CHAPTER 1

INTRODUCTION

1.1. Background.

Competition between automobile manufacturer is getting higher at the present. The strategy was changed from high volume, low variety to low volume with high variety of models. Supplier of car manufacturer must adapt along with the market change. The flexible automation, CNC machine tools , automated material handling can be applied to improve productivity. But it needs higher investment.

1.2 Company background.

Selected pilot company is a joint-venture between Japanese company and Thai company., started the mass production from June 1991. On the first year, the products, i.e, cooling water pump and lubrication oil pump were supplied to Isuzu and Nissan's pick-up engine, followed by Mitsubishi and Toyota Engine on consecutive year.

At present , the product are not only water pump or oil pump but also temperature-coupling assembly, water drain, relief valve, shaft assembly rocker and air compressor parts. The number of direct employee are 109 persons and indirect employee are 57 persons. This company was certified ISO9000 and QS9000 in 1996.

1.2.1 Product definition.

Function of oil pump and water pump in engine are as follows

Water pump used for circulate coolant through the water jacket to cool all of hot metal parts in engine.

Oil pump used for supplies lubrication oil to all moving part in the engine by pick up oil from oil pan and send out through oil line.

1.2.2 Process chart of water pump and oil pump production.

The production process can be separated into 2 main steps. There are machining and assembling. All of production system are programmable automation .

Figure 1.1 shows the outline of a process to make engine pump. Bottle neck of process is machining operation because cycle time of machining process is higher than others.

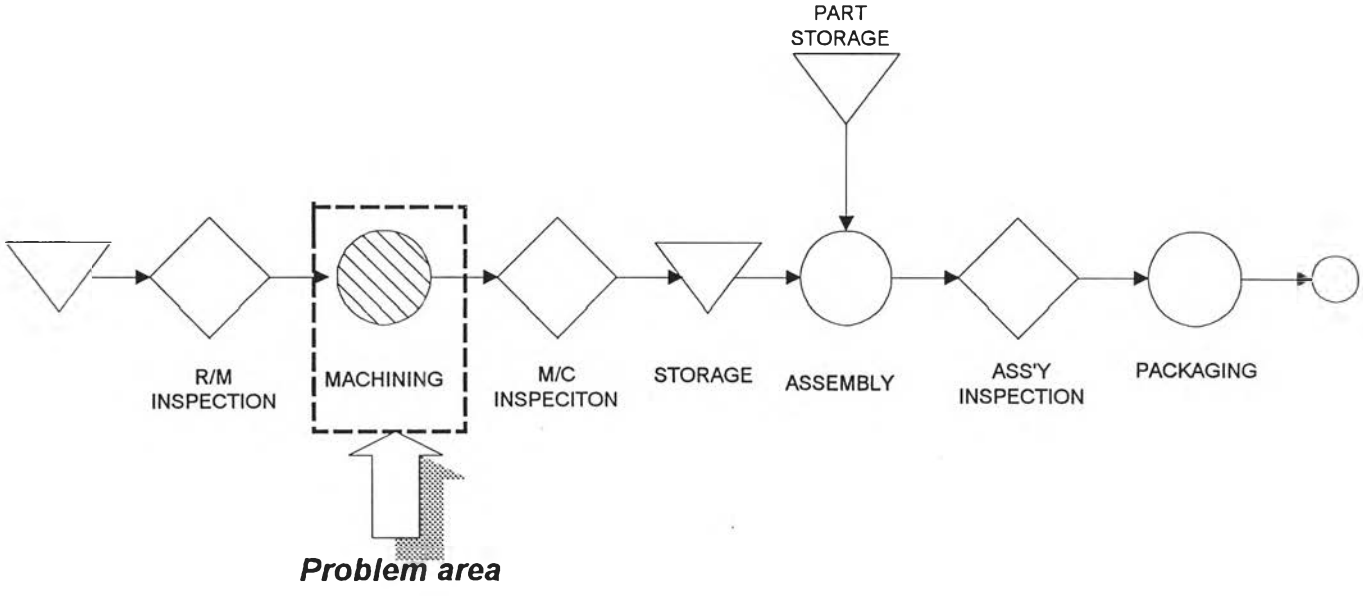

Figure 1.1 process chart

Manufacturitng type of pilot company is cell manufacturing. A cell is a close grouping of different types of equipment, each of which performs an operation in a frequency repeated series of operations. Cells are beneficial where the same item is made in large numbers or a familiar of items that require the same series of operation.

