CHAPTER III

DATA ANALYSIS

3.1 Introduction

The purpose of this study is to eliminate after market problem in ABC company.

From the study and analysis by engineering, supervisor and concerned department, the problem has been reported via warranty claim system since produce launching period on September 2004. The defect has been detected and complained by customer 100% which it couldn't found in production line.

Year 2005-2006	September	October	November	December	January
Seat Production (Units)	6841	7219	7498	7581	7729
Defect Part claim in aftermarket (units)	107	100	69	100	105
% Defect	1.56	1.38	0.92	1.31	1.35

Table 3.1: Defect Complain in After Market

Month	Production	Defect from customer complaint									
		Noise		No Sliding		Dirty		Others		Total defect	% Defect
		units	%	units	%	units	%	units	%		
Sept	6841	57	0.83	32	0.46	12	0.17	6	0.08	107	1.56
Oct	7219	61	0.84	18	0.24	8	0.11	13	0.18	100	1.38
Nov	7498	48	0.64	7	0.09	8	0.10	6	0.08	69	0.92
Dec	7581	49	0.64	29	0.38	14	0.18	8	0.10	100	1.31
Jan	7729	53	0.68	37	0.47	11	0.14	4	0.05	105	1.35
Total	36868	268	0.72	91	0.24	53	0.14	37	0.10	449	1.21

Table 3.2: Defect Classification in After Market (September – January 2005)

From the table above, FMEA team was collected data to analyze percent defect which happen in each months. As from table, the percent defect wasn't varied with the amount of production in each month.

The most problem which complaint from customer in after market came from noise problem (268 units/5 months), no sliding (91 Units/5 months), Dirty (53 Units/5 months), Others (37 Units/5 months) by respectively.

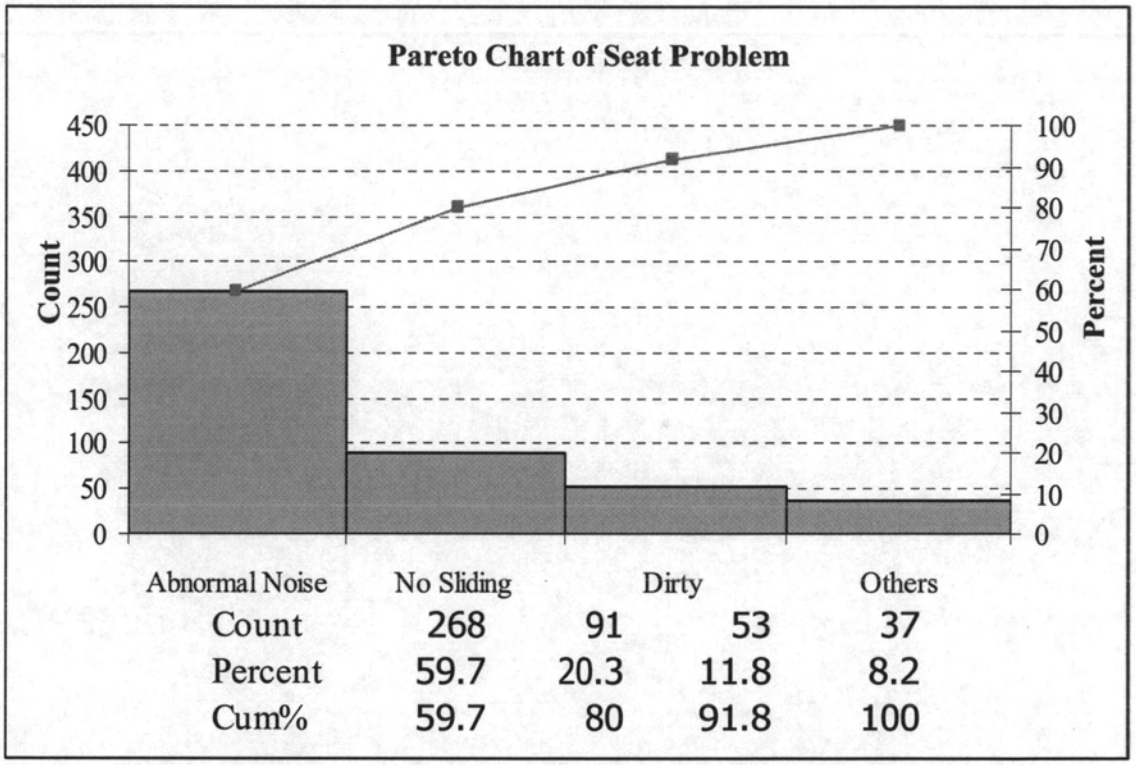

Figure 3.1: Seat Problem (Sept' 05 – Jan' 06)

From the Pareto Chart, it could represent seat problem which concerned of abnormal noise problem (59.7%), no sliding problem (20.3%), dirty problem (11.8%) and others problem (8.2%) respectively.

3.2 Problem Positioning

PROBLEM POSITION	ASSEMBLY	DESIGN
APPERANCE	(A)	(B)
FUNCTIONAL	(C)	(D)

Table 3.3 Problem Position of Automotive Seat

The figure above could described problem characteristic and position. These can explain as follows;

(A) Appearance and Assembly

Problem will concerns with appearance of product, it would come from the production line. Most problems will complaint from end user as rust and dirt on product.

(B) Appearance and Design

It could explain that end user would dissatisfaction with the complete product. The design was affected to the appearance such as the color shade, product shape and etc,. It may from mistaking of product design.

(C) Functional and Assembly

The product couldn't operate correctly and will complaint as usage condition. Main problem came from wrong assembly from in line process. It was total effected to product inoperative.

