CHAPTER V

PROPOSED METHODS FOR PRODUCT QUALITY IMPROVEMENT FOR END USERS

5.1 Introduction

From the current tools of control charts and 8-D corrective actions in Molex Thailand which is described in chapter 4, there are still have quality problems occurred in manufacturing and they are the risk which might be able to lead to the increase of customer complaints. Therefore, quality criteria should be improved by other technique such as FMEA technique.

5.2 Workmanship standard to quality defect

Molex Thailand does not have standard term for defect parts that lead to many problems between internal customers and external customers. For example, sales department could not feed back the quality problems to quality department because the communication was not effective. Result of that, it lead to customer dissatisfaction.

For external customers, some of the time quality problem was solved in the wrong quality issue because of the communication was not effective between external customer and either sales department or quality department.

Figure 5.1 show the example of workmanship standard of quality defect type. In figure 5.1, there are eight main things which are listed as following. In appendix B show the other defect types which are standardized into workmanship standard

1 Defect type
2 Defect code
3 Definition of defect type
4 Possible cause of defect that type
5 Basic criteria for control
6 How to measuring and inspection
7 Picture of that defect type
8 Rationale

Defect Type : **Insulator Over and Under Crimp**

Defect Code : **30**

Definition : Over crimp refers to insulator that is extruded / extended into the conductor barrel while crimping .And under crimp refers insulator that do not flushed or extended beyond insulation support (insulator barrel).

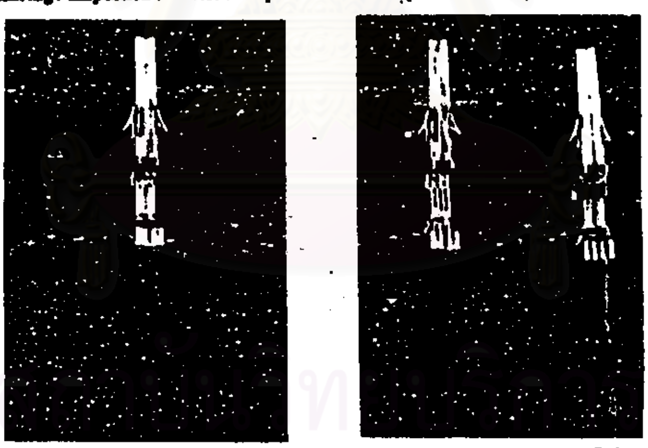
Causes :
a) Poor tooling set-up
b) Poor feeding of wire during crimping process.
c) Poor feeding of terminal from reel.

Criteria For Control :

a) If wire insulation does not extend beyond insulation support / insulator barrel or even do not flush with insulation barrel, reject the product.

b) If wire insulation is extruded / extended into conductor barrel , reject the product.

Measuring / Inspection : Visual inspection under low power microscope



Good *Reject* *Reject*

Rationale :
a) Under crimp may create poor retention force in the terminal.
b) Over crimp may create electrical failure as conductor is not properly matched with conductor barrel.

Figure 5.1- Workmanship standard for quality defect type

5.3 Fundamental steps to analyze quality problems from customer points of view

The bellowing steps are the fundamental steps to analyze quality criteria problems from customer complaints. Figure 5.2 show the flow chart for the analysis of customer complaint record.

5.3.1 Apply Pareto diagram

This Pareto diagram is to select the most critical quality criteria from customer point of view. This pareto diagram apply to both frequency aspect and value aspect.

5.3.2 Apply cause-effect diagram

This cause-effect diagram is to find the causes that lead to the customer complaints. This will be applied in each main factor. Apply this diagram to 5M: man, machine, methods, measurement and material

1 If customer complaints are too broad, customer complaint have to be listed all possible specific problems that result to customer complaints by using fish bone diagram.

2 After completed fish bone diagram in step 5.3.2.1. Apply Pareto diagram to that causes that lead to customer complaint. Then the critical quality criteria can be identified by using both value aspect and frequency aspect.

3 Apply cause-effect diagram (5M) to the selected quality criteria. It is the same concept as step 5.3.2

5.3.3 Check quality criteria

After selected the top most critical quality criteria, the output of quality criteria should be checked whether it is under current control or not.

5.3.4 Determine the appropriate Q.C tools

After step 5.3.3, Q.C tools should be considered whether it is the appropriate chart in the application or not.

5.3.5 Analysis the failure mode

Apply FMEA technique to prevent that critical quality criteria from step 5.3.2 Not only that but FMEA technique also prevent the potential failures. Apply FMEA technique to the critical products or part number which used to have the selected critical quality criteria.