The products are typically made in batches. To produce each new batch, the program must be changed with the set of machine instruction that corresponded to the new product. The physical set up compose of tooling and jig& fixture. Total productivity is inclusive of time for set-up and adjustment.

The low level of productivity came from the excess work contents as follow.

1. Work contents added by poor design or specification of product to the parts, or improper utilization of materials such as poor design and frequent design changes, waste of material and incorrect quality standards.

2. Work contents added by inefficient method of manufacturer or operation. The ineffective time can be due to inappropriate handling methods, poor maintenance of machinery or equipment resulting in frequent breakdowns, or poor inventory control causing delays because of an absence of products or parts or higher costs as a result of overstock.

3. Work content resulting mainly from the contribution of human resources. For example, absenteeism and lateness, poor workmanship and occupational hazards.

1.3 Situation review

1.3.1 Lost time in manufacturing line.

In 1997, average lost time of machining line was 25.01% from January- December, as shown in figure 1.2.

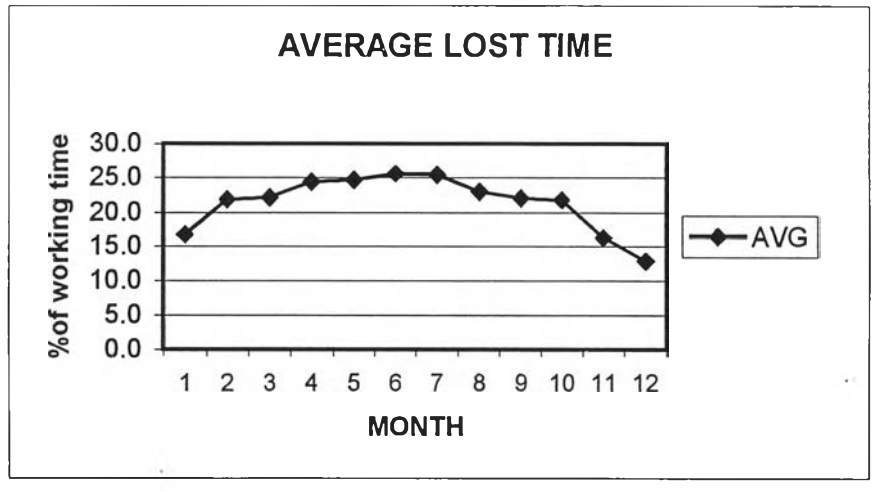

Figure1.2 Average lost of all line time ,year 1997

These data were recorded from all machining operation. Products of machining operation are oil pump casing and water pump body. Both of these products have a similar cutting process. Average lost time of oil pump was 24.06%, water pump was 22.27%. Lost time of oil pump and water pump is similarly as shown in figure 1.3.

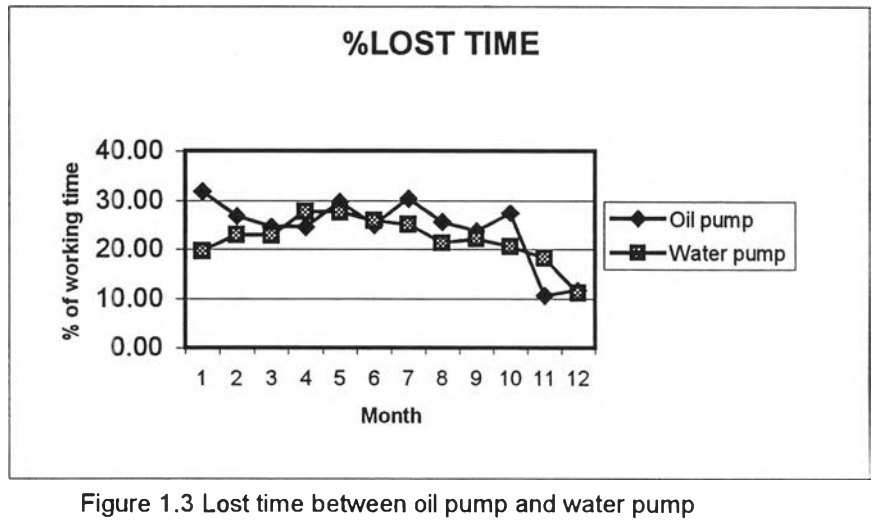

Figure 1.3 Lost time between oil pump and water pump

1.3.2 Classification of causes of down time in a pilot company

Factor which affects the production lost time can be classified into 2 main factors. There are

