



## Quality Control Analysis on Animal Feed Storage to Minimize Defect Using Six Sigma Method in PT XYZ

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### Abstract

At PT XYZ, defects in animal feed storage were found in the form of expired, infested, skewed lots, and leaking sacks. The purpose of this research is to analyze quality control to minimize the number of defects in animal feed storage at PT XYZ. The method used is the Six Sigma method with the DMAIC (Define, Measure, Analyze, Improve, and Control) stages and the Kaizen Five-M Check List method at the improve stage. The result of this study is the highest number of defects in animal feed storage in the form of leaky sacks with a percentage of 83% of 1.459 sacks. The Defect Per Million Opportunities (DPMO) value obtained shows that there is a possibility of 59.726 defects per one million production with a sigma level value of 3,125 which means that the quality is not consistent and maximum. The conclusion of this research is that the company needs to implement the improvement suggestions that have been given to minimize the number of defects in animal feed storage and routinely conduct inspections and evaluations to avoid the same mistakes that can later cause defects so that quality and sigma levels can be improved.

**Keywords:** Defect, DMAIC, Kaizen, Quality Control, Six Sigma

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### 1. Introduction

Along with the times and technology, there are more and more companies that sell similar products and cause consumers to be very selective in choosing a brand. Companies compete with each other for consumers and produce products that are in demand by consumers. This requires each company to always maintain and improve the balance between the quantity and quality of the products produced. Quality is a factor in a product that shows whether or not the function is in accordance with the purpose of making the product [1]. A quality product will attract consumers to buy the product. Therefore, quality control is a process that is very influential in producing good quality products so that it can provide satisfaction to consumers. Quality control is an activity carried out starting from before the production process, during the production process, and after production. Quality control is carried out so that the products produced can meet the desired and planned standards and are expected to improve the quality of products that were previously considered not to meet the standards [2]. The less defects caused, the less losses the company will experience and the company will have good branding in the eyes of customers.

One of the industrial fields that has many competitors is the animal feed industry, one of the companies that produces animal feed is PT XYZ. The products produced have various types and are distributed both at home and abroad. To always maintain the quality of the products produced, PT XYZ carries out quality control activities including during the storage of animal feed before being distributed to consumers. Quality control during storage consists of checking the environment and the animal feed itself. Although quality control procedures have been implemented, some defects can still be found in the storage of animal feed either in the product or in the environment.

Research on product quality control is not new, there has been research on this subject, such as "Analysis of Product Quality Control Using Six Sigma and Kaizen Methods (Case Study: PT XYZ)". In the study, there were four types of defects identified in the production of the initial components of mill 1, namely cracks and holes, knots, color defects, and also size error defects with the most dominant type of defect being cracks and holes with a percentage of 50.04%. These defects are caused by various factors such as negligent employees, a less ergonomic work environment, an improper wood drying process, wood materials that do not meet specifications, and machines that lack maintenance. Proposed improvements to overcome these factors include conducting training and socialization for workers, rearranging the work environment, routine maintenance for machines, and making SOP that regulate all aspects related to production [3]. In this study, the problem analyzed is the presence of defects in animal feed storage. The problem is analyzed using the Six Sigma method with the DMAIC (Define, Measure, Analyze, Improve, and Control) stages and the Kaizen Five-M Check List method to determine improvements that must be made to minimize defects in animal feed storage.

## 2. Literature Review

### 2.1. Quality

Quality is a dynamic condition of products, services, processes and tasks, and the environment that meets customer or consumer expectations. The quality of goods and services is defined as a combination of the characteristics of these goods and services based on marketing, engineering, production, and maintenance which allows customers or consumers to assess whether these goods and services can meet expectations or not. A good or service will be considered quality if it can meet consumer expectations for the value of the good or service [4]. The quality of a product is one of the criteria considered by consumers in choosing a product. Product quality is also an important indicator for companies in order to continue to exist amid the intense competition that exists in the industrial world. Product quality is solely determined by consumers so that customer satisfaction can only be achieved by providing good quality ad in accordance with what consumers want [5].