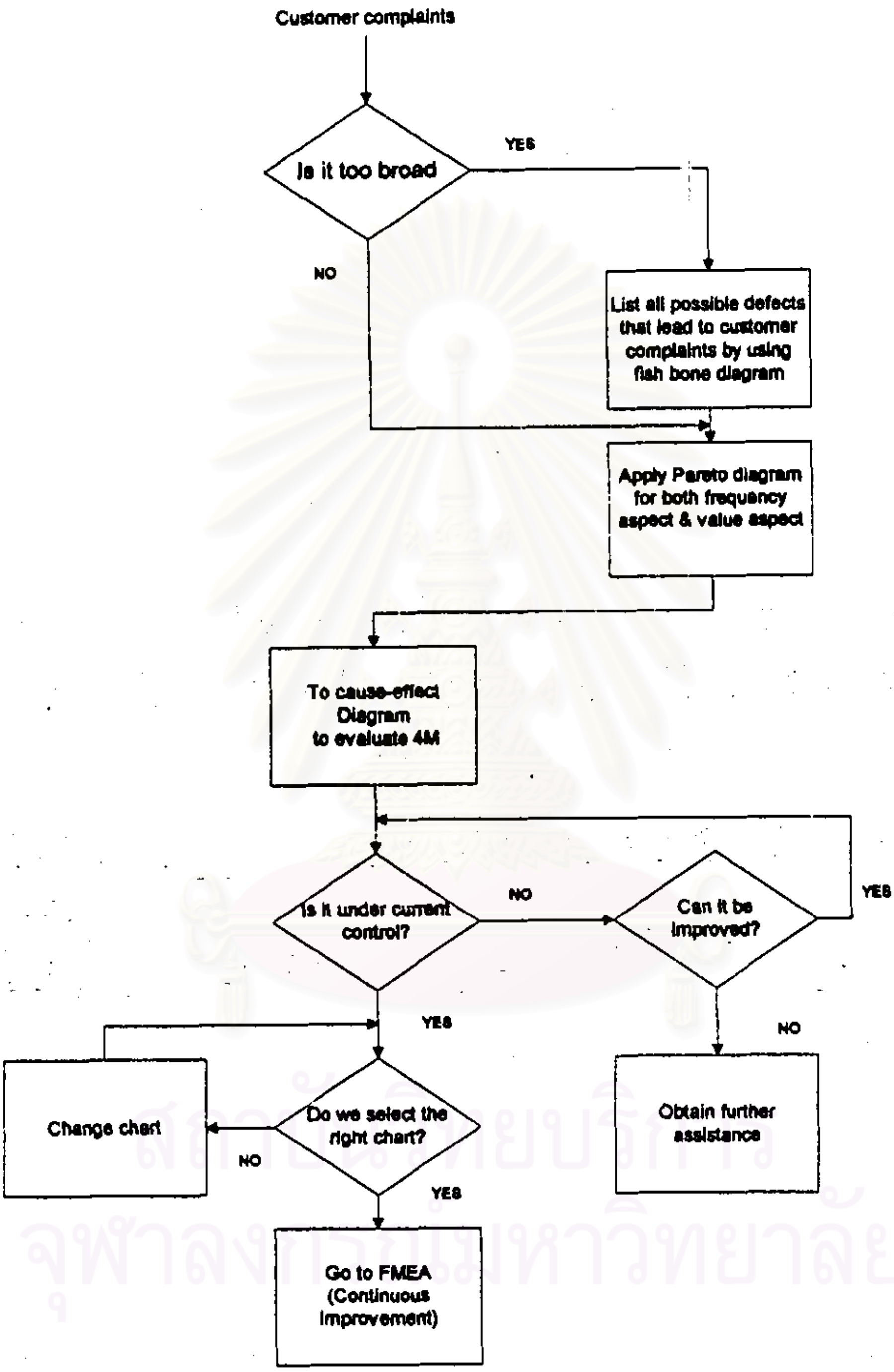


Figure 5.2- Flow chart for the analysis of customer complaint record

5.4 FMEA technique

FMEA stand for Potential Failure Mode and Effect Analysis. The objective of this technique is to prevent possible problems and eliminate failures, error and problems. In this thesis, FMEA technique is applied to improve of existing product.

5.4.1 Failure

Failure is something that does not conform the specification or does not conform customer requirement such as missing pin and alternation wire.

5.4.2 Failure mode

Failure mode is syndrome of failure. For example, failure is missing pin. The syndrome of missing pin open circuit. Another example, if failure is alternation wire. The syndrome of alternation wire is short circuit

5.4.3 Effect

Effect is the result of the failure to the customers. In this thesis, internal customers and external customers are both considered. For example, what happen to the next operation person if the input is bad and this input is the output of the previous person. This is called the effect of the internal customer. Definitely, the result of the effect from internal customers will effect to the external customers or end users as well because the end users are the ones who recieve and perceive the outputs from the last internal customer. It always has a risk.

5.4.4 RPN

RPN stand for risk priority number. Basically, there are three things that are important in FMEA technique. Firstly, it is severity. Secondly, it is occurrence. And the last one is detection method. However, to improve all quality criteria at the same time is not impossible. Therefore, risk priority number is used to prioritize the quality criteria. RPN is equal to the multiplication of severity number, occurrence number and detection number. These number is described in chapter 2.

1 Severity

Severity is how serious of failure mode. This is subjective which need argument and brainstorming. In this thesis, severity number comes from experience basis and come out consensus. This number basis on severity number in chapter 2.