(D) Functional and Design

The criteria of this problem most from some of the end user, after the product complete, it will from the usage condition. Unexpected of product functional would affect to end user mind and satisfaction. To correct the problem was very complicate and it depends on the amount of complaint.

PROBLEM POSITION	ASSEMBLY	DESIGN
APPERANCE	Dirty	-
FUNCTIONAL	No sliding	Noise

Table 3.4 Current Problem Position

After received product complaint from customer, it could be classified the problem positioning as in the table above. Dirty could be group as problem of appearance and assembly, seat no sliding problem could group as functional and assembly and noise could be group as functional and design.

3.3 Automotive Seat Production Process

Flow Diagram	Process	Responsibility
	Receive Component Part / Inspection	Part Logistic Centre / QA
	Assy Slide & Arm	QC
	Assy Frame Cush, with Slide / Sewing Sub Assy	QC
	Front Cushion Covering Assy	QC
	Front Cushion & Frame Front Cushion	QC
	Front Back Covering Assy	QC
	F/B Covering & Frame Front Back	QC
	Steaming	QC
	Front Back & Front Cushion Sub Assy	QC
	Assy Component Part	QC
	F/B – F/C Steaming	QC
	Assy Component Part	QC
	H/R Sub Assy	QC
	Assy Belt & H/R Opeartion Check	QC
	Final Inspection	QA
	Delivery	Part Logistic Centre

Figure 3.2: Automotive Seat Production Process Flow Chart

From the process flow chart as above, FMEA teams has limited the scope of research especially for QC and QA only, in order to easy and convenience for describe and determined the probable cause of each problems.

3.4 Warranty Claim Route

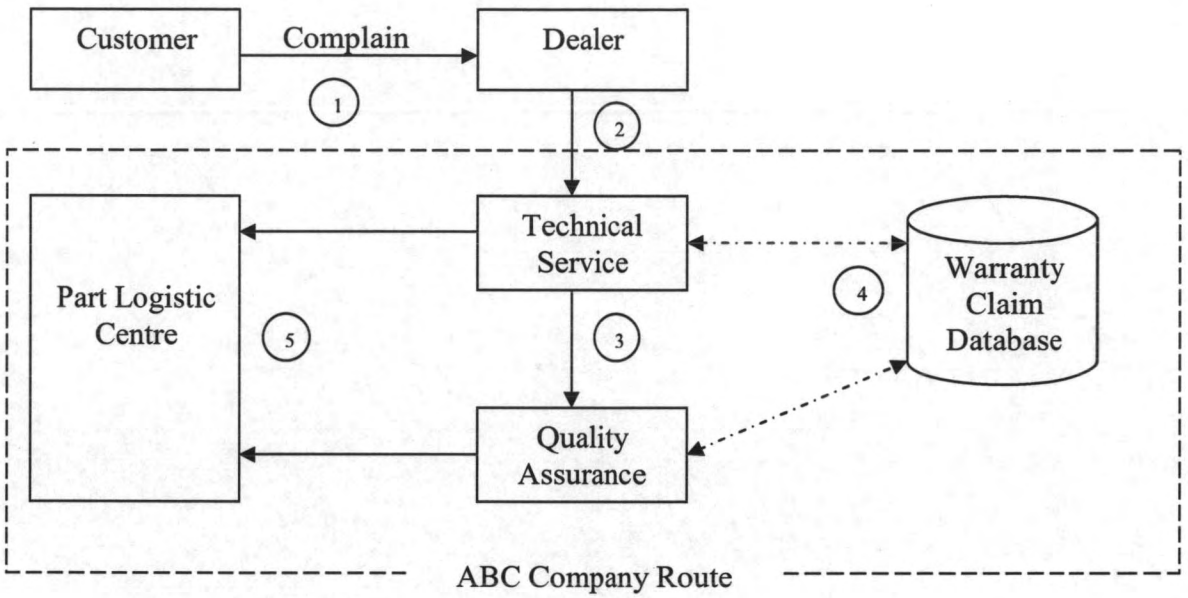

Figure 3.3: ABC Company's Warranty Route Claim

Procedure

1. Customer complaint to dealer side for the defect which lead to dissatisfied of usage condition.
2. Dealer will inform to Technical service department for prime investigation result and complaint report.
3. Technical service takes action to Quality assurance department for the defect which concerned from production and factory side.
4. Quality assurance will deep analyzed and investigation problem. Technical service and Quality assurance record defect claim in warranty claim database.
5. Part order will request via part logistic centre, in order to replace new part for customer.

3.5 General Root Cause Analysis (Cause – and – effect diagram)

A brainstorming session was conducted among FMEA team members to identify possible causes by applying a cause and effect diagram. Team members brainstormed to identify possible causes of failures for each step which can be categorized as follows:

Manpower: The operators may have no skill due to the new product just start in production line, thus operators may confuse about assembly process. For others cause may come as follows:

- Long time operation
- Operator has no skill
- Poor training for operator
- Error in assembly process
- Not follow work instruction for machine operation

Machines: There are many potential causes that can lead to the problem. Once has been suspected that machine doesn't work properly was the main factors due to new machine has implemented for new product.

- Machine doesn't work properly
- Machine maintenance periodic check
- Over load using
- Jig assy was error

Method: The potential causes from methods of operation are that there was no enough for item check in each of assembly process.

- Wrong sequence for assembly
- Assembly method is hard to follow
- Poor item check in each of assembly process

Material: Material was considered as a cause dimension of part may be out of specification.

