

# Improving the quality of IndiHome services using six sigma DMAIC method: Case in industrial area

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## Abstract

As one of the internet service providers ISP, Telkom Indonesia with IndiHome products cannot avoid customer complaints. In Tangerang's Mekarjaya industrial area, IndiHome complaints reach 14 percent per month. The purpose of this study is to reduce IndiHome complaints with the six sigma DMAIC cycle method. Other tools for analyzing this problem are Pareto Diagrams, Cause and Effect Diagrams and FMEA. IndiHome complaints that were prioritized for improvement were complaints because they were unable to connect 59.4 percent and complaints about intermittent internet connections 35.8 percent. In the improvement phase, poka yoke is implemented as a preventative measure in quality control. After the implementation of the six sigma IndiHome complaints decreased to 7% per month with a level of six sigma 3.47 and this research also succeeded in reducing the cost of repairing IndiHome services from IDR 7,888,889 to IDR 1.666.667 per month which means it changed 78.8% per month.

**Keywords:** *complain, FMEA, ISP, Poka Yoke, six sigma,*

## 1. Introduction

The impact of the Fourth Industrial Revolution (or Industry 4.0) is the increased connectivity, interaction between humans, machines, and other resources that are increasingly linked through information and communication technology. Almost all company operational activities require a fast and stable internet connection. This condition is a business opportunity that can be exploited by many internet service providers (ISP).

Indonesia digital home or known as IndiHome is a product of internet service provider (ISP) Telkom Indonesia which provides high speed internet up to 100 mbps. Telkom Indonesia's efforts in providing quality Indihome services cannot be separated from customer complaints. IndiHome customers complain about problematic Indihome product services. Complaints by IndiHome subscribers: (1) internet service is down or unable to connect (2) intermittent internet connections (3) internet speed has decreased. IndiHome service problems can be said to be a defect.

A case study in the Mekar Jaya Tangerang industrial area, there are 384 companies subscribing to the internet service provider Telkom IndiHome. In December 2018 - November 2019 there were 648 IndiHome complaints. The average monthly complaint for Indihome reaches 14%, which is around 54 complaints from IndiHome customers in the Mekar Jaya industrial area per month. The total cost of poor quality is IDR. 71,000,000 with a monthly average of IDR. 7.888.889. IndiHome service quality control is needed to reduce the number of complaints from IndiHome customers.

There are many ways to do quality control, six sigma is one of the methods of improvement and quality control that is applied by many companies or organizations. The six sigma concept emphasizes the principle of 3.4 defective per one million products that are proven to increase the competitiveness of a company or organization (Trimarjoko, Saroso, Purba, Hasibuan, & Aisyah, 2019). Six Sigma is a quality assurance and quality management approach with an emphasis on continuous quality improvement. The ultimate goal of this approach is to achieve a level of quality and reliability that will satisfy and even exceed customer demands and expectations (Manohar & Balakrishna, 2015).

Reference to previous research that has carried out the application of six sigma to Indihome Services was carried out by (Putra & Widiyanesti, 2018) in the South Jakarta Telecommunications area. However, the scope of the research area was too broad and was not focused on one area and only carried out two Phase, including defining and measuring the types of problems in IndiHome products which resulted in an analysis of the number of IndiHome DPMO services being 55,563, IndiHome service quality was at the sigma level. 3.09.

Based on this phenomenon, this research is motivated to apply the six sigma 5 phases of DMAIC to indiHome services to reduce complaints about IndiHome problems which are focused on the Mekar Jaya Industrial area and see the capabilities of the current IndiHome repair process.

## 2. Theoretical Framework

### 2.1 Six Sigma

Six sigma is a systematic method for process improvement strategies that uses a statistical approach and scientific methods to reduce the defect rate determined by the customer (Croft, 2012; Syafwiratama, Hamsal, & Purba, 2017). Six sigma is a structured methodology to improve processes that are focused on reducing process variances while reducing defects (products/services that are outside specifications) by using statistics and problem solving tools intensively (Manggala, 2005; Ferdyan, 2015). Meanwhile, Gaspersz, (2002) six sigma is an increase in the vision of quality towards the target of 3.4 failure per million opportunities (defect per million opportunity) DPMO for each product transaction (goods and services). The higher the sigma target achieved, the better the industrial system performance will be. Six sigma can also be viewed as an industrial control process that focuses on customers through process capabilities (Shofia et al., 2015).

Six sigma is a process that provides added value to customers and stakeholders with a focus on improving product quality and company productivity. There are five phase called the DMAIC (definition, measurement, analysis, improvement, control) method (Indrawati & Ridwansyah, 2015). DMAIC is a classic six sigma problem solving process. This approach is applied to existing conditions, steady state processes or product supply. Variations are found from customer specifications in either the product or process main problem and these variations can occur in many forms. DMAIC solves the problem of defects, deviations from targets, excess time or costs (Nithyanandam et al., 2014; Syafwiratama et al., 2017).

### 2.2 FMEA

Failure Mode and Effects Analysis (FMEA) is a technical method used to define, identify, and eliminate potential failures, problems, errors and so on from a system, design, process and service before reaching the customer (Stamatis, 1995). The FMEA method can be used to review a product, process or system design by identifying existing weaknesses and then eliminating them (Peratec, 1994; Nugroho, 2017; MJ & Hasibuan, 2020).

FMEA is a methodology designed to identify potential failure modes of a product or production process, consider risks based on failure modes, and to identify and implement corrective actions. The risk priority number (RPN) is an important indicator for determining the appropriate corrective action regarding the failure mode. RPN is used in the FMEA procedure to estimate risk using three criteria, namely: severity, occurrence, and detection. The RPN priority number is a product rating of the severity level, incidence, and detection that is displayed (Indrawati & Ridwansyah, 2015).

### 2.3 Poka-Yoke

According to Szewieczek (2009), Poka-Yoke is a strategy and policy to prevent defects at the source by conducting continuous inspections so that zero defect products can be achieved. Kumar (2016) state that the Poka-Yoke methodology consists of identifying problems, namely the first step in identifying problems by identifying processes that have the potential to cause problems. Observation at the workstation is the stage after knowing the source of the problems and problems that occur using a fishbone diagram. Brainstorming for ideas is carried out by submitting the problem being researched to the relevant internal company, then reviewing the problem and after that a plan and solution will be sought for improvement using existing creative thinking by several internal parties of the relevant company. Choose the best idea, after getting several alternative solutions by several related

internal company parties, the next step is to choose the best (Putri & Handayani, 2019).