1. External causes are causes from outside organization, which can not be controlled. External causes, such as electrical shutdown, raw materials problems, improper supply of raw materials. External causes are extremely rare. From January – March 1998, loss time from external causes are 1 % of total time.

2. Internal causes. These causes arising from inadequate control. There are

- Human causes
- Mechanical causes
- Raw material causes
- Methodological causes.

The pilot company divided the stoppage losses into 9 categories as shown in table 1.1

Table 1.1 Separate lost time

Item	Description	Type of cause
Set up time.	Losses are caused by changes in product and condition operation.(equipment changeover, exchanges of dies, jigs and tools)	Internal cause
Tool change time	Losses are caused by wear of tool.	Internal cause
Lack of raw material	Losses are caused by transportation of raw material from store to operation line.	Internal cause
Lubrication	Losses are caused by apply any lubricate oil in machine such as slide oil, coolant oil	Internal cause
Machine breakdown	Losses are caused by equipment defects, which require any kind of repair.	Internal cause
Inspection and adjustment	These losses consist of adjust conditions of operation and sampling inspection for each shift.	Internal cause
Electrical shut down		External cause
Lack of raw material	Losses are caused by delay of delivery.	External cause
Quality of raw material	Losses are caused by raw material manufacturing method or equipment restriction	External cause

1.4 Sample line selection.

The pilot factory has 25 machining lines and 16 assembly lines. Each line makes a different product model. Main products of machining operations are automobile parts and air conditioning parts. Manufacturing type of this factory is cells manufacturing which a difference machine are grouped in one line

For this research sample line was selected to improve productivity. The data were collected from production report of January – September 1997. Figure 1.4 shows graph of average lost time(minute). Line M05 had the highest lost time for product oil pump and water pump. This line was selected as a sample to analyze cause and effect of lost time.

