Two primary technical descriptors are material selection and manufacturing process.

Secondary technical descriptor under material selection may be: Steel, Aluminium & Titanium. Secondary technical descriptor under manufacturing process may be Brazing, Welding, Die casting, Sand casting, Forging & Powder metallurgy. Numerous other technical descriptors of finishing processes such as electro plating, painting etc. may be listed to make the list as exhaustive as needed.

Relationship Matrix between WHATs and HOWs

The next step is to compare the customer requirements and technical descriptors. One HOW may affect more than one WHAT and vice versa. To compare each of the customer requirements to each of the technical descriptors, an L-shaped relationship matrix is constructed. The list of technical descriptors is positioned perpendicular to the list of customer requirements. The relationship matrix represents graphically the degree of influence between each technical descriptor and each customer requirement.

Symbols are used to represent the degree.

A solid circle represents strong relationship ● = 9

A single circle represents medium relationship ○ = 3

A triangle represents weak relationship △ = 1

The box is left blank if no relationship exists. For future trade-off situations, the symbols are given values also (strong=9, medium =3 & weak=1). In the bicycle handlebar example, the relationship between customer requirement of lightweight and technical descriptor of steel would be weak (1), because steel is heavier than aluminium and titanium. This is total teamwork and all technical expertise is needed in this exercise.

Interrelationship Matrix

The roof of the HOQ, called the interrelationship matrix, is used to identify any interrelationships between each of the technical descriptors. Symbols are used to describe the strength. The diagram shows which technical descriptors support one another and which are in conflict. Conflicting ones are extremely important because they are frequently the result of conflicting customer requirements. Trade-offs must be made at these points, may be a managerial decision of higher level. An example of trade-off is fuel economy vs safety – stronger bumpers, air locks, antilock brakes, etc.

In our example, the interrelationship matrix is constructed by assigning the following symbols/numbers to represent the degree of correlation.

◉ = +9 ----- a solid circle represents a strong positive relationship

◎ = +3 ----- a single circle represents a positive relationship

⊕ = -3 ----- a + in a circle represents a negative relationship

★ = -9 ----- an asterisk represents a strong negative relationship

The competitive assessment is a pair of weighted tables that depict item for item how competitive products compare with current organisation products.

Competitive Assessments

Customer assessment and technical assessment are done separately.

Customer assessment is a block of columns corresponding to each customer requirement. It is a rating matrix with 1 for worst and 5 for best. Customer competitive assessment for the handlebar example comparing their product and two competitors 'A' and 'B' is shown.

Technical competitive assessment makes up a block of rows corresponding to each technical descriptor.

It is often useful in uncovering gaps in engineering judgment. It is a rating matrix with 1 for worst and 5 for best. Technical competitive assessment for the handlebar example comparing ours and two competitors 'A' and 'B' is shown.

Prioritised Customer Requirements

The prioritised customer requirements make a block of columns corresponding to each customer requirement. They include a variety of factors like Importance to customer, Target value, Scale up factor, Sales point & Absolute weight.

Importance to Customers

The QFD team ranks each customer requirement by assigning it a rating from 1 to 10. This represents the relative importance of each customer requirement in terms of each other. Though very difficult, the importance rating is useful for prioritising efforts and making trade-off decisions.

Target Value

The target value is given on a 1 to 5 scale depending on whether the team wants to keep their product unchanged, improve the product, or make the product better than the competition. The target value is determined by evaluating the assessment of each customer requirement.

Scale-up factor

The scale-up factor is the ratio of the target value to the product rating given in the customer competitive assessment. The higher the number, more effort is needed.

Sales Point

The QFD team has to identify the customer requirement that will help the sale of the product. The sales point is a value between 1.0 and 2.0, with 2.0 giving the best sales.

Absolute Weight

The absolute weight is calculated by multiplying the importance to customer, scale-up factor and sales point for each customer requirement. The absolute weight is useful as a guide for the planning phase of the product.

For instance, the absolute weight for reasonable cost is,

8 x 1.3 x1.5 = 8 x 1.95 = 16 (rounded off).

Prioritised Technical Descriptors

The Prioritised Technical Descriptors make up a block of rows corresponding to each technical descriptor

These Prioritised Technical Descriptors contain Degree of technical difficulty, Target value, Absolute weight & Relative weight.

The QFD team has to identify technical descriptors that are most needed to fulfil customer requirements and need improvement. These measures provide specific objectives that guide the subsequent design and provide a means of objectively assessing progress and minimising subjective opinions.

Degree of technical difficulty

Degree of technical difficulty is a measure for implementing each technical descriptor, which is expressed in the first row. The degree of technical difficulty helps to evaluate the ability to implement certain quality improvements. This is determined by rating each tech. descriptor from 1(least difficult) to 10 (Very difficult).

Target Value

A target value for each technical descriptor is also included below the degree of technical difficulty.

This is an objective measure that defines values that must be obtained to achieve the technical descriptor. How much it takes to meet or exceed the customer's expectations is answered by evaluating all the information entered into the house of quality and selecting target values.

Absolute weight

The last two rows of the prioritised technical descriptors are the absolute weight and relative weight.

The absolute weight for each technical descriptor is determined by dot product of the column in the relationship matrix and the column for importance to customer.

For instance, the absolute weight for aluminum is

(9x8) + (1x5) + (9x5) + (9x2) + (9x7) + (3x5) + (3x3) = 72+5+45+18+63+ 15+9 = 227.

Relative Weight

The relative weight for each technical descriptor is determined by dot product of the column in the relationship matrix and the column for absolute weight in the prioritised customer requirements.

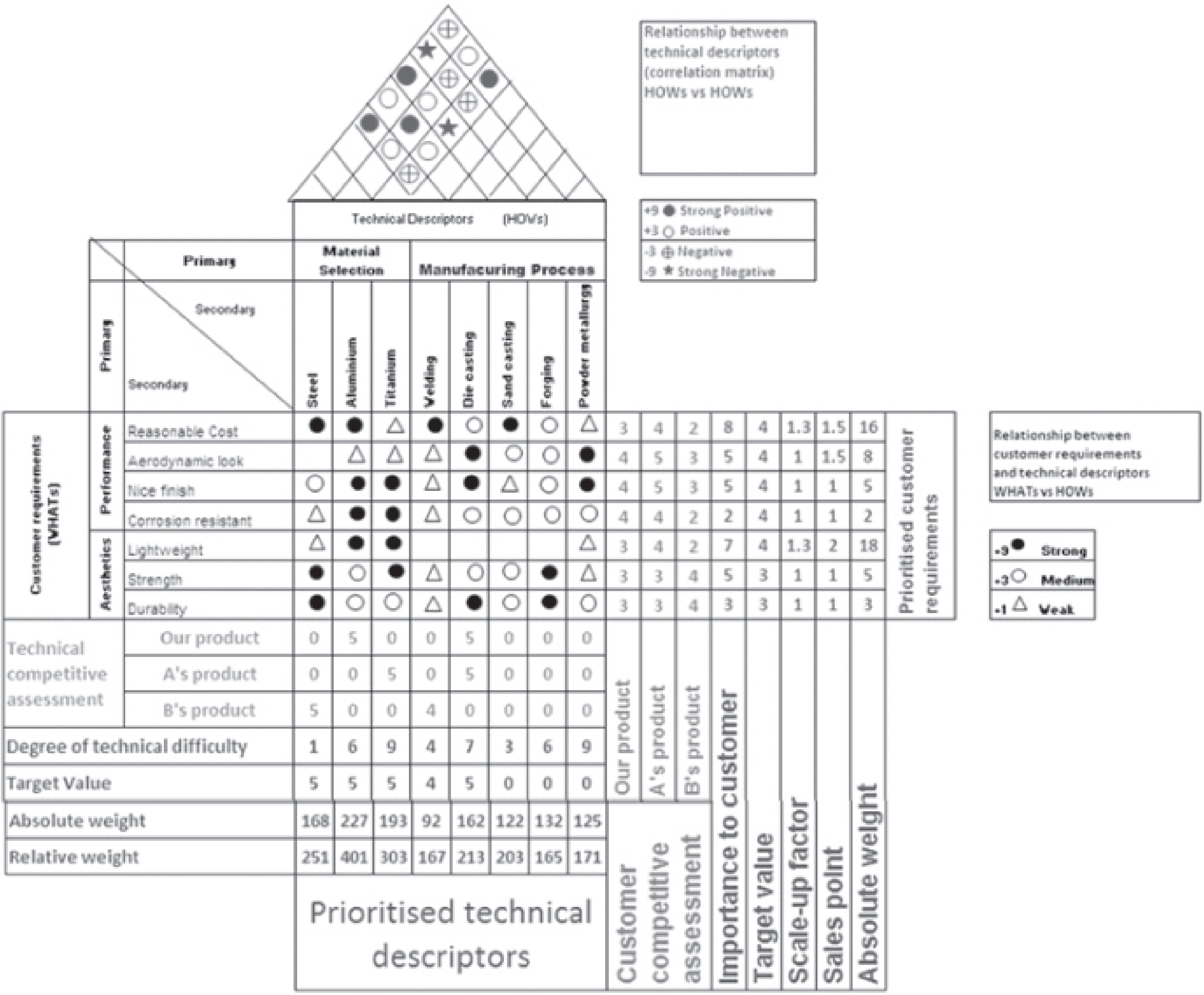
For instance, the relative weight for die casting is