Solution from all the solutions that have been collected. Implementation of the plan, at this stage the company begins to implement the best solution obtained through previous negotiations. Monitoring and sign off is the last stage, where it is time for the company to monitor each production process using the improvements that have been determined (Putri & Handayani, 2019).

### 3. Research Methodology

The research methodology is a systematic description of the steps the author takes from the beginning to the end of the study so that the research implementation becomes clear and focused in accordance with the research objectives. This study uses Six Sigma DMAIC as a method to reduce IndiHome complaints in the Mekar Jaya Industrial area. The steps in data processing using the six sigma DMAIC method are as follows: (1) Describe the problem that occurs in IndiHome services, (2) Measure baseline performance or sigma level as the initial standard for correcting IndiHome problems, (3) Analyze the factors that cause product failure on IndiHome services, (4) Determine improvement efforts that can be made to improve the quality of the IndiHome problem repair process, and (5) Evaluate and control the results of improvements. The five stages follow the rules of problem solving using the Six Sigma method, namely the DMAIC stage (Define, Measure, Analyze, Improvement and Control).

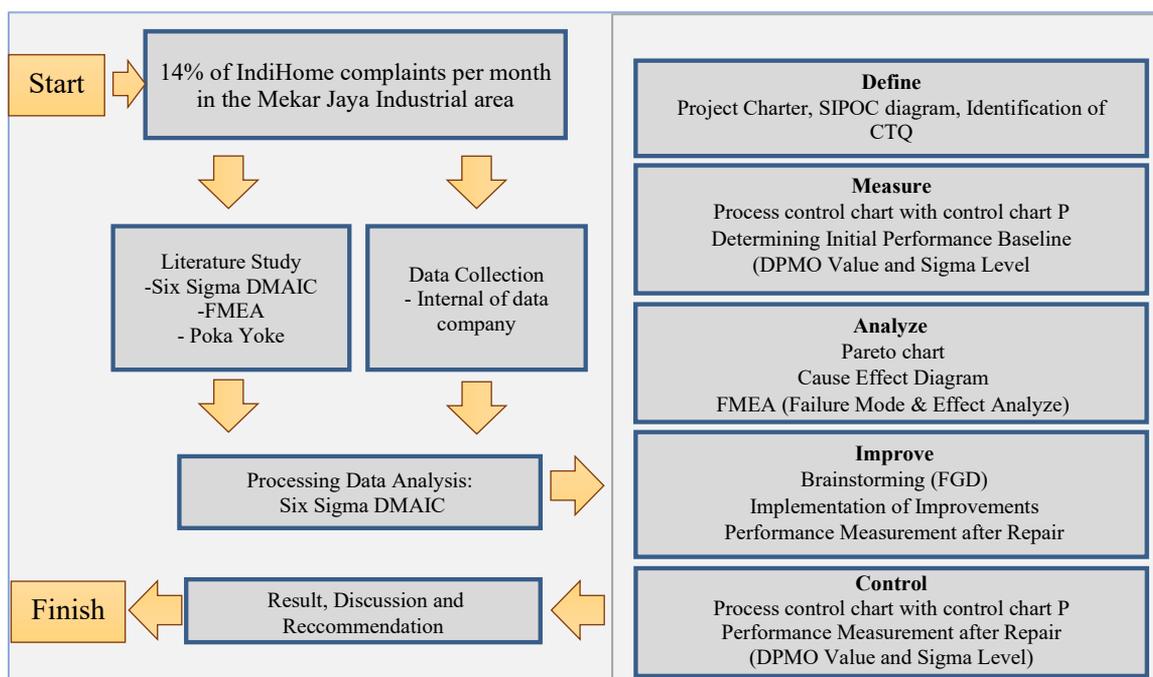


Figure 1 IndiHome Complaint Problem Solving Research Methodology.

### 3. Result and Discussion

#### 3.1 Define Phase

Defining IndiHome services in the Mekar Jaya industrial area with a target of process improvement consistent with customer demand or needs and company strategy. The project charter is the first step in the decisive stage. Project charter is used as a six sigma tool to determine the objectives of implementing six sigma in IndiHome services.

Project Charter	
Project Name	Reducing IndiHome complaints
Project Start Date	October 2019
Expiration Date	March 2020

