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Host: Universiti Teknologi Malaysia (UTM), Co-Host: Universitas Sebelas Maret (UNS), Indonesia
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Sept. 13-15, 2022, Johor Bahru, Malaysia
Hosts: Universiti Teknologi Malaysia (UTM) & Universitas Sebelas Maret (UNS), Indonesia
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Quality Improvement And Waste Minimization With Lean Six Sigma Method In Cement Production Process At PT. C

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Abstract

The research was conducted at the packaging stage in a cement factory. Cases of product defects in cement bagging with kraft 50 type occurred from December 2021 to February 2022 with a total percentage of 7.54%. The research objective is to identify product defects and minimize waste that arises so that production is more effective and efficient. The research uses the lean six sigma method. Lean to reduce waste that occurs in the production process. Six sigma to reduce the level of defects by using the Define, Measure, Analyze, Improve, and Control stages. The stage of defining a problem with existing data to improve the process and product quality using SIPOC and CTQ diagrams. The measuring stage uses a p control chart to identify product defects, then uses DPMO calculations and sigma levels to calculate the capability of defective products with the result before repair that is 19708 with a sigma level of 3.57 sigma. mapping Value Stream Mapping and calculating Process Cycle Efficiency with the result before repair of 6.99%. The analysis phase uses an Ishikawa diagram for analysis. Proposed improvements at the repair stage are operator training, display of the 5S concept, and machine maintenance checklist. Then the control stage makes a VSM proposal by combining activities. So the calculation of the new DPMO is 11985 with a sigma level of 3757 sigma. Then the new PCE count is 7.62%.

Keywords

Defective Products, Lean Six Sigma, DMAIC Method, Waste, and Value Stream Mappin

1. Introduction

At PT. C produces three types of products, namely composite Portland cement (using cement bags), bulk cement products, and concrete products. There are 2 types of cement bags and 2 types of cement bag contents, namely kraft 40 Kg, kraft 50 Kg, woven 40 Kg, and woven 50 Kg. The difference between kraft and woven types lies in the use of the cement bag. Kraft type is used for cement bags which will be distributed by land route, while woven is used for cement bags which will be distributed via waterways. At the cement bagging stage, it is done manually, therefore there are still many problems caused by several factors causing waste of production costs issued by the company and can have an impact on product quality because it is not in accordance with product standards that have been determined by the company. The criteria for a good cement bag is that it must have the SNI (Indonesian National Standard) logo which is a sign of meeting the standardization requirements on products that have been set by BSN (National Standards Agency). In addition, a suitable cement bag is not easily damaged, can maintain the quality of the cement production in the cement bag, and must be tightly closed (no patches or wet). The purpose of this research is to improve the quality of a standard product characteristics that aim to satisfy customer needs. A quality Conformance quality is related to product specifications that have been made. The modern definition is that quality is inversely proportional to variability (D. C. Montgomery 2013). In addition, this study aims to identify and reduce problems in the cement bagging process using the lean six sigma method. The lean method is useful for reducing waste that occurs during the production process. While the six-sigma method is useful for reducing levels by using the DMAIC (Define, Measure, Analyse, Improve, and Control) stages. These stages are expected to help companies improve product quality and production efficiency in the production process. The stages carried out in the DMAIC stage are as follows (V. Gaspersz and A. Fontana 2011) the define stage aims to define a problem that occurs with data that has been collected using several tools so that it can improve the process and quality of a product. The tools used at this stage, namely the SIPOC Diagram (Supplier, Input, Process, Output, Customers) can identify components related to process improvement and help show important steps in a process without detail (V. Frank et al. 2013) and Critical To Quality (CTQ). The next step is measure which is a measurement using a control chart tool p to identify product defects in the data that is already under control or vice versa, then using DPMO and sigma level to calculate the capability of defective products. Furthermore, for the production process section using the Value Stream Mapping (VSM) tool, a big picture of a process and allows to understand the process carried out and create a vision to improve the process by connecting materials, people, and information flows in one image and Process Activity Mapping (PAM) is a description of the physical flow and information about the time that needs to be used for each activity. Identification of activities that will be classified into five types, namely operation, transportation, inspection, delay, and storage. At the analyse stage doing an analysis using data - data from the previous stage which aims to analyse the production process of packaging and defects in the product using an Ishikawa diagram that depicts lines and symbols that show the relationship between the effects and causes of a problem. This diagram is used to determine the consequences of a problem for further corrective action to be taken. After carrying out the analyse stage, the improve stage is carried out which aims to improve or improve quality by minimizing defects. Improvements made must be based on analysis of the causes of the problem so that it can plan and carry out experiments to determine the optimal cause-and-effect relationship. After analysing using existing data, suggestions for improvements that can be made are in the form of training for operators and updating check sheets regarding machine maintenance on the packer. The last stage is the control stage which aims to test new data that has been obtained from the improve stage by measuring again.

1. Literature Review

Table 1. Previous Research

No	Research	Author
1	Pengendalian Kualitas Proses Pengemasan Gula Dengan Pendekatan *Six Sigma* (Aulia and Lailatul 2017)	Aulia Kusumawati and Lailatul Fitriyeni
2	Pemetaan Pemborosan Dalam Proses Produksi Kantong Semen Menggunakan *Value Stream Mapping Tools* (Yesmizarti et al. 2017)	Yesmizarti Muchtiar, Aidil Ikhsan, dan Ayu Bidiawati, JR
3	Analisis Pengendalian Kualitas Pada Proses Pengemasan *Portland Pozzolan Cement* (PPC) di PT Semen Gresik (PERSERO), Tbk. Pabrik Tuban (Rizki 2018)	Rizky Nanda Ghifari
4	Analisis Pengendalian Kualitas Kemasan Glukosa Dengan Peta Kendali p di PT. Budi Starch & Sweetener Tbk.Lampung Tengah (Emy et al. 2019)	Emy Khikmawati, Heri Wibowo, dan Irwansyah
5	Perancangan Perbaikan Kualitas Produk Baut dan Sekrup Menggunakan Metode *Six Sigma* dan *Data Mining* di PT.A (Rina and Nur 2019)	Rina Fitriana dan Nur Anisa
6	Identifikasi Waste Dengan Menggunakan Metode *Value Stream Mapping* Pada Industri Perumahan (Yassir 2019)	Yassyir Maulana
7	Analisis Pengendalian Kualitas Proses Pengantongan Semen Menggunakan *Six Sigma* (Studi Kasus PT Semen Bosowa Banyuwangi) (Rio et al. 2020)	Rio Yonathan, Teja Kusuma, dan Dosep Guritno
8	Penerapan Value Stream Mapping Dan Process Activity Mapping Untuk Identifikasi Dan Minimasi 7 Waste Pada Proses Produksi Sepatu X di PT.PAI (Ananda and Taufiqur 2020)	Ananda Muhammad Zulfikar, dan Taufiqur Rachman
9	Usulan Penerapan *Lean Six Sigma* Untuk Meningkatkan Kualitas Produk Semen (Vera and Nurul 2020)	Vera Devani, dan Nurul Amalia