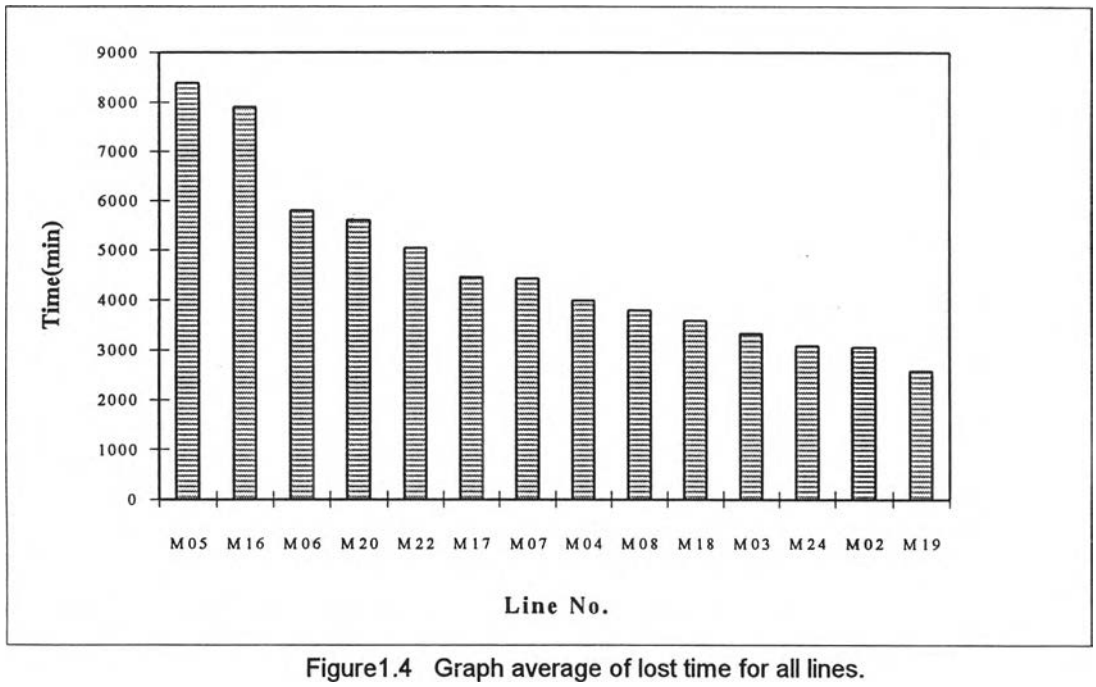

Figure1.4 Graph average of lost time for all lines.

1.5 Statement of problems.

Working time compose of 2 parts, there are operation time and down time. If down time lost can be reduced, line productivity will be increased because of longer operation time.For example, in April 1997, lost time is 25% of operation time.The following graph in figure 1.5 shows the percentage of lost time and operation time of all lines.

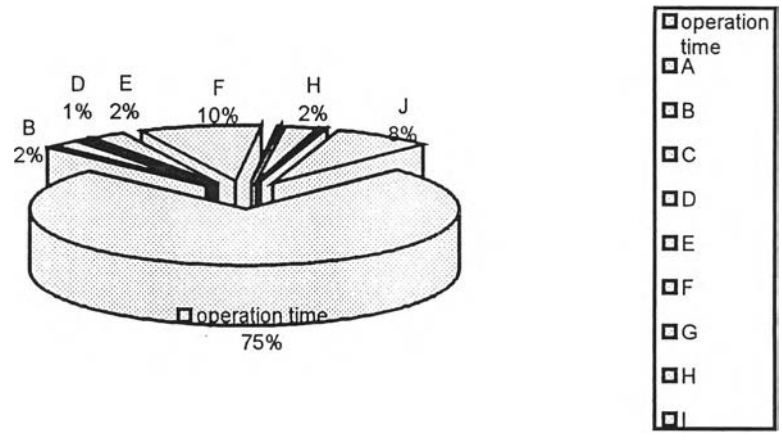

Figure 1.5 Percent of lost time in April 1997

According to company data in year 1997, from January to April. Lost time in production line can be classified into 9 items as follow

A. Set-up time.

B. Tool replacement time.

C. Time for movement of material within factory.

D. Machine lubricated time.

E. Machine breakdown time.

F. Time for dimension adjustment

G. Electrical shutdown.

H. Lack of raw materials.

I. Low quality of raw materials.

Table 1.2 Average percentage of lost time of machining line

	JAN (%)	FEB (%)	MAR (%)	APR (%)	Average
A	1.11	1.01	2.91	6.94	2.99
B	8.63	7.48	6.14	1.6	5.96
C	1.9	4.55	4.11	21	7.89
D	2.08	2.17	3.81	5.27	3.33
E	7.06	8.29	10.4	9.81	11.85
F	36.5	33.4	38.6	13	30.37
G	2.03	0.51	0.48	2.64	1.41
H	8.99	5.86	8.62	13.6	9.27
I	1	1.01	0.82	5.07	1.97