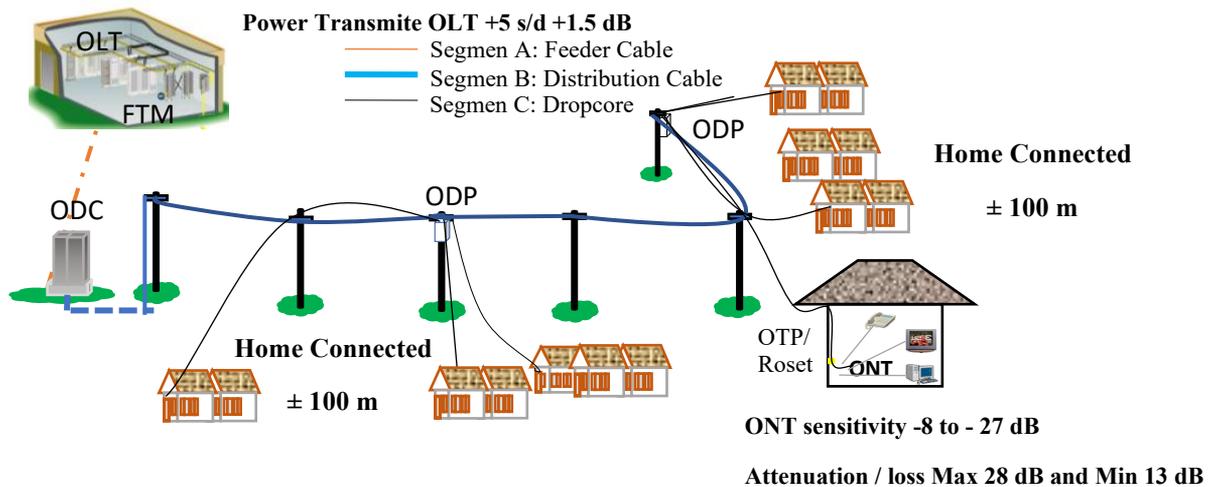


Figure 2 IndiHome Network Topology in The Mekar Jaya Industrial Area

<p><b>Problem:</b></p> <p>The average number of IndiHome complaints in the Mekar Jaya industrial area reached 14% in the period (December 2018-November 2019). Problems complained of by customers include internet service is down or unable to connect, intermittent internet connections and internet speed has decreased.</p> <p><b>Monetary Benefits</b></p> <p>Reducing COPQ The average amount spent for mass problem per month is IDR 7,888,889</p> <p><b>Additional Benefits</b></p> <p>reduce indihome complaints Increase customer satisfaction Reduces the likelihood of customer defection</p>	<p><b>Goals:</b></p> <p>During 5 months succeeded in reducing the average number of IndiHome problems to 9% of the number of customers to meet customer needs.</p> <p><b>Scope Project / Focus Project</b></p> <p>Fixed IndiHome problems in the Mekar Jaya industrial area on the ODC FAF network</p> <p><b>Project Team:</b></p> <table border="0"> <tr> <td>Project Leader</td> <td>Abby Yazid Bustommy</td> </tr> <tr> <td>Project Champion</td> <td>Vicky alfiandri</td> </tr> <tr> <td>Mentoring</td> <td>Bayu Purnomo</td> </tr> <tr> <td>Process Owner</td> <td>Anwar Syadad</td> </tr> <tr> <td>Controlling</td> <td>Rizki Fadhillah</td> </tr> <tr> <td>Team Member</td> <td>Ridwan Susilo Hadi</td> </tr> <tr> <td>Team Member</td> <td>Mahdani</td> </tr> </table>	Project Leader	Abby Yazid Bustommy	Project Champion	Vicky alfiandri	Mentoring	Bayu Purnomo	Process Owner	Anwar Syadad	Controlling	Rizki Fadhillah	Team Member	Ridwan Susilo Hadi	Team Member	Mahdani
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Figure 3 Project Charter Reducing IndiHome complaints.

After the project charter is formed, the next step is to describe the scope of the project. Figure 3 describes the IndiHome network in the Mekar Jaya Industrial area and Figure 4 formulate the IndiHome improvement process using the SIPOC tool. Its purpose is to focus on the process where it begins and ends where it will be the scope of the project to be completed.

Based on Figure 2, it explains the topology of the IndiHome network based on fiber optic technology as the medium of delivery. Home connected is a network connected to a number of houses or buildings connected to the customer point. There are 3 segments of the optical distribution network including OTP to ODP, ODP to ODC and ODC to MDF/OLT. IndiHome network cable installation using a dropcore with a distance of  $\pm 100$  m. Attenuation/loss network quality standards Max 28 dB and Min 13 dB.

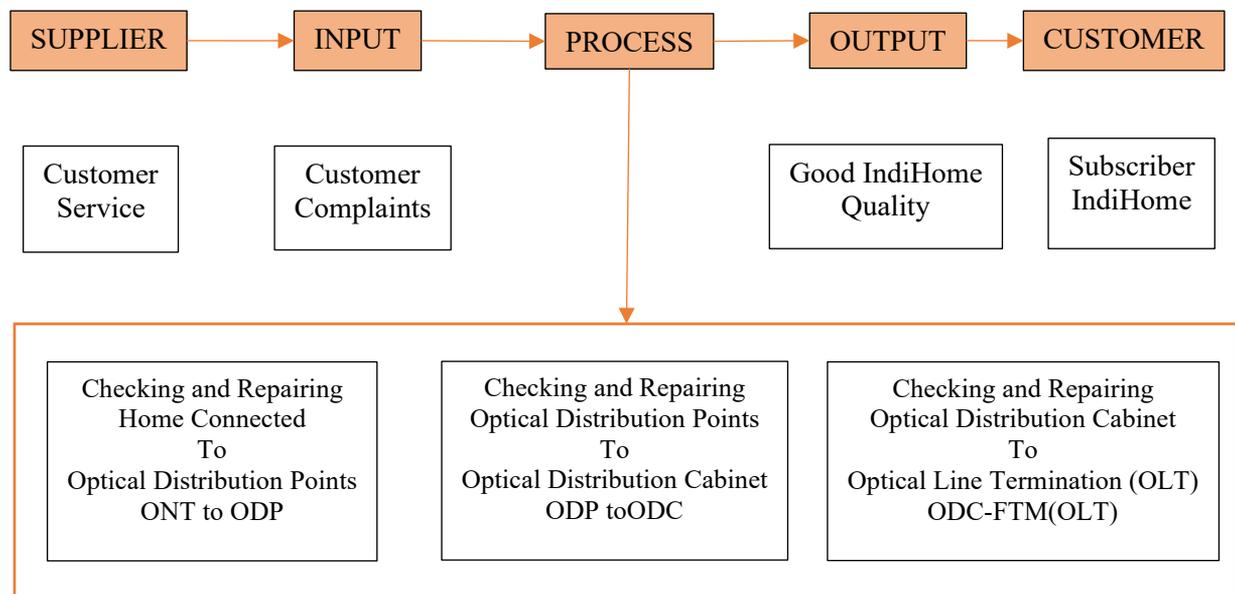


Figure 4 SIPOC Diagram of The IndiHome Problem Fixing Process.

Figure 4. Explains that the scope of the project to be completed is starting from customer service receiving customer complaints to fixing IndiHome problems with good quality. Where the focus of improvement is on the process of checking and repairing subscriber/home connected to optical distribution points, optical distribution points to optical distribution cabinet and checking and repairing optical distribution cabinet to optical line termination.

The next tool used in the Define phase is the CTQ (quality critical) which is used to capture the voice of the customer and convert the requirements into measurable data. Customer demands are usually vague and are a function of implicit factors that are not always clearly stated when they place an order/complaint. The CTQ on Indihome is shown in Table 1.