No	Research	Author
10	Aplikasi *Lean Six-Sigma* Untuk Mengurangi Pemborosan Di Bagian Packaging Semen (Reni and Lahtifurahman 2020)	Reni Dwi Astuti, dan Lathifurahman
11	Kapabilitas Proses *Packing* Semen Dengan Menggunakan Statistikal *Quality Control* (Studi Kasus: PT. Semen Bosowa Maros) (Irwan et al. 2021)	Irwan, Try Azisah Nurman, dan Risna Sukardi
12	Analisis Pengendalian Kualitas Dengan Menggunakan Metode Lean *Six Sigma* di PT. XYZ (Ahmad and Tutuk 2021)	Ahmad Fauzi, dan Tutuk Safirin
13	Sistem Pengantongan Semen Di PT. Semen Baturaja (Persero)Tbk (Futhupal, et al. 2022)	Futhupal Bagus Pramico, Deri Aditya Nugraha, dan Safaruddin
14	Analisis Pengendalian Kualitas Produk *Base Plate* Dengan Menggunakan Metode Lean Six Sigma (DMAIC) Pada PT XYZ (Suseno and Taufik 2022)	Suseno, dan Taufik Alfin Ashari
15	Analisa Pengendalian Kualitas Produk Packaging Karton Box PT. X dengan Menggunakan Metode Statistical Quality Control (Haifa and Wahyuddin 2022)	Haifa Anbar Fadhilah, dan Wahyudin

2. Methods

Increasing the six-sigma target can be done using the Define, Measure, Analyse, Improve, Control (DMAIC) methodology. DMAIC is used to improve existing business processes. The stages carried out at the DMAIC stage are as follows (V. Gaspersz and A. Fontana 2011):

a. The define stage is the initial stage in data processing which aims to find problems that occur in cement bags with the kraft 50 type by using the SIPOC diagram and Critical to Quality (CTQ) tools
b. The measure stage which is a measurement using the p control chart tools to identify product defects in the data that has been controlled or vice versa, then using DPMO and sigma levels to calculate the capability of defective products. Furthermore, for the production process using Value Stream Mapping (VSM) and Process Activity Mapping (PAM) tools.
c. In the analyse stage, an analysis is carried out using data from the previous stage which aims to analyse the bag production process and defects in the product using an Ishikawa diagram.
d. Improve stage is a stage of improvement or quality improvement by minimizing defects. The control stage is the last in the lean six sigma method. This stage aims to improve quality control that has been corrected so that there are no previous mistakes.
e. The last stage is the control stage which aims to test new data that has been obtained from the improvement stage by measuring again.

3. Data Collection

The problems faced by PT. Cemindo Gemilang Tbk-Plant Bayah in producing cement bags with kraft 50 type is the discovery of various types of waste, namely defects and waiting. Cases of product defects in cement bagging with kraft type 50 that occurred during December 2021 to February 2022 reached a percentage of 7.54% in the last three months which can be seen in Table 2 Percentage of Defects of Cement Bag Products with Kraft Type 50.

Table 2. Percentage of Defects of Cement Bag Products with Kraft Type 50

Bulan	Kapasitas Produksi (unit)	Jumlah Produk Cacat (unit)	Persentase Produk Cacat (%)
Dec-21	9675	504	5.21%
Jan-22	12580	1200	9.54%
Feb-22	4602	362	7.87%
Rata - rata			7.54%

Determination of the tolerance limit for defective products set by the company at 5% per month. Based on Table 2. on the percentage of defective products in the last three months the percentage of defective products is above the tolerance limit set by the company. Therefore, it is necessary to evaluate the process and quality of production in the cement bagging so that the company can minimize the waste that occurs.

4. Results and Discussion

A. Define stage

The define stage is the initial stage in data processing which aims to find problems that occur in cement bags with the kraft 50 type by using the SIPOC diagram and Critical to Quality (CTQ) tools.

The SIPOC (Supplier, Input, Process, Output, Customers) diagram serves to describe a process flow in cement bagging from suppliers to customers. Critical To Quality is used to describe consumer needs that can be quantified and easier to process

B. Measure Stage

Furthermore, the second stage is the measurement stage used for the selection and determination of quality according to customer needs, data collection to improve quality, and measuring performance in the cement bagging process.

1. P Control Chart

P control chart is a control chart that is used to calculate control and classify into defective and non-defective categories of cement bagging products. Table 3 shows the calculation of the control chart for p.

Table 3. Control Chart Calculation P

Periode	Production Capacity (units)	Number of Defective Products (units)	Proportion of Defective Productst	CL	UCL	LCL
1	0	0	0,00	0,0954	0	0
2	496	60	0,12	0,0954	0,1350	0,0558
3	114	17	0,15	0,0954	0,1779	0,0129
4	157	12	0,08	0,0954	0,1657	0,0251
5	402	45	0,11	0,0954	0,1393	0,0514
6	569	45	0,08	0,0954	0,1323	0,0584
7	222	13	0,06	0,0954	0,1545	0,0362
8	582	57	0,10	0,0954	0,1319	0,0589
9	493	31	0,06	0,0954	0,1351	0,0557
10	306	16	0,05	0,0954	0,1458	0,0450
11	932	86	0,09	0,0954	0,1243	0,0665
12	454	44	0,10	0,0954	0,1367	0,0540
13	109	11	0,10	0,0954	0,1798	0,0110
14	186	21	0,11	0,0954	0,1600	0,0308
15	218	30	0,14	0,0954	0,1551	0,0357
16	162	22	0,14	0,0954	0,1646	0,0262
17	231	20	0,09	0,0954	0,1534	0,0374
18	450	59	0,13	0,0954	0,1369	0,0538
19	550	35	0,06	0,0954	0,1330	0,0578
20	491	45	0,09	0,0954	0,1352	0,0556
21	144	16	0,11	0,0954	0,1688	0,0220
22	581	70	0,12	0,0954	0,1320	0,0588
23	265	35	0,13	0,0954	0,1495	0,0413
24	312	36	0,12	0,0954	0,1453	0,0455
25	850	70	0,08	0,0954	0,1256	0,0652
26	510	52	0,10	0,0954	0,1344	0,0564
27	493	64	0,13	0,0954	0,1351	0,0557
28	297	31	0,10	0,0954	0,1465	0,0443
29	1126	85	0,08	0,0954	0,1217	0,0691
30	518	50	0,10	0,0954	0,1341	0,0567
31	360	22	0,06	0,0954	0,1418	0,0489
Jumlah	12580	1200	2,99	2,9571	4,3313	1,3920

