



Proposed Improvement Plan for Quality Management in Crafting Industry (Case Study of PT Global Kriya Nusantara)

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ABSTRACT: Crafting industry is one of the creative economy subsectors under the Ministry of Tourism and Creative Economy of the Republic of Indonesia. PT Global Kriya Nusantara or later will be mentioned as Kriya Nusantara is one of the craft industry actors in West Java, specifically in Bandung City. Established in 1995, Kriya Nusantara exported craft goods to several countries. In order to fulfil its demand, Kriya Nusantara needs a great strategy, especially for its quality management. In this case, the proposed system to be improved is the quality management of Kriya Nusantara due to the occurrence of rejected products in one of its project production processes. One of the projects that will be analysed in this research is Ramadhan Box 2022 which was ordered by Al-Jazeera Perfumes – Qatar. The problem is, that there are some defective finished goods that later will be rejected and needs to be repaired or reworked.

The Six Sigma method has been utilised in this research as a primary tool. The Six Sigma in this research contains the DMAIC framework that will be useful to define the main issue, measure the capability of the process, analyse the business situation, and propose the improvement plans along with the control plans for the production process of Kriya Nusantara. According to this research, there are six defect types that occurred in this production process, and the defect type that has the greatest RPN value is the Minor Paint Defect with a 320 RPN value and has critical risk level. The causes of each defect type have been analysed using FMEA analysis and there are four causes which are human error, miscommunications, unskilled labour, and defective raw materials. The FMEA analysis also has been utilised to propose the business solution alternatives in this research. There are three proposed business solutions for the causes which are progress monitoring for the human error and miscommunication issues, labour training for the unskilled labour, and supplier's product evaluation for the defective raw materials. Those improvements will reduce the defect of the products so that the quality of the products of Kriya Nusantara will be enhanced.

KEYWORDS: Defect, DMAIC, DPMO, FMEA Analysis, Quality Management, Six Sigma.

INTRODUCTION

Crafting industry is one of the creative economy subsectors under Ministry of Tourism and Creative Economy of the Republic of Indonesia. Based on the book Creative Economy: Indonesia's New Power Towards 2025, Crafts are defined as a type of applied art that comes from a legacy of tradition or contemporary ideas, and the results can be in the form of works of art, functional products, decorative and decorative objects, and can be classified based on materials and exploration of the technical tools utilised, as well as the thematic product (Kemenparekraf, 2014). In West Java, the top three subsectors creative economic are music, culinary, and art performance industries. While the top three cities/districts are Bandung City, Bandung District, and Depok City. Even though craft industry is not on the top three in West Java, it still has an important role in the development of the creative economy in West Java. PT Global Kriya Nusantara or later will be mentioned as Kriya Nusantara is one of the craft industry actors in West Java, specifically in Bandung City.

Established in 1995, Kriya Nusantara exported craft goods to several countries in Middle East such as Qatar, Kuwait, and Dubai since 2001. It also shipped its products to Europe, United States, and Asia. In order to fulfil its demand, Kriya Nusantara needs a great strategy especially for their quality management. As the time goes by, Kriya Nusantara has to adapt with the situation especially when it faced the pandemic outbreak back in 2019 to 2020. Therefore, in order to enhance its strategy, improvement plan is a mandatory for Kriya Nusantara. In this case, the proposed system to be improved is quality management of Kriya Nusantara due to occurrence of the rejected products in one of its project productions processes. The reduction of defected or rejected products is mandatory for the company.



BUSINESS ISSUE

Based on researcher observation, there are several rejected finished goods in the production process of the project of PT Global Kriya Nusantara. One of the projects that will be analysed in this research is Ramadhan Box 2022 which was ordered by Al-Jazeera Perfumes – Qatar. It is the project for the perfume boxes for the Al-Jazeera Perfumes products. The project contains four categories, which are Ramadhan Box Small, Ramadhan Box Medium, Ramadhan Box Large, and Ramadhan Box XL. Actually, Ramadhan Box is one of the annual projects ordered by Al-Jazeera Perfumes – Qatar since 2017. Each category in each project has different quantity. The project of Ramadhan Box 2022 requires 6,100 pieces of products in total to be completed. The problem is, there are some defective finished goods that later will be rejected and needs to be repaired or reworked. The company requires acceptable defective percentage of 5 per cent. Here is the data of rejected finished goods of Ramadan Box 2022 project.

Product	Project Code	Costumer Name	Project Name	Order Quantity	Accepted Quantity	Rejected Quantity	Rejection Category	
							Major	Minor
Ramadhan Box Small	KNG 110	Al-Jazeera Perfumes - Qatar	Ramadhan Box 2022	2,800	2,331	469	103	366
Ramadhan Box Medium	KNG 109	Al-Jazeera Perfumes - Qatar	Ramadhan Box 2022	2,000	1,686	314	58	256
Ramadhan Box Large	KNG 108	Al-Jazeera Perfumes - Qatar	Ramadhan Box 2022	1,200	1,043	157	31	126
Ramadhan Box XL	KNG 136	Al-Jazeera Perfumes - Qatar	Ramadhan Box 2022	100	86	14	3	11
Total				6,100	5,146	954	195	759

Figure 1. Product Reject Report
(Source: Company Database)

Based on the *Figure 1* above, minor rejection of the finished goods happened the most than major rejection. However, it could not be ignored as it also hampered the production process. The finished goods that have a minor defect such as a minor scratches or dents on the paint, and damaged or jammed hinge, only need to be repaired. While the ones that have major defects such as dimension fault which do not meet the requirements, major paint scratches and dents, dents on the veneer, or other defects that requires advance treatment, will be reworked. Moreover, the major rejection that highly impacted the production process was dimensional defect because if the product dimension was not met the requirements, it has to be reworked from the very start of the production.