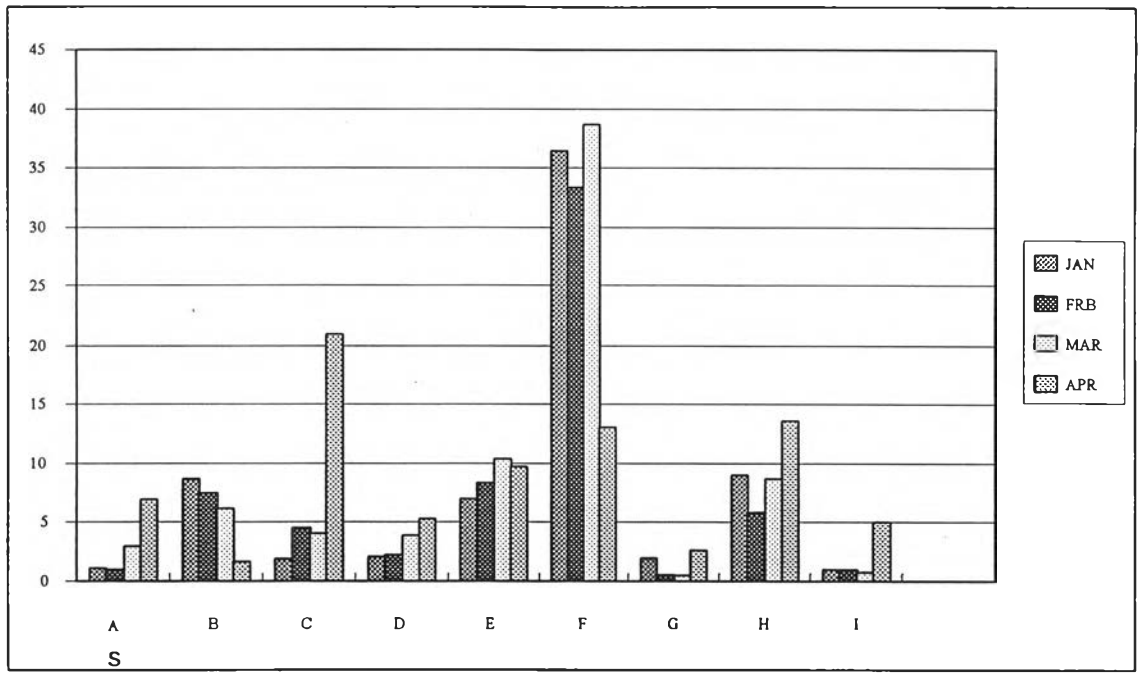

Figure 1.6 Lost time January-March 1997

From the percent of line stop's graph as shown in figure 1.6 the main problem occurred in dimension adjustment. Average % of lost time (in table 1.2) show that operation and adjustment time took more than 30 % of lost time in previously 3 months.

1.6 Objectives.

To improve productivity of machining cells by reduction of lost time.

1.7 Scope.

1. For this research, the problem of lost time in machining section with specific product (oil pump or water pump) will be studied.
2. The effect from human being are not considered.
3. This research will find out the problems of internal factor(set-up time, adjustment time, maintenance time) and external factor(raw materials problem, electrical shutdown).

1.8 Procedures.

1. Study related theories and present problems situation in machining line.
2. Collect existed data of sample line (overall data and focusing data).
3. Identify problems and causes.
4. Analyze the relationship between causes and effects.
5. Planning and implementation of countermeasures.
6. Apply with case study
7 . Analyzes data after improvement.
8. Summarize the improvement and prepare recommendation .

9. Prepare report and presentation.

1.9 Expected benefit.

1. Reduce cycle time for produce 1 piece of product.
2. Reduce down time losses.

1.10 Schedule

Procedure (Year 1998)	1	2	3	4	5	6	7	8
1. Study related theory and present situation in machining line.	◄	►						
2. Collect existed data of sample line (overall data and focusing data).	◄	—	►					
3. Identify problems and causes.			◄	►				
4. Analyze the relationship between causes and effects .			◄	►				
5. Planning and implementation of countermeasures.					◄	►		
6. Apply with case study					◄	—	►	
7. Analyzes data after improvement.							◄	►
8. Summarize the improvement and recommend.							◄	►
9. Prepare report and presentation.		◄	—	—	—	—	—	►

1.11 Productivity measurement

Refer to chapter 2, item 2.3 , there are 3 types of productivity measurement

- Utilization and efficiency measure
- Partial productivity measurement
- Total productivity measurement.

The suitable measurement for pilot company is partial productivity measurement which concern operating time of operator, called labor productivity. This research assume that all machinery are fixed and can not be more invested .The main factors which affect productivity for machining line composes of manual time and machine time. Labor productivity can be defined as "output per unit of time" or "output per labor hour."

Productivity improvement is percentage of the different of productivity before and after improvement with the productivity before improvement. The high percentage will show the effectiveness of improvement means.