$$CL = \bar{p} = \frac{total\ unit\ cacat}{total\ unit\ produksi} = \frac{1200}{12580} = 0{,}0954$$

$$UCL = 0{,}0954 + 3\sqrt{\frac{0{,}0954\ (1-0{,}0954)}{ni}}$$

$$UCL = 0{,}0954 + 3\sqrt{\frac{0{,}0954\ (1-0{,}0954)}{360}} = 0{,}1418$$

$$LCL = 0{,}0954 - 3\sqrt{\frac{0{,}0954\ (1-0{,}0954)}{ni}}$$

$$LCL = 0{,}0954 - 3\sqrt{\frac{0{,}0954\ (1-0{,}0954)}{360}} = 0{,}0489$$

The calculation of the CL value is 0.0954. Then the UCL value and LCL value have different control limits every day. The result value will be 0 if the data value is < 1. Figure 1. is the result of plotting the p control chart data using the MINITAB software. In the MINITAB calculation, it can be concluded that the data is within the control limits or nothing is out of control.

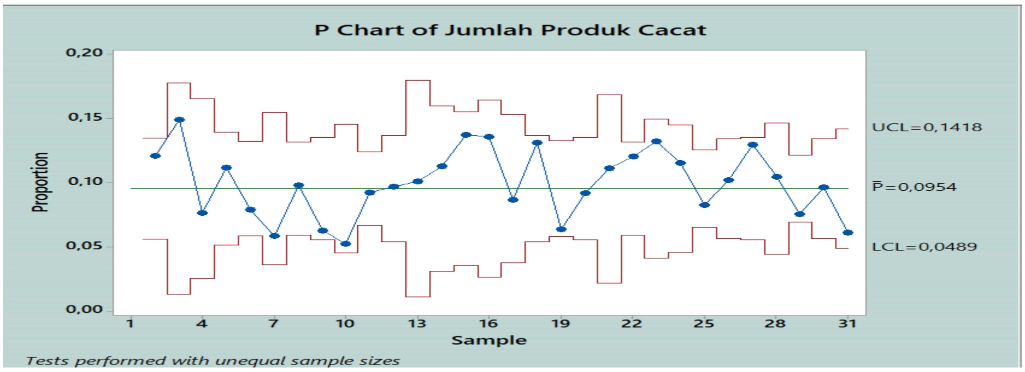


Figure 1. Plot Data Using a P Control Chart

2. Calculation of DPMO and Sigma Level

The calculation of Defect Per Million Opportunity (DPMO) is carried out to determine the sigma level of how well the cement bagging production process is. Following are the steps for calculating DPMO:

Is known:

Number of Products Checked:12580 units

Number of Defective Products :1200 units

Opportunities: 5

- ***Defect* per *Unit* (DPU)**

  $$\text{DPU} = \frac{Defect}{Unit} = \frac{1200}{12580} = 0{,}0954$$

- ***Defect* per *Opportunities* (DPO)**

  $$\text{DPO} = \frac{Defect}{Unit\ x\ Opportunities}$$

  $$= \frac{1200}{12580\ x\ 5} = 0{,}0190$$

- ***Defect* per *Million Opportunities* (DPMO)**

  DPMO = DPO x 1.000.0000
  = 0,0190 x 1.000.0000
  = 19078

- **Sigma Level**

  Sigma Level = (((1.000.0000 - DPMO)/ 1.000.0000) +1,5)
  Sigma Level = (((1.000.0000 - 19078)/ 1.000.0000) +1,5)
  = 3,573 Sigma

The sigma level value of 3.573 means that the activities of the cement bagging production process can be said to be quite good. This can be seen from the defects in the production data that are still within the control limits, but the company still has to fix the existing problems so that it can further minimize the defects of the product.

1. Identify Value Added and Non-Value Added

Value-Added and Non-Value-Added activities. Value added is an activity that is feasible to increase productivity or activities that have added value. Meanwhile, non-value-added are activities that do not provide added value and can increase production costs. The results obtained Value Added of 10.10 while for Non-Value Added of 134.35 and for manufacturing lead time of 144.45.

2. Calculation of Process Cycle Efficiency

Process Cycle Efficiency (PCE) is a calculation between Value Added (VA) and total lead time. If the results in this calculation have a greater value, it can be said that the process is running efficiently.

$$PCE = \frac{Value\ Added\ Time}{Manufacturing\ Lead\ Time}\ x\ 100\ \%$$

$$= \frac{10{,}10}{144{,}45}\ x\ 100\ \% = 6.99\ \%$$

3. **Process Activity Mapping**

This method is a description of the physical flow and information about the time that needs to be used for each activity. Identification of activities that will be classified into five types, namely operation, transportation, inspection, delay, and storage. Table 4. represents activities using the PAM method

Table 4. Identification Of Activities Using PAM

No.	Kegiatan	Mesin	Jarak	Waktu	Aktivitas				
					⬭	▭	⇨	D	▽
1	Administrasi Awal			12 menit				●	
2	Pengambilan Bahan Baku Pembuatan Semen			5 menit				●	
3	Proportion Bin Cement Mill			2 menit				●	
4	Pengambilan Bahan Pembantu Pembuatan Semen			1 menit				●	
5	Proportion Bin Cement Mill			30 detik				●	
6	Inspeksi QC			15 menit		●			
7	Proses Vertical Roller Mill	Vertical Roller Mill		10 menit	●				
8	Inspeksi QC			20 menit		●			
9	Penyimpanan Semen (Semen Silo)			1 menit					●
10	Proportion Bin Packer			10 detik				●	
11	Pemuatan Semen	Rotary Packer		1 menit				●	
12	Pengambilan Kantong Semen Kosong	Handpallet	5 meter	7 menit			●		
13	Pembukaan Kantong Semen Kosong			30 menit	●				
14	Kantong Semen Kosong Masuk Ke Dalam Tube Mesin 8 Filling Station	Rotary Packer		25 detik	●				
15	Proses Pengisian Semen Kedalam Kantong Semen Kosong Menggunakan 8 Filling Station	Rotary Packer		10 detik	●				
16	Belt Conveyor Loading Machine	Belt Conveyor		4 menit				●	
17	Inspeksi Kantong Semen			2 menit		●			
18	Penyimpanan Kantong Semen Ke Dalam Jumbo Bag			30 detik					●
19	Penyimpanan Jumbo Bag Ke GBJ	Forklift	3 meter	3 menit					●
20	Pemuatan Jumbo Bag Ke Dalam Truk	Forklift	3 meter	30 menit				●	

4. **Current Value Stream Mapping**

Value stream mapping is a method that aims to map the big picture of a process and allows to understand the process being carried out and create a vision to improve the process by connecting materials, people, and information flows in one picture. In Figure 2. This is the Value flow mapping.