(3x16) + (9x8) + (9x5) + (3x2) + (0x18) + (3x5) + (9x3) = 48+72+45+6+0+15+27 = 213.

Higher absolute and relative weight ratings identify where engineering efforts need to be concentrated. The relative weight also includes information on customer scale-up factor and sales point. These weights show the impact of the technical characteristics on the customer requirements. They can be organised into a Pareto diagram to show which technical characteristics are important in meeting customer requirements.

Along with the degree of technical difficulty, decision can be made concerning where to allocate resources for quality improvement. Each QFD team customises the house of quality to suit their particular needs. For example : column for the number of service complaints, environmental requirements, Govt. regulations etc.

The greater values in the absolute and relative weight ratings in the bicycle example show that the handle bar stem should be of Aluminium Die Casting.



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VALUE ENGINEERING - A CASE STUDY

Prof. D. R. Kiran

Value Engineering is a systematic and creative method using proven methods to obtain performance at a lower cost so as to improve the value of goods or products and services by critical examination of its function. This is akin to the modern DFSS tool of DMAIC, involving critical examination and analysis of the design of a component with reference to its functional value. The emphasis on analysing the functional values of all design features of a component makes Value Engineering a special among all DFSS tools.

The concept of Value Engineering originated in around 1945 at General Electric, USA. It soon became a valuable tool for all design engineers to such an extent that Value Engineering societies like SAVE (American Society of Value Engineering), SJVE (Society of Japanese Value Engineering), and INVEST (Indian Value Engineering Society) started functioning in several industrialized nations. This paper highlights Value Engineering as an effective cost saving and design tool illustrating with a case study.

1. Value vs Price

The term value is distinct from price or cost. Value is more an abstract concept referring to the cost benefit aspect. It is the ratio between a function for customer satisfaction and the cost of that function. We can relate value to quality, performance, style, and design in comparison to the product cost, as given by Value=Performance/Cost, or V= P/C.

Value increases if the numerator is increased without increasing the denominator. In other words, a product can be engineered for improved value by either increasing the quality, reliability availability, maintainability, serviceability etc., for the same cost or by reducing cost for the same degree of the above factors of quality, reliability performance etc.

Types of values

- *Cost Value* – is the cost of manufacturing and selling an item
- *Exchange Value* – is the price a customer is prepared to pay for the product, or service
- *Esteem Value* – is the prestige a customer attaches to the product
- *Place Value* - Same item may have different values at different places. For example, a glass of water in a desert.
- *Time Value* - An item may have a high value at certain point of time. Once the time is passed, it may lose its value. For example blood transfusion to a patient during an operation.

2. Functions of a product as the customer wants it

Functions are those things for which the customers believe they are paying. As explained earlier value engineering is based on a study of functions of a product or service. It involves the identification of functions from the knowledge of the customer needs. The first approach to the identification of functions should be focused on basic functions. There are usually only one or two basic functions per product or service.

All the functions can be grouped as below as per their levels of importance,

- The basic function which is the very purpose of the product or service

- The secondary functions are those not directly accomplishing the primary purpose, but support it from a specific design approach. These can also be subcategorized as use functions or aesthetic functions.
- Use functions are those, which answer the question how the basic function is achieved. For example if the primary purpose of a bottle is to contain a liquid, the secondary purpose can be strength to support the contents even when dropped or transparency so that the contents can be identified without opening the bottle.
- Aesthetic functions, whose purpose is only to add beauty or esteem value to the product and are associated with feelings. In the above example, the attractive colour or shape provides the aesthetic function.

It is generally found that the primary functions are achieved by 20% of the total cost whereas the secondary functions account for 80% of the cost. This is the crux of value engineering.

3. The 6 Phases of Value Analysis

3.1 General Phase

After identifying the existing product or the process to be analyzed, its general description is given indicating the functions and design features of the product as well as its components.

3.2 Information Phase

Additional data like the operational sequences or the time standards are recorded. These data would assist in analysis and in the comparison of the proposed process to the existing process.

3.3 Function Phase

Identify and list all the functions of the product or process, for which the customer is paying. Here it is necessary to indicate each function in only 2 words, a noun and a verb. This enables conciseness. By trying to describe a function in a sentence, we may unwittingly combine 2 or more functions which would cause confusion in our analysis (Table 2).

Again while identifying a function, specify it so as not to limit the ways in which it can be performed. For example: Don't say 'screw nameplate' but say 'attach a nameplate', since the nameplate can be attached not only by screwing but also by soldiering, riveting, or gluing etc. The later specification would help us in thinking of alternative solutions for this function.

Once all the functions are listed, isolate the basic function followed by all the secondary functions.

- Basic function is the primary reason for an item or system. It is the performance that must be attained if it has to perform its purpose.

- A secondary function is the features of an item which supports the basic function, and even without that function, the item can perform its functions. For example the primary function of paint is to protect the surface, while the secondary function is to give a good appearance.

3.4 Investigation phase

The investigation is the heart of the methodology with full application of creativity. The objective of this phase is to find a better way to do the main function by asking the following questions for each of the identified function and determine the relative importance of each function, preferably by asking a representative sample of customers.

3.5 Evaluation Phase

- Each idea generated should be analysed and developed in a manner to be more logical and practical making its function better.
- Identify barriers like mind set concepts opposing the idea and discuss whether the barriers hold strongly against the ideas. Isolate and eliminate them but after recording them for future reference.
- Choose two to four ideas among them and make a comparative study regarding the cost as well as performance.

3.6 Recommendation and follow-up Phases

After all any analytical study has to be approved by the top management. It is hence imperative that the value analyst team prepares a report detailing the several factors considered as detailed earlier emphasizing the net cost saving as well as the functional improvements achieved and submit the same to the top management as their recommendation. Once the recommendation is accepted, the operatives and other related personnel will have to be trained and regular follow-up with the implementation has to be maintained. This phase is similar to the steps Install and Maintain of method study.

<u>CASE STUDY</u>

This old case study is chosen from a student's project just to illustrate the step by step methodology. The study was made during early 1970s before the advent of CNC machines.

The component chosen, **clutch base plate,** was one of the costly parts in a power sprayer used to spray pesticide by the farmers. The main purpose of this study was to reduce the manufacturing time and cost to meet the competition. The clutch plate was produced in an ordinary capstan lathe. Since the volume was low the clutch base was produced by turning from 80mm dia. medium carbon steel (En8) in a lathe. The Green Revolution during that period enhanced the market requirement. That prompted the manufacturer to embark on value engineering study.

The component chosen for the study was Clutch Base Plate used in the Transmission Assembly of pesticide sprayers and cycle rickshaws with 0.25 HP Petrol Engine.