- Component part damaged before assembly
- Part dimension is out of standard
- Part durability test is weak

Therefore, after brainstorming through the use of cause and effect diagram to determine all potential causes of failure, the next task of team is to find the factors that are mostly to be the real causes of failure. To accomplish this, the team assigns ranking severity, occurrence and detection can calculate the Risk Priority Number (RPN) for each potential causes. Current process control and recommended corrective action for each scenario to be filled in process FMEA form.

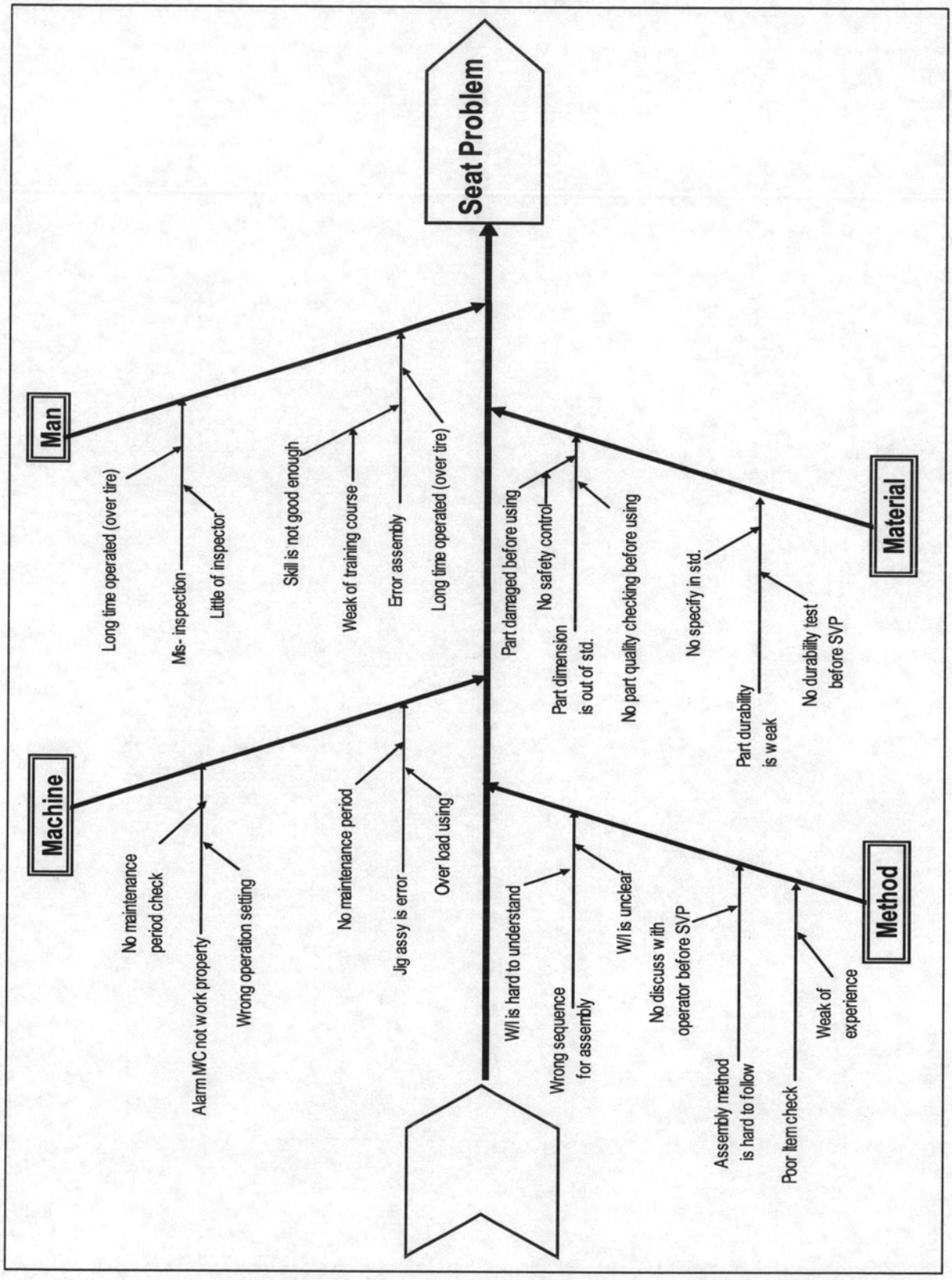

Figure 3.4: General Cause – and – effect diagram

3.6 Abnormal Noise Root Cause Analysis (Cause-and-effect diagram)

The cause of seat abnormal noise was come from the many possibility causes. For root cause analysis, team member have discussed and classified many causes in each category below;

Man: The result has shown from work output of operator was error, and after analyzed possibility causes of failures. There was found some of the error might come from operator had low skill for operation due to lack of training and another cause may from poor inspection which affected from no tooling for support their skill. The other causes has been listed to analyze as below;

- Leg Fr seat bolt loose

The looseness pf Fr. Seat bolt could affect to product operation usage and lead to noise failure, especially when vehicle was in driving condition.

- Seat belt log bolt loose

Another suspect causes of noise failure was due to looseness of seat belt lock bolt which could experience problem while vehicle driving on rough road.

- Poor inspection

Operators have no tooling for support inspection and lead to poor inspection method.

Machine: Machine poor performance was one cause of the problem which consisted of poor cutting, poor assembly, and poor welding as detail below;

- Poor Accuracy Cutting

This might from manual unclear and machine error

- Poor Accuracy Welding

Old machine (long time used without maintenance) would lead to failure as subject.

- Poor accuracy assembly

These could lead to problem of "gap between arm and bracket" which affected from machining error.