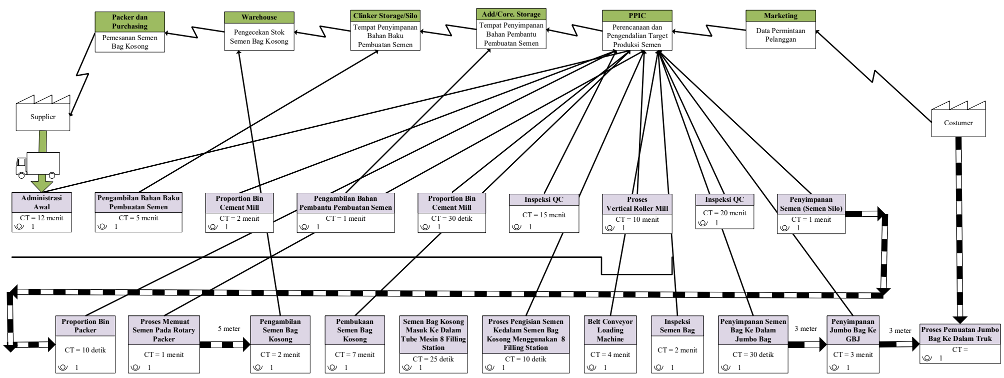


Figure 2. Value stream mapping

C. Analyse Stage

At the analyse stage, the identification of possible causes of product defects and waste processes in cement bagging production is carried out using tools, namely the Ishikawa diagram.

1. **Analysis of the Causes of Waste**

Based on the activity mapping process, the most frequently performed activity is waiting time. Basically, waiting time is included in one type of waste. Therefore, an analysis of the causes of waste is carried out using the Ishikawa diagram tools. Ishikawa diagram is made based on observations and interviews directly at PT. C. Some of the factors used in this Ishikawa diagram include human factors, material factors, and machine factors. Figure 3. shows an Ishikawa diagram of the causes of wastage

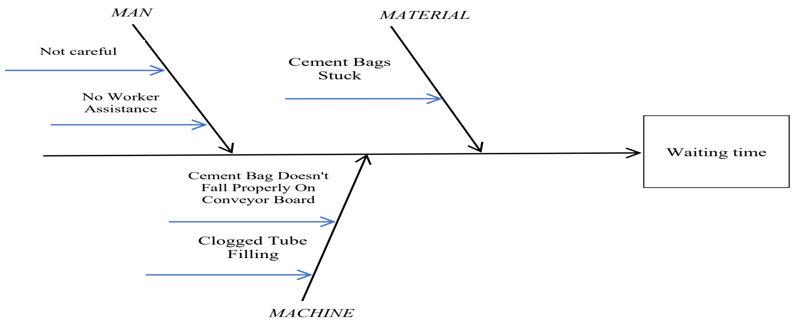


Figure 3. Ishikawa Diagram of the Cause of Waste

2. **Analysis of the Causes of Product Defects**

Based on the analysis of one of the characteristics of the defects that occur in cement bagging. There is a defect, namely the cement bag is torn. Figure 4. shows an Ishikawa diagram of the causes of product defects.

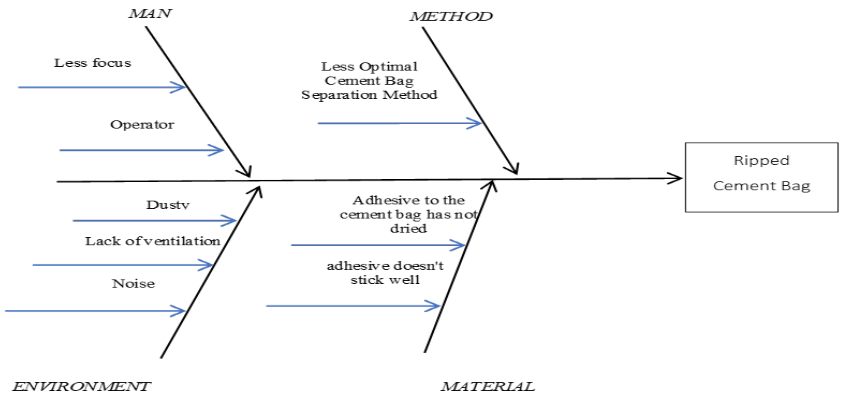


Figure 4. Ishikawa Diagram of the Cause of Product Defects

D. Improve stage

Improve stage is a stage of improvement or quality improvement by minimizing defects. Repairs made must be based on an analysis of the causes of the problems that occur. Proposed improvements are made using Ishikawa diagram tools to analyse the causes of wastage and product defects in cement bagging production

1. Proposed Improvements to Operators

One of the factors that cause defects is caused by humans or operators, one of which is the lack of training / training for operators. This can cause work errors due to a lack of understanding of work instructions. Therefore, the proposed improvement that needs to be done is by making training/training for operators which aims to improve skills or insight regarding cement bagging procedures. Training/training for operators can be done at least once per year. Figure 6. shows the proposed improvements to the operator (Figure 5).

CEMINDO GEMILANG	**PT. CEMINDO GEMILANG TBK - PLANT BAYAH**
	PELATIHAN OPERATOR
Tujuan Pelatihan : 1. Menambah wawasan mengenai sistem packer 2. Menambah wawasan mengenai *maintenance* peralatan utama dan pendukung mengenai sistem packer 3. Mengendalikan operasi sistem packer 4. Menambah wawasan mengenai kondisi emergency di area sistem packer 5. Meningkatkan peforma kinerja pada operator	
Materi Pelatihan : 1. Pengetahuan sistem packer 2. Pengetahuan mengenai peralatan sistem packer 3. Standar prosedur kerja	
Instruktur : Training dapat dilakukan oleh kepala departemen	
Alur Training : 1. Pembukaan 2. Pemberian materi 3. Pembinaan Operator 4. Praktek pada lantai produksi 5. Evaluasi	
Tempat dan Waktu Pelaksanaan Training : Tempat : Ruangan Learning Center PT. Cemindo Gemilang Tbk-Plant Bayah Waktu : Sekali dalam setahun	
Dibuat Oleh Nadia Shesarina	Disetujui Oleh Bapak Zulkarnain Ariko

Figure 5. Proposed Improvements to Operators

2. Proposed Improvements to Machines

Besides operators, machines are factors that can cause defects. One of the causes of defects in the rotary packer machine is a clogged tube filling station which is the place where cement is filled into cement bags. This can hamper the cement bagging production process because it cannot be used properly. Proposed improvements that need to be made to the problem by adding a check sheet regarding repairs to the packaging machine. This is done so that the remaining cement spilled on the machine does not cause damage to the machine. Figure 6. shows the proposed improvements to the machine