The six phases of the study are as follows.

I - General phase
II - Information Phase
III - Functional Phase
IV - Investigation phase
V - Evaluation Phases
VI - Recommendation Phase
VII - Follow-up Phase.

I. General phase.

The clutch base plate supports clutch plate and absorbs the heavy thrust while transmitting the force from the engine to sprayer. The whole system is to engage and disengage the driving and driven assemblies as and when required.

II. Information Phase.

The clutch base was machined from 80 mm dia. BS970 En8 steel bar. The sequence of operations is in the table 1.

Machined from Bar stock (Before Value Engineering)			Machined from Forging (After value Engineering)		
Op. No.	**Operation**	**Std. time in (min)**	**Op. No.**	**Operation**	**Std. time in (min)**
1	Cut blanks 28 mm thick in a Hacksaw	2.60			
2	Face one side, drill, ream and counter bore	8.00	**1**	Load on lathe, face one side, drill, and ream 17 dia. and counter bore	12.00
3	Bore 17mm through hole	5.80			
4	Face other side and turn dia 23 mm	8.00			
5	Countersink	0.50	**2**	Face other side and turn dia 23 mm	0.50
6	Copy turn first side	4.20			
7	Copy turn second side	3.93			
8	Broach key way	2.50	**3**	Broach key way	2.50
9	De-burr key way	1.00	**4**	De-burr key way	0.30
10	Mill 6 slots	6.75	**5**	Drill six Through holes and counter sink	3.00
11	Drill 3 hales	1.50	**6**	Drill 3 holes	1.50
12	Countersink 3 holes	0.80	**7**	Countersink 3 holes	0.80
13	Tap 3 holes	1.50	**8**	Tap 3 holes	1.50
14	Grind 55.3 dia	3.00	**9**	Grind 58 mm dia	3.00
15	Grind 62 mm dia	2.00			
16	Face the boss	1.00	**10**	Face the boss	2.00
17	De-burr, coat anti rust and store	3.00	**11**	De-burr, coat anti rust and store	3.00
	Total time	**56.08**		**Total time**	**29.10**

Table 1

III. Functional Phase

Sl.No.	**Functions**		**Functional Level**		**Remarks**
	Verb	**Noun**	**Primary**	**Secondary**	
1	Facilitate	Drive	-----	Yes	To pinion
2	Resist	Bending moment	-----	Yes	
3	Support		----	Yes	Of the reduction assembly
4	Absorb	Thrust	Yes	----	From the clutch plate
5	Provide	Location	----	Yes	For drive pin

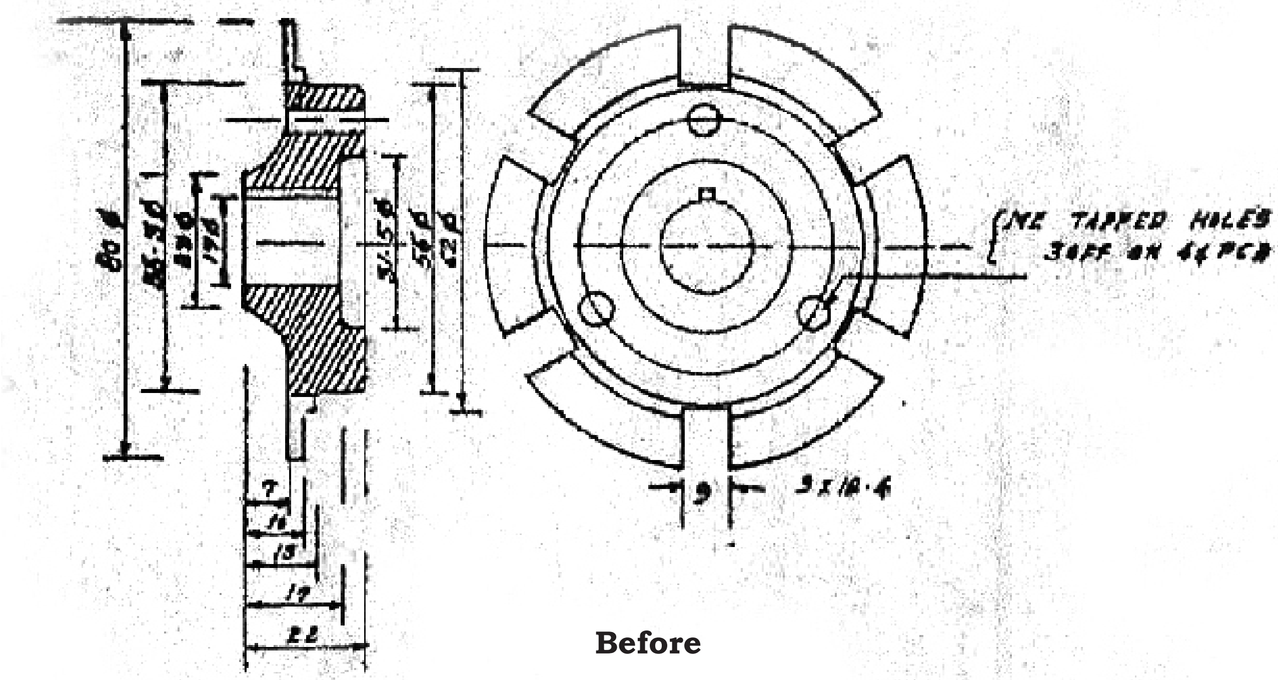
Table 2

IV. Investigation phase

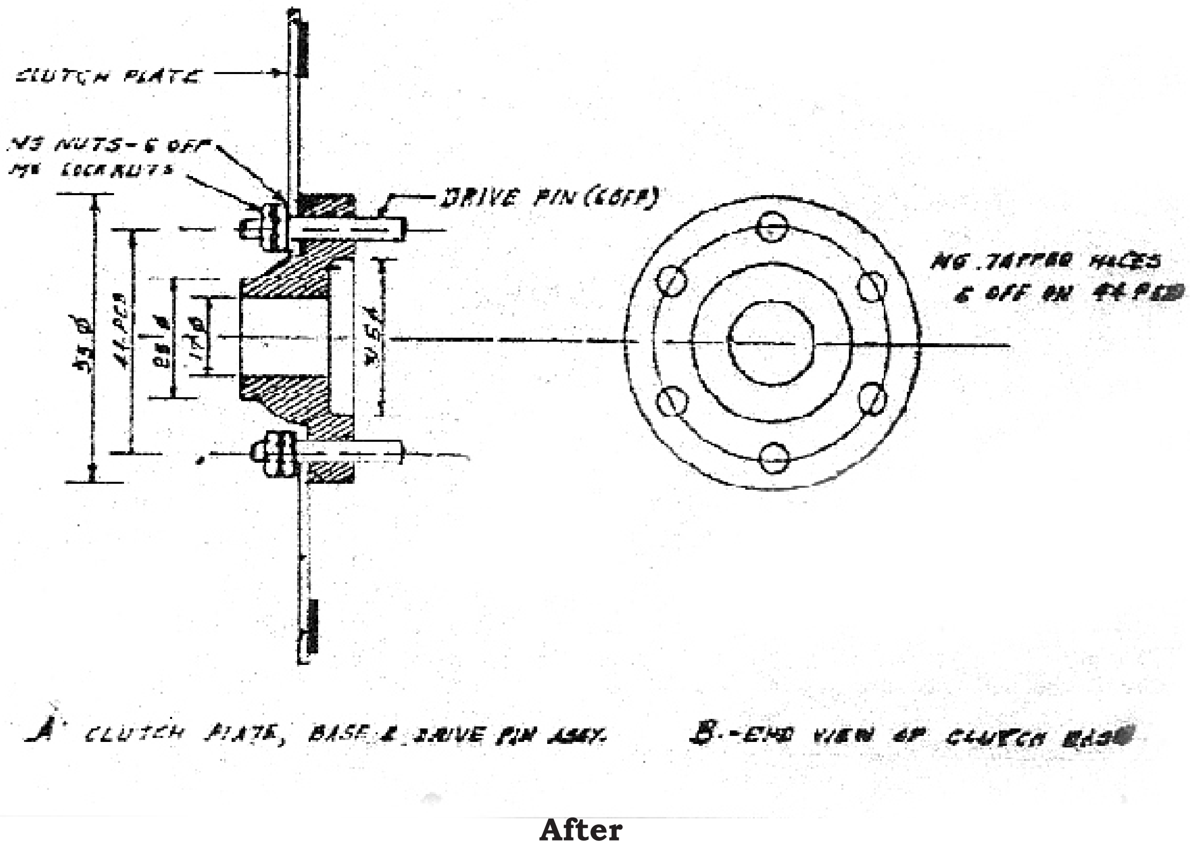
The total cost of maintaining the secondary functions account to considerable percentage of the total cost. Especially the secondary function of 'facilitate drive' can be rated as the costliest due to the cost of providing the flange and the slots. This gave an idea as to which design features should be questioned more thoroughly to get maximum cost reduction by changing only the minor and secondary design features.