After consideration by team members, poor accuracy assembly will lead to problem of "head rest component vibrate" which could explain in cause and effect diagram.

Method: As from cause and effect diagram, specification of tightening torque is one of the cause which could affect to inspection standard.

- Poor inspection method (no have inspection after assembly)
- Bolt low tightening toque (concern with design matter)

Material: Component of part itself was one cause of the problem as our investigation below

- Plastic part deforming.
- Frame cushion deforming due to material was low specification.

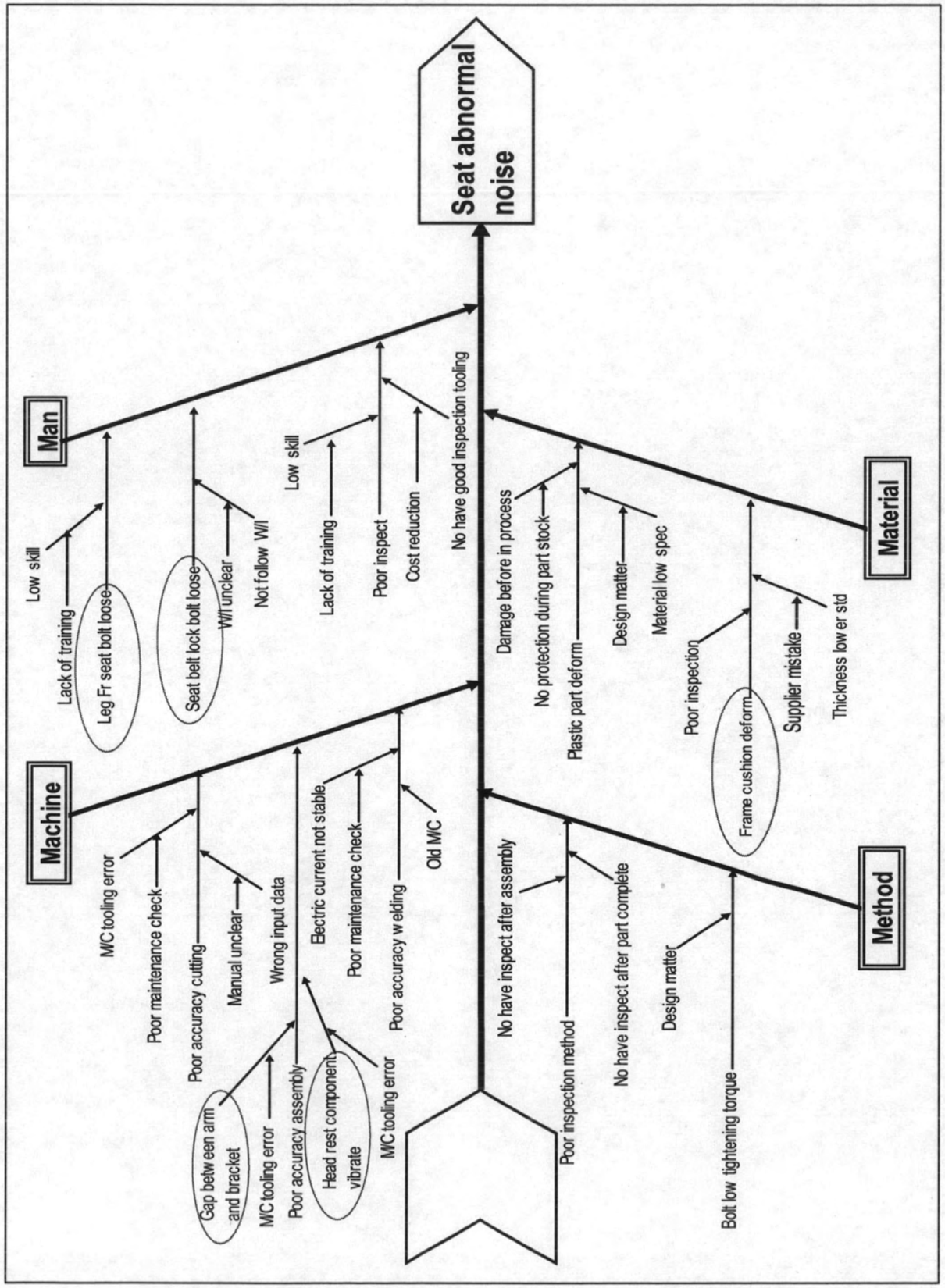

Figure 3.5: Cause – and – effect diagram (Seat Abnormal Noise)

3.7 Seat Sliding Operation Failure Root Cause Analysis (Cause-and-effect diagram)

After analysis the root cause of seat sliding operation failure, the result was shown that cause was come from many factors as team member investigated and concluded as details below;

Man: Operation output from operator was error cause of their own low skill and work instruction was hard to understand. Another cause was come from component part was short and operator had to skip to next process but some of them forgot to back assembling the skipping process causing of seat failure operation.

- Adjust handle NG operation

  Operators do not follow W/I because W/I was hard to understand and follow.

  New operator has poor skill and lack of training.
- Forget to assemble some component part.

  Operators have skipped process by didn't follow procedure step by step when assembly component part.

Machine: Machine was another cause of problem because welding machine was error and time setting for welding was wrong so it was made welding line incomplete operation. Also with lubricant oil filling machine that had dust stuck inside and made machine error operation

- Crack due to incomplete welding line (insufficient time for welding)
- No Grease for slide (Filling M/C error and dust accumulate inside)

Method: Current inspection method was not effective due to too little and W/I for indication operator was hard to understand right

- Inspection not effective (W/I unclear mention)
- Lack of inspection.