CEMINDO GEMILANG				FORM PEMBERSIHAN MESIN PADA PACKER			
Nama Mesin : Nama Produk : Kode Produk : Shift :				SETELAH PENGISIAN FORM HARAP MELAPORKAN KE PENANGGUNG JAWAB			
Hari/Tanggal	Waktu	Indikator Yang dikerjakan		Nama Operator	Paraf Operator	Penanggung Jawab	Keterangan
		Pembersihan	Pengecekan				
Dibuat Oleh Nadia Shesarina				Disetujui Oleh Bapak Zulkarnain Ariko			

Figure 6. Proposed Improvements to Machines

3. Proposed Improvements to the Implementation of the 5S/5R Concept Display

The display is a medium to provide information indirectly. Meanwhile, the 5S concept consists of Seiri (Concise), Seiton (Neat), Seiso (Clean), Seiketsu (Treat), and Shitsuke (Diligent) which function to increase productivity, eliminate various wastes, and increase the comfort of the work area. The following Figure 7 is a display of the 5S/5R method.

Figure 7. 5S/5R Concept Display

E. Control stage

Control is the last stage of DMAIC which aims to ensure whether the proposed improvements have a good impact on the.

1. Implementation of 5S/5R. Concept Display

The displays that have been made are installed in every corner of the room as a reminder for employees to apply the 5S/5R concept in the work environment to increase a culture of discipline within employees which will make the work easier. Figure 8 is one of the displays that has been installed in the room

Figure 8. Implementation of the 5S/5R Concept Display

Figure 9. Before the Implementation of the 5S Concept

Figure 10. After the Implementation of the 5S Concept

In Figure 9 it is a defect cement bag that is not arranged neatly so it is messy and also the cement in the bag is wasted. Meanwhile in Figure 10, after the implementation of the 5S/5R concept, it looks neater and the broken cement bags are arranged into one so that the cement in the bag is not wasted a lot. In addition, it can also keep the work environment clean so that it is more well-maintained.

1. Implementation of Repairs on Machines

The proposed repair on the machine in the form of a check sheet approved by the company to be implemented has been running for 14 days. Previously, a briefing was held for all packer machine users. A check sheet filled in by the operator will be checked by the person in charge of each packer machine. The indicator used in this implementation is that the engine part is protected from the rest of the cement so that it does not dry out, especially in the tube filling section (Figure 11 & 12)

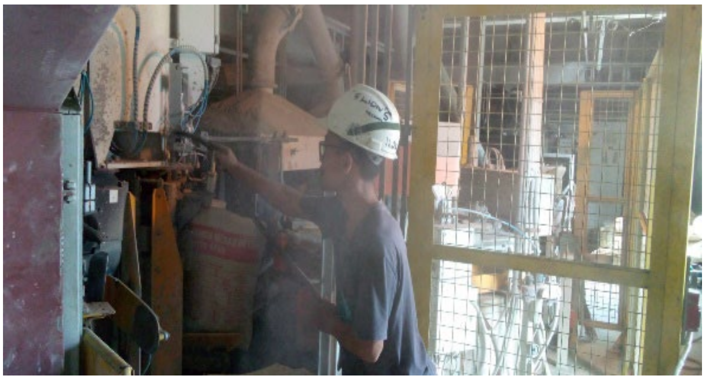
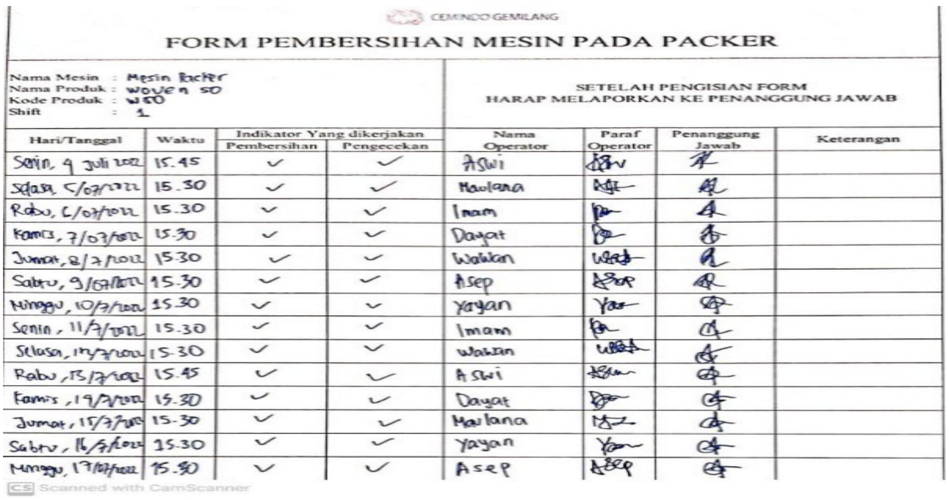


Figure 11. Cleaning on Parts Using a Compressor



CEMINDO GEMILANG

FORM PEMBERSIHAN MESIN PADA PACKER

Nama Mesin : Mesin Packer
Nama Produk : woven 50
Kode Produk : W50
Shift : 1

SETELAH PENGISIAN FORM
HARAP MELAPORKAN KE PENANGGUNG JAWAB

Hari/Tanggal	Waktu	Indikator Yang dikerjakan		Nama Operator	Paraf Operator	Penanggung Jawab	Keterangan
		Pembersihan	Pengecekan				
Senin, 4 Juli 2022	15.45	✓	✓	Aswi	[illegible]	[illegible]	
Selasa, 5/07/2022	15.30	✓	✓	Maulana	[illegible]	[illegible]	
Rabu, 6/07/2022	15.30	✓	✓	Imam	[illegible]	[illegible]	
Kamis, 7/07/2022	15.30	✓	✓	Dayat	[illegible]	[illegible]	
Jumat, 8/7/2022	15.30	✓	✓	Wawan	[illegible]	[illegible]	
Sabtu, 9/07/2022	15.30	✓	✓	Asep	[illegible]	[illegible]	
Minggu, 10/7/2022	15.30	✓	✓	Yayan	[illegible]	[illegible]	
Senin, 11/7/2022	15.30	✓	✓	Imam	[illegible]	[illegible]	
Selasa, 12/7/2022	15.30	✓	✓	Wawan	[illegible]	[illegible]	
Rabu, 13/7/2022	15.45	✓	✓	Aswi	[illegible]	[illegible]	
Kamis, 14/7/2022	15.30	✓	✓	Dayat	[illegible]	[illegible]	
Jumat, 15/7/2022	15.30	✓	✓	Maulana	[illegible]	[illegible]	
Sabtu, 16/7/2022	15.30	✓	✓	Yayan	[illegible]	[illegible]	
Minggu, 17/07/2022	15.30	✓	✓	Asep	[illegible]	[illegible]	