2 Occurrence

Occurrence is how often of the potential cause. In this thesis, occurrence number comes from voting and brainstorming in FMEA team and also basis on occurrence number in chapter 2.

3 Detection

Detection is the chance to detect the failure. In this thesis, detection number comes from team brainstorming and basis on the detection number in chapter 2.

4 To reduce risk priority number

Molex Thailand confidential level is 95 percent. So, how much RPN that should be considered. The maximum of RPN is ten power three which is equal to one thousand. Each ten come from the maximum number of severity, occurrence and detection in chapter 2. The minimum RPN is one power three which is equal to one.

According to Molex Thailand confidential level is equal to 95%, the RPN which can accept is equal to 50. It comes from the result of minus between 1000 and 950. This nine hundred and fifty value come from ninety five percent of the maximum risk priority number. Type I error is equal to fifty.

In other word, risk priority number which is greater than fifty will be all considered. Molex Thailand can accept RPN at level fifty. However, FMEA team should pick up the highest RPN value first.

5 Fundamental steps to implement FMEA technique

The bellowing steps are the basic steps to implement FMEA technique. In this thesis, there are thirteen steps which are described as following.

5.1 Set up cross functional team

5.2 Train FMEA technique to all team member

5.3 Brainstorming known and the potential failures by using process flow chart of that target product as a guide line in each process.

5.4 Collect data and sample of existing failure of the product

5.5 Brainstorming and estimate the priority of each potential and existing failure in term of severity, occurrence and detection

5.6 Calculate the risk priority number (RPN)

5.7 Select the most critical one due to the highest RPN value to be improved

5.8 Analyze process and brainstorm the actions or plan

5.9 Recommend action on the selected issue

5.10 Identify the person who incharge the actions or plan

5.11 Implement that plan or actions

5.12 Evaluate the taken action

Basically, there are three questions which always discussed in FMEA team that are listed out as following

5.12.1 Is it improved?
5.12.2 Is it more worse?
5.12.3. Is it the same as before?

5.13 If the taken action can not improve, it means that RPN increased or RPN remain the same. FMEA team should recommend alternative actions and implement it. Then analytical process and RPN calculation have to be done again until RPN value is reduced. Iterate step 5.4.5.8 to 5.4.5.11 until RPN is improved.

Note: Figure 5.3 show the flow chart of FMEA fundamental steps and figure 5.9 show the FMEA form. This form will be used in chapter 6 for implementing FMEA technique.

In figure 5.17, it consists of the following portions.

