Quality Assessment of Nylon Filament Yarn Product Using DMAIC Method and Failure Mode and Effect Analysis (FMEA) Method (Case Study: PT.ITS)

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Abstract

Applying integrated system, product quality and production process are important on both manufacturing organization and service organization efficiently and productively. One of improving quality method mostly used in industry around the world is six sigma. This method concerns on significantly improvement in which costumers' demands are considered as quality improvement ways in the company. The most determining factors to improve process quality from six sigma method consist of five stages such as DMAIC method (Define Measure, Analyse, Improve, and Control). DPMO and Sigma Quality Level score for Nylon Filament Yarn production process on July 2014 was 14875 and its sigma was 3.72 and in the yield process level on July 2014 was 92.1%.

Keywords:

DMAIC, FMEA, Quality, SQL, and The DPMO

1. Introduction

1.1 Background of the Study

In this globalization era, every company faces strict competition. It is because of free global market which increases competition in international market. As a consequence, company should be able to run their business strategies efficiently in order to be able to survive in facing the competition.

One of the most quality improvement method used in international industry is six sigma (DCMAIC). This method concerns on significantly improvement in which costumers' demands are considered as quality improvement ways in the company. Target to be achieved by six sigma is 3.4 defects for every one billion defect possibilities. This method is able to improve the quality step by step into zero defect level.

1.2 Problems of the Study

1. What kinds of defects do become main problems that decrease the product quality in PT. Indonesia Toray Synthetics?
2. What factors do cause defect product?
3. What action should be done to control the quality of product in PT. Indonesia Toray Synthetics?

1.3 Objectives of the Study

1. To find out the kinds of defects which become main problem of product quality.
2. To describe the cause of defect using fishbone diagram.
3. To suggest improvement recommendation to control the quality of product.

2. Materials and Methods

2.1 Manufacture Definition

Manufacture is a branch of industry which uses machines, tools, and employees and a process medium to change raw materials into a finished product. This term refers to human activity from handicraft into high technology industry. However, this term is mostly used in industry in which raw materials exchange into finished products in big scale.

2.2 Product Definition

According to Kotler & Keller (2009) product is everything that can be offered, sold, used or consumed to satisfy costumers demands or needs. Conceptually, product is subjective perception from producer toward something that can be offered as an effort to attain organization's objectives through fulfilment the needs and consumption, in accordance with the competence, organisation capacity and purchasing power in the market as well.

2.3 Quality Control

Quality control is an activity (company management) to maintain and lead in order to maintain the quality of the product (and service) as planned. It is a preventive and done before the product quality is defect. (Ahyari, 2000). Quality definition is abroad because it is related to some elements that influence the quality which has to be included and considered.

*2.*4 Six Sigma

Six sigma is a process of using statistical tools and defect reduction technique which is not more than 3.4 defects from one billion possibility to attain totally customers satisfaction. Six sigma gives more value to the costumers and share-holder by focusing on quality and company's productivity improvement (Gaspersz, 2001).

2.5 Research Problems

Preliminary observation and further observation. This stage is started by understanding the vision, mission, and desired objectives and the problems faced by the company at the time of this research. Then the researcher observed directly on production process site.

2.6 Library Research

Library research is a reference arrangement stage which is related and supports this study. The references are from books, journals, previous research, and other sources which support this study about quality control, six sigma, and other supporting tools.

3. Result and Discussion

3.1 Data Collection

The following data are about production and defects data of *Nylon* Filament Yarn on July 2014 on

Table 1. Production and Deffect Data of Nylon Filament Yarn

No	Date	Full Pirn (unit)	Types of Defects							Total (unit)
			Dirty (unit)	Bobin Defect (unit)	Mottled /UV (unit)	Badform (unit)	Oil (unit)	Zure/ Flyes (unit)	Keba (unit)	
1	01-Jul-14	113	11				7			18
2	02-Jul-14	119	3		4		2			9
3	03-Jul-14	117	8		5	1	8	1		23
4	04-Jul-14	224	8	2	5		13			28
5	06-Jul-14	252	5		7	2	8			22
6	07-Jul-14	116			1	20	4			25
7	08-Jul-14	118	5	1	2		2			10

8	09-Jul-14	126			5		3			8
9	10-Jul-14	121	2		6		4	2	1	15
10	11-Jul-14	97	3		4		1		1	9
11	12-Jul-14	145	4		10		5		1	20
12	13-Jul-14	118	2		6	1	4		3	16
13	14-Jul-14	108	4		1		3		1	9
14	15-Jul-14	122	3		2		5			10
15	16-Jul-14	119	5		2		6			13
16	17-Jul-14	235	6	1	20		8		1	36
17	18-Jul-14	213	3	1	10		7	1		22
18	21-Jul-14	113	2	1	6		1			10
19	22-Jul-14	235	9	1	9	1	5	2		27
20	23-Jul-14	250	8		11		10		1	30
21	24-Jul-14	111	1		2		2			5
22	25-Jul-14	122					4			4
23	26-Jul-14	239					6			6
24	27-Jul-14	117					4			4
25	28-Jul-14	226	5		6	28	1			40
26	30-Jul-14	365	7		5	5	5			22
27	31-Jul-14	118	4		3	3				10
	Total	4359	108	7	132	61	128	6	9	451

3.2 Tabulation Data

3.1 Define Stage

Define stage is a preliminary stage in DMAIC method. At this stage, the researcher defines the plans, action that should be done to control the quality. It aims to know the condition and problems deeper from the process side.