1.12 Measurement definition

Materials are converted into products through a process in a management system. Efficiency of production line is measured from actual time and cycle time. Cycle time is a standard time for producing 1 piece of products.

$$\text{Cycle time} = \frac{\text{Total time for produce n Pcs.}}{n} \quad \text{----------(1.1)}$$

n = number of products

$$\text{Actual time} = \frac{\text{Total working time}}{\text{Total quantity}} \quad \text{----------(1.2)}$$

% total efficiency shows the efficiency of each line include loss time and operator efficiency.

$$\%\ \text{total efficiency} = \frac{\text{Cycle time X 100}}{\text{Actual time}} \quad \text{----------(1.3)}$$

Efficiency of operator is the efficiency of working time not include lost time.

$$\text{Operator efficiency} = \frac{\text{Cycle time X100}}{\frac{\text{(Total working time- lost time)}}{\text{Total quantity}}} \quad \text{----------(1.4)}$$

Productivity measurement in manufacturing is

$$\text{Productivity} = \frac{\text{Output (Unit)}}{\text{Labor hours(man- hour)}} \quad \text{----------(1.5)}$$

Productivity improvement index can be defined as

$$\text{Productivity improvement} = \frac{(\text{Productivity}_{(\text{after})} - \text{Productivity}_{(\text{before})}) \text{ X100}}{\text{Productivity}_{(\text{before})}} \quad \text{----------(1.6)}$$

Operator will collect data of working time, lost time and quantity which they produce in "daily manufacturing report". As shown in figure1.7.

Daily productin report

Part No.			DATE	/ 199
Quantity require		SHIFT	LINE	

Part name	Production time	Finish work		Down time	Code	Cause	Lost time code	Total time
		pcs/time	accumulate	From- To			A :Change new model	
	8.00-10.00						B: Change tool	
	10.00-10.20						C: internal R/M shortage	
	10.20-12.00						D: Lubrication	
	12.00-12.40						E: machine breakdown	
	12.40-15.00						F: Adjustment	
	15.00-15.10						G: Electric & Air	
	15.10-17.00						H: Lack of raw material	
Over time							I: Quality of raw material	
							J: Other	
Total quantity(pcs)							Total time(min)	

Non-conforming form machining

Code	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
PROBLEM	DIAMETER OVER SPEC	DEPTH OVER SPEC	PARALLEL NG(//)	PERPENDICULAR NG	CIRCULARITY NG	RUNOUT NG	CONCENTRICITY NG	P.C.D NG	SCREW OVER SPEC	DAMAGE OF DRILL	TAPPING NG	ROUGHNESS NG	PITCH NG	RADIUS NG	SETTING NG	ELECTRIC PROBLEM	MACHINE MISTAKE	FORGET MACHINE	FLAW	MACHINE NOT FINISH
QTY																				
PCs																				

TOTAL M/C-NC PCs

Raw material NC

	001	002	003	004	005	006	007	008	009	010	011
	MACHINING ALLOWANCE(-)	MACHINING ALLOWANCE(+)	HARDNESS	BLOW HOLE	APPEARANCE	CRACK	DELAMINATION	RUST, OXIDATION CORROSION	DIMENSION	LEAK	COMPONENT PART NG FORM DISASSY
QTY											
PCs											

TOTAL R/M-NC PCs

TRANSFER FW FROM SHIFT PCS		TOTAL FW PCS	Qty for stock shift 1 2 3	Total pcs
Reporter	leader	supervisor	comp	Operator

Figure 1.7 Daily manufacturing report

1.13 Description of lost time.

A: set-up time.

Operation of set up time composes of

1. Preparation of jig, tooling and raw material. Checking the function of instrument before settings also include in this step. Leader will transfer jig and support instrument from jig storage station to line. Jig number was identifying at plate of each jig for easily to search.
2. Mounting and removing tool & jig fixture. After finish working, operator will complete all working process. Leader will remove jig and change program of CNC machine. At jig plate has been set standardize position for locate pin to mount with master plate in every machine.
3. Trial runs and adjustment. In this stage, leader will adjust after testing of first piece of production. After the first good quality is made, the production will be started.