Table 1 CTQ IndiHome

Voice Of Customer/Business	Complain	Solution	Cause	Specification	Other	True Need	CTQ
<ul style="list-style-type: none"> <li>Internet service is down or unable to connect</li> <li>Check and repair network cable installation</li> <li>Drop cable disconnected, red los indicator unreadable attenuation or above -50 dbm total service off</li> <li>Normal service (-18 dbm to -28 dB)</li> <li>Internet intermittent (disconnected for minutes)</li> <li>Check and repair the network</li> </ul>	<ul style="list-style-type: none"> <li>✓</li> <li></li> <li></li> <li></li> <li>✓</li> <li>✓</li> </ul>	<ul style="list-style-type: none"> <li></li> <li>✓</li> <li></li> <li></li> <li></li> <li>✓</li> </ul>	<ul style="list-style-type: none"> <li></li> <li></li> <li>✓</li> <li></li> <li></li> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> <li></li> <li></li> <li>✓</li> <li></li> <li></li> </ul>	<ul style="list-style-type: none"> <li></li> <li></li> <li></li> <li></li> <li>Good Quality Product Service</li> <li></li> </ul>	<ul style="list-style-type: none"> <li>Reliable internet connection (standard installation distance ± 100 m)</li> <li></li> <li></li> <li></li> <li></li> <li>Stable Internet Service (-13 db to -28 dB)</li> </ul>	

<ul style="list-style-type: none"> <li>• Unspect Network, the indicator can sometimes be used sometimes not, the network is more than 28 dbm ✓</li> <li>• Normal service (-3 to -28 dB) ✓</li> <li>• Internet speed has decreased ✓</li> <li>• Perform device check and device logic/system configuration ✓</li> <li>• Malfunctioning/improper device or configuration error ✓</li> <li>• Connection 10 mbps up to 100 mbps ✓</li> </ul>	<ul style="list-style-type: none"> <li>• Fast Internet Service (10Mbps up to 100mbps)</li> </ul>
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Based on Table 1 what IndiHome customers need is Good Quality Product Service. There are 3 CTQs required including reliable internet connection, Stable Internet Service and Fast Internet Service. This is based on complaints that Internet services are down or unable to connect, connection is intermittent and Internet speed has decreased. The solution to the problem is that it is necessary to check and repair the network in accordance with the network standards Attenuation/loss Max 28 dB and Min 13 dB.

### 3.2 Measure Phase

This phase is the second step of DMAIC, where this phase is to measure the level of performance which becomes the baseline from the initial performance before the improvement is carried out. Baseline performance measurement is a key goal in the Measure phase. The baseline measurement uses IndiHome complaint data from December 2018 to November 2019.

Based on Table 2, it can be seen that the average monthly IndiHome complaint reaches 14%. The average DPMO for IndiHome customers is 46875. That way the baseline of performance in the The process of improving IndiHome services is at the 3.18 sigma level. The DPMO value and the sigma value still need to be increased to approach zero defect. In February, the lowest DPMO was reached at 29514 with the highest sigma value of 3.39, this indicates the need for improvement analysis on IndiHome services. Then process control is carried out to see whether the process is controlled or not by looking at the point of the process that is out of control, or still under control. The defect proportion table for calculating the proportion of CL, UCL and LCL defects is used.

Table 2 Measuring of DPO, DPMO and Sigma Levels January 2018 - May 2019

Month	User	Defect	%	CTQ	TOP	DPU	DPO	DPMO	YIELD	Sigma level
Dec-18	384	50	13	3	1152	0.13021	0.04340	43403	95.66%	3.21
Jan-19	384	61	16	3	1152	0.15885	0.05295	52951	94.70%	3.12
Feb-19	384	34	9	3	1152	0.08854	0.02951	29514	97.05%	3.39
Mar-19	384	36	9	3	1152	0.09375	0.03125	31250	96.88%	3.36
Apr-19	384	42	11	3	1152	0.10938	0.03646	36458	96.35%	3.29
May 19	384	72	19	3	1152	0.18750	0.06250	62500	93.75%	3.03
Jun-19	384	66	17	3	1152	0.17188	0.05729	57292	94.27%	3.08
Jul-19	384	51	13	3	1152	0.13281	0.04427	44271	95.57%	3.20
Agu-19	384	38	10	3	1152	0.09896	0.03299	32986	96.70%	3.34
Sep-19	384	83	22	3	1152	0.21615	0.07205	72049	92.80%	2.96
Oct-19	384	47	12	3	1152	0.12240	0.04080	40799	95.92%	3.24
Nov-19	384	68	18	3	1152	0.17708	0.05903	59028	94.10%	3.06
$\bar{X}$ Average			14					46875		3.18

Table 3 The Proportion of IndiHome defects

Monthly	Jumlah Produksi	Jumlah Cacat	Proporsi Cacat	UCL	CL	LCL
Des-18	384	50	0.130	0.228	0.141	0.087
Jan-19	384	61	0.159	0.228	0.141	0.087
Feb-19	384	34	0.089	0.228	0.141	0.087
Mar-19	384	36	0.094	0.228	0.141	0.087
Apr-19	384	42	0.109	0.228	0.141	0.087
Mei-19	384	72	0.188	0.228	0.141	0.087
Jun-19	384	66	0.172	0.228	0.141	0.087
Jul-19	384	51	0.133	0.228	0.141	0.087
Agu-19	384	38	0.099	0.228	0.141	0.087
Sep-19	384	83	0.216	0.228	0.141	0.087
Okt-19	384	47	0.122	0.228	0.141	0.087
Nov-19	384	68	0.177	0.228	0.141	0.087

Based on Table 3, it can be seen that in the period December 2018-November 2019 the proportion of IndiHome defects was 0.141 with an upper control limit of 0.228 and a lower control limit of 0.087. To find out that the IndiHome problem repair process is under controlled or uncontrollable conditions it is shown on the p-chart diagram.