1. Process name
1.1 Part number

2. Manufacturing responsibility
2.1 Person responsibility

3. Involvement of others

4. Supplier involvement

5. Product/Model

6. Engineering release date
6.1 Key production date

7. Prepared by

8. FMEA date

9. FMEA rev date

10. Process function of selected part number

11. Potential failure mode

12. Potential effects of failure

13. Severity number

14. Potential causes of failure

15. Occurrence number

16. Detection method

17. Detection number

18. Risk priority number

19. Recommended action

20. Responsible person and expected complete date

21. Action taken

22. Reevaluate
22.1 severity number
22.2 occurrence number
22.3 detection number

23. Risk priority number (RPN)

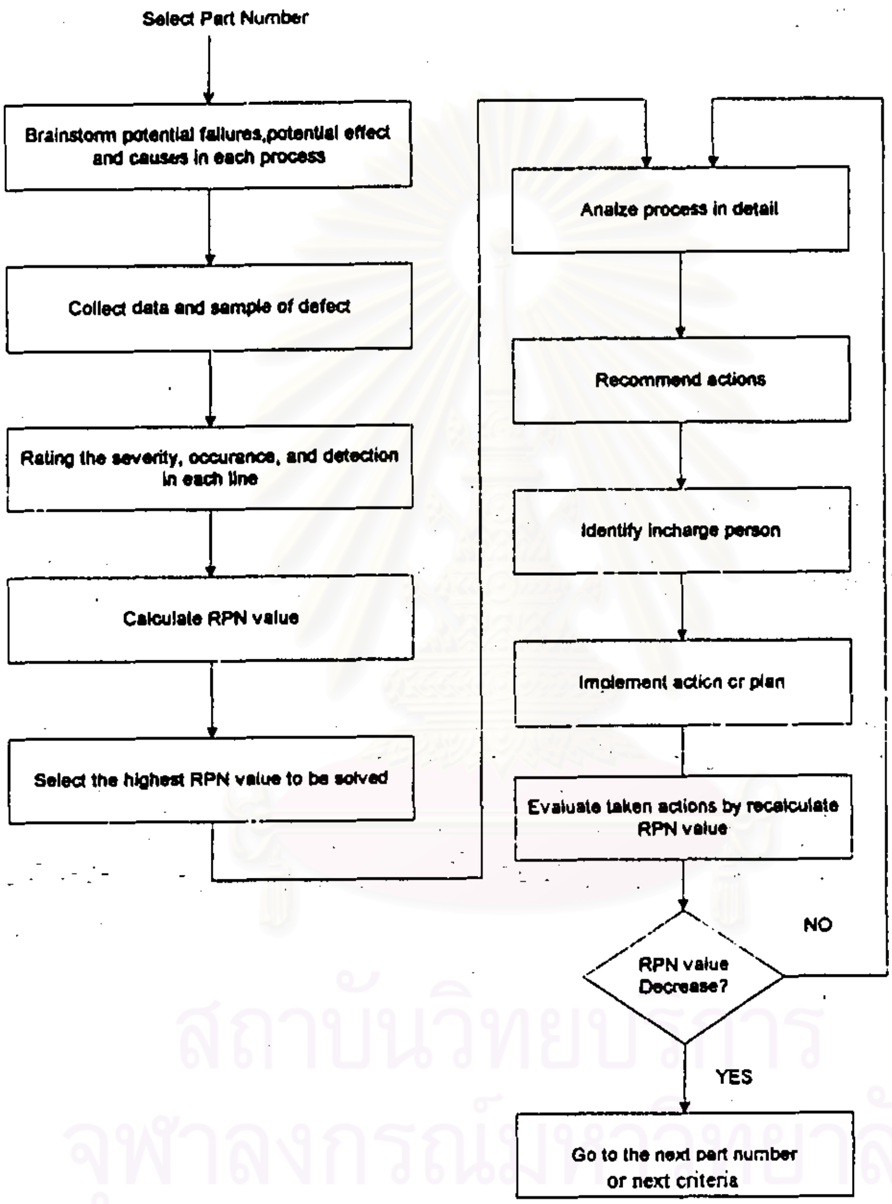


Figure 5.3 show the flow chart of FMEA fundamental steps

MOLEX FAILURE MODE AND EFFECTS ANALYSIS

Team Member : 1. ____ 2. ____ 3. ____ 4. ____ 5. ____ 6. ____

FMEA no.______

(1) Process name : ______________
(1A) Part name: ______________
(2) Mfg or design responsibility: ______________
(2A) Person responsibility: ______________

(3) Involvement of others: ______________
(4) Supplier involvement: ______________
(5) Model/product: ______________
(6) Engineering release date: ______________

(6A) Key prod. date: ______________
(7) Prepared by: ______________
(8) FMEA date: ______________
(9) FMEA rev. date: ______________
Page ____ of ____ pages

Process Function	Potential Failure Mode	Potential Effect(s) of Failure	SEV	Potential Cause(s) of Failure	OCC	Detection Method	DET	RPN	Recommended Action	Individual / Area Reponsible and Completion Date	Action Taken	Action Results SEV	OCC	DET	RPN

Approval Signatures

Concurring Signatures

Figure 5.9- Proposed FMEA form

5.5 Guideline to analyze method factor

In figure 5.4 show the guideline how to evaluate method factor as a loop. Firstly, it starts with checking the output of process whether it is in statistical control or not. Then the capability of process is considered whether it meets tolerances or not. Then FMEA technique is considered for preventing the potential failures for long term improvement. FMEA also can help to reduce known failure by reducing the potential causes that might lead to the known failure as well.

5.6 Guideline to analyze machine factor

In figure 5.5 show the guideline how to evaluate machine factor as a loop. Firstly, it starts with checking the output of machine whether it is in statistical control or not. Then capability ratio of machine is considered whether it is greater than one or not. Then FMEA technique is considered for preventing the potential failures for long term improvement. FMEA also can help to reduce known failure by reducing the potential causes that might lead to the known failure as well.

5.7 Guideline to analyze man factor

In figure 5.6 show the guideline how to evaluate man factor as a loop. Firstly, it starts with checking the output of human whether the histogram is normal or not. Then the customer specification such as tolerance is considered whether it meet or not. Then FMEA technique is considered for preventing the potential failures for long term improvement. FMEA also can help to reduce known failure by reducing the potential causes that might lead to the known failure as well.

5.8 Guideline to analyze measurement factor

In figure 5.7 show the guideline how to evaluate machine factor as a loop. Firstly, it starts with checking the accuracy of measuring whether it is in Molex Thailand acceptable level or not. Then the repeatability and reproducibility of measuring instrument is considered whether it is in Molex Thailand acceptance level or not. Then FMEA technique is considered for preventing the potential failure for long term improvement. FMEA also can help to reduce known failure by reducing the potential causes that might lead to the known failure as well.