V. Evaluation Phases

While the finished piece of the clutch base plate is 300gms, the raw material used is 80 mm blank weighing 1200gms, thus 75% of the material being lost as scrap.



Before



After

Table 1 pin points the operations 2 and 4 (facing), 3 (boring) and 10 (milling) which account for 50% of the total operational time which should be studied further.

VI. Recommendation Phase.

Three changes were recommended.

1. Raw material- 80mm medium carbon steel bar stock to low carbon steel forgings.
2. Avoid milling of square slots and provide six round holes.
3. Integration of the flange portion of the base plate with the clutch plate itself by fastening with screws and reduce out side dia. to 58mm.

a. *Design Change No.1* - Changing the Raw material specification from 80mm hot rolled medium carbon steel, (BS970En8) bar to low carbon steel forging with just 1 mm machining allowance. That resulted in saving of **15%** material and considerable machining time. Conversion to forging has resulted in further saving as the low carbon steel was cheaper than medium carton steel and less consumption of material. The low carbon steel was cheaper than medium carbon steel and less consumption of material.

b. *Design Change No.2* - There were two steps at 55 mm dia and 62 mm dia; the former to match with the clutch plate and the latter to match with the gear. The design Department has agreed to reduce the diameter to 58mm with no steps. This change has resulted in further material saving and machining time.

c. *Design Change No. 3* - Integration of the flange portion of the base plate with the clutch plate itself by screwing.

VII. Follow-up Phase

- *Recommendation No. 1, has been accepted and implemented.*
- *Recommendation No. 2, was withheld still the approval by field trial. The same was implemented after six months.*
- *Recommendation No. 3 was accepted in principle and tried out in actual usage and then accepted.*

Savings achieved:

1. Substitution by forged piece: Saving Rs 4.55/piece.
   Saving per year Rs. 4.55 x 24,000= Rs.1,09,200/- year

2. Reduction in conversion cost: Rs. 12/ piece x 24,000 = 2,88,000 / year Total saving was Rs. 3,97,200/- per year. During 1970s it was a huge saving for a small company.

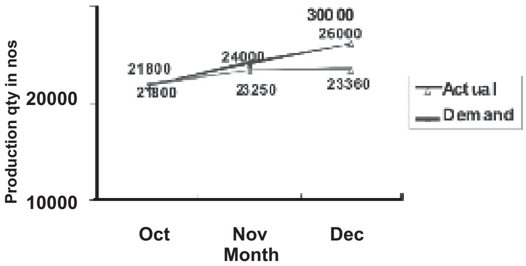
Prof. Ravi Kiran, Post Graduate Mechanical Engineer and has three decades of teaching experience. He is the author of three books on Professional Ethics and Human Values, Maintenance and TQM.

QC Story - WABCO India Ltd. - TQM News

1.0 PROBLEM

Unable to meet customer demand in Type 20/24 Spring Brake Actuator

1.1 Production details of Type 20/24 SBA



1.2 PROBLEM BACKGROUND

Unable to meet customer demand in Type 20/24 Spring Brake Actuator 26000 nos per month and the required cycle time is 60 sec.

Present cycle time is 66 seconds / piece. It has to be reduced to 60 seconds to meet the demand.

Required cycle time
What is Taketime?
Takttime = Total time available in seconds Customer demand

Customer demand =
26520no's/month (appox)
Total time available in seconds =1,72,63,600

No. of working days/month
No. of working hours/day

Calculated Take time is 60 seconds

1.3 IMPORTANCE OF PROBLEM

Not able to supply customer demand leads to...

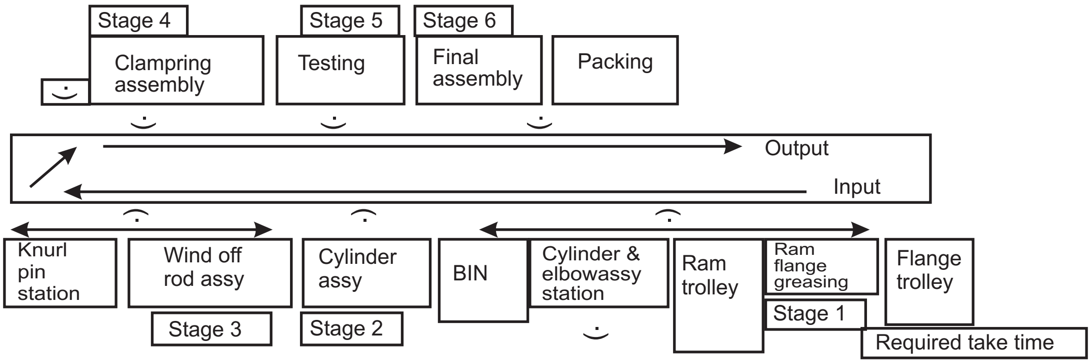
- Customer assembly line will be affected.
- We are the single source supply of Type 20/24 Spring brake actuator, If we do not supply these actuators customer can't despatch vehicle.
- Actuators are despatched through special vehicle.

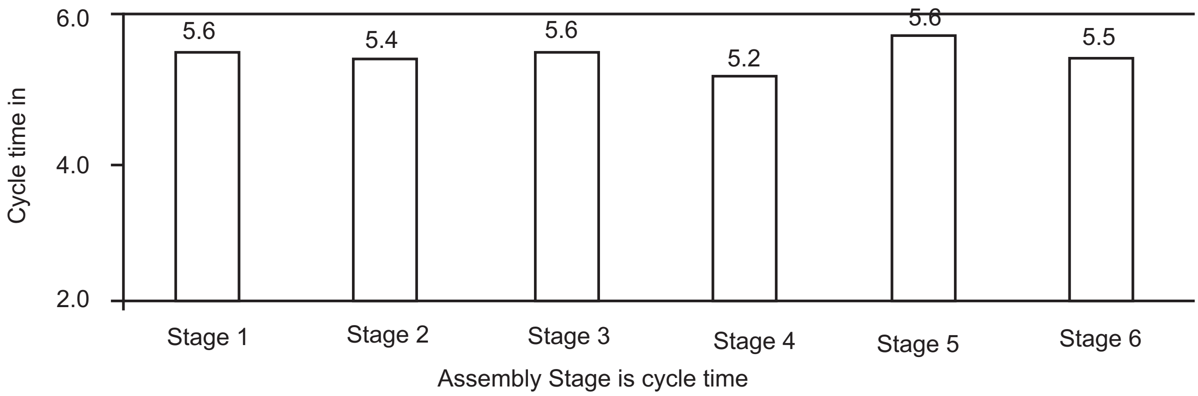
1.4 SETTING GOALS AND TARGET

To reduce the cycle time of type 20/24 Spiring brake actuator Assembly from 66 sec to 60 sec before Mar '08

2.0 OBSERVATION

Process Flow of Type 20/24 Spring brake Actuator Assembly

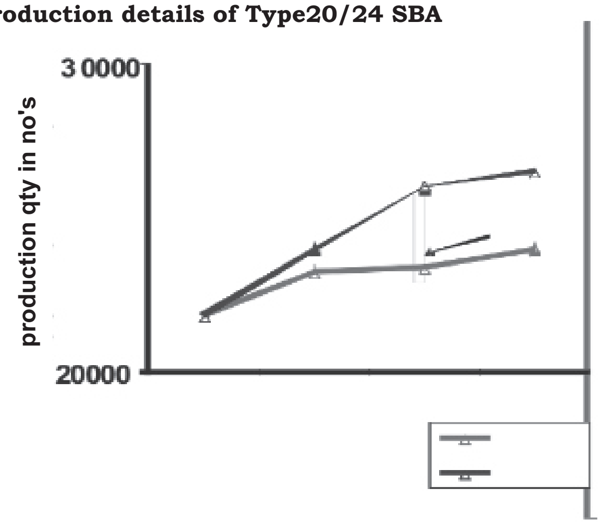




3.0 ANALYSIS

Result : Assembly cycle time is below required take time.
Inference : Assembly capacity enough to supply these demand.