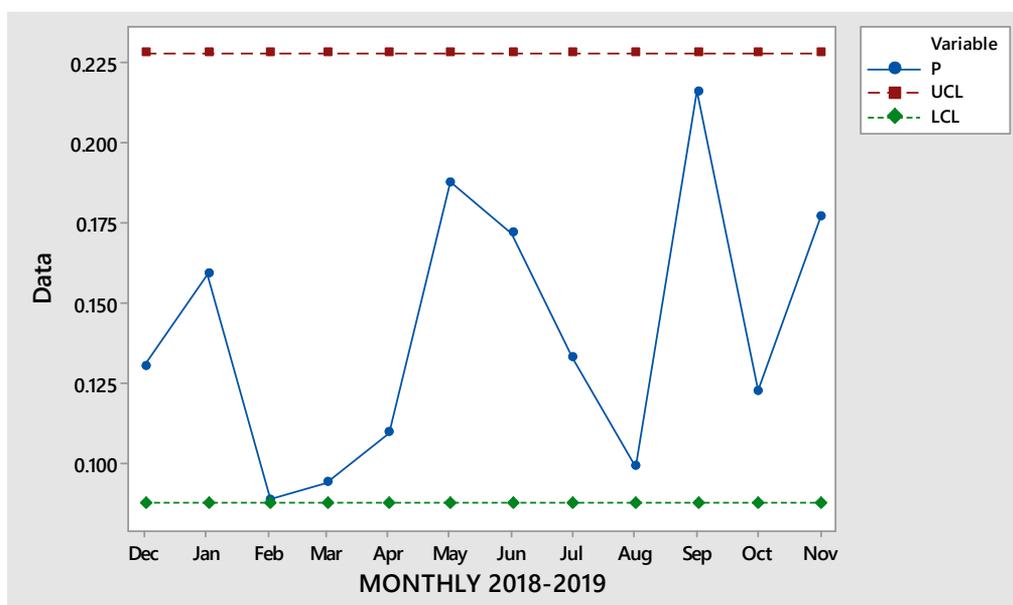


Figure 5 P-chart IndiHome Complain.

From the P-chart, it can be seen that the repair process for IndiHome is under control but not stable, it still needs to be improved. Shown from the point proportion there is nothing that crosses the upper and lower limits. The next step is measuring the cost of poor quality (COPQ) to see the financial losses caused by defective products. Based on data on complaints about mass indihome problems (distribution and feeder) December 2018-September 2019 the costs that must be paid by the company is present in Table 4.

Table 4 shows the COPQ that must be borne by the company, because Indihome's improvements are non-value added. The monthly average that must be borne by the company to improve IndiHome services in the Mekar Jaya Industry is IDR 7.888.889.

### 3.3 Analysis

At this Phase, analysis of the cause and effect relationship from various factors is carried out to determine the dominant factors that need to be controlled. However, before analyzing the causal relationship, it is necessary to know which defects are dominant in IndiHome services. Based on IndiHome complaint data for the period

December 2018-November 2019 there were 385 complaints that internet services were disconnected or unable to connect. There were 232 complaints of intermittent internet connection and complaints about internet speed decreased were 31 complaints. To see which defect is more dominant, it can be done by making a Pareto diagram. The Pareto chart is used to determine the top 80 percent of complaints about IndiHome services that will be quality control priorities (Figure 6).

Table 4 COPQ Repair Indihome Problems

Date	Incident	Indication	Cost	Total COPQ/Month
9/1/2019	IN45812457	DISTRIBUSI CUT	4000000	11.000.000
11/1/2019	IN45904466	DISTRIBUSI LOS	1000000	
19/1/2019	IN46288927	DISTRIBUSI CUT	4000000	3.500.000
22/1/2019	IN46424806	DISTRIBUSI LOS	1000000	
30/1/2019	IN46864381	DISTRIBUSI LOS	1000000	
3/2/2019	IN47046028	DISTRIBUSI LOS	1000000	
12/2/2019	IN47523983	DISTRIBUSI LOS	1000000	10.000.000
19/2/2019	IN47817355	DISTRIBUSI LOS	1000000	
26/02/2020	IN48014297	REDAMAN TINGGI	500000	4.000.000
2/3/2019	IN48389025	DISTRIBUSI CUT	4000000	
10/3/2020	IN63861863	DISTRIBUSI LOS	1000000	
12/3/2019	IN48803923	DISTRIBUSI LOS	1000000	
15/3/2019	IN48929834	DISTRIBUSI CUT	4000000	18.000.000
1/4/2019	IN49645744	DISTRIBUSI LOS	1000000	
10/4/2019	IN50036487	DISTRIBUSI LOS	1000000	
15/4/2019	IN50226092	DISTRIBUSI LOS	1000000	
25/4/2019	IN50563548	DISTRIBUSI LOS	1000000	10.000.000
9/5/2019	IN51913538	DISTRIBUSI LOS	1000000	
11/5/2019	IN51227514	DISTRIBUSI LOS	1000000	
11/5/2019	IN51225935	DISTRIBUSI CUT	4000000	
14/5/2019	IN51227514	DISTRIBUSI CUT	4000000	8.000.000
24/5/2019	IN51735547	DISTRIBUSI CUT	4000000	
25/5/2019	IN51787413	DISTRIBUSI CUT	4000000	
4/6/2019	IN52082366	DISTRIBUSI LOS	1000000	
23/6/2019	IN52687619	REDAMAN TINGGI	500000	2.500.000
25/6/2019	IN52774026	REDAMAN TINGGI	500000	
18/6/2019	IN52444804	DISTRIBUSI CUT	4000000	
29/6/2019	IN52959160	DISTRIBUSI CUT	4000000	
5/7/2019	IN53244994	DISTRIBUSI CUT	4000000	4.000.000
8/7/2019	IN53244994	DISTRIBUSI CUT	4000000	
2/8/2019	IN54382903	DISTRIBUSI LOS	1000000	4.000.000
22/8/2019	IN55133335	DISTRIBUSI LOS	1000000	
29/8/2019	IN55193280	REDAMAN TINGGI	500000	4.000.000
2/9/2019	IN55432861	FEEDER LOS	1000000	
8/9/2019	IN55770491	DISTRIBUSI LOS	1000000	
9/9/2019	IN55786985	DISTRIBUSI LOS	1000000	
21/9/2019	IN56255699	FEEDER LOS	1000000	
Total Cost				IDR.71.000.000
Average/Month				IDR.7.888.889

Based on the Pareto diagram, it is known that the highest interference is in IndiHome complaints with 59.4 percent with complaints of Internet Service Is Down or Unable to Connect and in complaints of intermittent internet connection by 35.8 percent. The two complaints against IndiHome will be a priority in controlling the quality of fixing IndiHome problems. After knowing the dominant defect which is the priority in quality control, the next step is to create a cause effect diagram to determine the causes of defects in IndiHome products. The method used to make a cause and effect diagram is the brainstorming method or FGD (Focus Group Discussion) with the project team and technicians in the field. The results of the brainstorming are as in Figure 7.