In nylon Filament Yarnproducts still have some defects which become the problems in production process. So that, the researcher defines the types of defects on *Nylon Filament Yarn*. Those types of defects are arranged in this CTQ tree diagram:

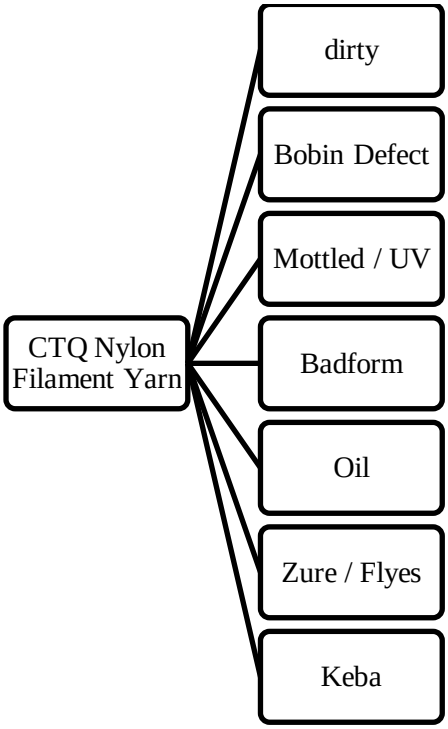

Figure 1. CTQ Tree Nylon Filament Yarn Product

3.2 Measure Stage

The next stage is performance assessment as first reference before doing improvement measurement to know the company production process condition including calculation of control chart P, DPMO, SQL, dan Yield.

Table 2. DPMO and SQL score of Nylon Filament Yarn Product

No	Date	Production	Defect	CTQ	DPO	DPMO	SQL
1	01-Jul-14	113	18	7	0,02276	22756	3,50
2	02-Jul-14	119	9	7	0,0108	10804,3	3,80
3	03-Jul-14	117	23	7	0,02808	28083	3,41
4	04-Jul-14	224	28	7	0,01786	17857,1	3,60
5	06-Jul-14	252	22	7	0,01247	12471,7	3,74
6	07-Jul-14	116	25	7	0,03079	30788,2	3,37
7	08-Jul-14	118	10	7	0,01211	12106,5	3,75
8	09-Jul-14	126	8	7	0,00907	9070,29	3,86
9	10-Jul-14	121	15	7	0,01771	17709,6	3,61
10	11-Jul-14	97	9	7	0,01325	13254,8	3,72
11	12-Jul-14	145	20	7	0,0197	19704,4	3,56
12	13-Jul-14	118	16	7	0,01937	19370,5	3,57
13	14-Jul-14	108	9	7	0,0119	11904,8	3,76
14	15-Jul-14	122	10	7	0,01171	11709,6	3,77

15	16-Jul-14	119	13	7	0,01561	15606,2	3,66
16	17-Jul-14	235	36	7	0,02188	21884,5	3,52
17	18-Jul-14	213	22	7	0,01476	14755,2	3,68
18	21-Jul-14	113	10	7	0,01264	12642,2	3,74
19	22-Jul-14	235	27	7	0,01641	16413,4	3,64
20	23-Jul-14	250	30	7	0,01714	17142,9	3,62
21	24-Jul-14	111	5	7	0,00644	6435,01	3,99
22	25-Jul-14	122	4	7	0,00468	4683,84	4,10
23	26-Jul-14	239	6	7	0,00359	3586,37	4,19
24	27-Jul-14	117	4	7	0,00488	4884	4,08
25	28-Jul-14	226	40	7	0,02528	25284,5	3,46
26	30-Jul-14	365	22	7	0,00861	8610,57	3,88
27	31-Jul-14	118	10	7	0,01211	12106,5	3,75
	Total	4359	451	7	0,01488	14875	3,72