  Operator does not follow W/I because method hard to follow.
- Sliding assy NG parallel with cushion

  Operator was mistaken to assembly sliding assy with cushion thus sliding operation couldn't work properly.

Material: Error from component part itself was one of this problems and also with lubricant oil poor performance was the cause of seat inoperative sliding

- Grease oil poor property

By less grease amount apply to seat sliding groove, it would effect to seat sliding operation directly. Another case was from low specification of grease chemical substances.

- Sliding part deform, these was mainly from material hardness was out of specification.
- Sliding groove without specification. These lead to the problem of seat sliding operation failure when perform operation.

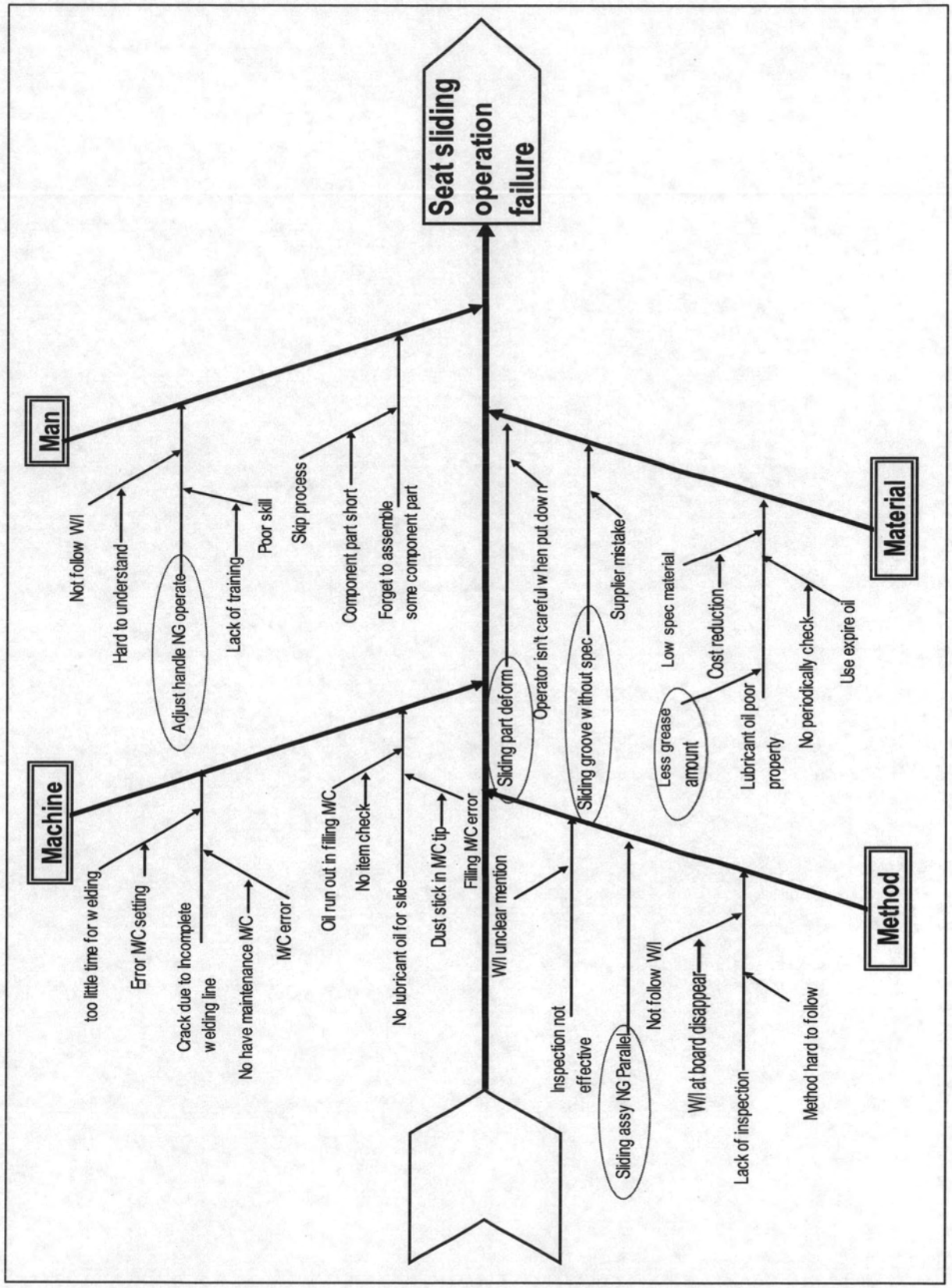

Figure 3.6: Cause – and – effect diagram (Seat Sliding Operation Failure)

3.8 Seat Dirty Root Cause Analysis (Cause-and-effect diagram)

After analysis dirt problem, it was shown dirt was consist of dust, scratch and wax and the root cause of them was classified as below;

Man: Dirt from operator can be happened in assembly process cause of uncomfortable to clean their hand due to working place was far from toilet and no glove to prevent dust from hand. Another cause was from no cleaning in warehouse or stock area.

- Dirt from operator in assy process
  - Operator don't clean hand before assemble
  - No grove to use for operator in assy process
- Dirt from operator in packing process
  - No clean store room
  - No clean complete part during packing (dust accumulated)

Machine: Wax supply machine was error and made uncontrollable for quantity of wax spray was one cause of dirt, conveyor which was very dirt also could made dirt on part due to seat directly contact them during delivery.

- Conveyor is dirty
  - Main cause was from dust accumulate inside conveyor.
- Excessive wax for seat cover due to old machine and toolong

Method: Poor inspection method was cause of defect out flow and method during processing was important also and concern to dirt on part.