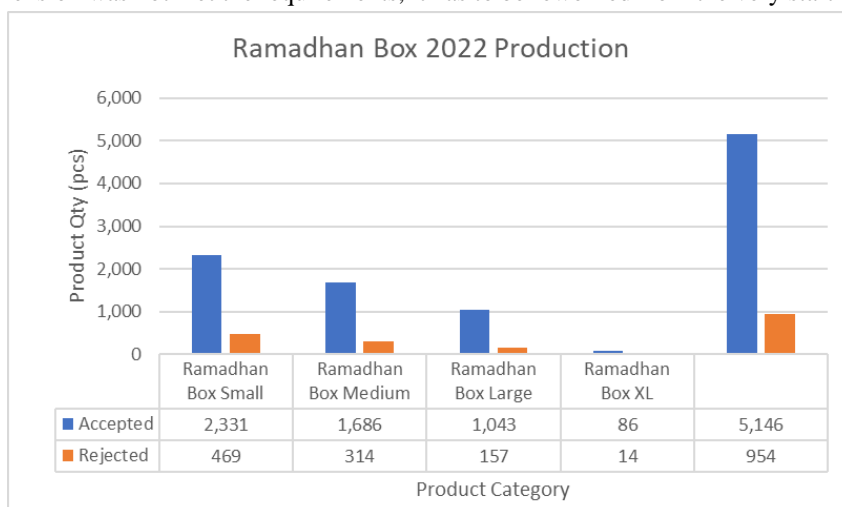


Figure 2. Production Data of Ramadhan Box 2022 Project
(Source: Company Database)

From the chart above, there are data of the rejected products in total of 954 pieces of products. Which is about 15.64% of total production. It surely the number that cannot be denied by the company. This issue surely gives the bad impact for the company especially for its operating costs.

BUSINESS ISSUE EXPLORATION

A. Conceptual Framework

In order to facilitate the researcher or author in finding the root causes of the business issues that arose to later be analysed and elaborated, a conceptual framework was created. Relevant basic theory was involved in this conceptual framework to solve the business issues that arose with a proper solution. In this research, the main business issue is the rejected product of Ramadhan Box 2022 Project of PT Global Kriya Nusantara. Due to this main issue, researcher have to propose an improvement plan for PT Global Kriya Nusantara. The Six Sigma method has been utilised in this research as a primary tool in order to find the root causes of the business issue. This method will assist the author in analysing the business situation due to the determined root causes. The Six Sigma in this research contains a main issue, which is the rejection of finished goods in the production process of the Ramadhan Box 2022 Project of PT Global Kriya Nusantara. Afterward, this issue will be analysed further to obtain the root causes. Here is the conceptual framework for this research.

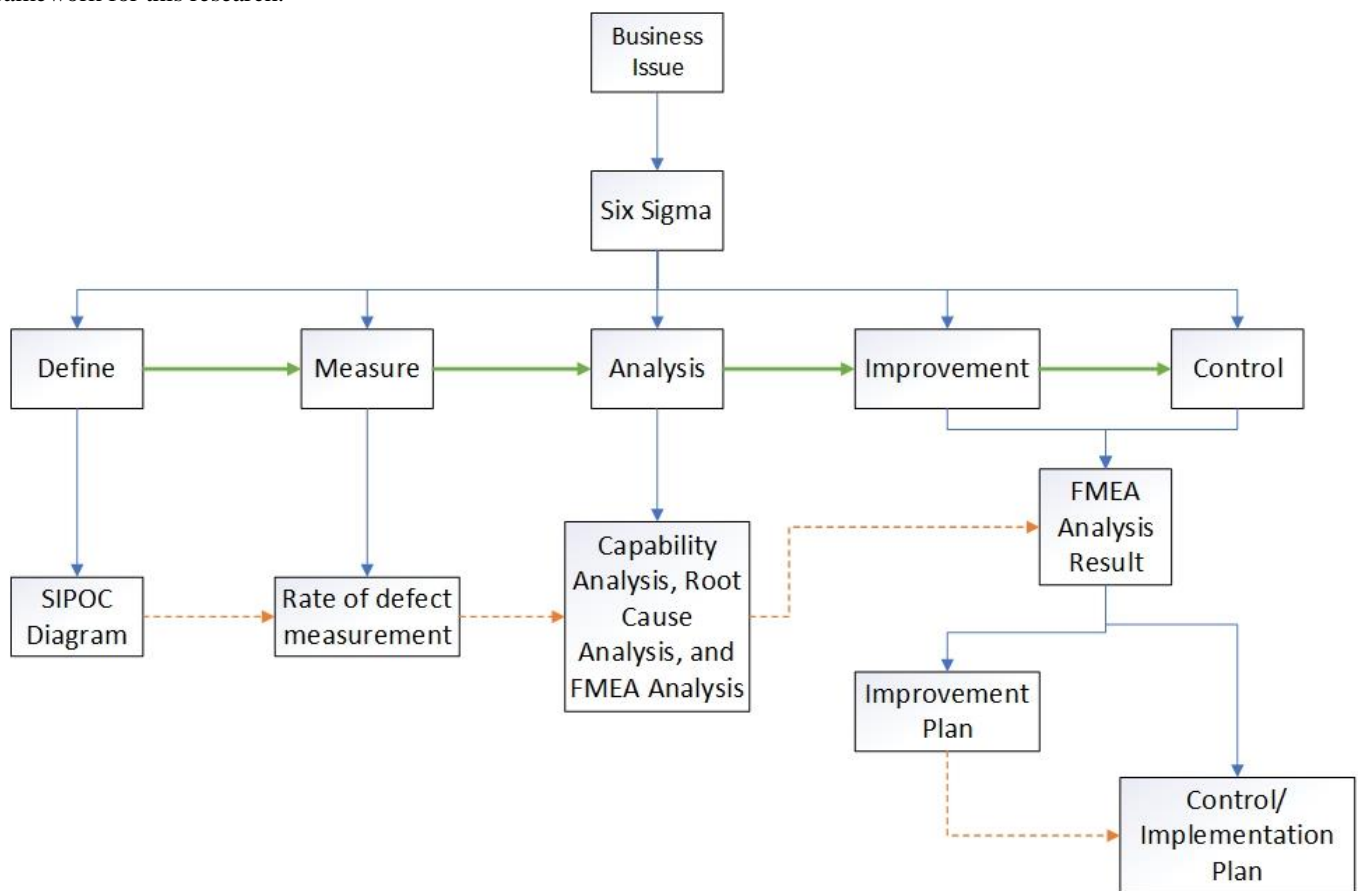


Figure 3. Conceptual Framework

First, the business issue will be defined using the SIPOC diagram in the define phase of DMAIC cycle. And then, the significant rate of defect will be measured in the Measure phase. The third step is to extract information from the data obtained in the measure phase using capability analysis in the Analyse Phase. The Analyse Phase also utilising FMEA Analysis. The root causes will also be determined in this phase by utilising 5 Why Framework. The specified root causes will next be analysed and the improvement plan will be proposed. This research will utilise the results of the Failure Mode and Effect Analysis (FMEA) for the Improvement and



Control phase inside DMAIC of Six Sigma for the improvement plan as a proposed business solution. The Six Sigma that has been utilised in this research contains DMAIC which stand for Define, Measure, Analyse, Improvement, and Control to solve the root causes of the main issue. The output of this framework is the improvement plan for quality management in Kriya Nusantara that later will be proposed to the company.