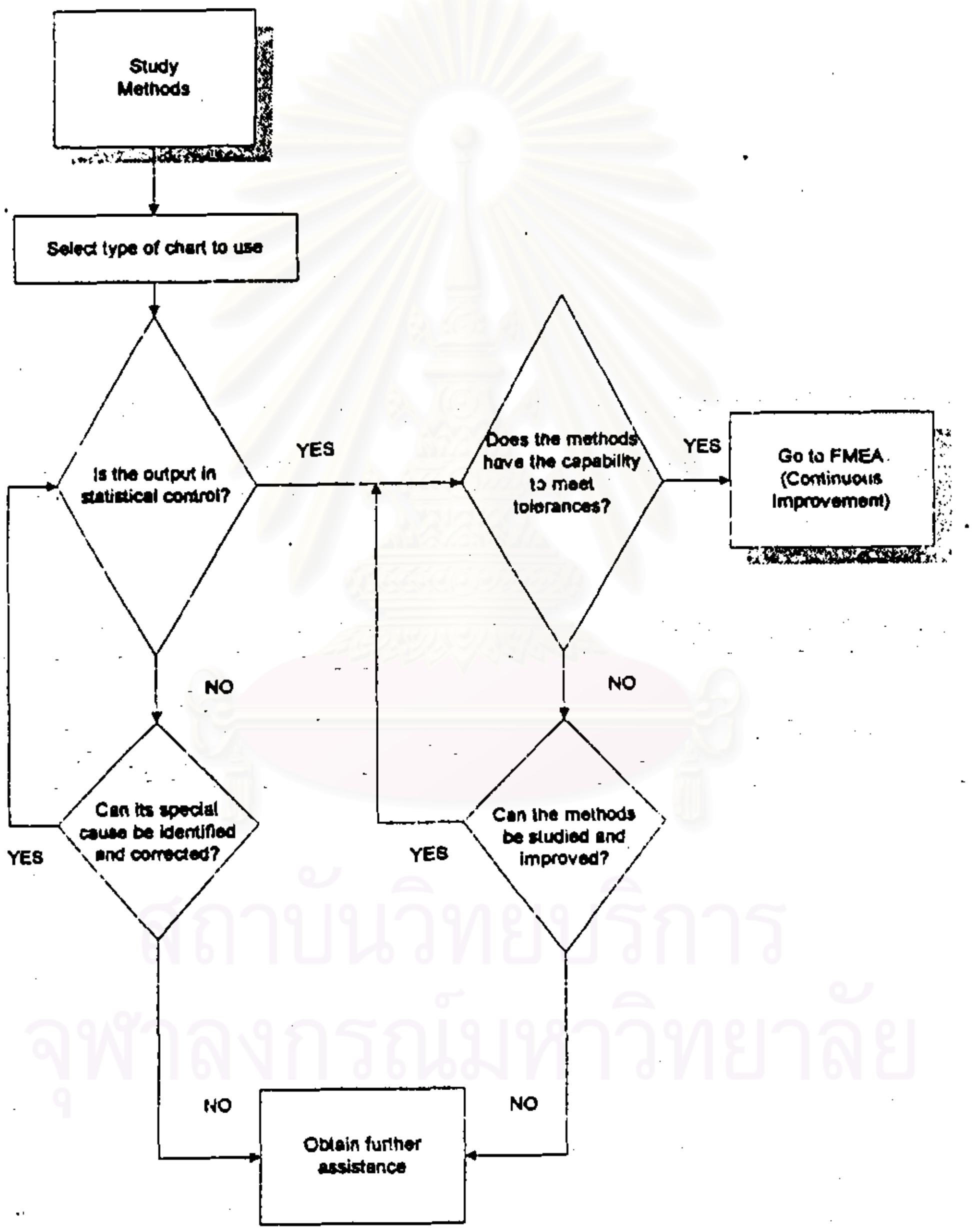


Figure 5.4- Guideline how to evaluate method factor as a loop

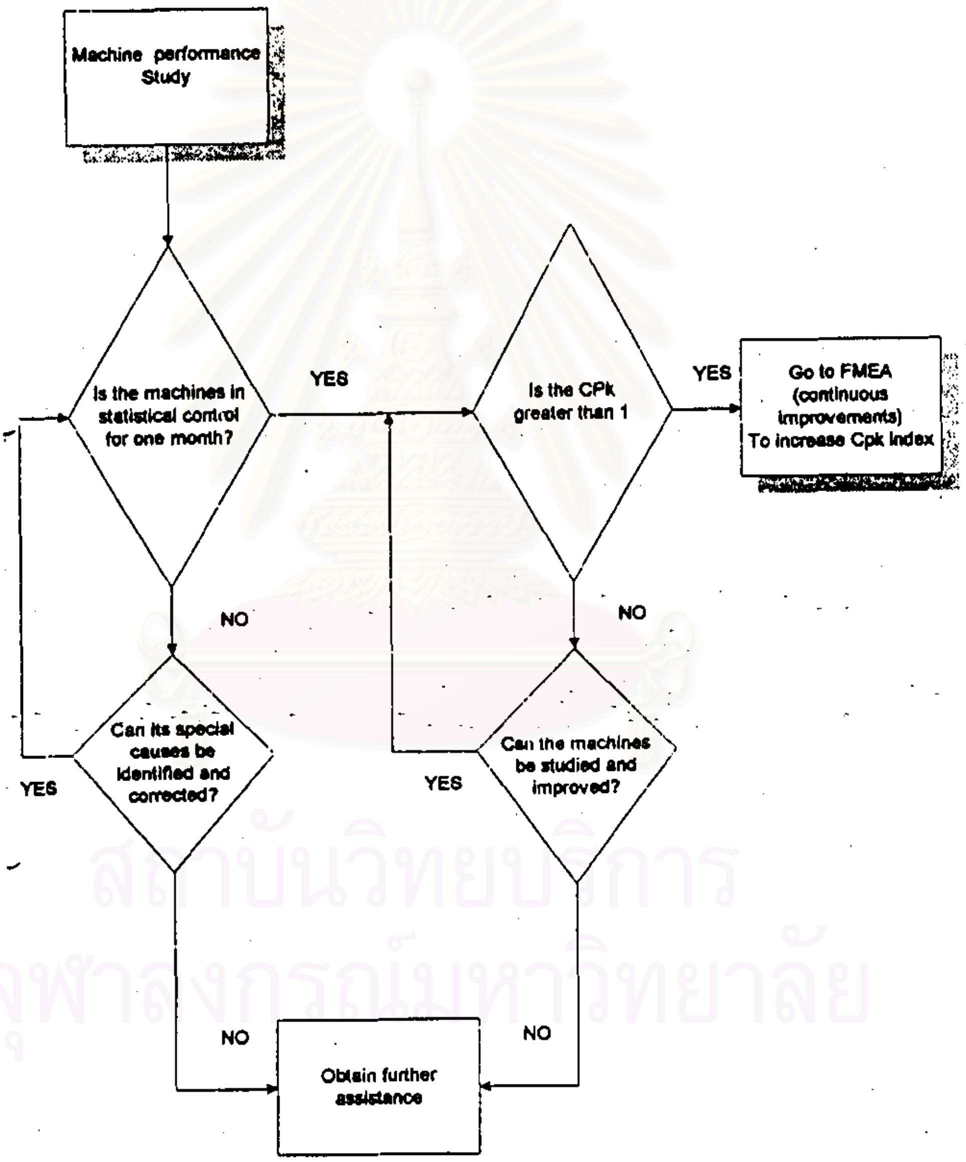


Figure 5.5- Guideline how to evaluate machine factor as a loop

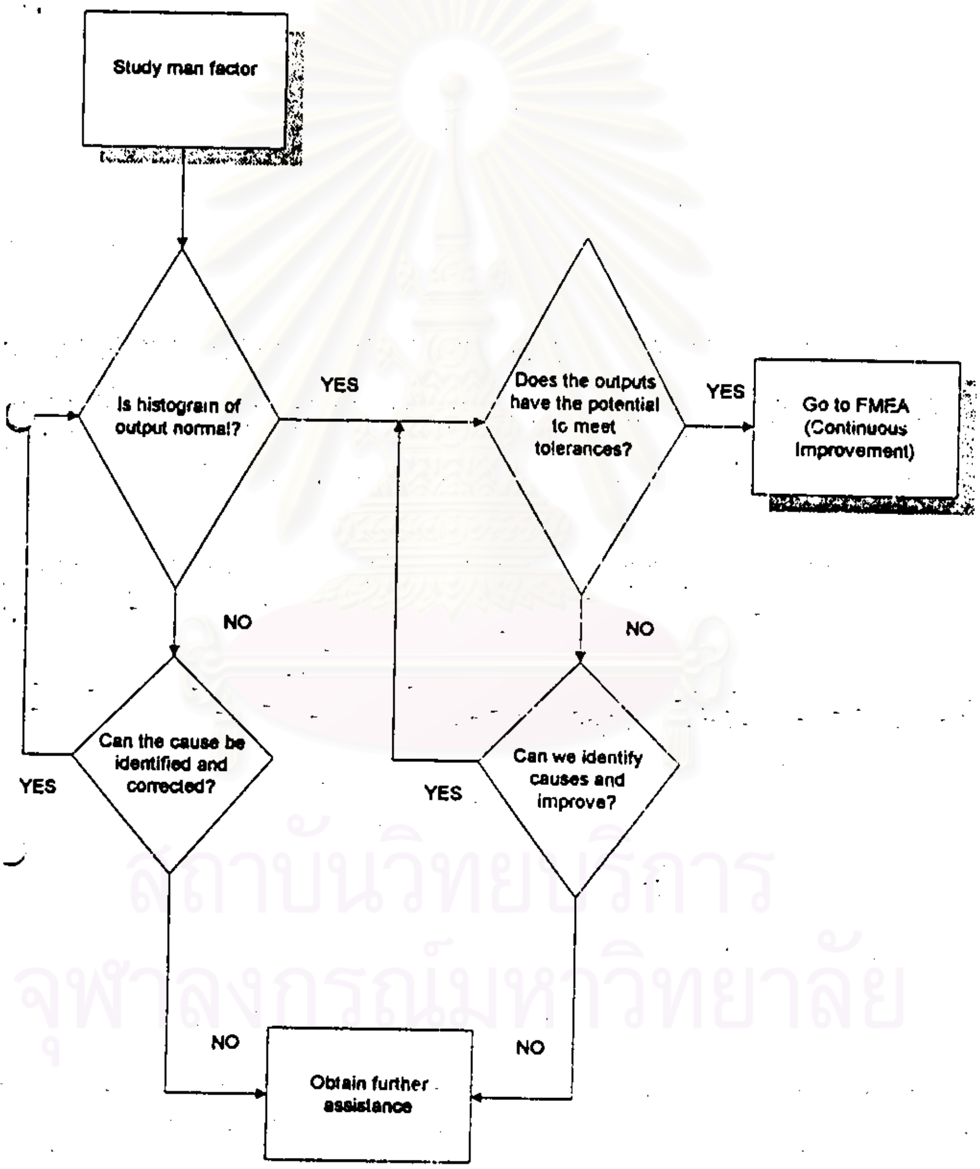


Figure 5.6- Guideline how to evaluate man factor as a loop

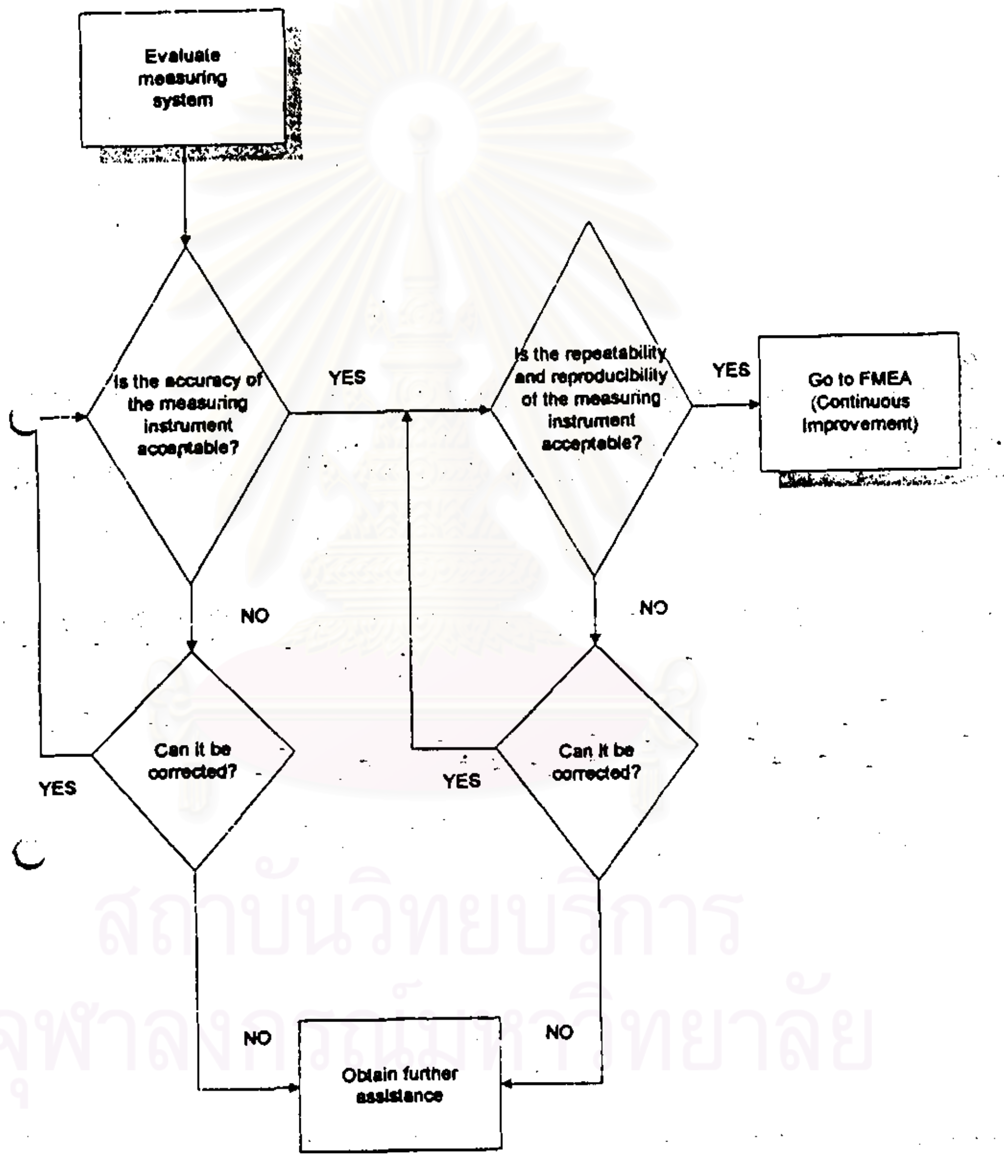


Figure 5.7- Guideline how to evaluate measurement factor as a loop

5.9 Add marking process on housing of wire harness

Some of the time, Molex Thailand is second source. Dot marking on the connector of harness wire can help both party which are customers and Molex Thailand to be able to classify which harness wire was produced from Molex Thailand and which one was not belonging to Molex Thailand.

5.10 Sampling plan

In the past, Molex Thailand has only one inspection level (AQL = 0.1) which is not effective enough. Molex Thailand still have customer complaints on quality of products. Switching rule concept as described in chapter is proposed in this thesis to increase the degree of inspection. With this switching rule, Molex Thailand strengthen the sampling plan and enhance Molex Thailand to detect reject parts more efficient than usual. This switching rule is applied in the outgoing area which is the last gate before parts are shipped to customers.