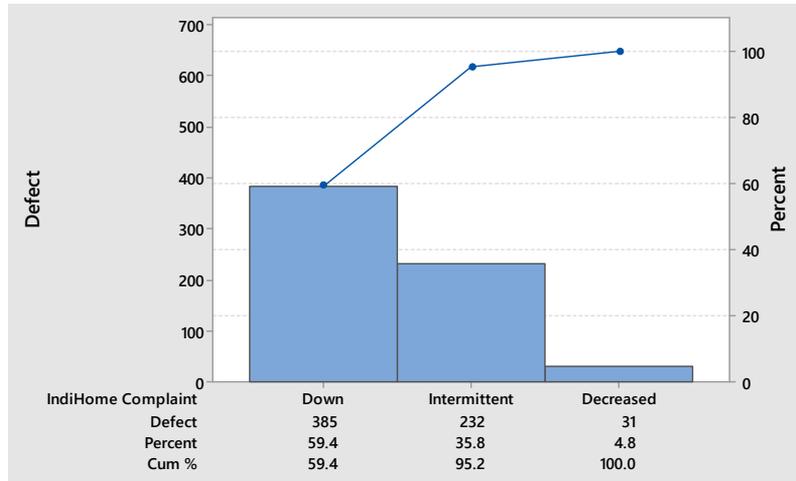


Figure 6 Pareto Chart IndiHome Complain.

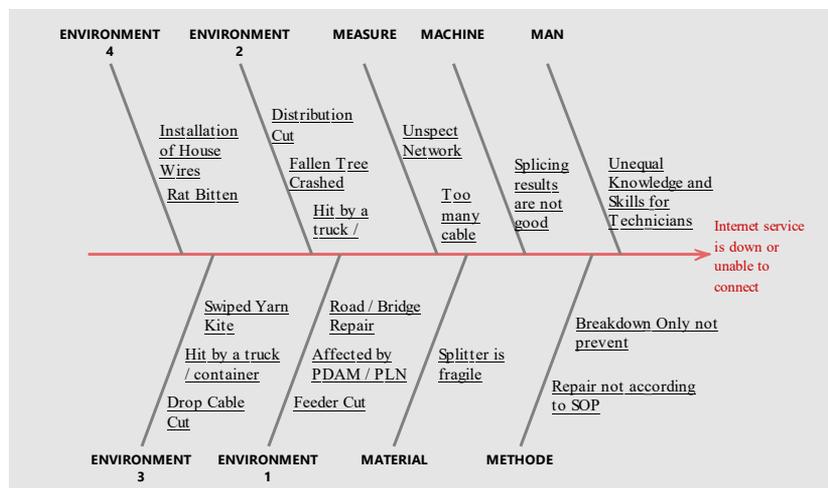


Figure 7 Cause Effect Diagram IndiHome Down or unable to connect.

Internet service is down or unable to connect due to environmental factors. There have been many incidents where the distribution cable lines and feeders were hit by containers or were exposed to excavation. This is because the pile height is getting lower after road repairs. In the repair process, there are many that do not comply with the procedure because the technician's ability is not evenly distributed.

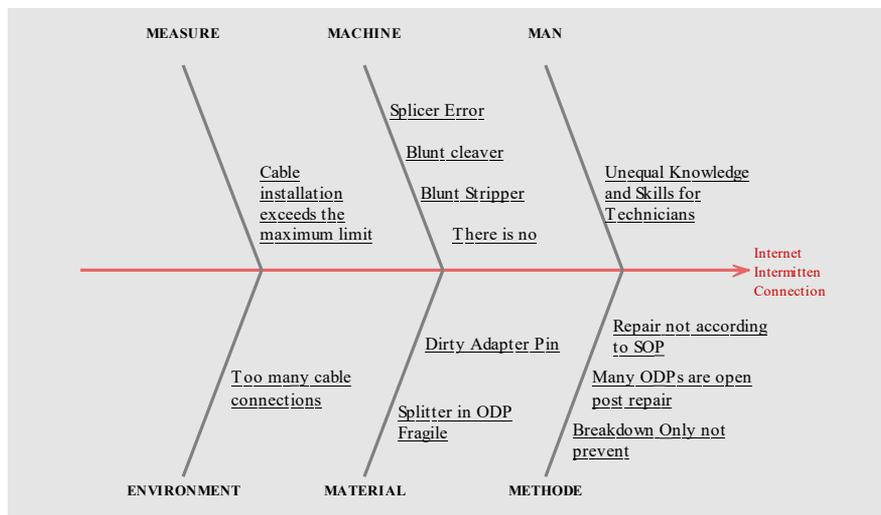


Figure 8 Cause Effect Diagram Internet Intermittent Connection.

Internet Intermittent Connection is caused because the network does not meet specifications due to the number of connection points due to breakdown repairs, technician negligence in repairing disturbances that are not according to procedures, such as after repairing the distribution line where the ODP equipment is not closed again so that the splitter becomes fragile and the adapter pins are dirty which may cause interference in the future. The next steps for the project team to provide quantitative results for anything that caused the impact of the cause of failure/defect (severity), whatever caused the failure to take place in the current process control process (detection). The results are as follows,

Table 5 FMEA IndiHome Problem

Failure Modes	Failure Effect	S	Cause of Failure	O	Current Process Control	D
Defect Feeder	1 core feeder break can cause 32 IndiHome service units to completely shut down, generally 1 ODC device has 12-24 cores.	10	Excavated/ Affected by road widening	1	There is no control process yet	10
Defect Distribution	1 distribution core break can cause 8 service units to die in total, generally there are 12 cores -24 distribution cores channeled	10	Affected by road widening	6	There is no control process yet	10
Defect Drop	1 customer service is Down	1	Hit by a container because the cable height is too low	3	In the process of repairing disturbances, a recall or change of lanes was carried out to reduce the disturbance	4
		1	Scrapped wires or threads	6		4
		1	Hit by a container because the cable height is too low	1		4
Defect of House / Building Wires	1 customer service is down	1	Hit by a fallen tree	5	Installation of the cable tray pipe Rosette wiring	4
		1	Bitten by a mouse	7		3
Network does not meet Specifications	Intermittent interruption of IndiHome service	10	Cable connection is broken	6	Joint closure installation	5
		10	Too many connection points	3	Internal care	4
Repair not according to SOP	Causes annoyance later on	6	Poor cable connection results	6	Reminding to close ODP after Crash Repair	5

Based on the value of severity, occurrence and detection in the FMEA table, the value of risk priority number (RPN) can be calculated using the formula of severity x occurrence x detection. Based on the largest RPN value in the FMEA table, it can be seen the failure modes that are the main causes of product defects. Likewise, the corrective actions/recommended actions that are formulated to reduce ranking severity and occurrence are the result of the project team brainstorming.