B. Analysis of Business Situation

Creative design products such as crafts and furniture require creativity and high skills of craftsmanship to make it unique and have additional values. Nowadays, crafters or manufacturers also involve modern and high technology to create their products besides creativity and craftsmanship. As a manufacturer of crafting products, PT Global Kriya Nusantara or commonly known as Kriya Nusantara combines modern technology and the best touch of master-level expertise to produce high-quality products. As a manufacturer of custom-made products, Kriya Nusantara has a make-to-order or also known as a build-to-order manufacturing strategy, which is referred to as a pull-type supply chain operation. So, before manufacturing and producing the products, Kriya Nusantara firstly creates designs of the products and lets the customers choose the best design according to them. Next, they will create a prototype of the chosen design. Designs of the products are created or designed by the research and development division. The design will also contain the estimation of the raw materials used, R&D costs, Prototyping costs, and determine the lead times in every step of the manufacturing process. Every project has its own specific design and requirements. The chosen design will next be mass-produced.

As mentioned before, any component that does not meet the customer's specifications is simply considered to have a defect. Six Sigma methods aim to reduce the variation in the processes that generate these defects since every step or activity in a company provides a potential for defects. The Six Sigma Method has been utilised in this research to improve the quality management of PT Global Kriya Nusantara, especially for the upcoming Ramadhan Box Projects. The define, measure, analyse, improve, and control (DMAIC) cycles of Six Sigma are utilised to apply many of the statistical tools that were used in prior quality initiatives in a systematic project-oriented manner. Here is the following DMAIC cycle for a standard approach to Six Sigma project.

1) Define

The first step in the DMAIC cycles of Six Sigma is defining the business situation such as identifying customers and their priorities. After that, researcher can define the issue that occurred. In this research, the main issue that occurred is the rejection of finished goods in the production process of the Ramadhan Box 2022 Project of PT Global Kriya Nusantara. One of the objectives of this research is to propose the best alternative solution to sort out problems or issues in Kriya Nusantara. In this case, author needs to propose the best alternative solution to reduce the rejected products to obtain zero defects. After that, researcher have to map the process. In this research, author utilises SIPOC Diagram to map the process. SIPOC Diagram is a form of process mapping. The task of putting a project's goals and, in some circumstances, specific steps on how those goals will be achieved is referred to as process mapping. It's a straightforward yet efficient way to make sure that company management and every member of the project team are on the same page. Additionally, it provides an instant project overview. Here is the SIPOC Diagram of this research.