- Poor inspection method.
  - No tooling to support operator work.
- Dust accumulate during warehouse store.
  - No covering part for packing then dust could affect to product as dirt mark.
- Scratch on seat
  - Scratch on seat before send to warehouse

Material: Wax which was used for seat cover coating was hard to remove out causing of dirt due to unsuitable spec and no chemical to support cleaning; also with material of part itself was old looking.

- Seat cover property is easy for dust accumulate (concern with design matter)
- Wax is hard to remove.

  The cause was from unsuitable specification of wax chemical substance.
- Old looking for appearance (concern with design concept)

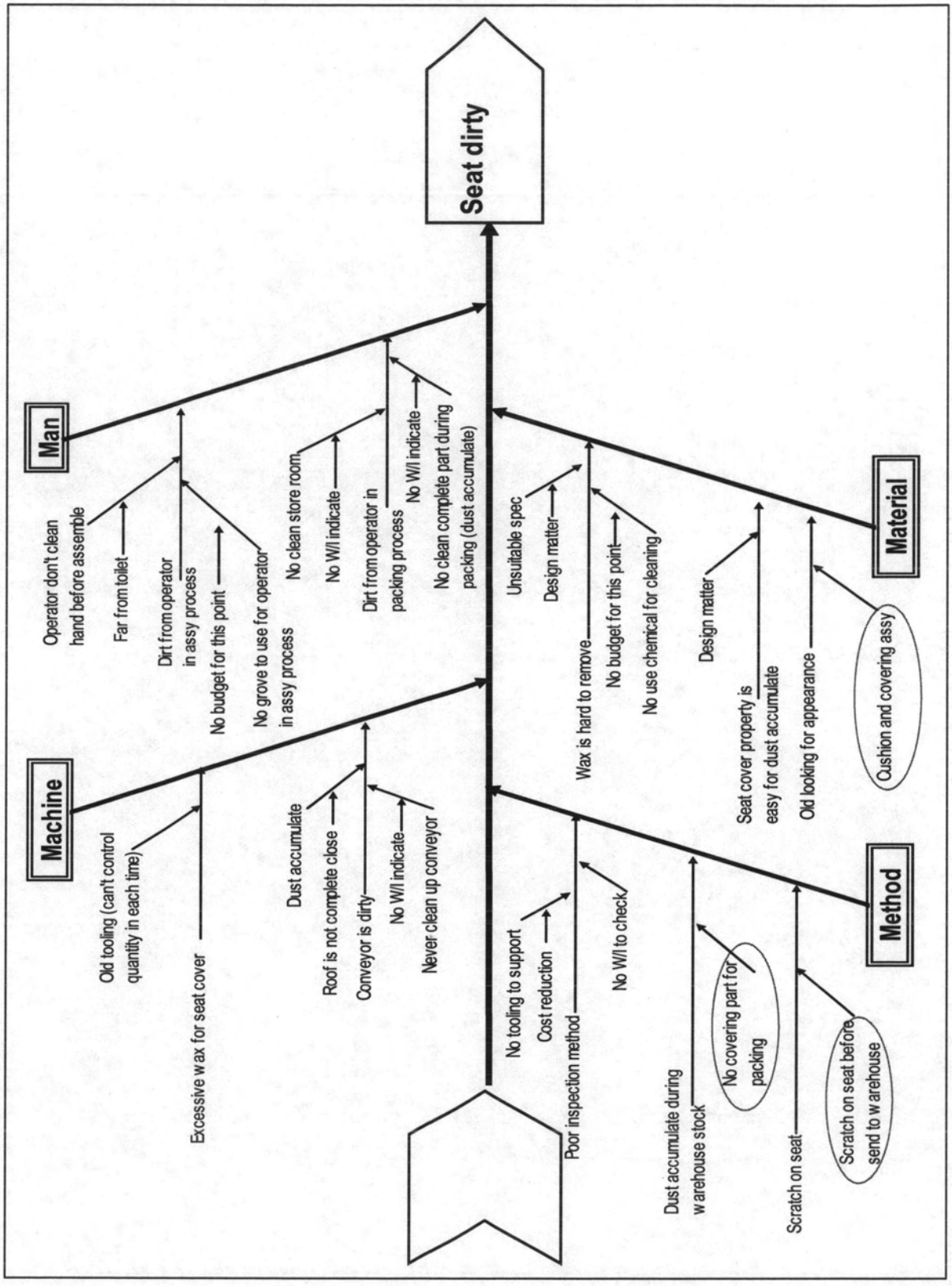

Figure 3.7: Cause – and – effect diagram (Seat Dirty)

3.9 Problem Analysis by "FMEA" Techniques

3.9.1 The FMEA Team Selection

FMEA couldn't conduct by individual person because the FMEA is a team function. This team must be conducted the FMEA as appropriate for a specific problem and could serve as the FMEA company. FMEA team has been established to solve the problems, in order to meet a complete job with the best results, the number of engineers team has selected to conduct FMEA team is three persons. They all have an intensive experience and good knowledge of FMEA conducting and implementation. They are familiar with working group by willingness to participate in FMEA team.

3.9.2 The Process of Conducting the FMEA

After FMEA has conducted and were done by FMEA team, the problem has been analyzed with the discussion of evaluation and qualification by the value of severity, Occurrence and Detection for the process FMEA. FMEA couldn't detect the defect to customer 100%. In fact, there still be some of defect could outflow to after market

To solve the problem which exists in market, the process FMEA is applied to in this case in order to minimize or eliminate all possible causes and mechanisms that affected to customer satisfaction.