B: Change cutting tool

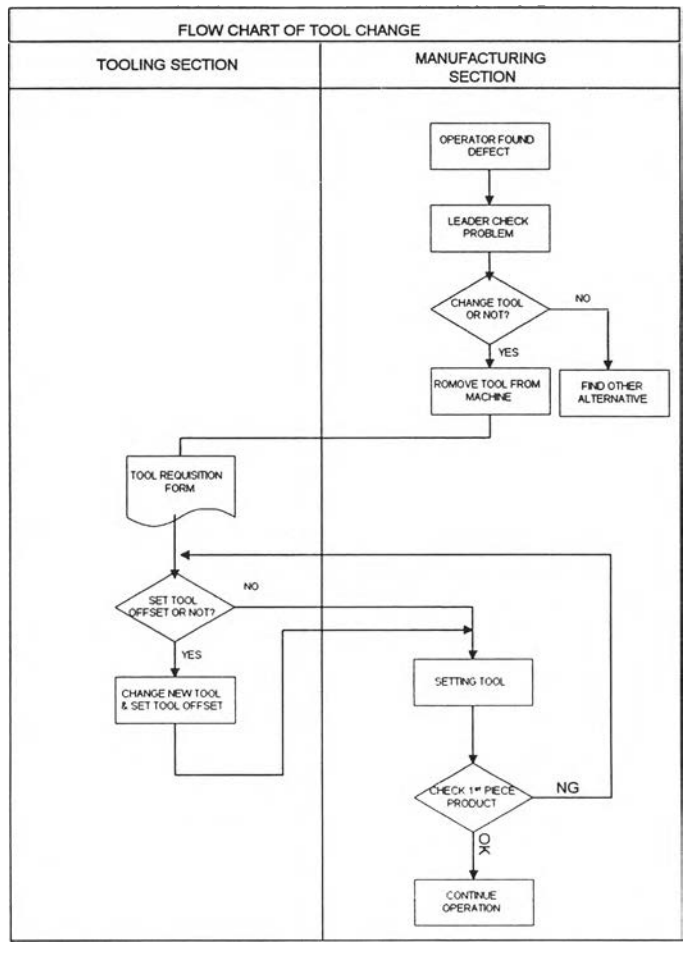

Figure 1.8 flow chart of tool change system

This is the time for change wear tool which have effect to the quality of product.
Procedures of changing tool are as the flow chart shown in figure 1.8. Leader of line will change tool if the controlling dimension is out of specification. Waste tool will be changed with the new tool at tooling section.
Tooling section responsible for control tooling stock and change tooling with the failure tool.
Tool which is regrindable will be checked and resharpended. Type of tool changing is separated into 3 types

1. tool for horizontal machine
2. tool for drilling machine
3. Tool for CNC lathe

C: Internal raw material transfer

Lost time occur from transportation of raw material from store to line operation or problem in internal communication.

D: Lubrication

Lost time in lubrication compose of

1. lubricate machine
2. Time for change coolant and clean coolant tank.

E: Machine breakdown

Machines for this line are CNC machine and automatic machine. Maintenance section will check for preventive maintenance 1 time/month. There are 2 types of maintenance preventive and remedial
Preventive maintenance consists of maintenance activities perform before equipment break down. Such as periodic inspection and record keeping assessing the condition of equipment, lubricating, painting cleaning, adjusting to maintain operating conditions.
Remedial maintenance consists of effort to restore machine to an acceptable operating operation.

F: Adjustment and inspection.

The quality of product must be controlled in the accepted area. Adjustment is the first step for solved the problem. Causes of low quality occur from tooling, jig & fixture, cutting condition. Time for adjustment can be reduced by increase the accuracy of equipment (tool, jig and machine).

Inspection is part of manufacturing process. In every working shift, operator will inspect and collect data to ensure quality of product.

G: Electrical shut down:

The problems are from the main electrical supply, which interrupt all the manufacturing. The problem of air compressor shutdown is also including in this case.

H: Raw materials shortage

Lost time caused by the external cause such as supplier of planning error.

I Quality of raw materials.

Quality control section responsible for control quality of raw materials by inspection in receiving stage. But the low quality is still found because some cases of raw materials can not be inspected before machining. The example of raw materials problems, which found in machine line, are machining allowance too low, machining allowance too high, hardness, blow hole, appearance, crack, delaminating, rust or oxidation corrosion, dimension, leak of aluminum and quality of component.