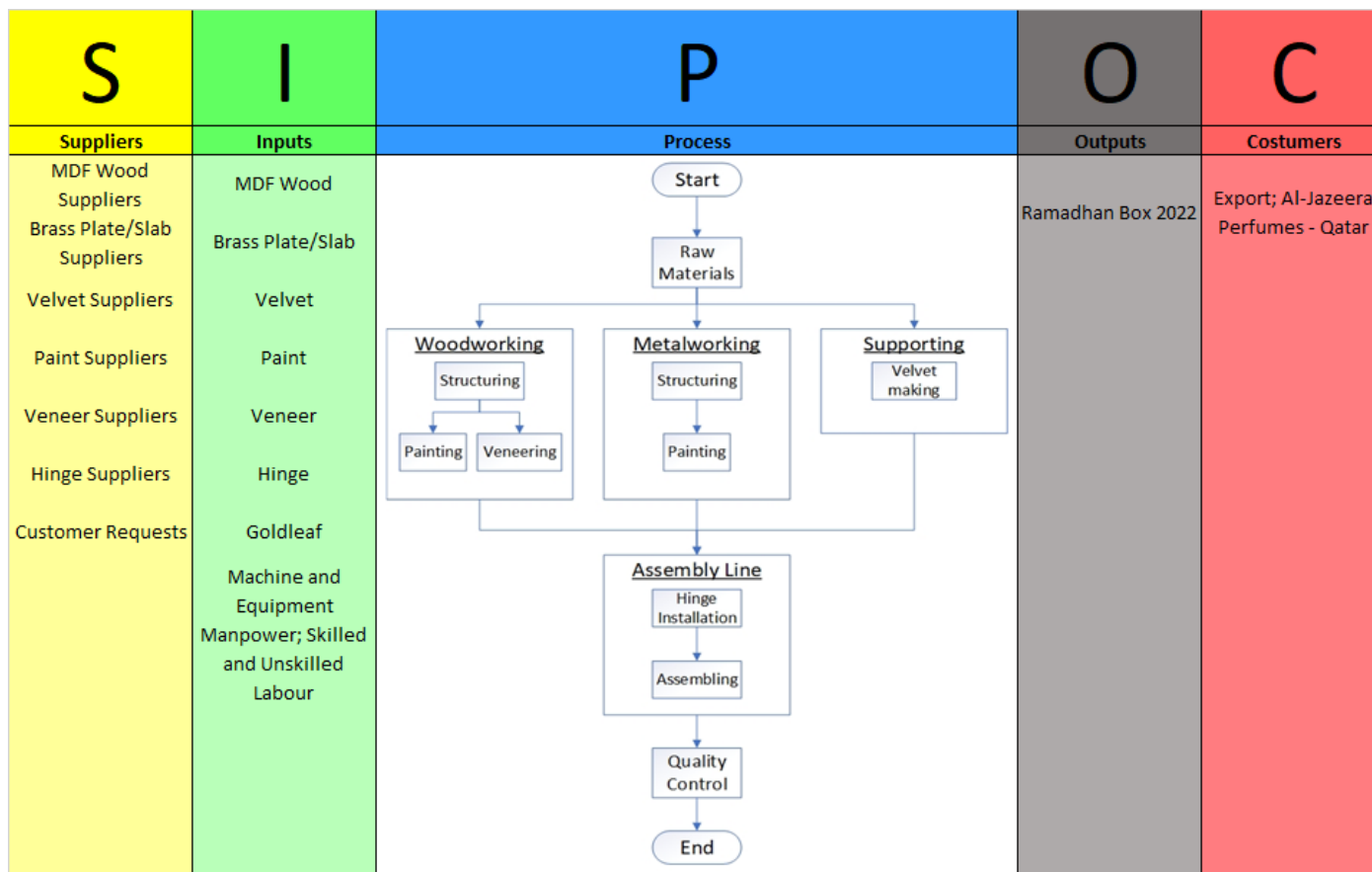


Figure 4. SIPOC Diagram

The resulting SIPOC diagram offers a high-level process map, the kind used by leadership to swiftly outline a project and give all team members a common frame of reference. It can also assist in identifying issues and separating out portions that are unnecessary or of little use.

2) Measure

The measure phase has been conducted in order to assess the extent of the issue and quantify it with data. This research conducted a measurement phase to obtain the significant rate of the defect in the production process of Ramadhan Box 2022 in order to know further about how the performance. Moreover, several defects have been identified and there are six types of defects that came from different processing. The defects are divided into two categories, major and minor. The minor defect consists of minor paint defects such as scratches and dents that occurred in both woodworking and metalworking processes, and another one is a jammed or damaged hinge that happened in hinge installation during the assembling processes. And then there are four types of major defects. The first is major paint defects such as scratches and dents or worse, miscoloured paint, that occurred in both woodworking and metalworking processes. Next is dimension fault where the dimension of the products does not meet the requirements. It happened in the woodworking and metalworking processes. The third defect type is the veneer defect. It only happened when there are scratches or dents on the veneer. The reason that makes it a major defect is because if there are any scratches or dents on the veneer, it cannot be covered or coated, it needs to be reinstalled. Then the last one is imprecise velvet. As well as the veneer defect, the velvet defect is also a type of major defect because it needs to be reworked if it does not match or meet the requirements. Here are the details of each defect along with the number of products that own those defects.



Product	Project Code	Rejection Category		Product Defect Type						
				Category :	Minor		Major			
				Work Process :	Woodworking; Metalworking	Assembly	Woodworking; Metalworking	Woodworking; Metalworking	Woodworking	Supporting
Defect Type :	Minor Paint Defect	Jammed or Damaged Hinge	Major Paint Defect	Dimension Fault	Veneer Defect	Imprecise Velvet				
Ramadhan Box Small	KNG 110	103	366		332	34	53	27	17	6
Ramadhan Box Medium	KNG 109	58	256		234	22	27	19	8	4
Ramadhan Box Large	KNG 108	31	126		113	13	4	3	14	10
Ramadhan Box XL	KNG 136	3	11		11	0	0	1	0	2
TOTAL					690	69	84	50	39	22
Total Defect	954									
Total Production	6,100									

Figure 5. Product Defect Type and Amount

From the total 6,100 unit produced, there are 954 rejected products which is about 15.64% of total production due to the defects it has. It surely the number that cannot be denied by the company. from the 954 rejected products, there are 759 units contain minor defect while the rest has major defect. The highest number of defects is minor paint defect with 690 occurrences. And the least number of defects is imprecise velvet with only 22 products has it. These data will next be calculated and analysed.

3) *Analyse*

The analysis phase has been conducted in order to extract information from the data obtained in the measure phase. This phase is also useful for the most likely causes of defects determination (Jacobs, 2018). Furthermore, the DPMO value and sigma level of the production process of Ramadhan Box 2022 will be analysed. The capability analysis can be conducted by calculating the defect per million opportunities (DPMO) value and sigma level. The lower the DPMO, the greater the sigma. The greater the sigma, the bigger the percentage of accepted products or lower defect or rejected products. DPMO can be calculated by the following equation.

$$DPMO = \frac{D}{(U \times O)} \times 1,000,000$$

Thus,

D = Number of Defects

U = Number of Units

O = Number of Opportunities for error per unit

After the DPMO value obtained, the value can be simply converted using the six-sigma conversion table. However, in this research author utilise the Minitab software to obtain those values due to the simplicity and accuracy of the results. Here are the DPMO values and sigma levels for the production process of Ramadhan Box.

Table 1. Data of DPMO Value and Sigma Level

Defect Type	Defect Number	DPMO Value	Sigma Level	% Defect
Minor Paint Defect	690	113,115	2.71	11.31
Jammed or Damaged Hinge	69	11,311	3.78	1.13
Major Paint Defect	84	13,770	3.70	1.38
Dimension Fault	50	8,197	3.90	0.82
Veneer Defect	39	6,393	3.99	0.64
Imprecise Velvet	22	3,607	4.19	0.36
Total Defect	954	156,393	2.51	15.64
Maximum Accepted Defect	305	50,000	3.14	5.00
Total Production	6,100			

Based on the table of DPMO value and sigma level above, the minor paint defect has the highest DPMO value and the least sigma level with respectively 113,115 and 2.71. Which means there will be 113,115 minor paint defects in a million production of Ramadhan Box 2022. Meanwhile, the defect type that has the least DPMO value and the highest sigma level is imprecise velvet with the number of 3,607 and 4.19 respectively. That means there will be 3,607 imprecise velvets in a million production of Ramadhan Box 2022. Moreover, the total defect of Ramadhan Box 2022 has the DPMO value of 156,393 and sigma level of 2.51; meaning there will be 156,393 defects or rejected products in a million production of Ramadhan Box 2022. Nevertheless, the minimum requirement set by the company is only 5% of defects or equal to a maximum of only 305 defects accepted. And the minimum requirement has the DPMO value of 50,000 and sigma level of 3.14; that means there will be 50,000 defects or rejected products in a million production of Ramadhan Box 2022.