Production details of Type20/24 SBA



1. Type 20/24 ram
2. Type 20/24 flange

3. Diaphram
4. Push rod assembly
5. Dust seal
6. Fork
7. Adaptor
8. Bearing
9. O-ring
10. Wind off rod
11. Stem plug
12. Clamp ring
13. Non pressure plate
14. Spring
15. Cylinder

Line now running more than 97% efficiency but we are not able to meet the demand

↓ why

MAJOR CAUSE FOR GAP IS MATERIAL SHORTAGE FROM MACHINE SHOP

Component wise cycle time analysis :

Two parts are machined as in-house and their status of cycle time mentioned as below:

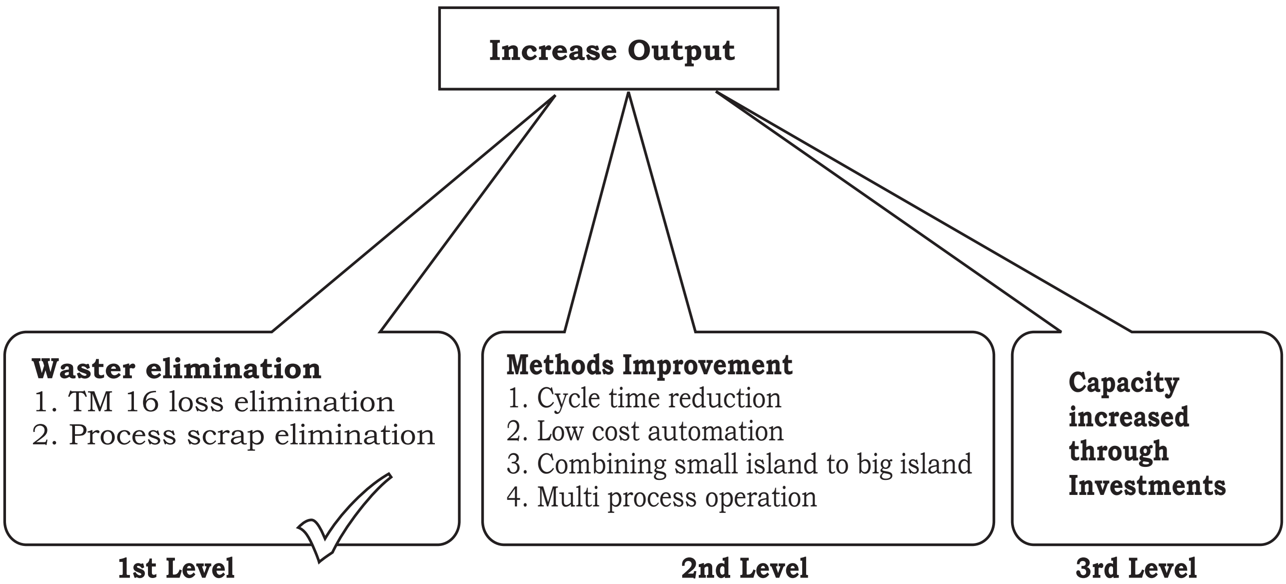
Type 20/24 RAM-45 seconds.   Type 20/24 Flange - 60 seconds.

Inference:

Type 20/24 Flange machining cycle time is higher than required take time hence focused on flange machining.

4.0 ACTION

We decided to improve our out put in the following way



4.1.0 WASTE ELIMINATION :

According to our company procedure we following 16 losses sheet for deducting losses

16 LOSSES DETAILS

No.	Loss	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1.	Machine Breakdown																															
2.	Setting								■																							
3.	Tool change			■												■														■		
4.	Tod service																															
5.	Notool/No fixture																															
6.	Fixture service																															
7.	Coolant block				■					■						■							■									
8.	Swarf removal																															
9.	Reduced speed																															
10.	Planned stoppage																															
11.	Material waiting			■																					■							
12.	Investigation/Trvout																															
13.	Line orgn./deaning																	■														
14.	Waiting for container																															
15.	Measurement & adjst.									■																			■			
16.	Waiting for operator																														■	

Total loss hours = 4.4 hours per month

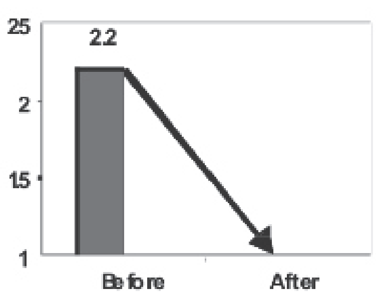
Major loss : coolant blockage 2.2 hours in total loss of 4.4 hours per month

Our team made one KAIZEN for eliminating coolant blockage

Before we used single Stage filtration

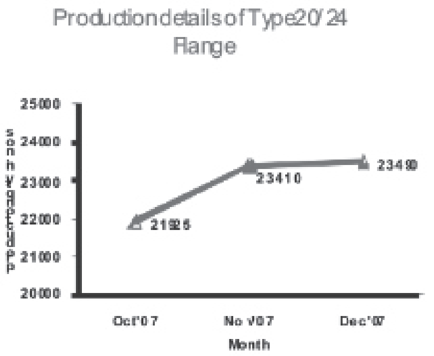
After we introduced multistage filtration

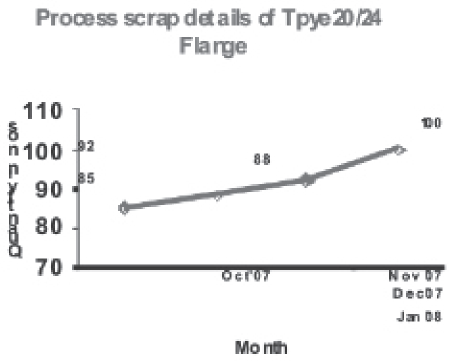
Benefits:



Coolant blockage time eliminated 2.2 hours to 0 per month.

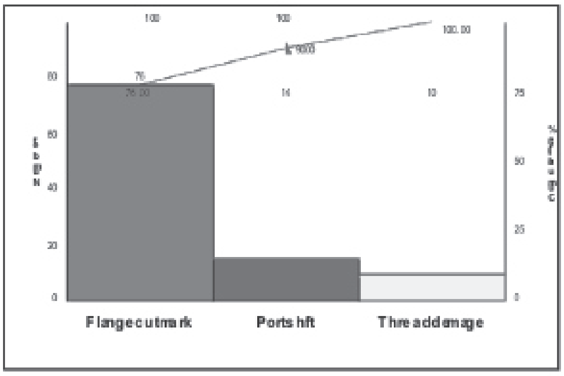
4.2.0 WASTE ELIMINATION (PROCESS SCRAP ELIMINATION) :





Overall line efficiency = Rate of quality*Performance efficiency
*Availability Our present Overall line efficiency = 95%

Flange process scrap details



76% rejection (in Pareto)
Due to Flange cut mark

Why Why Analysis :

Type 20/24 Flange cut mark on the machined face :

Cut mark on the flange machined face

↓ ?

Burr impression on the flange machined face

↓ ?

Burr clogged between fixture and machined face of flange

↓ ?