### 2.2. Quality Control

Quality control is an activity that is carried out starting from before the production process, during the production process, and after production. Quality control activities in the production process include controlling, managing, and ensuring that all processes experienced by a product starting from raw materials to finished goods run well, so that the quality of products produced by the company is always in accordance with the standards that have been determined according to company policy and if any deviations, corrective action can be taken immediately. Good quality control is very necessary to be applied in a production flow to minimize the possibility of defective products and the products produced are of good quality and can meet customer needs [6]. In addition to ensuring that the quality of the products produced is always good, quality control also aims to keep the costs used by the company in producing a product as small as possible so that the profits the company has can be higher. With guaranteed product quality, the company can meet consumer demand and have good branding in the eyes of the community [7]

### 2.3. Six Sigma

Six Sigma is a comprehensive and flexible system to achieve, support, and maximize a process that focuses on understanding consumer needs based on facts, data, statistical analysis, and careful attention to continuously manage, improve, and reviewing a business process [8]. The concept of six sigma statistics is to measure a process related to defects at the six sigma level, which is only 3,4 defects out of one million opportunities. Six Sigma focuses on removing defects from a process by emphasizing understanding, measuring, and improving the process. Six Sigma aims to produce sustainable success by continuing to grow and master market growth by continuing to innovate. In six sigma there are DMAIC stages which are the process of eliminating unproductive steps and focusing on new measurements and applying technology to improve quality towards six sigma targets, the DMAIC stages include [9]:

1. Define  
Define is the first step in determining the process to be evaluated by considering the stages of the process that significantly affect profit creation for the company.
2. Measure  
Measure is the second step in the six sigma method which aims to determine the extent of the production process's ability to produce final products that can meet customer requirements.
3. Analyze  
In the analyze stage, problem identification and determination of the source of the cause of quality problems are carried out using a cause and effect diagram.
4. Improve  
At the improve stage, identification and description of corrective actions are carried out which become recommendations for solving problems at the process stage so as to increase sigma capability. The purpose of this stage is to improve system elements to achieve the desired target.
5. Control  
The control stage is the control stage after making corrective efforts by evaluating all actions and improvements that have been attempted to determine the success of the efforts that have been applied, and so that when there are new problems, they can be handled immediately to prevent greater damage.

### 2.4. Kaizen

Kaizen is a system used to make continuous or sustainable improvements by involving all elements in the company. This system can be successfully carried out with the support of good and appropriate human resources because humans are the most important factor in the process of improving quality and productivity. Implementation tools used in kaizen include [10]:

1. Kaizen Five M-Checklist  
This tool is used and focuses on making improvements based on five factors in an activity or process, namely man (worker), machine, material, method, and environment.

2. Kaizen Five Step Plan

This tool is often used by Japanese companies to minimize problems that occur in the existing process, often referred to as 5S, namely Seiri (organization of goods by getting rid of unnecessary items and grouping according to function and type), Seiton (arrangement of goods according to their place for safety, maintaining quality, and making it easier to find), Seiso (cleaning all facilities and the environment), Seiketsu (activities to maintain health and cleanliness to avoid deviations and take precautions as soon as possible), and Shitsuke (motivating workers to comply with existing regulations in the company).