The FMEA members have various responsibilities. They will brainstorms and analyze all potential causes of failure for each process and step of stretching process that could potentially lead to the unexpected problem. To organize brainstorm ideas, PDCA cycle and fishbone diagram (cause and effect diagram) will be employed. Current process control and recommended corrective action for each scenario need to be filled in process FMEA form. It is important to make and assignment of responsibility and project the completion date to the appropriate member.

In addition, FMEA members are expected to assign ranking severity, occurrence and detection for evaluation criteria and ranking of severity, occurrence and detection. The risk priority number (RPN) which is the degree of risk of each failure is represented by the product of these 3 ranked indices. RPN value should be used to rank the concerns in process.

The leader of FMEA members implements corrective action to reduce the high risk failure modes according to its priority from the RPN. FMEA is a living document and never ends because new potential causes and corrective action are updated on new FMEA revisions as the research goes on. Once the actions have been implemented, it is required for the team to continue documenting the FMEA actions for an evaluation of effectiveness as part of the FMEA documentation.

Severity, Occurrence and Detection are re –assessed after these FMEA actions have been taken and revised RPN is reviewed to determined whether further actions is required. Once FMEA member has a consensus that the FMEA does not require any changes then the FMEA file will be kept in a folder for documentation and history tracking purposes. It is important to update the FMEA as the design or process changes so that the assessment changes or new information becomes known

Problem	Cause	Severity	Occurrence	Detection	RPN
Noise	Gap between arm and bracket	6	6	7	252
	Head rest component vibrate	6	2	7	84
	Frame cushion deform	6	1	7	42
	Leg front seat bolt no tighten	6	1	7	42
	Seat belt lock bolt no tighten	6	1	7	42
No Sliding	Sliding groove width out of specification	8	5	6	240
	Sliding part deform	8	1	6	48
	Sliding assy NG parallel with cushion	8	1	6	48
	Less grease amount	8	1	6	48
	Adjust handle NG operate	8	1	6	48
Dirty	Packing for part Fr. Seat no good	6	4	6	144
	Scratch part on pallet before delivery at warehouse	6	2	7	84
	Cushion & back covering assy	6	1	7	42

Table 3.5: Problem Evaluation (RPNs)

Table above also shows the severity of effects, occurrence ranking and detection ranking for each problem of seat starting with noise, no sliding and dirty.

The team brainstormed that the failure have high RPN (higher than 125), they were considered for recommend corrective action.

Month	Production	Defect from customer complaint (Seat Noise)											
		Gap btw arm & bracket		H/R component vibrate		Frame cushion deform		Leg front seat bolt		Seat belt lock bolt		Total	%
		units	%	units	%	units	%	units	%	units	%	defect	Defect
Sept	6841	57	0.83	2	0.03	0	0	0	0	0	0	59	0.86
Oct	7219	61	0.84	4	0.06	1	0.01	0	0	0	0	66	0.91
Nov	7498	48	0.64	2	0.03	0	0	0	0	0	0	50	0.67
Dec	7581	49	0.64	2	0.03	0	0	1	0.01	0	0	52	0.69
Jan	7729	53	0.68	1	0.01	0	0	0	0	1	0.01	55	0.71
Total	36868	268	0.72	11	0.03	1	0.002	1	0.002	1	0.002	282	0.76

Table 3.6: Defect Units Complaint by Month (Noise)

Month	Production	Defect from customer complaint (Seat sliding operation failure)											
		Sliding groove width		Sliding part deform		Sliding assy NG		Less grease amount		Adjust handle NG		Total	%
		units	%	units	%	units	%	units	%	units	%	defect	Defect
Sept	6841	32	0.46	0	0	0	0	0	0	0	0	32	0.47
Oct	7219	18	0.24	0	0	1	0.01	0	0	1	0	20	0.28
Nov	7498	7	0.09	0	0	0	0	0	0	0	0	7	0.09
Dec	7581	29	0.38	0	0	0	0	0	0	1	0	30	0.4
Jan	7729	37	0.47	0	0	0	0	0	0	0	0	37	0.48
Total	36868	91	0.24	0	0	1	0.002	0	0	1	0.002	93	0.25

Table 3.7: Defect Units Complaint by Month

(Sliding Operation Failure)

Month	Production	Defect from customer complaint (Seat Dirty)							
		Packing for part seat no good		Scratch part on pallet		Cushion & back covering assy		Total	%
		units	%	units	%	units	%	defect	Defect
Sept	6841	12	0.17	1	0.01	0	0	13	0.19
Oct	7219	8	0.11	4	0.06	0	0	12	0.17
Nov	7498	8	0.1	2	0.03	1	0.01	11	0.15
Dec	7581	14	0.18	2	0.03	0	0	16	0.21
Jan	7729	11	0.14	1	0.01	0	0	12	0.16
Total	36868	53	0.14	10	0.03	1	0.002	64	0.17

Table 3.8: Defect Units Complaint by Month (Dirty)

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(PROCESS FMEA)

FMEA NUMBER IMV-S-045

หน้าที่ 10 ของ 12

Item **FR. S/B SEPA** Process Responsiblility **ENGINEERING SECTION** Prepared By **MR.SUPHAT**

Model Year (s)/Vehicle(s) **2004 / V** Key Date **1-Apr-06** FMEA Date (Orig.) **1-Apr-06** (Rev.)