5.11.1 Samples must be taken randomly from the submitted lot in according to the C=0 sampling plans with switching rule as described in figure 5.8. Whenever the sampling plan was done and found only one reject part, Molex Thailand will reject the whole lot and Molex Thailand will sort the whole lot in house before that lot be shipped to customer.

5.11.2 The starting inspection point for any part number is normal level at AQL = 0.1 with C=0. See table 5.1 for sampling plan with C=0

5.11.3 Condition for normal level (AQL = 0.40 with C=0) to reduced level (AQL = 0.10 with C=0) This will be effective when the bellowing condition is exist.

1 Five consecutive lots are accepted

5.11.4 Condition for reduced level (AQL = 0.4 with C=0) to normal level (AQL = 0.1 with C=0) This will be effective when any one of the bellowing condition is exist.

1 Any lot was rejected

2 Irregular production
For example, there is no production in the last 10 consecutive working days

3 After ten lots was inspected

5.11.5 Condition for normal level (AQL = 0.1 with C=0) to tightened level (AQL = 0.04 with C=0) This will be effective when the bellowing condition is exist

1 Two of five consecutive lots was rejected

5.11.6 Condition for tightened level (AQL = 0.01 with C=0) to Normal level (AQL = 0.1 with C=0) This will be effective when the bellowing condition is exist

1 Five consecutive lots accepted

Table 5.1- C=0 sampling plans index values (Associated AQLS)

LOT SIZE	0.01	0.015	0.025	0.04	0.065	0.1	0.15	0.25	0.4	0.65	1	1.5	2.5	4	6.5	10
2 to 8	*	*	*	*	*	*	*	*	*	*	*	*	5	3	2	2
9 to 15	*	*	*	*	*	*	*	*	*	*	13	8	5	3	2	2
16 to 25	*	*	*	*	*	*	*	*	*	20	13	8	5	3	3	2
26 to 50	*	*	*	*	*	*	*	*	32	20	13	8	5	5	5	3
51 to 90	*	*	*	*	*	*	80	50	32	20	13	8	7	6	5	4
91 to 150	*	*	*	*	*	125	80	50	32	20	13	12	11	7	6	5
151 to 280	*	*	*	*	200	125	80	50	32	20	20	19	13	10	7	6
281 to 500	*	*	*	315	200	125	80	50	48	47	29	21	16	11	9	7
501 to 1200	*	800	500	315	200	125	80	75	73	47	34	27	19	15	11	8
1201 to 3200	1,250	800	500	315	200	125	120	116	73	53	42	35	23	18	13	9
3201 to 10,000	1,250	800	500	315	200	192	189	116	86	68	50	38	29	22	15	9
10,001 to 35,000	1,250	800	500	315	200	294	189	135	108	77	60	46	35	29	15	9
35,001 to 150,000	1,250	800	500	490	476	294	218	170	123	96	74	56	40	29	15	9
150,000 to 500,000	1,250	800	750	715	476	345	270	200	156	119	90	64	40	29	15	9
500,001 to over	1,250	1,200	1,112	715	556	435	303	244	189	143	102	64	40	29	15	9

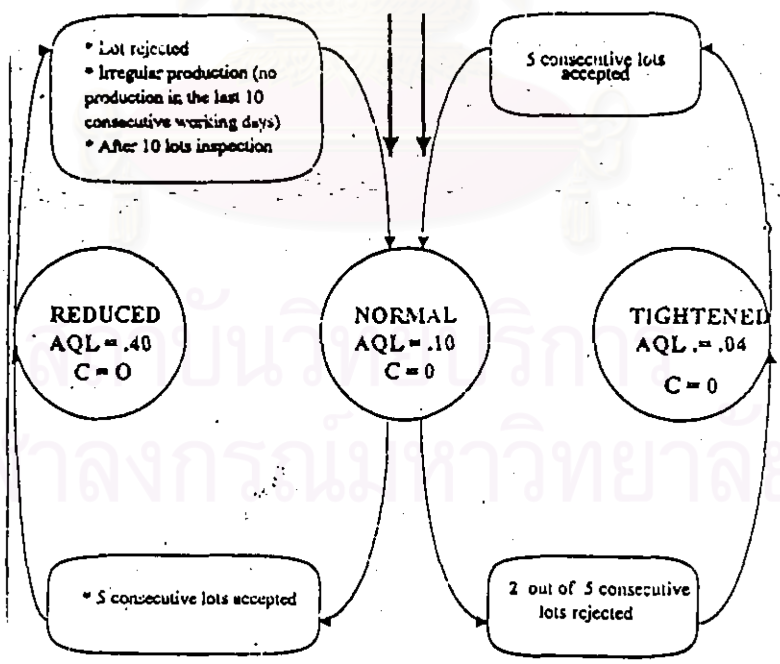


Figure 5.8- C=0 Sampling plan with switching rule