3. Kaizen 5W+1H

A method used to find and investigate problems in a production process or work environment. Includes what, who, when, where, why, and how

3. Research Method

3.1. Data Source

The research was conducted directly through collaboration with the Quality Control Department, so the data used is primary data in the form of quantitative data and qualitative data obtained from PT XYZ. The quantitative data used is data on animal feed storage defects in the company for the last 10 months, namely month January to October 2024 with a total of 40 data obtained from company document and data archives. Meanwhile, qualitative data was obtained from direct observations and interviews at the company

3.2. Data Analysis Method

In this study, the analysis was carried out using the Six Sigma method. In the first stage of Six Sigma, namely define, there is a project statement and SIPOC Diagram to identify problems. Then, at the measure stage, analysis is carried out with Critical to Quality (CTQ) to determine the number of each type of defect, Kolmogorov-Smirnov Test to determine whether the data is normally distributed, as well as DPMO and Sigma calculation to determine the sigma level of existing quality. Then, at the analyze stage, a pareto diagram is used to determine the types of defects that must be prioritized for handling and then looking for the causal factors using a fishbone diagram. At the improve stage, the Kaizen Five-M Check List method is used to determine the proposed improvements from the factors that cause existing defects. Then, at the control stage, further action is determined after the proposed improvements are carried out.

4. Result and Discussion

From the observations made at PT XYZ, defect data was obtained on the storage of animal feed products from January to October 2024 which resulted in 40 data. Data processing is carried out using the Six Sigma method and analyzed with DMAIC (Define, Measure, Analyze, Improve, and Control) as follows:

1. Define

Define is the first step in the six sigma method, at the define stage the problems that occur in the company are identified, namely the high number of defects in the storage of feed products.

Table 1: Project Statement

Component	Explanation
Business Case	PT XYZ is a company that produces animal feed. The company wants to deal with the problem of defects found in the storage of animal feed before distribution. Therefore, PT XYZ wants to analyze to minimize defects in the storage of animal feed products
Problem Definition	There are 4 types of defects found in animal feed storage, namely expired, ticky, tilted plots, and leaky sacks.
Project Scope	The object observed are feed products and animal feed storage area that was defective. The data used is observation data for 10 months and produced 40 sample data.
Goal Statement	Analyzing using the six sigma method with the stages of define, measure, analyze, improve, and control so as to provide suggestions for improvements that can be implemented by PT XYZ.

SIPOC (Supplier, Input, Process, Output, and Customer) diagram is a diagram used to provide a general description such as what suppliers will be input, then the production process that is passed which then produces the product as desired, and who are the consumers of the product.

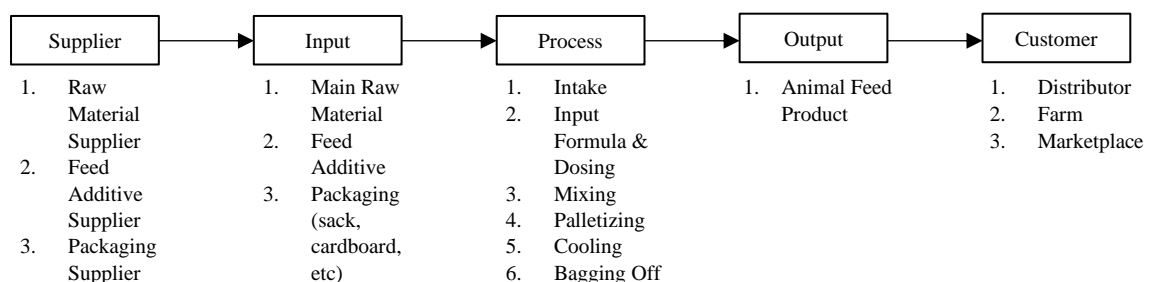


Fig. 1: SIPOC Diagram

2. Measure

Measure is the second stage in the six sigma method, at this stage problem identification and measurement of the data that has been obtained are carried out. Identification of defective products is used to determine Critical to Quality (CTQ) and DPMO values using six sigma which shows that defective products in animal feed storage amount to 1,459 sacks, which means that improvements need to be made to minimize the number of defective products or even produce zero defects.