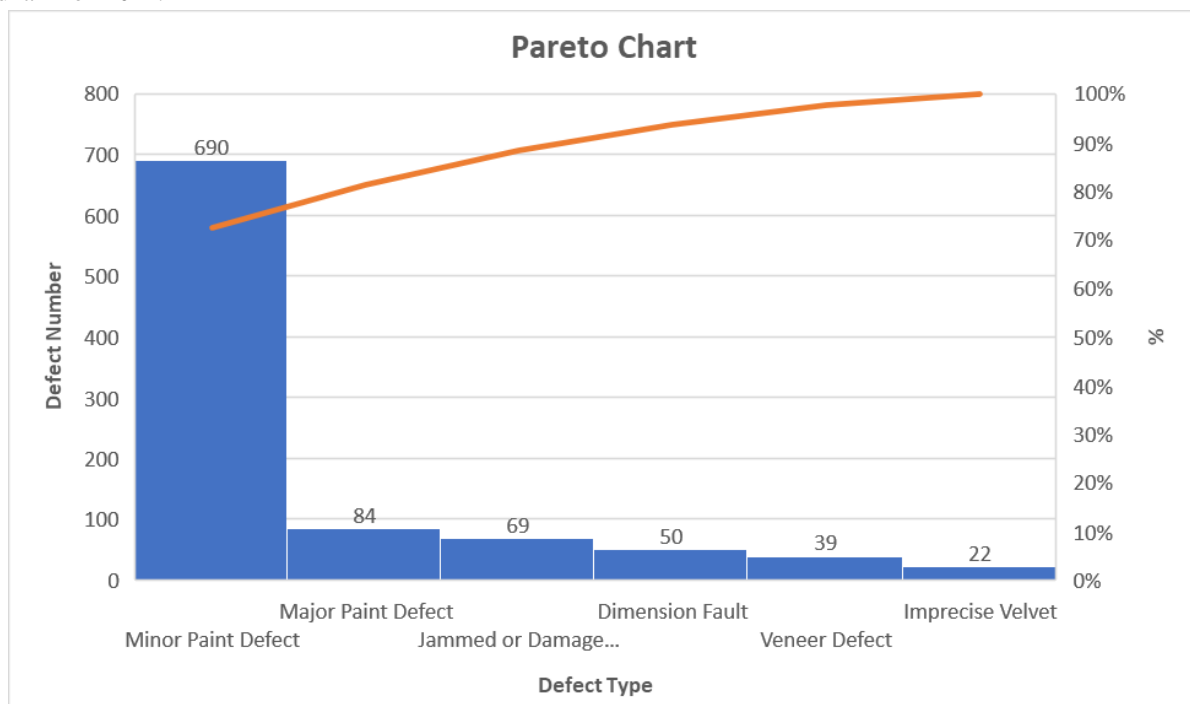


Figure 6. Pareto Chart of Defects in Ramadhan Box 2022

This research also utilises the Pareto Chart as one of its analytical tools for Six Sigma to help to break down an issue into the relative contributions of its components. Its basis is the widely accepted empirical conclusion that a big proportion or percentage of problems result from a small proportion or percentage of causes. Based on the pareto chart, the highest defect number owned by minor pain defect while the least defect number owned by imprecise velvet. That means, the minor paint defect requires to be solved and the priority would be high for this issue. The Pareto Chart also assist to sort the data from the highest to the lowest in order.

C. Root Cause Analysis – 5 Why

The root causes for the issue arose are determined using the 5 Why framework. The 5 Why framework is utilised to explore further until the actual root cause of an issue is found. When an event may have several causes, the procedure might be divided in order to focus on the underlying cause (Barsalou, 2015). The 5 Why framework should proceed from the main cause to the root cause. The following is the root causes that were determined by 5 Why framework of this research.

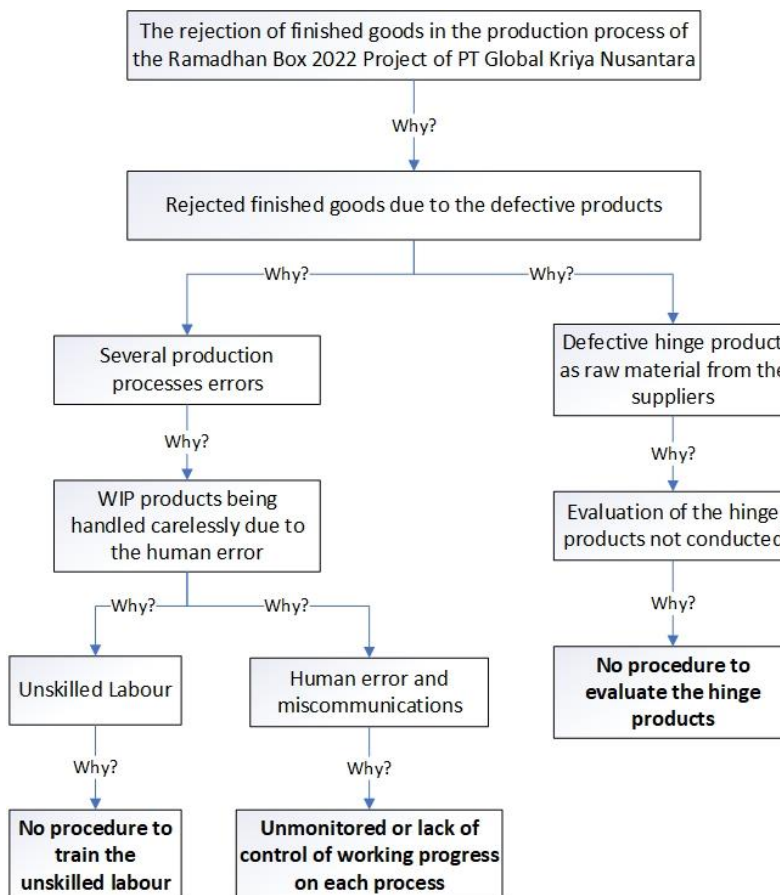


Figure 7. 5 Why Framework for Root Cause Determination of This Research

The main issue is the rejection of finished goods in the production process of the Ramadhan Box 2022 Project of PT Global Kriya Nusantara. And it was happened because of the rejected finished goods due to the defective products. The products were defective because there are several production processes errors and defective hinge product as raw material from the suppliers. The production processes errors occurred because of the WIP products being handled carelessly due to the human error. And it was occurred due to the human error and miscommunications and also the unskilled labour. The human error and miscommunications happened because of the working progress on each process was unmonitored, while the labour was unskilled because there was no procedure to train the labour. Meanwhile, the defective hinge products exist because the company did not conduct the evaluation of the hinge products. And the evaluation was not conducted because there was no procedure to evaluate the hinge products from the suppliers. Furthermore, the root causes of the issue arose in this research are unmonitored or lack of control of working progress on each process, there was no procedure to train the labour, and there was also no procedure to evaluate the hinge products from the suppliers.