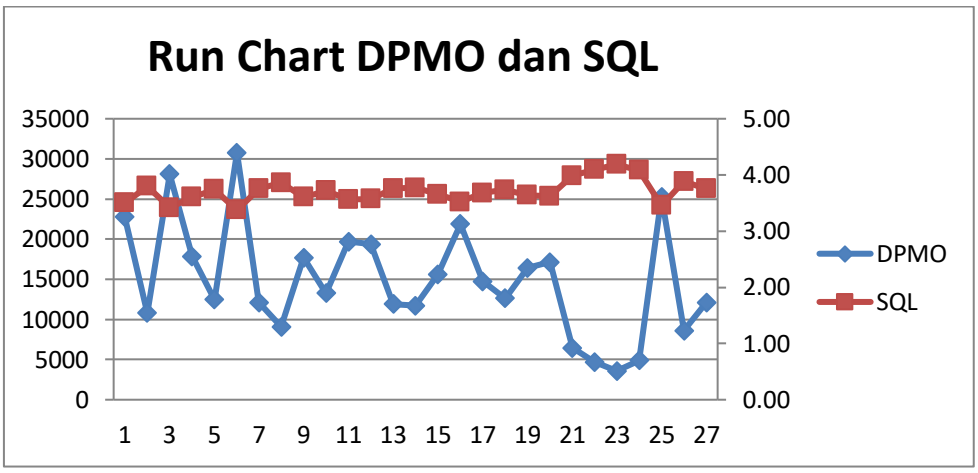

Figure 2. Graphic of DPMO and SQL score Nylon Filament Yarn Product

3.3 Data Analysis

3.3.1 Analysis Stage

At this stage, the researcher will analyse the causes of defect possibility on the production process stage of Nylon Filament Yarn. However, to make the analysis easier, the first step that should be done is to make pareto diagram to know thedominant types of defect of the products. After that, it will make problem solver by making cause and effect diagram or fish bone.

Table 3. Percentage Defect Types

Types of Defect	Total	Defect (%)	Cumulative (%)
Mottled /UV	132	29,27	29
Oil	128	28,38	58
Dirty	108	23,95	82

Badform	61	13,53	95
Keba	9	2,00	97
Bobin Defect	7	1,55	99
Zure/Flyes	6	1,33	100
Total	451		

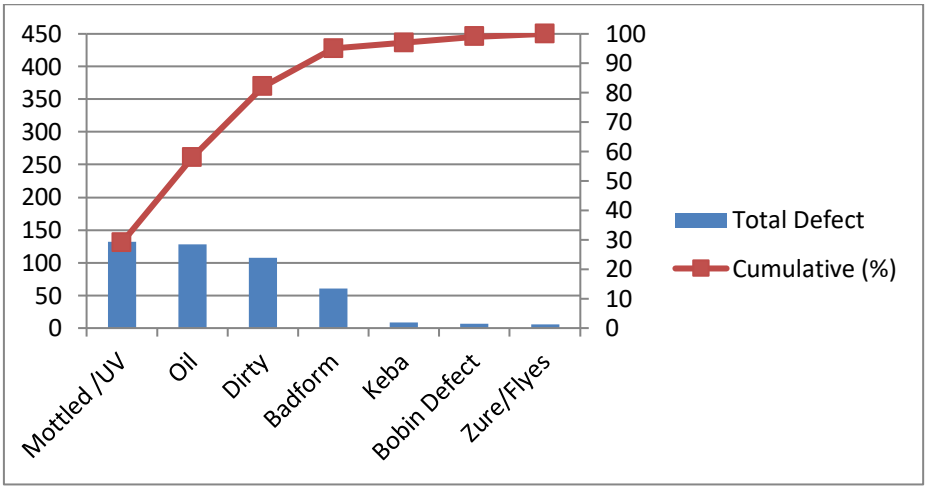

Figure 3. Graphic of Pareto Diagram of Nylon Filament Yarn

4. Conclusion and Suggestion

4.1 Conclusion

1. Based on Pareto diagram, it shows the dominant types of defect of Nylon Filament yarn. The dominants defects are mottled/UV about 29,3%, oil about 28,4%, dirty about 23,9%, bad form about 13,5%, and the rest about 4,9%.
2. DPMO and Sigma Quality Level score for Nylon Filament Yarn process on july 2014 is 14875 and its sigma score is 3.72. It means that sigma score is influenced by DPOM score. If DPMO score decreases so the sigma score will raise by itself and vice versa.

4.2 Suggestion

1. It is better to apply DMAIC and FMEA Method on the production process of Nylon Filament Yarnat PT. Indonesia Toray Synthetics to improve the quality of product and to decrease the defect of the product later on.
2. The company should give training to the operator in order to comprehend employees Standard Operating Procedure (SOP) and to be more careful. Moreover, it would be better to give training to new employees who do not understand SOP, so that they can decrease the number of defect because of new operator who are dereliction and careless and also improve the air circulation in company.

References

Ahyari Agus, *Manajemen Produksi*, (Yogyakarta : BPFE), 2000

Gaspersz V, *Total Quality Manajemen Untuk Praktisi Bisnis dan Industri*, (Jakarta: GramediaPustakaUtama), 2001

Gasperz, Vincent.,"*Lean Six Sigma for Manufacturing and Service Industries-Strategi Dramatik Reduksi Cacat/Kesalahan Biaya, Inventori, dan Lead Time dalam Waktu Kurang dari 6 Bulan"*, Gramedia Pustaka Utama, Jakarta, 2007

Gasperz, Vincent.,"*Metode Analisis Untuk Peninngkatan Kualitas ISO 9001:2000 Clause 8: Measurement, Analysis and Improvement"*, Gramedia Pustaka Utama, Jakarta, 2003

Gaspersz, Vincent., "*Total Quality Management",* Gramedia Pustaka Utama, Jakarta,2001

Kotler P & Keller K.L, *Manajemen Pemasaran*, (Jakarta: PT. Indeks), 2009

S.Pande, Peter, Robert P.Neuman, dan Roland R. Cavanagh, 2000,***The Six sigma Way***, New York: McGraw-Hill.

Biographies

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