**Table 2: Critical to Quality**

No.	Defect Type	Total	Percentage of Defects (%)	Cumulative Percentage (%)
1.	Expired	55	4%	4%
2.	Ticky	85	6%	10%
3.	Tilted Plot	106	7%	17%
4.	Leaky Sack	1213	83%	100%
<b>Total</b>		<b>1459</b>	<b>100%</b>	

Before calculating the DPMO value, the Kolmogorov-Smirnov test was carried out to find out whether the existing data was normally distributed or not. The Kolmogorov-Smirnov test was carried out using IBM SPSS software.

Parameters:

- Sig > 0,05 then the data is normally distributed.
- Sig < 0,05 then the data is not normally distributed.

**One-Sample Kolmogorov-Smirnov Test**

		Unstandardized Residual
N		40
Normal Parameters <sup>a,b</sup>	Mean	.0E-7
	Std. Deviation	16.91808747
Most Extreme Differences	Absolute	.099
	Positive	.050
	Negative	-.099
Kolmogorov-Smirnov Z		.624
Asymp. Sig. (2-tailed)		.831

- a. Test distribution is Normal.
- b. Calculated from data.

**Fig. 2: Kolmogorov-Smirnov Test**

Based on the output obtained from the IBM SPSS software, it is known that the number of observations is 40 with an average value of 0E-7, a standard deviation of 16,92, and a Kolmogorov-Smirnov Z value of 0,624. A significant value > 0,05 is 0,831, so it can be concluded that the data is normally distributed.

**Table 3: DPU, TOP, DPO, DPMO, and Sigma (σ)**

Week	Total Observations	Total Defects	CTQ	DPU	TOP	DPO	DPMO	SIGMA
1	153	6	4	0,0392	612	0,0098	9803,9216	3,8338
2	152	28	4	0,1842	608	0,0461	46052,632	3,1844
3	154	8	4	0,0519	616	0,0130	12987,013	3,7266
4	157	53	4	0,3376	628	0,0844	84394,904	2,8761
5	153	5	4	0,0327	612	0,0082	8169,9346	3,9012
6	154	68	4	0,4416	616	0,1104	110389,61	2,7245
7	154	19	4	0,1234	616	0,0308	30844,156	3,3685
8	150	48	4	0,3200	600	0,0800	80000	2,9051
9	153	3	4	0,0196	612	0,0049	4901,9608	4,0827
10	153	40	4	0,2614	612	0,0654	65359,477	3,0113
11	154	26	4	0,1688	616	0,0422	42207,792	3,2256
12	153	43	4	0,2810	612	0,0703	70261,438	2,9738
13	152	15	4	0,0987	608	0,0247	24671,053	3,4656
14	150	24	4	0,1600	600	0,0400	40000	3,2507
15	151	62	4	0,4106	604	0,1026	102649,01	2,7666
16	152	43	4	0,2829	608	0,0707	70723,684	2,9704
17	155	64	4	0,4129	620	0,1032	103225,81	2,7634
18	153	54	4	0,3529	612	0,0882	88235,294	2,8517
19	155	14	4	0,0903	620	0,0226	22580,645	3,5031
20	151	46	4	0,3046	604	0,0762	76158,94	2,9314
21	155	15	4	0,0968	620	0,0242	24193,548	3,4740
22	151	39	4	0,2583	604	0,0646	64569,536	3,0175
23	151	51	4	0,3377	604	0,0844	84437,086	2,8758
24	152	46	4	0,3026	608	0,0757	75657,895	2,9349
25	150	49	4	0,3267	600	0,0817	81666,667	2,8939
26	155	24	4	0,1548	620	0,0387	38709,677	3,2659
27	153	28	4	0,1830	612	0,0458	45751,634	3,1875
28	155	33	4	0,2129	620	0,0532	53225,806	3,1143
29	155	39	4	0,2516	620	0,0629	62903,226	3,0309
30	153	56	4	0,3660	612	0,0915	91503,268	2,8316