BUSINESS SOLUTION

After conducting several analyses related to the business issue, the business solution alternatives will be proposed. The main issue of PT Global Kriya Nusantara is the rejection of finished goods in the production process of the Ramadhan Box 2022 Project of PT Global Kriya Nusantara. And the causes of the issue have been determined. In this chapter, the author will propose business solution alternatives for the company regarding its business issue based on the causes of the issue.

A. Failure Mode and Effect Analysis (FMEA Analysis)

The FMEA Analysis result will be utilised to propose the improvement plan as the business solution alternatives and also to propose the implementation plan. Here is the Failure Mode and Effect Analysis (FMEA) of this research.



Table 2. FMEA Analysis

Type of Defect	Failure Mode	Failure Effects	Causes	Current Controls	Occ.	Sev.	Det.	RPN	Risk Level
Minor Paint Defect	Minor scratches or dents on the painted surface of products	Lower the product quality Need to be repaired (repainted)	WIP products being handled carelessly due to the human error Unskilled labour	Regular quality checking before assembly process	8	5	8	320	Critical Risk
Major Paint Defect	Major scratches or dents on the painted surface of products. Including the miscoloured products	Product being rejected Need to be reworked or repaired (repainted) Scrap	Human error and miscommunications Unskilled labour	Regular quality checking before assembly process	7	7	4	196	Medium Risk
Jammed or Damaged Hinge	Malfunctioned hinge, jammed, or damaged	Lower the product quality Need to be repaired (re-installment of hinge) The product can be inoperable	Defective Hinge products from suppliers	The defect found during installation on assembly process	6	8	2	96	Low Risk
Dimension Fault	Product dimension does not meet the requirements. Including the misshaped products	Product being rejected Need to be reworked Scrap	Human error and miscommunications	Final quality checking of finished goods	6	8	6	288	High Risk
Veneer Defect	Scratches or dents on the veneered surface of products	Product being rejected Need to be reworked (re-installment of veneer) Scrap	WIP products being handled carelessly due to the human error Unskilled labour	Regular quality checking before assembly process	6	7	6	252	High Risk



Imprecise Velvet	The velvets dimension does not meet the requirements. Including the misshaped velvet and unmatched formats.	Product being rejected or at least lower the quality For Velvet: Need to be reworked For Main Boxes: Need to repaired (re- instalment of velvet as the interior of the products) Scrap	Human error and miscommunications	Final quality checking of finished goods	6	6	2	72	Low Risk
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After the calculation of RPN has been conducted, the next step is to determine the type of defects that has the highest RPN. Defects with the highest RPN should be highly prioritised to be solved. After the value of occurrence, severity, and detection has been calculated and the RPN value has been obtained, the next step is to analyse the results. As we could see, the defect type that has the greatest RPN value is Minor Paint Defect with 320 RPN value and has critical risk level. That means the minor pain defect requires to be improved immediately. Other defect types that also requires high priority is Dimension Fault and Veneer Defect with RPN value as high as 288 and 252 respectively, which as the second and the third largest RPN value after minor paint defect and has high risk level. Surprisingly, the major paint defect has only 196 RPN value, which only has medium risk level, making it only require moderate priority for improvements. Meanwhile, the type of defects that has low risk level are Jammed or Damaged Hinge with an RPN value of 96 and Imprecise Velvet with an RPN value of 72. Those defects also require some improvements but with low priority.

Furthermore, there are six defect types that occurred on this production process. Those six types of defects in order based on the highest RPN value to the lowest RPN value are minor paint defect, dimension fault, veneer defect, major paint defect, jammed or damaged hinge, and imprecise velvet. Those defects have its own causes. The minor paint defect occurred due to the WIP products being handled carelessly due to the human error and the unskilled labour. The dimension fault defect happened because of the human error and miscommunications. The veneer defect happened because of the WIP products being handled carelessly due to the human error and the unskilled labour. While the major paint defect occurred due to the human error and miscommunications and also the unskilled labour. Other than that, the jammed or damaged hinge happened due to the defective hinge products from suppliers. And lastly, the imprecise velvet occurred because of the human error and miscommunications.

B. Business Solution Alternatives

PT Global Kriya Nusantara is a manufacturing industry. As the manufacturing industry, the production process improvements and updated is highly recommended in order to enhance its production processes. The main business issue that occurred in PT Global Kriya Nusantara is the rejection of finished goods in the production process of the Ramadhan Box 2022 Project of PT Global Kriya Nusantara. Which means Kriya Nusantara has the issue regarding its quality management. And the Six Sigma Method has been utilised in this research to improve the quality management of PT Global Kriya Nusantara, especially for the upcoming Ramadhan Box Projects. Furthermore, several defects have been identified and there are six types of defects that came from different processing. The defects are divided into two categories, major and minor. The defects are minor paint defect, jammed or damaged hinge, major paint defect, dimension fault, veneer defect, and imprecise velvet. Those defects have been analysed and the DPMO value, Sigma level, and Risk Priority Number (RPN) for those defects has been calculated and determined. The defect type that requires to be



improved immediately is Minor Paint Defect with DPMO value of 113,115; sigma level of 2.71; and RPN value of 320. While the defect type that require the least priority of improvements is Imprecise Velvet with an RPN value of 72. Moreover, there are several business solution alternatives that will be proposed to the company for its production process regarding quality management.

C. Analysis of Alternatives

The Improvement phase inside DMAIC of Six Sigma will be conducted in this sub-chapter. The utilisation of FMEA analysis as a tool also will be continued in this chapter to propose an improvement plan for the issues. The following is the FMEA analysis for the improvement plan.