Scanned with CamScanner

Figure 12. Check sheet That Has Been Used

2. Calculation of P Control Map After Implementation

Table 5. Control Chart Calculation P After Implementation

Periode	Kapasitas Produksi (unit)	Jumlah Produk Cacat (unit)	Proporsi Produk Cacat	CL	UCL	LCL
1	230	6	0,03	0,0599	0,1069	0,0130
2	157	12	0,08	0,0599	0,1168	0,0031
3	190	3	0,02	0,0599	0,1116	0,0083
4	168	5	0,03	0,0599	0,1149	0,0050
5	157	12	0,08	0,0599	0,1168	0,0031
6	222	16	0,07	0,0599	0,1077	0,0121
7	493	31	0,06	0,0599	0,0920	0,0279
8	306	16	0,05	0,0599	0,1006	0,0192
9	151	14	0,09	0,0599	0,1179	0,0020
10	176	12	0,07	0,0599	0,1136	0,0063
11	265	12	0,05	0,0599	0,1037	0,0162
12	140	15	0,11	0,0599	0,1201	0
13	125	10	0,08	0,0599	0,1236	0
14	157	12	0,08	0,0599	0,1168	0,0031
Jumlah	2937	176	0,88	0,8390	1,5628	0,1192

$$CL = \bar{p} = \frac{total\ unit\ cacat}{total\ unit\ produksi} = \frac{176}{2937} = 0{,}0599$$

$$UCL = 0{,}0599 + 3\sqrt{\frac{0{,}0599\ (1-0{,}0599)}{ni}}$$

$$UCL = 0{,}0599 + 3\sqrt{\frac{0{,}0599\ (1-0{,}0599)}{157}} = 0{,}1168$$

$$LCL = 0{,}0599 - 3\sqrt{\frac{0{,}0599\ (1-0{,}0599)}{ni}}$$

$$LCL = 0{,}0599 - 3\sqrt{\frac{0{,}0599\ (1-0{,}0599)}{157}} = 0{,}0031$$

count of data usage after implementation at a CL value of 0.0599. Then the UCL value and LCL value have different control limits every day. (Table 5). The result value will be 0 if the data number is < 1. Figure 13 is the result of the p control chart data plot after implementation using the MINITAB software. In the MINITAB calculation, the key can be that the data is within the control limits or nothing is out of control.

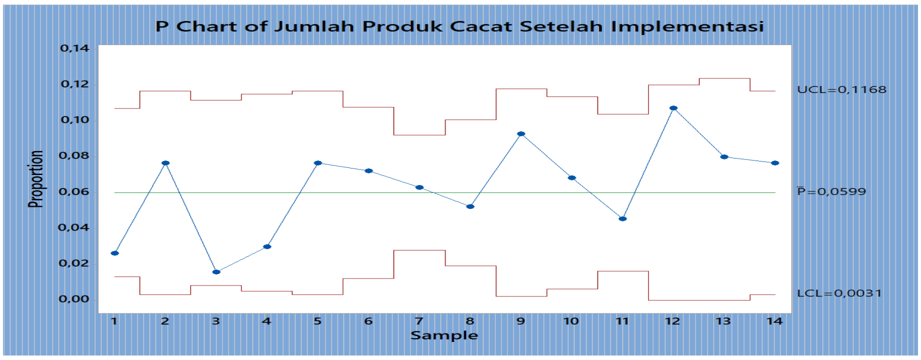


Figure 13. Plot Data Using a P Control Chart After Implementation

3. Calculation of DPMO and Sigma Level After Implementation

Number of Products Checked:12580 units
Number of Defective Products :1200 units
Opportunities: 5

- ***Defect* per *Unit* (DPU)**

  $$DPU = \frac{Defect}{Unit} = \frac{176}{2937} = 0{,}0599$$

- ***Defect* per *Opportunities* (DPO)**

$$DPO = \frac{Defect}{Unit\ x\ Opportunities}$$

$$= \frac{176}{2937\ x\ 5} = 0{,}0120$$

- ***Defect* per *Million Opportunities* (DPMO)**
  DPMO = DPO x 1.000.0000
  = 0,0120 x 1.000.000 = 11985
- **Sigma Level**
  Sigma Level = (((1.000.0000 DPMO)/ 1.000.0000) +1,5)
  Sigma Level = (((1.000.0000 - 11985)/ 1.000.0000) +1,5)
  = 3,757 Sigma

After the implementation, the sigma level value obtained is 3.757 which means that the activities of the cement bagging production process have increased after implementation. This can be seen from the increase in the value of the sigma level of 0.184 compared to the value of the sigma level that occurred in January 2022.

1. Identify Value Added and Non-Value Added After Implementation

The results were obtained after giving the added value of 10, while for non-value added of 122.35 and for manufacturing lead time of 132.45. The calculation results of Process Cycle Efficiency (PCE) after implementation have greater values than before, so it can be said that the process is running efficiently.

2. Calculation of Process Cycle Efficiency After Implementation

The calculation results of Process Cycle Efficiency (PCE) after implementation have greater values than before, so it can be said that the process is running efficiently. The following is the calculation after implementation

$$PCE = \frac{Value\ Added\ Time}{Manufacturing\ Lead\ Time}\ x\ 100\ \%$$

$$= \frac{10{,}10}{132{,}45}\ x\ 100\ \% = 7{,}62\ \%$$

3. Process Activity Mapping (PAM) After Implementation (Table 6)

Table 6. Identification Of Activities Using PAM After Implementation

No.	Kegiatan	Mesin	Jarak	Waktu	Aktivitas				
					○	□	⇨	D	▽
1	Administrasi Awal			12 menit				●	
2	Pengambilan Bahan Baku Pembuatan Semen			5 menit				●	
3	Proportion Bin Cement Mill			2 menit				●	
4	Pengambilan Bahan Pembantu Pembuatan Semen			1 menit				●	
5	Proportion Bin Cement Mill			30 detik				●	
6	Inspeksi QC			15 menit		●			
7	Proses Vertical Roller Mill	Vertical Roller Mill		10 menit	●				
8	Inspeksi QC			20 menit		●			
9	Penyimpanan Semen (Semen Silo)			1 menit					●
10	Proportion Bin Packer			10 detik				●	
11	Pemuatan Semen	Rotary Packer		1 menit				●	
12	Pengambilan dan Pembukaan Kantong Semen Kosong	Handpallet	5 meter	25 menit			●		
13	Kantong Semen Kosong Masuk Ke Dalam Tube Mesin 8 Filling Station	Rotary Packer		25 detik			●		
14	Proses Pengisian Semen Kedalam Kantong Semen Kosong Menggunakan 8 Filling Station	Rotary Packer		10 detik	●				
15	Belt Conveyor Loading Machine	Belt Conveyor		4 menit				●	
16	Inspeksi Kantong Semen			2 menit		●			
17	Penyimpanan Kantong Semen Ke Dalam Jumbo Bag			30 detik					●
18	Penyimpanan Jumbo Bag Ke GBJ	Forklift	3 meter	3 menit					●
19	Pemuatan Jumbo Bag Ke Dalam Truk	Forklift	3 meter	30 menit				●	