Week	Total Observations	Total Defects	CTQ	DPU	TOP	DPO	DPMO	SIGMA
31	153	58	4	0,3791	612	0,0948	94771,242	2,8119
32	151	36	4	0,2384	604	0,0596	59602,649	3,0581
33	150	39	4	0,2600	600	0,0650	65000	3,0141
34	150	37	4	0,2467	600	0,0617	61666,667	3,0409
35	154	49	4	0,3182	616	0,0795	79545,455	2,9081
36	155	53	4	0,3419	620	0,0855	85483,871	2,8691
37	152	35	4	0,2303	608	0,0576	57565,789	3,0755
38	152	35	4	0,2303	608	0,0576	57565,789	3,0755
39	151	38	4	0,2517	604	0,0629	62913,907	3,0308
40	154	30	4	0,1948	616	0,0487	48701,299	3,1576
<b>Total</b>	<b>6111</b>	<b>1459</b>	<b>160</b>	<b>9,556209</b>	<b>24444</b>	<b>2,389052</b>	<b>2389052,3</b>	<b>124,9845</b>
<b>Rata-Rata</b>	<b>152,775</b>	<b>36,475</b>	<b>4,000</b>	<b>0,239</b>	<b>611,100</b>	<b>0,060</b>	<b>59726,307</b>	<b>3,125</b>

Based on the calculation table above, it can be seen that the DPMO value obtained by from animal feed storage data from January to October 2024 is 59.726 and then converted to a sigma level of 3,125. This value indicates that there is a possibility of 59.726 damage for one million productions. The resulting sigma level value shows that the quality is still not consistent and maximized, so improvements need to be made in order to improve quality and sigma level. If not handled properly, this can affect the company and can even cause losses. The resulting quality can be considered very good if it has received a level sigma value of 6. If the level sigma value owned by the company is 6, the company can be classified as a competitive company and can compete well in the industrial world.

3. Analyze

Analyze is the third stage in the six sigma method, at this stage the most dominant defects are identified along with the root causes of the problems that affect the defects. To find out the most dominant defects, pareto diagrams are used, as well as fishbone diagram to find out the root cause of the defects.

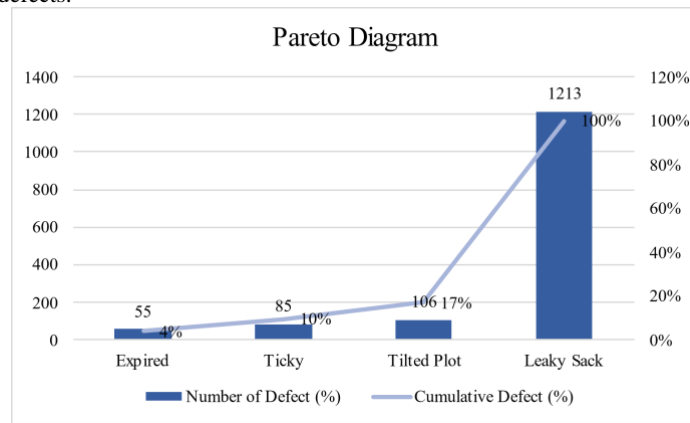


Fig. 3: Pareto Diagram

The pareto diagram above show that the type of defect that must be prioritized is a leaky sack so that the number of defects in animal feed storage can be reduced so that the company does not experience losses.