Table 6 Recommended Action

Cause of Failure	S	O	D	RPN (S x O x D)	Recommended Action
• Defect feeder due to excavation/road widening	10	1	10	100	The application of Poka-Yoke with the Prevent Mistakes approach is an approach to prevent mistakes before errors or quality problems occur. So it is necessary to check the feeder line when there is road work
• Defect Distribution Due to being hit by a container because the cable height is too low	10	6	10	600	Poka-Yoke implementation by doing Elimination / replacement of Telkom poles/re-installing the poles to adjust the height so as not to be hit by containers
• Defect of drop cable Fallen tree	1	3	4	12	Poka-Yoke is applied by doing Elimination/replacement of Drop core
• Run over by the container because the cable height is too low	1	1	4	4	Prevent mistakes by changing lanes
	1	6	4	24	Poka-Yoke implementation by doing Elimination/replacement of Telkom poles/re-installing the poles to adjust the height so as not to be hit by containers
• Bitten by a mouse	1	5	4	20	Prevent Mistakes the pipe tray installation
• Cable connection is broken	1	7	3	21	Prevent Mistakes installation of joint closure
• Too many connection points	10	6	5	300	Elimination is carried out by replacing the 12/24 core capacity distribution cable
• Poor cable connection results	10	3	4	120	Prevent Mistakes are treated with machine splicer, cleaver and stripper
• Passive on ODP devices is fragile because it doesn't close after fixing the fault	6	6	5	180	Elimination is carried out by changing the ODP or adding a tool to lock the ODP

### 3.4 Improve

At this stage, it is necessary to determine the proposed improvement from the root causes that have been carried out at the Analyze stage by conducting brainstorming using a causal diagram and prioritizing it based on RPN calculations on the dominant cause of IndiHome defects. Based on the calculation of the risk priority number (RPN), the causes of failure with the largest RPN value are a priority for corrective action. The priority causes of failure are sorted from those with the highest value, as follows:

- 1) The distribution defect of 600 RPN is caused by Telkom's low pole height while the recommendation for improvement is to apply the Poka-Yoke approach concept with the elimination method, which requires replacing Telkom poles or re-installing Telkom poles according to the height of the passing container.
- 2) The attenuation is not suitable due to the number of connection points with a value of 300 RPN which is caused by too many cable connection points, as for the recommendations for improvement, namely replacement of distribution cables with a capacity of 12 to 24 cores or repair of the connection by installing a joint closure
- 3) Passive ODP (optical distribution point) is fragile with a value of 180 RPN caused by a technician's error not to close the ODP after repairing the IndiHome fault, as for the recommendations for repair, namely eliminating or replacing ODP/passive splitter and several tools to remind technicians to close ODP again after repairing the disturbance. Based on the priority of cause of failure recommended by the project team in improving it, it is necessary to use the The Poka-Yoke method is a tool for eliminating defects (zero defects). The improvement phase can be seen on the Poka-Yoke improvement form

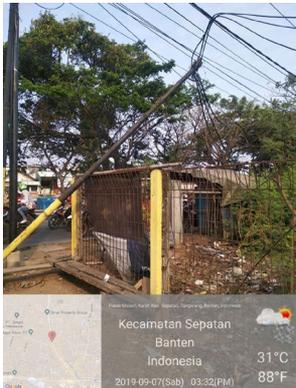
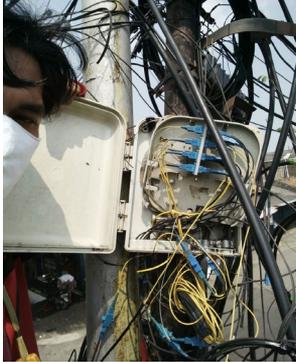
Poka-Yoke Improvements Form			
Environment	Defect distribution	Level	Category
Date	1-12 2019	1) Warning	a) Wrong Action
Issue Rise By	Abby Yazid B	2) Prevention	b) Measurement Error
Consequency	Defect Distribution	3) Elimination	c) Forgetfulness
<b>Problem Statement</b>		Elimination	No Visual Indication
1) The distribution cable lines in the Mekar Jaya industrial area are often hit by containers because the distance of the Telkom Poles is too low		Action : Re-installation of Telkom Poles at several points	
2) The attenuation is not suitable due to the number of connection points that affect the network including bad connections and connections that are not of good quality		Elimination	Wrong Action
3) Unspect attenuation because technicians often forget to close the Optical Distribution Point (ODP) so that the passive splitter is easily fragile and the adapter pins are dirty		Action : Joint closure installation at several point	
		Elimination	Forgetfulness
		Action : ODP Replacement	
<b>Improvement</b>		Starting Date:	Finish Date:
1) Elimination of Telkom poles on the distribution cable line at points that are often hit by containers		07-12-2019	13-12-2019
2) Network repair by reconnecting and installing joint closures		Starting Date:	Finish Date:
3) Replaces the optical distribution point model with a separate protected and passive splitter and closed adapter pins		14-12-2019	22-12-2019
		Starting Date:	Finish Date:
		23-12-2019	29-12-2019
1) Before	After	2) Before	After
			
3) Before	After	Results After repair	
			

Figure 9 Poka Yoke Improvements.