4. Future Value Stream Mapping (Figure 14)

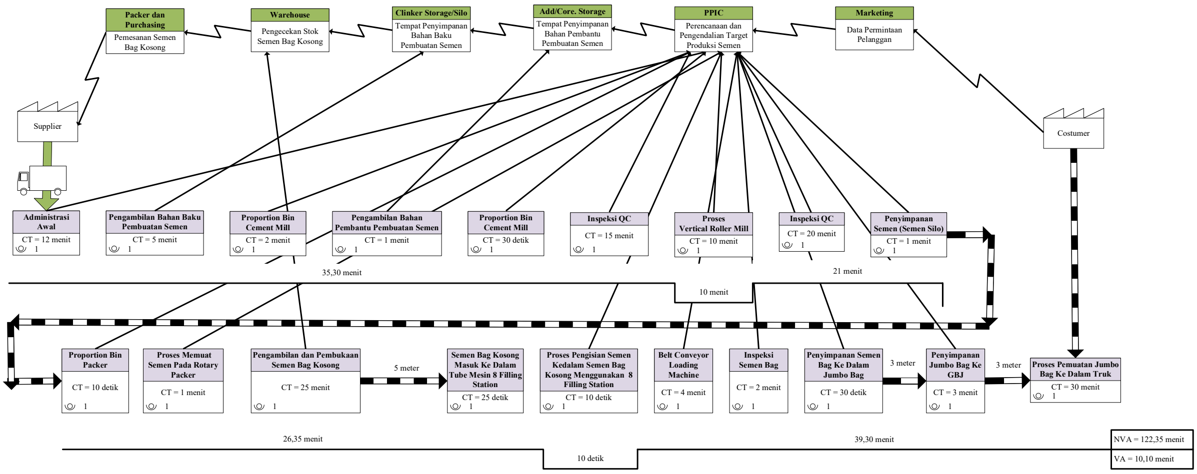


Figure 14 Future Value Stream Mapping

5. Conclusion

Based on the results of data processing and analysis of the results that have been carried out, the conclusions that can be drawn are:

1. The results of the types of waste and the factors that cause waste in the production process of Portland cement composite bagging are waiting time in the process and torn cement bags in the product. This can occur due to clogged tubes at the filling station and the method of opening the cement bag is less than optimal
2. Before the implementation of the sigma level value in the process of 3.573, it means that the activities of the cement bagging production process can be said to be quite good. After the implementation, the sigma level value obtained is 3.757 which means that the activities of the cement bagging production process have increased after implementation. This can be seen from the increase in the value of the sigma level of 0.184 compared to the value of the sigma level that occurred in January 2022.
3. The results obtained value added value is 10.10 minutes while for non-value added is 134.35 minutes and for manufacturing lead time is 144.45 minutes. In the PCE calculation before implementation, the results were obtained by 6.99%. Meanwhile, after implementation for non-value added of 122.35 minutes and for manufacturing lead time of 132.45 minutes with PCE calculation results of 7.62%. For comparison, PCE increased by 0.63%
4. The implementation of the improvements made is making a checksheet for cleaning the packer machine, and implementing the 5S/5R concept display. The training/training for operators cannot be carried out due to insufficient time estimation, while other suggestions for improvement have been made.

References

A. Tauseef, Total Quality Management and Six Sigma. Intech publisher,2014

A. Reni Dwi, dan Lathifurahman, "Aplikasi Lean Six-Sigma Untuk Mengurangi Pemborosan Di Bagian Packaging Semen," vol. 7, no 2, Agustus 2020.

D. C. Montgomery, Introduction to Statistical Quality Control, 7 Edition. New York: John Wiley & Sons Inc, 2013

D. Vera, dan Nurul Amalia, "Usulan Penerapan Lean Six Sigma Untuk Meningkatkan Kualitas Produk Semen," J. Tek. Ind., Vol. 16, No. 1, Januari 2020.

F. Ahmad, dan S. Tutuk, "Analisis Pengendalian Kualitas Dengan Menggunakan Metode Lean Six Sigma di PT. XYZ," Journal of Industrial Engineering and Management, vol.16, no.02, pp. 13-24, 2021.

F. Haifa Anbar, dan Wahyudin, "Analisa Pengendalian Kualitas Produk Packaging Karton Box PT. X dengan Menggunakan Metode Statistical Quality Control," Serambi Engineering, vol. VII, no.2, pp. 2948 – 2953, April 2022.

G. Rizky Nanda, "Analisis Pengendalian Kualitas Pada Proses Pengemasan Portland Pozzolan Cement (PPC) di PT Semen Gresik (PERSERO), Tbk. Pabrik Tuban," 2018.

Irwan, N. Try Azisah, dan S. Risna," Kapabilitas Proses Packing Semen Dengan Menggunakan Statistikal Quality Control (Studi Kasus: PT. Semen Bosowa Maros)," J. Teknosains, vo.l 15, no. 1, pp. 58-66, Januari-April 2021.

K. Aulia, dan F. Lailatul, "Pengendalian Kualitas Proses Pengemasan GulaDengan Pendekatan Six Sigma," vol. 1, no. 1, pp. 43-48, Juli 2017.

K. Emy, W. Heri, dan Irwansyah, "Analisis Pengendalian Kualitas Kemasan Glukosa Dengan Peta Kendali p di PT. Budi Starch & Sweetener Tbk.Lampung Tengah" J. Ilmiah Tek. Ind.,vol. 7 no. 1, pp. 27 – 33 , 2019.

M. Yassyir, "Identifikasi Waste Dengan Menggunakan Metode Value Stream Mapping Pada Industri Perumahan," J. JIEOM, vol. 02, no.02, NOVEMBER 2019

M. Yesmizarti, I. Aidil, dan Ayu Bidiawati, JR, "Pemetaan Pemborosan Dalam Proses Produksi Kantong Semen Menggunakan Value Stream Mapping Tools," May 2017.

P. Futhupal Bagus, N. Deri Aditya, dan Safaruddin, "Sistem Pengantongan Semen Di PT. Semen Baturaja (Persero)Tbk," J. vokasi, vol.1 no.1, Januari 2022.