Core team **PFMEA CROSS FUNTIONAL TEAM (Refer organization or PFMEA before mass production)**

Process Function / Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Machanism(s) of Failure	Occur	Current Process Controls Prevention	Current Process Controls Detection	Detec	R. P. N.	Reconnended Action(s)	Responsibility & Target Completion Date	Action Results				
													Action Taken	Sev.	Occ.	Det.	R.P.N.
'10. SUB ASSY'	- DISTURBANCE	-NOISE WHILE	6	B	-GAP BETWEEN ARM	6	- REGULAR CHECK	- OPERATION	7	252	- CONFIRM NOISE	- QA (11'106)					
COMPONENT	NOISE	DRIVING ON			AND BRACKET		BY VISUALIZATION	CHECK ON			IN FINAL						
PART		ROUGH ROAD						INSPECTION LINE			INSPECTIION LINE						
											BY VISUALCHECK						
											AND TOUCHING						
			6	B	-HEAD REST	2	-REGULAR CHECK	- OPERATION	7	84	-NONE						
					COMPONENT VIBRATE		BY VISUALIZATION	CHECK ON									
								INSPECTION LINE									
			6	B	-FRAME CUSHION	1	-FOLLOW W/I	-DRIVE TEST	7	42	-NONE						
					DEFORM		ASEEMBLY										
			6	B	-LEG FR SEAT BOLT	1	-POKAYOKE	-DRIVE TEST	7	42	-NONE						
							CONTROL TORQUE										
							WRENCH										
			6	B	-SEAT BELT LOCK	1	POKAYOKE	-DRIVE TEST	7	42	-NONE						
					BOLT		CONTROL TORQUE										
							WRENCH										

Table 3.9: FMEA Implement Result (Seat Abnormal Noise)

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(PROCESS FMEA)

FMEA NUMBER :MV-S-045

หน้าที่ 11 ของ 12

Item **FR. S/B SEPA** Process Responsiblility **ENGINEERING SECTION** Prepared By **MR.SUPHAT**

Model Year (s)/Vehicle(s) **2004 / V** Key Date **1-Apr-06** FMEA Date (Orig.) **1-Apr-06** (Rev.)

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													Action Taken	Sev.	Occ.	Det.	R.P.N.
"1OPERATION	-SEAT SLIDING	-ENDANGEROUS	8	S	SLIDING GROOVE	5	- SAMPLING	-CONFIRM PART	6	240	-CONTROL AND	-QA (23/01'06)					
CHECK ASS'Y	COULDN"T	CUSTOMER			WIDTH OUT OF		CHECK FIRST	BY OPERATION			CHECK SLIDING						
SLIDE & ARM	OPEARTE				SPECIFICATION		UNIT IN EVERY LOT	CHECK			GROOVE WIDTH						
											IN 9.7 ±0.2 mm						
			8	S	-SLIDING PART DEFORM	1	-HARDNESS	-CONFIRM PART	6	48	-NONE						
							CHECK BY	BY OPERATION									
							PUSH PULL	CHECK									
							GAUGE										
			8	S	-SLIDING ASSY NG	1	-CALIBRATE AND	-CONFIRM PART	6	48	-NONE						
					PARALLEL WITH		CONTROL JIG	BY OPERATION									
					CUSHION			CHECK									
			8	S	-LESS GREASE AMOUNT	1	-REGULAR	-CONFIRM PART	6	48	-NONE						
							CONTROL AMOUNT	BY OPERATION									
								CHECK									
			8	S	-ADJUST HANDLE NG	1	-FOLLOWWI	-CONFIRM PART	6	48	-NONE						
					OPERATE		SUB ASSY	BY OPERATION									
							ADJUST HANDLE	CHECK									

Table 3.10: FMEA Implement Result (Seat Sliding Operation Failure)

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(PROCESS FMEA)

FMEA NUMBER :IMV-S-045

หน้าที่ 12 ของ 12

Item **FR. S/B SEPA** Process Responsiblility **ENGINEERING SECTION** Prepared By **MR.SUPHAT**

Model Year (s)/Vehicle(s) **2004 / V** Key Date **1-Apr-06** FMEA Date (Orig.) **1-Apr-06** (Rev.)

Core team **PFMEA CROSS FUNTIONAL TEAM (Refer organization or PFMEA before mass production)**

Process Function / Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Machanism(s) of Failure	Occur	Current Process Controls Prevention	Current Process Controls Detection	Detec	R. P. N.	Reconnended Action(s)	Responsibility & Target Completion Date	Action Results				
													Action Taken	Sev.	Occ.	Det.	R.P.N.
12.DELIVERY PART	-PART FR.SEAT	-PART 'NG' AND	6	B	-PACKING FOR PART	4	-CHECK PALLET	- APPEARANCE	6	144	-PM DAILY CHECK	-DELIVERY (7/03/05)					
SEAT ASS'Y	ASS'Y DIRTY	CUSTOMER			FR.SEAT NO GOOD		BEFORE PACKING	CHECK AND			PALLET BY						
CUSTOMER	ON PASSENGER	DISSATISFACTION						MARK CHECK			SCHEDULE						
	SIDE							100%ON			-CLOSED AREA						
								PALLET			IMPROVE						
											WAREHOUSE						
			6	B	-SCRATCH PART ON	2	-WEEKLY CHECK	-VISUAL CHECK	7	84	-NONE						
					PALLET BEFORE		BY STAFF	BEFORE									
					DELIVERY AT		STORE	DELIVERY									
					WAREHOUSE												
			6	B	-CUSHION & BACK	1	-REGULAR	-APPERANCE	7	42	-NONE						
					COVERING ASSY		CHECK COVER	CHECK ON									
							SURFACE	INSPECTION									
								LINE									

Table 3.11: FMEA Implement Result (Seat Dirty)