Improvement was made to minimize the factors causing the high complaints about IndiHome disturbances, namely the re-installation of Telkom Poles at several points prone to accidents that cause defects. Then repair the connection by installing a joint closure which is useful for maintaining the quality of the cable connection. And also some distribution points were replaced by optical distribution points in order to minimize errors made by technicians and also maintain network quality according to specifications. The results of the improvement efforts that have been made are the network measurement to be better and according to specifications (-13 dbm to -28dbm) and the distribution network to be safer from the factors that cause problem of IndiHome services in the Mekar Jaya industrial area.

### 3.5 Control

The control phase is the last step of the six sigma DMAIC method. The control phase aims to evaluate and control the results of quality improvement by ensuring a new level of performance in standard conditions and maintaining the values of the improvement. At this stage, monitoring and control of results are carried out after improvements in the period January 2020-March 2020. Evaluating and controlling the results of improvements are carried out using the P-Chart to see process control, measure DPMO and Sigma to see process capabilities, and to see the costs incurred by the company for IndiHome improvements after Improvement using COPQ.

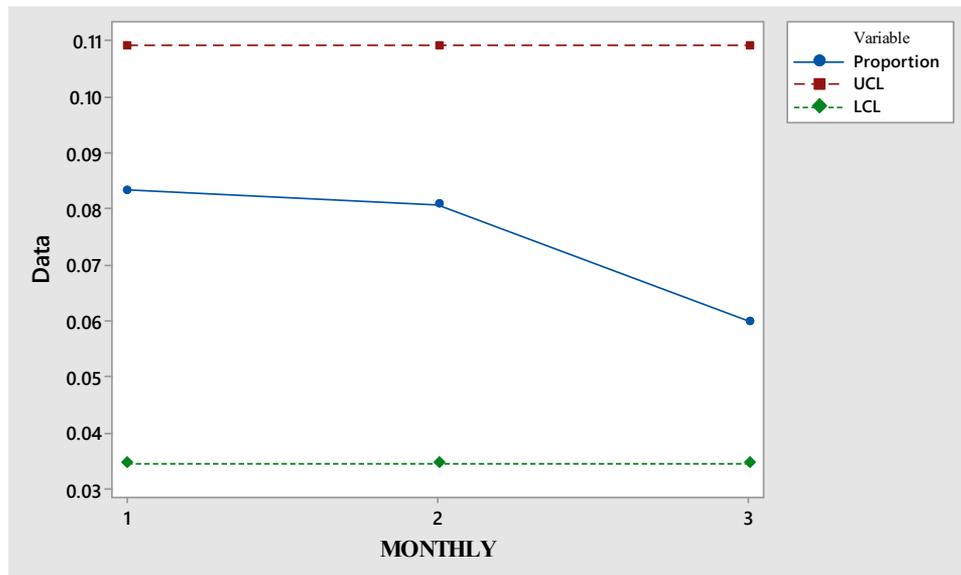


Figure 10 P-chart IndiHome complain after improvement

From the P-chart, it can be seen that the process from January to March 2020 did not have any point that came out of the line of control either the upper or lower control limits, this means the process was under control. And the upper limit is lower with a value of 0.109 which previously had a value of 0.228. Furthermore, the ability of the process can be calculated.

Table 7 Measuring DPO, DPMO and Sigma Levels January 2020 - March 2020

Month	User	Defect	%	CTQ	TOP	DPU	DPO	DPMO	YIELD	Sigma Level
Jan-20	384	32	8.33	3	1152	0.08333	0.02778	27778	97.22%	3.41
Feb-20	384	31	8.07	3	1152	0.08073	0.02691	26910	97.31%	3.43
Mar-20	384	23	5.99	3	1152	0.05990	0.01997	19965	98.00%	3.55
$\bar{X}$ Average			7.47					24884	97.51%	3.47

Based on the Table 7, the average monthly IndiHome complaints after repairs was 7.47 percent. With a defect per million opportunity of 24,884 DPMO. With this, it can be seen that the performance of the IndiHome service improvement process after repairs is at the sigma level of 3.47. Based on the 5 Phase of DMAIC that have been carried out. The results of the improvements can be seen in Table 9.

Table 8 COPQ after Improvement

Date	Incident	Indication	Cost	Total Cost
29/1/2020	IN45812457	DISTRIBUSI LOS	1000000	1.000.000
--/2/2020	-	-	-	0
11/3/2020	IN63861863	DISTRIBUSI CUT	4000000	4.000.000
Total Cost				IDR.5.000.000
Average/Month				IDR.1.666.667

Table 9 Result After Improvement

Item	Before Improvement	After Improvement
% Average Defect/bulan	14%	7.47%
DPMO	46875	24884
Sigma Value	3.18	3.47
Average COPQ/ Monthly	IDR 7.888.889	IDR 1.666.667

The application of six sigma in the repair process of IndiHome disturbances in the Mekar Jaya Industrial Estate succeeded in exceeding the target of research planning, which succeeded in reducing defects up to 7.47% of the repair target of 9% with the previous defect number of 14% per month. Then increase the baseline performance (sigma level) from 3.18 to 3.47 sigma. This research also succeeded in reducing costs due to IndiHome defects from IDR 7,888,889 to IDR 1,666,667 per month, which means a decrease of 78.8% per month.

After the improvement is successful, then the project team made a strategy that was applied to prevent defects. Including giving directions to fix the network that is preventive when doing IndiHome repairs and providing training to technicians is very necessary in order to provide insights to technicians how to make good trouble repairs and according to specifications determined by the company. The training provided is E-Learning and Fiber Optic Splicing Practices. While the prevention that is done is preventive distribution network.



Figure 11 Defect prevention strategies.

#### 4. Conclusion

The application of six sigma DMAIC in the IndiHome repair process in the Mekar Jaya industrial area has identified that distribution defects, unspect networks to human errors during the IndiHome repair process are the factors causing the high number of IndiHome complaints in the Mekar Jaya industrial area. Pokayoke is used as a tool for implementing Six Sigma in an effort to improve the IndiHome network, which has succeeded in reducing IndiHome customer complaints by 7.47% of the repair target of 9%. Then increase the baseline performance (sigma level) from 3.18 to 3.47 sigma. Technicians are provided with network improvement training, connection training according to SOPs and socialization related to IndiHome service maintenance, which are strategies implemented to prevent human errors

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