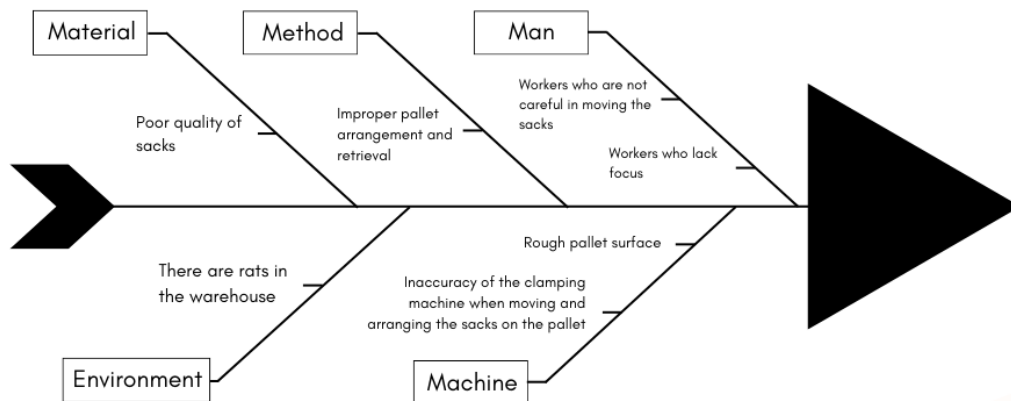


Fig. 4: Fishbone Diagram

4. Improve

Improve is the fourth stage in the six sigma method, at this stage improvement proposals are given to overcome existing problems using the Kaizen Five-M Check List, as follows:

Table 4: Kaizen Five-M Check List

Factor	Problem	Proposed Improvement
Man	<ul style="list-style-type: none"> <li>Workers who lack focus</li> <li>Workers who are not careful in moving the sacks</li> </ul>	Provide self-development training and regular briefings at the beginning of shifts to be more focused and careful in doing work.

<b>Method</b>	Improper pallet arrangement and retrieval	Ensure pallet stacking is in accordance with the SOP and the pallet retrieval process is correct / does not miss so that it is not hit by the sack.
<b>Material</b>	Poor quality of sacks	Selection of more quality sack materials (make an agreement with the supplier)
<b>Machine</b>	<ul style="list-style-type: none"> <li>• Rough pallet surface</li> <li>• Inaccuracy of the clamping machine when moving and arranging the sacks on the pallet</li> </ul>	<ul style="list-style-type: none"> <li>• Inspect the pallet to be used and immediately repair or provide a base on the pallet that has a non-conformity.</li> <li>• Make sure the machine clamp settings are appropriate.</li> </ul>
<b>Environment</b>	There are rats in the warehouse	Carry out effective rat pest control

## 5. Control

Control is the fifth and final stage in the six sigma method, this stage is carried out so that the company can maintain the success of the handling that has been done to reduce defects in animal feed storage. The action that need to be taken are:

- 1) Conduct routine inspections of workers, methods (SOP), materials, machines, and animal feed storage environments.
- 2) Conduct routine evaluations related to all activities that occur, especially in animal feed storage.

## 5. Conclusion

Based on the results of data analysis of animal feed storage defects at PT XYZ from January to October 2024, it is known that the most dominant type of defect is leaky sacks with a percentage of 83%. These defects are caused by various factors, namely humans, methods, materials, machines, and the environment. The human factor is workers who are less focused and less careful in moving the sacks with suggestions for improvement in the form of providing self-development training and briefing at the beginning of the shift. Method factors in the form of improper pallet arrangement and retrieval with suggestions for improvement in the form of ensuring pallet arrangement according to the SOP and the sack retrieval process does not miss so as not to be hit by the sack. Material factors in the form of poor quality sacks with suggestions for improvement in the form of choosing and making agreements with suppliers who sell sacks with good quality. Machine factors in the form of rough pallet surfaces and inaccurate clamping machines when moving and arranging sacks on pallets with suggestions for improvement in the form of checking the pallets and making repairs or providing mats on pallets that have discrepancies and ensuring that the clamping machine settings are appropriate. Environmental factors in the form of rats in the warehouse with suggestions for improvement in the form of effective rat pest control. To overcome the existing problems, the company should carry out handling in accordance with the improvement suggestions that have been given, then to avoid repeating the same mistakes the company should carry out routine checks and evaluations related to all existing activities, especially in animal feed storage. That way it is hoped that PT XYZ can improve the quality of animal feed storage so that existing defects can also be minimized.

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