Table 3. Proposed Improvement Plan (continuation of FMEA Analysis)

Type of Defect	Causes	Proposed Improvement Plan
Minor Paint Defect	WIP products being handled carelessly due to the human error	Assign a team to monitor working progress on each process
	Unskilled labour	Conduct short labour training for at least a month
Dimension Fault	Human error and miscommunications	Assign a team to monitor working progress on each process
Veneer Defect	WIP products being handled carelessly due to the human error	Assign a team to monitor working progress on each process
	Unskilled labour	Conduct short labour training for at least a month
Major Paint Defect	Human error and miscommunications	Assign a team to monitor working progress on each process
	Unskilled labour	Conduct short labour training for at least a month
Jammed or Damaged Hinge	Defective Hinge products from suppliers	Re-evaluate the hinge products from suppliers
Imprecise Velvet	Human error and miscommunications	Assign a team to monitor working progress on each process

1) Minor Paint Defect

As we could see from the Table 3 above, each type of defect has its own causes. The most critical defect is Minor Paint Defect. The causes for this defect are because of the WIP products being handled carelessly due to the human error and the unskilled labour. Both of the causes need to be eliminated or at least reduced by the improvement plans. The improvement plan for WIP products being handled carelessly due to the human error issue is by assign a team to monitor working progress on each process. The team has to make sure that the employees and/or labour strictly follow the procedures (SOP) made by the company. The assigned team also needs to warn the employees and/or labour that does not following procedures. The monitoring activity should be taken every day since the production process runs every day.

For the unskilled labour issue, the company could conduct a short labour training for at least a month. The labour training will be focused on and conducted by related division. Besides, the process-assistant needs to evaluate the potential skills of its labour so they could assign the task correctly based on the labour skillsets. The painting process of the detailed ornaments requires a high skill. That would be the reason the training for the labour is mandatory if the company wants to eliminate this issue. The training progresses should be reported every week so the supervisor can measure the progress of each person.



2) *Dimension Fault*

The dimension fault was caused by human error and miscommunications. To reduce or even eliminate the cause, the company needs to assign a team to monitor working progress on each process. By monitoring every progress on each process, the human error and miscommunications can be minimised. The assigned team also could discover the incompatibility early before the WIP product distributed to the next processes. The monitoring activity should be taken every day since the production process runs every day.

3) *Veneer Defect*

The causes of Veneer Defect issue were WIP products being handled carelessly due to the human error and the unskilled labour. Both of the causes need to be eliminated or at least reduced by the improvement plans. The improvement plan for WIP products being handled carelessly due to the human error issue is by assign a team to monitor working progress on each process. The team has to make sure that the employees and/or labour strictly follow the procedures (SOP) made by the company. The assigned team also needs to warn the employees and/or labour that does not following procedures. In Veneering process, the activity that really need to be monitored is veneer installation. As the installation will be using the permanent adhesive (specific glue), it cannot be undone once the veneer pasted to the box which means this activity need to be done carefully. The monitoring activity should be taken every day since the production process runs every day.

And then for the unskilled labour issue, the company could conduct a short labour training for at least a month. The labour training will be focused on and conducted by related division. Besides, the process-assistant needs to evaluate the potential skills of its labour so they could assign the task correctly based on the labour skillsets. The installation of the veneer also needs a high precision as it will impact the main design of complexion of the boxes' body. The training progresses should be reported every week so the supervisor can measure the progress of each person.

4) *Major Paint Defect*

The Major Paint Defect was caused by the human error and miscommunications and also the unskilled labour. Both of the causes need to be eliminated or at least reduced by the improvement plans. To reduce or even annihilate the human error and miscommunications cause, the company needs to assign a team to monitor working progress on each process. By monitoring every progress on each process, the human error and miscommunications can be minimised. The assigned team also could discover the incompatibility such as miscoloured or poor painting result early before the WIP product distributed to the next step of production processes. The monitoring activity should be taken every day since the production process runs every day.

Moreover, the unskilled labour issue can be annihilated by conducting a short labour training for at least a month. The labour training will be focused on and conducted by related division. Besides, the process-assistant needs to evaluate the potential skills of its labour so they could assign the task correctly based on the labour skillsets. Each colour has a specific code for its mixing formula. So, the formula cannot be mistaken if we want to produce the same colour. Other than that, airbrushing technique also require some sort of skills. The training progresses should be reported every week so the supervisor can measure the progress of each person.

5) *Jammed or Damaged Hinge*

The defective hinge products from suppliers were causing the jammed or damaged hinge issue. The jammed hinge can be repaired or refined so it could work properly. However, the damaged hinge will only produce scraps. The damaged hinge also will affect the functionality of the products as it will be inoperable. That is why it is really necessary to re-evaluate the supplier's products. Because if most of the products proved to be poor or defective, the company really need to make a claim to the suppliers. The evaluation of the hinge products should be conducted every month to obtain the sufficient data of the products.

6) *Imprecise Velvet*

The imprecise velvet issue occurred due to the human error and miscommunications. To tackle down or even vanish the human error and miscommunications cause, the company needs to assign a team to monitor working progress on each process. By monitoring every progress on each process, the human error and miscommunications can be minimised. The assigned team also could discover the incompatibility such as misshaped velvet or the unmatched format early before the WIP product distributed to the next step of production processes. The monitoring activity should be taken every day since the production process runs every day.



CONCLUSION AND IMPLEMENTATION

After conducting several analyses, including business issue analysis, root cause analysis, and business solution analysis, the conclusion has been made. The analyses of this research utilise Six Sigma as the main tool to explore the business issue. And to determine the root causes along with its proposed business solution, this research utilise FMEA analysis. The conclusion has been made also to conclude all the research and to answer the research questions.

A. Conclusion

After conducting several analyses related to the business issue, the business solution alternatives will be proposed. The main issue of PT Global Kriya Nusantara is the rejection of finished goods in the production process of the Ramadhan Box 2022 Project of PT Global Kriya Nusantara. And the causes of the issue have been determined. The business solution alternatives for the company regarding its business issue based on the causes of the issue also has been proposed along with the implementation plans that later will be written in this chapter on the next sub-chapter. The following is the answer for the research questions as the conclusion for this research.

