / 14 machine is 62 roll, Plug Wrap Porous for machine KDF2 is 65 roll and Plug Wrap Non Porous is 74 roll.
b. Based on the calculation of workload on the operator and helpers on machine KDF-M / 14 is not required to add the number of workers because the average workload is under the maximum conditions of worker's workload, which is 100%.
c. With an average workload of 64%, helpers on KDF-M / 14 machines tend to produce large non-productive activities. However, if the number of helper is reduced, will cause a high workload on one helper.
d. Based on the calculation of workload on the operator and helpers machine KDF2 / 04 required the addition of 1 worker so that the workload is close or same as the workers on KDF-M / 14 machine.

5.2 Suggestions

For continuous improvement, several recommendations are given as a suggestion for the company. Suggestions that are given upon this project are:

a. For daily orders, Unit Head needs to order 8 bale Acetate Tow for KDF-M / 14 machine, 4 bale Acetate Tow for KDF2 / 04 machine, 4 bale Acetate Tow for KDF2 / 05 machine, 2 bale Acetate Tow for KDF2 / 06 machine, 2 packs of Hotmelt, 3 drums Triacetine, 62 Plug Wrap Porous for KDF-M / 14 machines, 65 Plug Wrap Porous for KDF2 machines and 74 Plug Wrap Non-Porous. However, Unit Head also needs to pay attention to the amount of material in the inventory to avoid material buildup.
b. For monthly orders, Unit Head needs to order 45 jerry cans Inner Glue. However, Unit Head also needs to pay attention to the amount of material in the inventory to avoid material buildup.

c. Companies do not need to increase the number of operator on the KDF-M / 14 machine because the average workload is already optimal even though it produces many non-productive activities. Therefore, it is better for the operator to clean the parts of the machine more frequently, such as the ledge cover, hotmelt nozzle, inner glue nozzle, width sensor, ODM area, or other parts that often cause errors to reduce errors caused by dust-enclosed sensors, inner glue deposits, or other possibilities. So, with more frequent cleaning machine, it is expected that the quality of the filter can be maintained and the number of filters can increase because the machine rarely error.
d. Companies do not need to increase or decrease the number of helper of KDF-M / 14 machines because the average workload is already optimal although it will tend to generate a lot of non-productive activities. However, non-productive activities carried out do not affect the quality and quantity of products produced.
e. Preferably the helpers placed in the machine KDF-M / 14 is a worker with age category 20-40 years with minimum education standard SMA / SMK. So, the helpers can be given training on error handling on the KDF-M / 14 machine so they can help the operator when the machine is damaged or repair errors when the operator is leaving the work area.
f. With a 94% workload, the KDF2 / 04 workers actually has a workload that tends to be heavier as it approaches 100%. This will cause the workers will fatigue quickly. It would be better if the company adds one worker to reduce the workload or the average workload is close to the workload of workers on KDF-M / 14 machines. With the addition of workers, it is expected that the number of products produced will be more optimal and the quality of the resulting filter is maintained properly.

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APPENDIX

TABLE OF STANDARD DEVIATION

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7518	0.7549
0.7	0.7580	0.7612	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8631	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	.09834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.99865	0.99869	0.99874	0.99878	0.99882	0.99886	0.99889	0.99893	0.99897	0.99900
3.1	0.99903	0.99906	0.99910	0.99913	0.99916	0.99918	0.99921	0.99924	0.99926	0.99929
3.2	0.99931	0.99934	0.99936	0.99938	0.99940	0.99942	0.99944	0.99946	0.99948	0.99950
3.3	0.99952	0.99953	0.99955	0.99957	0.99958	0.99960	0.99961	0.99962	0.99964	0.99965
3.4	0.99966	0.99968	0.99969	0.99970	0.99971	0.99972	0.99973	0.99974	0.99975	0.99976
3.5	0.99977	0.99978	0.99978	0.99979	0.99980	0.99981	0.99981	0.99982	0.99983	0.99983
3.6	0.99984	0.99985	0.99985	0.99986	0.99986	0.99987	0.99987	0.99988	0.99988	0.99989
3.7	0.99989	0.99990	0.99990	0.99990	0.99991	0.99991	0.99992	0.99992	0.99992	0.99992
3.8	0.99993	0.99993	0.99993	0.99994	0.99994	0.99994	0.99994	0.99995	0.99995	0.99995
3.9	0.99995	0.99995	0.99996	0.99996	0.99996	0.99996	0.99996	0.99996	0.99997	0.99997
4.0	0.99996832									
4.5	0.99999660									
5.0	0.99999971									
5.5	0.99999998									
6.0	0.99999999									

Program Studi Teknik Industri Universitas Atma Jaya Yogyakarta
Lembar Bimbingan Pelaksanaan dan Penyusunan
Laporan Kerja Praktek/ Magang

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Perusahaan tempat KP : PT. Djarum
Tanggal pelaksanaan KP : 18 Desember 2017 - 29 Januari 2018
Dosen Pembimbing : Brilianta Budi N.

No	Tanggal	Agenda	Tanda Tangan Dosen Pembimbing
1	29 Nov '17	Penyerahan surat pembimbingan dan Konsultasi persiapan Kerja Praktek	
2	22 Des '17	Laporan atau konsultasi penugasan dari perusahaan	
	5 Feb '18	Laporan pertama setelah pelaksanaan Kerja Praktek dan konsultasi penyusunan laporan	
	7 Mar '18	Penyerahan draft laporan Kerja Praktek untuk pertama kali	
	14 Mei '18	Pengesahan laporan Kerja Praktek	