Suseno, dan A. Taufik Alfin, "Analisis Pengendalian Kualitas Produk Base Plate Dengan Menggunakan Metode Lean Six Sigma (DMAIC) Pada PT XYZ," J. Cakrawala Ilmiah, vol.1, no.6, Februari 2022.

R. Fitriana, D. Kemala sari, and A. Nur habyba, "PENGENDALIAN DAN PENJAMINAN MUTU. Wawasan Ilmu, 2020.

R. Fitriana and N. Anisa, "Perancangan Pebaikan Kualitas Produk Baut dan Sekrup Menggunakan Metode Six Sigma dan Data Mining di PT . A," J. Tek. Ind., vol. 9, no. 1, pp. 46–53, 2019.

The Council for Six Sigma Certification, Six Sigma: A Complete Step-by-Step Guide: A Complete Training & Reference Guide for White Belts, Yellow Belts, Green Belts, and Black Belts. Bufallo:Harmony Living LLC, 2018

V. Frank, H. H.James, M. Chuck and C. Rich, The Lean Six Sigma Black Belt Handbook: Tools And Methods For Process Acceleration. Boca Raton: CRC Press, 2013

V. Gaspersz and A. Fontana, Lean Six Sigma for Manufacturing and Service Industries. Bogor: Vinchristo Publication, 2011

Y. Rio, K. Teja, dan G. Dosep, "Analisis Pengendalian Kualitas Proses PengantonganSemen Menggunakan Six Sigma (Studi Kasus PT Semen Bosowa Banyuwangi)," J. Industry Xplore, vol.5, no.2, September 2020.

Z. Ananda Muhammad, dan R. Taufiqur, "Penerapan Value Stream Mapping Dan Process Activity Mapping Untuk Identifikasi Dan Minimasi 7 Waste Pada Proses Produksi Sepatu X di PT.PAI,"J. Inovisi, vol. 16 no.1, April 2020.

Biographies

Nadia Shesarina born on June 29, 2000, in Jakarta. The first child of husband and wife Mr. Hendri Elfist and Mrs. Eri Yuliana. Nadia studied at SDIT Al-Istiqommah Tangerang (2006-2012), Islamic Village Junior High School (2012-2015), and SMA Negeri 5 Tangerang City (2015-2018). The author is now an undergraduate student in Industrial Engineering, Faculty of Industrial Technology, Universitas trisakti. She entered in 2018 through the report card score. While being a student. the author is active in non-academic activities as a staff of the department of organizational development and human resources of the Industrial Engineering student association for the period 2018-2019, and Student Executive Board of the Faculty of Industrial Technology for the period 2020-2021 as treasurer. Nadia motto is "nothing is waste of time if you learned something". Nadia hobbies are swimming, playing badminton, listening to music. and watching movies. Nadia is a person who can work in a team or alone, can work under pressure, reliable, honest, and communicative. Nadia likes to explore new things. In addition, the author's internship experience and practice are to analyse product defects and minimize wastage of time during the production process so that it becomes more effective and efficient the research theme is Lean Six Sigma. Lean to reduce waste that occurs in the production process. Six sigma to reduce the level of defects by using the Define, Measure, Analyze, Improve, and Control stages. This research focuses on cement products, especially cement bags. This research is the result of Nadia first work.

Rina Fitriana is a Lecturer and Head of Department of Industrial Engineering Program in Universitas Trisakti. She earned Sarjana Teknik in Industrial Engineering from Universitas Trisakti, Indonesia, master's in management from PPM Manajemen Graduated School of Management, Indonesia and Dr in Postgraduate Program of AgroIndustrial Technology, Bogor Agricultural University, Indonesia. IPM (Intermediate Professional Engineer) was obtained from the Industrial Engineering Cooperation Agency of the Indonesian Engineers Association (BKTI PII). Asean Engineering was obtained from the AFEO Governing Board in 2018. Rina started her career as a Lecturer in the Department of Industrial Engineering, FTI Universitas trisakti since 2002. She has held the positions of Head of Quality Control and Head of Quality Engineering Laboratory. Rina is trusted to be the Chair of the IV Quality

Management Seminar. Rina has also been trusted to be the first and second Chair of the International Seminar on Industrial Engineering and Management (ISIEM). In 2014 he was trusted to be the Secretary of the Department of Industrial Engineering and Head of the Quality Engineering Lab. Then she was trusted to be the Head of the Department of Industrial Engineering from 2017 until now. She has proud experience when successfully delivering the Industrial Engineering Department to obtain Accreditation A from BAN PT in 2018, obtaining IABEE Provisional accreditation in 2018, obtaining IABEE General Accreditation and Superior Accreditation of the National Accreditation Board for Higher Education in 2021. In 2021, the Department of Industrial Engineering received PKKM Grants (Independent Campus Competition Program) worth 2.2 billion. Since 2008 Rina has been actively organizing as an administrator at BKSTI both the Central BKSTI and the BKSTI Korwil DKI Jakarta, and since 2018 she has been actively organizing as an administrator at BKTI PII. On various occasions, Rina became a resource person at various BKSTI events. She has published journal and conference papers. Dr Rina has completed many research projects. Her research interests include quality engineering, industrial system, business intelligence, data mining. She is member of ASQ

Elfira Febriani Harahap was born in Medan on February 15, 1991. Currently Elfira is a permanent lecturer at Industrial Engineering, Faculty of Industrial Technology, Universitas trisakti since 2018 until now. Elfira completed Bachelor of Industrial Technology (S1) and Postgraduate School (S2) at Bogor Agricultural University, Department of Agricultural Industrial Technology. Currently, she has produced many scientific papers published through international conferences and international journals indexed by Scopus. The focus of the research that has been carried out is performance management for MSMEs or small businesses, data mining and information system development. The following are some of the titles of scientific papers that were opened, namely : Performance Management Measurement Model for Agro industrial Product Innovation and Commercialization in 2013, The development of technology readiness assessment for commercialization innovation and product development based on digital business ecosystem in 2016, Analysis of information quality attribute for SME towards adoption of research result in 2017, Problems and requirement analysis as a first step to connect researchers and small and medium enterprises (SMEs) in 2018, Evaluating Storage Tank Cap 10000L Manufacturer by Using Lean Project Management in 2019, Integer Linear Programming Model and Algorithm to Integrate Heuristics Scheduling EDD, Inventory Control and Distribution Problems in a Modular Production System in 2019, System Entities Approach for First Step to Design System That Connecting Small and Medium Enterprises (SMEs) and Researchers in 2020, Teacher Skills Development Through Digital-Based Marketing Media Management Training in 2021, and Applying Data Mining of Association Rules as Decision Making In Coffee-Shop: a Case Study in 2021