1) *What are the root causes of the rejected product of Ramadhan Box 2022 Project of PT Global Kriya Nusantara issue?*

There are six defect types that occurred on this production process. Those six types of defects in order based on the highest RPN value to the lowest RPN value are minor paint defect, dimension fault, veneer defect, major paint defect, jammed or damaged hinge, and imprecise velvet. Those defects have its own causes. The minor paint defect occurred due to the WIP products being handled carelessly due to the human error and the unskilled labour. The dimension fault defect happened because of the human error and miscommunications. The veneer defect happened because of the WIP products being handled carelessly due to the human error and the unskilled labour. While the major paint defect occurred due to the human error and miscommunications and also the unskilled labour. Other than that, the jammed or damaged hinge happened due to the defective hinge products from suppliers. And lastly, the imprecise velvet occurred because of the human error and miscommunications. Subsequently, there are four root causes, which are the WIP products being handled carelessly due to the human error, the unskilled labour, human error and miscommunications, and defective hinge products from suppliers.

2) *What are the alternative solutions for the rejected product of Ramadhan Box 2022 Project of PT Global Kriya Nusantara issue?*

The alternative solutions for the rejected product of Ramadhan Box 2022 Project of PT Global Kriya Nusantara issue have been proposed in the previous chapter in the form of the improvement plans. The improvement plans were based on the causes of each problem. Subsequently, there are four root causes, which are the WIP products being handled carelessly due to the human error, the unskilled labour, human error and miscommunications, and defective hinge products from suppliers. The proposed alternative solutions for the WIP products being handled carelessly due to the human error and human error and miscommunications are assign a team to monitor working progress on each process. And for the unskilled labour, the issue could be tackled by conducting short labour training for at least a month. While the defective hinge products from suppliers could be mitigated by re-evaluating the supplier's products.

3) *How to create implementation plans for the rejected product of Ramadhan Box 2022 Project of PT Global Kriya Nusantara issue?*

The creation of the implementation plans regarding the rejected product of Ramadhan Box 2022 Project of PT Global Kriya Nusantara issue is a part of the control phase inside the DMAIC of Six Sigma. It is also the continuation of the FMEA analysis after the improvement plan has been proposed. The proposed action plan can be conducted by the company for its next Ramadhan Box project if the proposed business solution alternatives are accepted. And the implementation plan encompasses the "action taken" and "Responsibility" or "People in Charge (PIC)" section. Moreover, in order to create the implementation plan, the implementation plan schedule or timeline and future research has been made, and also as the part of control phase of DMAIC cycle.

B. Implementation Plan

The implementation plan is the control phase as the continuation of the FMEA analysis after the improvement plan has been proposed and is also a part of the control phase inside the DMAIC of Six Sigma. The implementation plan encompasses the "Action Taken" and "Responsibility" or "People in Charge (PIC)" sections. The following is the implementation plan for the proposed improvement plans for the company.



Table 4. Implementation Plan for FMEA Analysis

Type of Defect	Causes	Proposed Improvement Plan	Action Taken	PIC
Minor Paint Defect	WIP products being handled carelessly due to the human error Unskilled labour	Assign a team to monitor working progress on each process Conduct short labour training for at least a month	Monitoring by the assigned team Labour training	Team leader under the PPIC division Head Division of Responsible Division (Woodworking or Metalworking)
Dimension Fault	Human error and miscommunications	Assign a team to monitor working progress on each process	Monitoring by the assigned team	Team leader under the PPIC division
Veneer Defect	WIP products being handled carelessly due to the human error Unskilled labour	Assign a team to monitor working progress on each process Conduct short labour training for at least a month	Monitoring by the assigned team Labour training	Team leader under the PPIC division Head Division of Woodworking Division
Major Paint Defect	Human error and miscommunications Unskilled labour	Assign a team to monitor working progress on each process Conduct short labour training for at least a month	Monitoring by the assigned team Labour training	Team leader under the PPIC division Head Division of Responsible Division (Woodworking or Metalworking)
Jammed or Damaged Hinge	Defective Hinge products from suppliers	Re-evaluate the hinge products from supplier	Evaluation of the hinge products	PPIC Head Division
Imprecise Velvet	Human error and miscommunications	Assign a team to monitor working progress on each process	Monitoring by the assigned team	Team leader under the PPIC division

In Kriya Nusantara there is a team known as Perencanaan Produksi, Inventory, dan Control or can be described as Production Planning, Inventory, and Control which later be mentioned as PPIC. In this implementation plan, researcher suggest the company to



appoint the PPIC team to develop the action for the proposed improvement plan as it is the most relevant team or division in the company. The head of PPIC can develop a team inside his team to monitor the working progress on each process also appoint the people in charge as a leader to take the action. The PPIC can also re-evaluate the supplier’s products to prevent the defective hinge products from suppliers. Moreover, researcher suggest company to instruct the head of each factory to conduct the short labour training for at least a month in order to train the unskilled labour so they could be more skilful. And the PIC for this activity should be the head of respective factory.

The “Action Taken” section in the implementation plan should be filled based on each improvement plan by the respective officer. The responsible person or people in charge (PIC) also should be appointed by the respective officer. After the action for the improvement plan has been taken and the PIC has been pointed, the proposed business solution alternative can be fully implemented for this research regarding the business issue of the company which is the rejection of finished goods in the production process of the Ramadhan Box 2022 Project of PT Global Kriya Nusantara. The previous data was assumed that action has been taken and the PIC has been appointed. The next step is to determine the schedule or timeline regarding the implementation plan. Supposed the next Ramadhan Box 2023 project will be started at the beginning of December 2022 and set to be done by the end of February 2023, and the improvement plan will be implemented on the first day of the project and the labour training will be conducted on the first day of November 2022. The following is the schedule or timeline regarding the implementation plan.

Task Name	PIC	Duration	Start	Finish	November				December				January				February			
					1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Labour training	Head Division of Responsible Division (Woodworking or Metalworking)	1 month	Nov-22	Dec-22	■	■	■	■												
Labour training report		Weekly	Nov-22	Dec-22	■	■	■	■												
Monitoring by the assigned team	Team leader under the PPIC division	3 months	Dec-22	Feb-22					■	■	■	■	■	■	■	■	■	■	■	■
Evaluation of the hinge products	PPIC Head Division	Monthly	Dec-22	Feb-22									■				■			

Figure 8. Implementation Plan Timeline

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