Cleaning of burr in the fixture not effective

| How ?

Improve fixture cleaning

Eliminate machined butting face

↓ How?

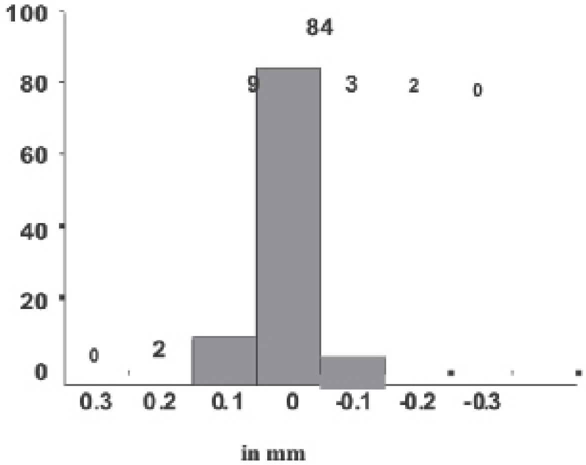
Take cast face as butting reference

In our Why Why Analysis we decided to make a cast face as a reference.

Validation to make cast face as reference :

It is a PD Casting. So not much variation in cast surface anticipated :

Diagram shows flange flatness Measurement variation.
As per CMM report No. of components checked = 100no's



100 components checked for flatness. As per CMM report not very much variation in casting face. So decided to take casting face as reference.

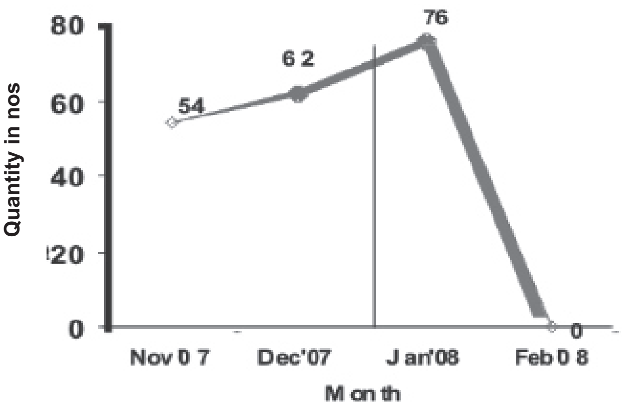
To take a cast surface as a reference available fixture not possible to load the component, so we have to go either New Fixture or modify the existing fixture.

We decided to modify the existing fixture.

After modifying the existing fixture we faced problem to load the component with machined face.

To eliminate this problem we provided a poka-yoke in the fixture to load cast face only.

After making a cast face as a reference flange cut mark has been eliminated



Flange cut mark details

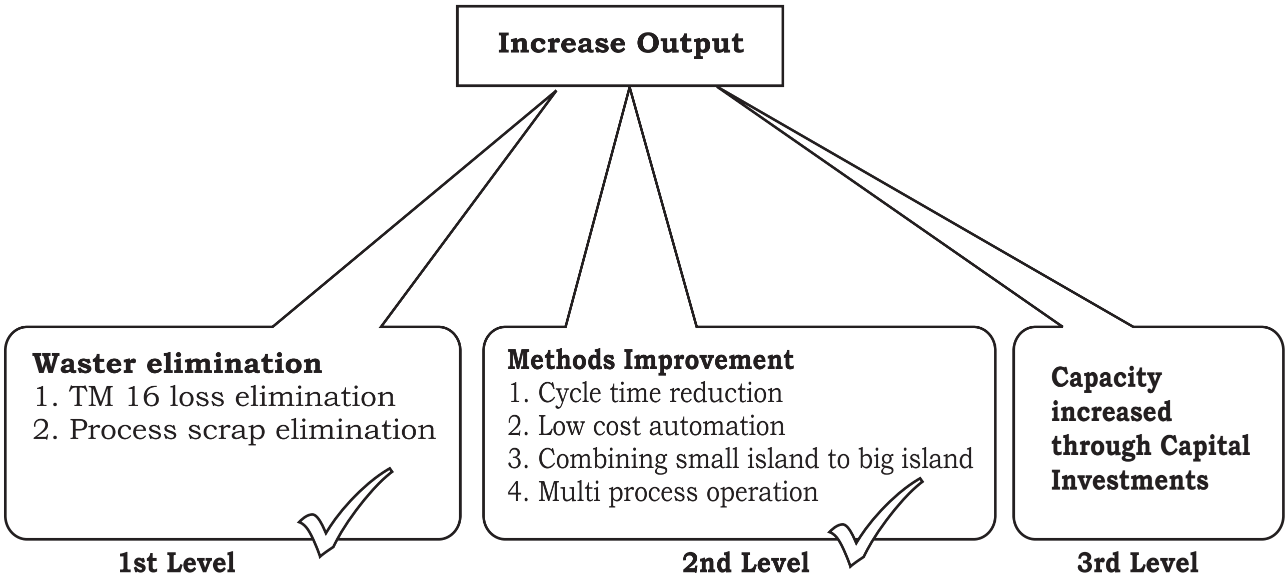
After this improvement:

1. Flange cut mark eliminated

2. Port shift eliminated

3. Thread damage eliminated

RESULT FIRST LEVEL IMPROVEMENT :

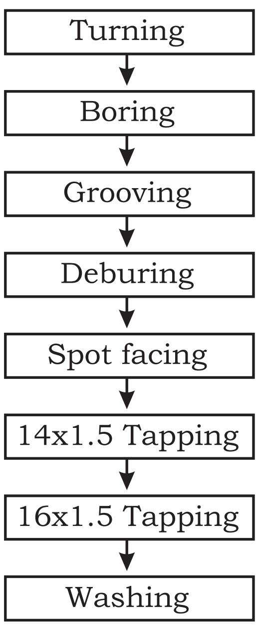


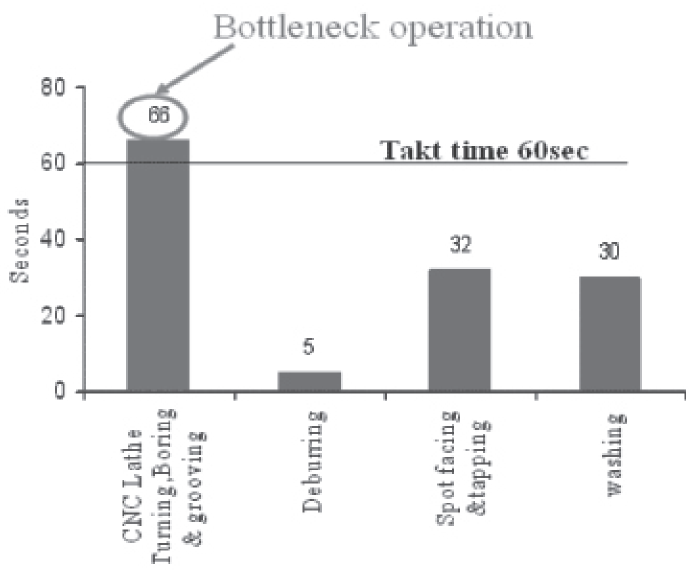
Result : In first level improvement overall line efficiency increased from 95% to 97%.

Inference : In first level improvement bottleneck CNC Lathe time is above the TAKE.

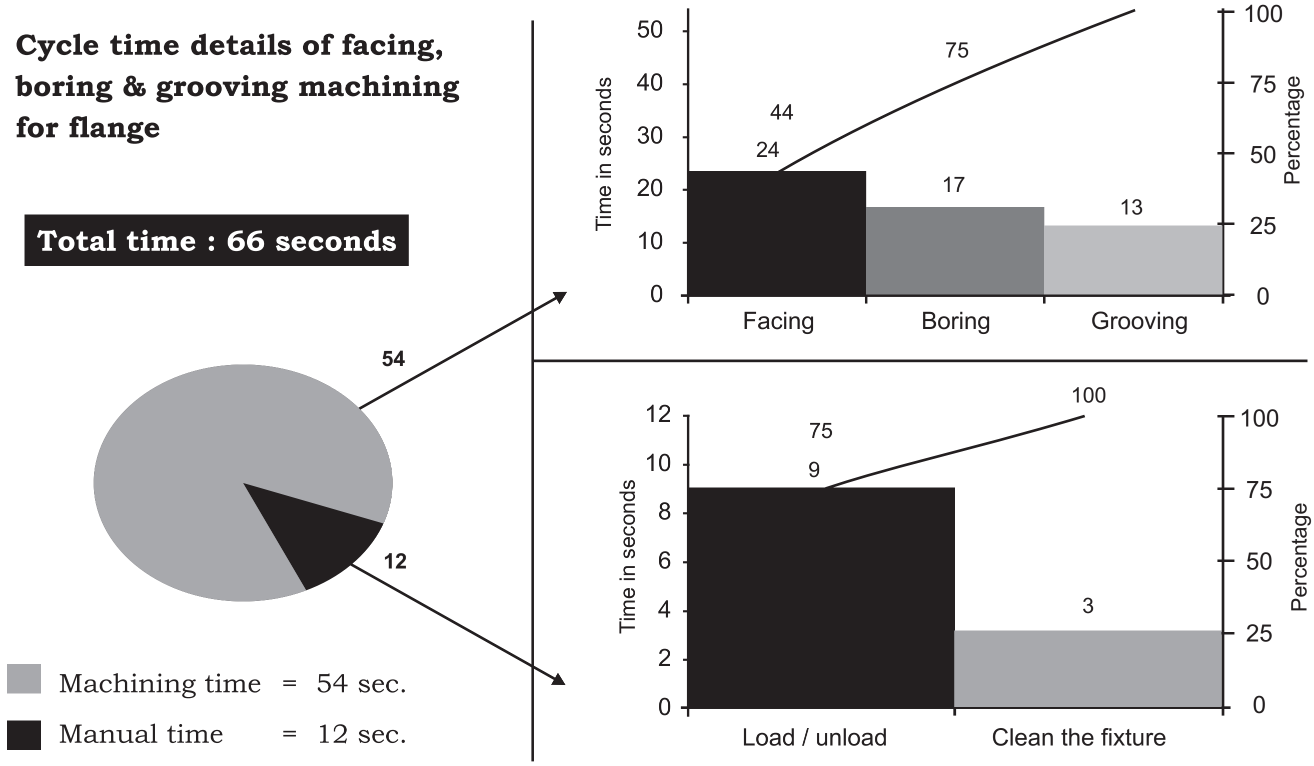
Level 2 : Methods improvement : Cycle time reduction.

Operation sequence of type 20/24 Flange machining :

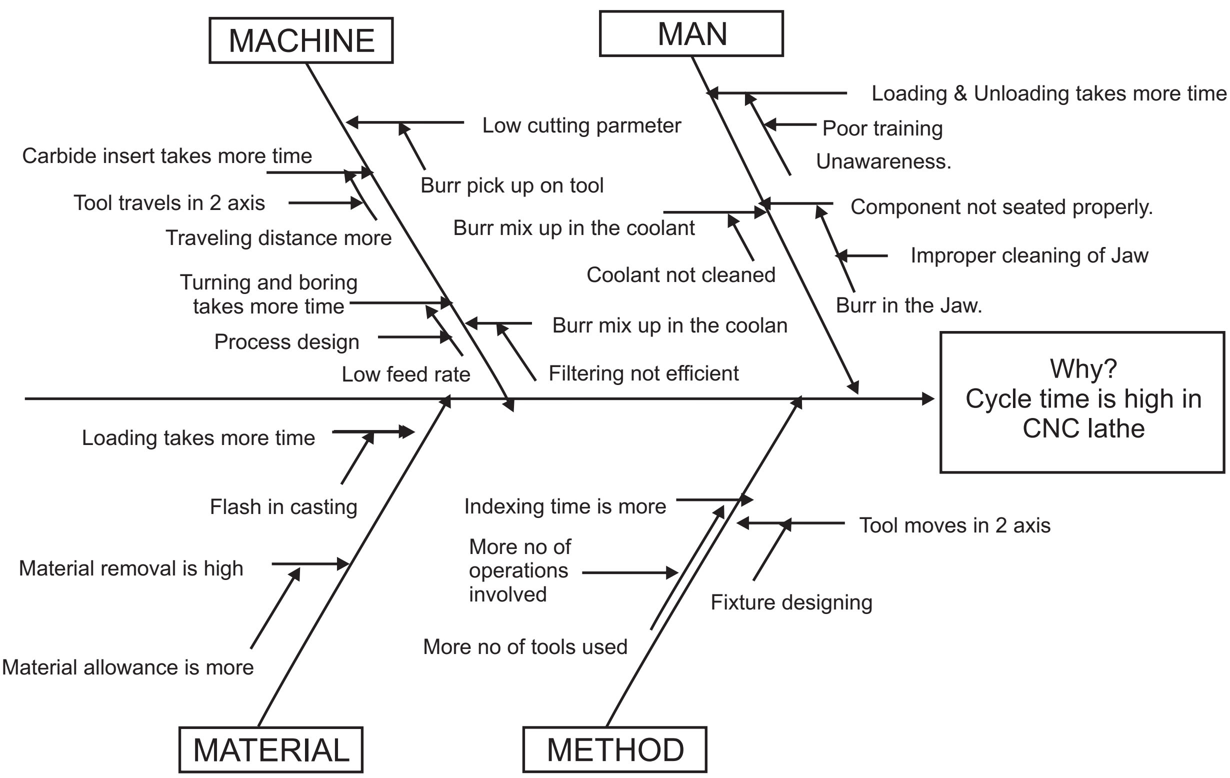




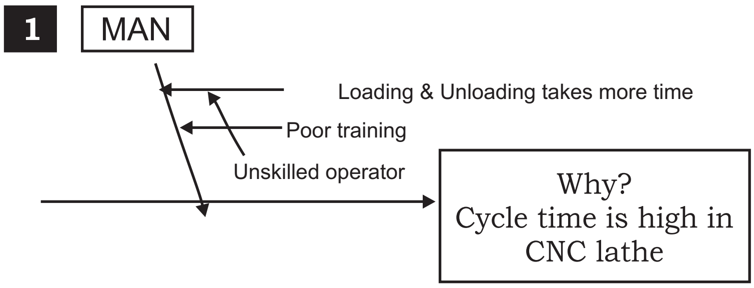
Time split up for CNC Lathe in Flange machining



OUR TEAM MADE CAUSE ANALYSIS TO REDUCE A CYCLE TIME



ROOT CAUSE ANALYSIS :



Cause : Poor training

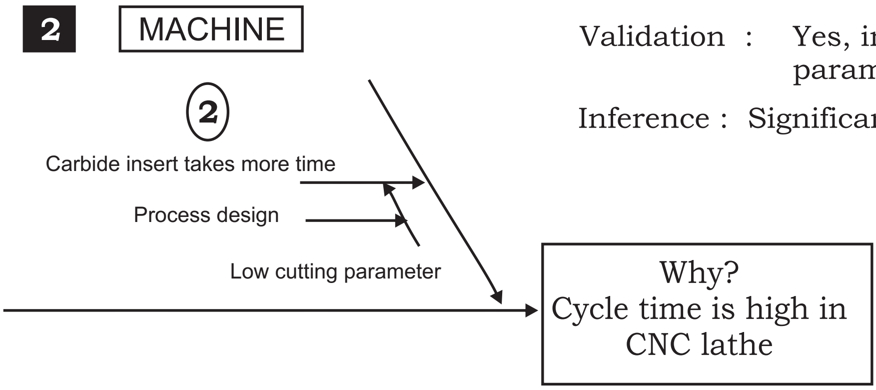
Validation :

In Gemba audit we found only skilled operators are working.

Inference : Insignificant cause

Time in seconds			
Observed times		Recommended time	
Loading	Unloading	Loading	Unloading
8	4	8	4
8	4		
8	4		

ROOT CAUSE ANALYSIS :

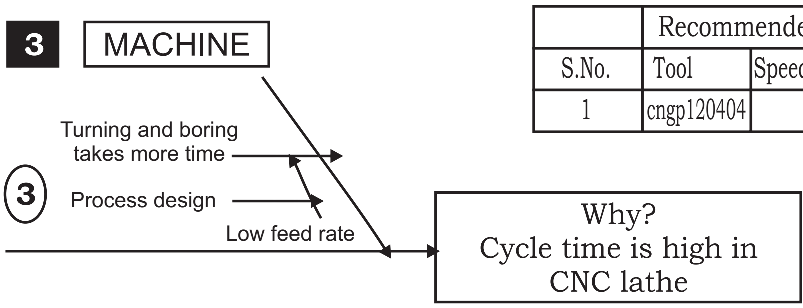


Cause : Carbide inserts takes more time

Validation : Yes, in Gemba audit it's low cutting parameter

Inference : Significant cause

ROOT CAUSE ANALYSIS :



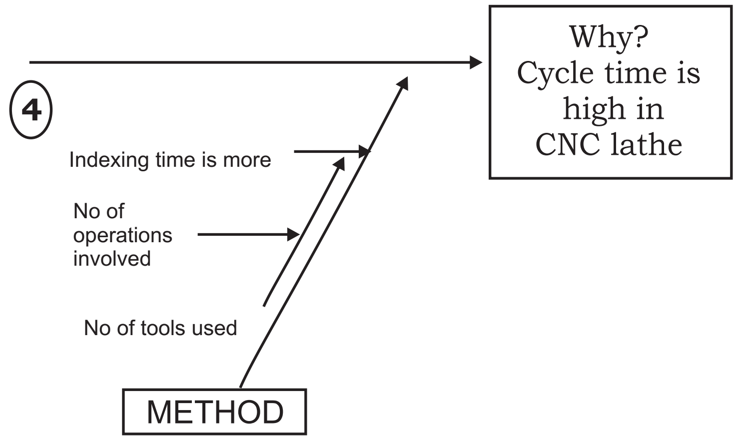
	Recommended parameter			Actual parameter	
S.No.	Tool	Speed'rpm'	Feed'mm'	Speed'rpm'	Feed'mm'
1	cngp120404	1500	0.15	1500	0.15

Cause : Training and boring takes more time

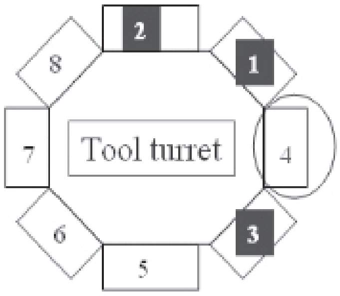
Validation : Even though the speed and feed is as per specification limit is not adequate to meet the Take time

Inference : Significant cause

4



Sl. No.	TOOLS USED
1.	CNMG 120404 turing tool
2.	CNMG 120404 Boring tool
3.	5mm Grooving tool



Tools are not is sequence

Cause : Indexing takes more time

Validation : Tools are not in sequence

Inference : Significant cause

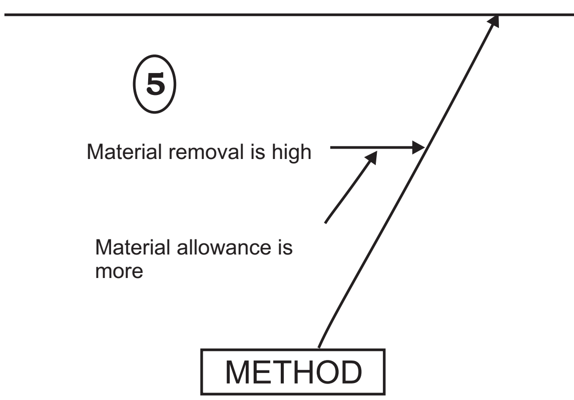
ROOT CAUSE ANALYSIS :

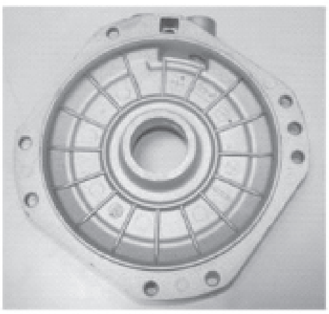
5

Cause : Material allowance is more

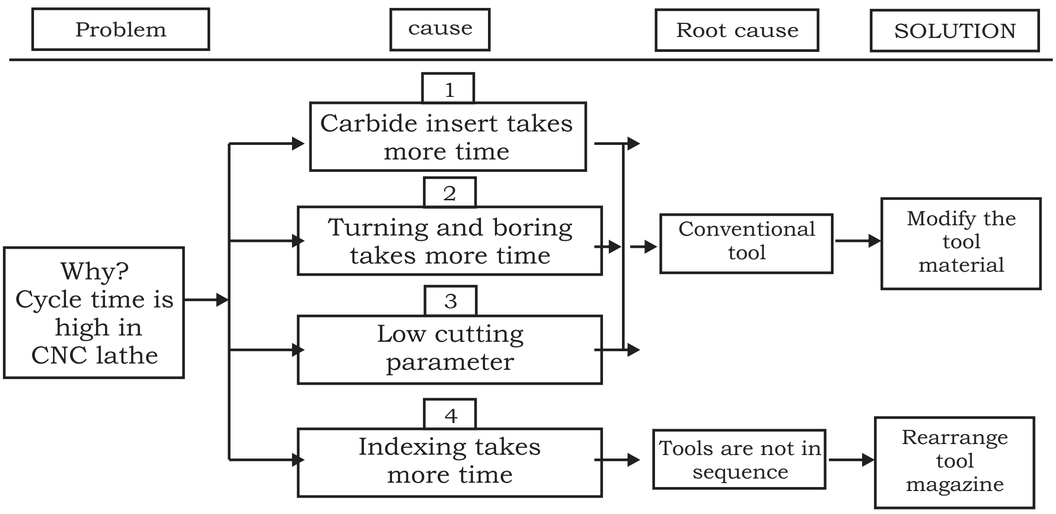
Validation : In Pressure die casting permissible Machining allowance is 0.6 mm actual allowance in casting is 0.6 mm

Inference : Insignificant cause




TYPE 20/24 FLANGE

DEVELOPMENT OF SOLUTION:



SOLUTION 1 : CYCLE TIME REDUCTION

To provide new diamond inserts for Turning :

Turning carbide insert is used

Inset cost = Rs. 480.00
Tool cost per component = Rs. 0.33

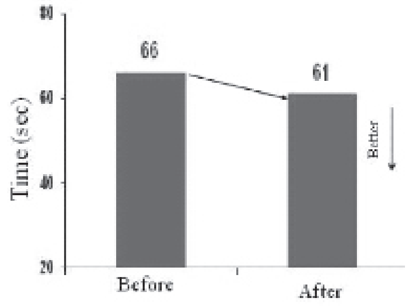
Speed = 1500rpm
Feed = 0.15m/min
Tool life = 1500nos

Turning carbide insert is used

Inset cost = Rs. 1100.00
Tool cost per component = Rs. 0.23

Speed = 3000rpm
Feed = 0.2m/min
Tool life = 4750nos

Cycle time reduction



SOLUTION 2 : CYCLE TIME REDUCTION

To provide new diamond inserts for boring :

Boring carbide insert is used

Insert cost = Rs. 376.00
Tool cost per component = Rs. 0.25

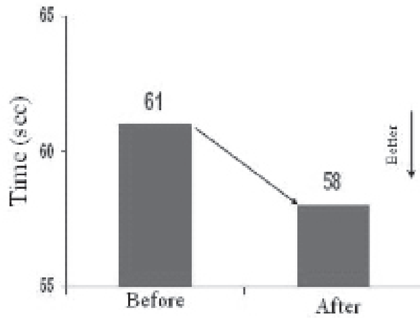
Speed = 1500rpm
Feed = 0.15m/min
Tool life = 1500nos

Boring diamond insert is to be used

Inset cost = Rs. 1000.00
Tool cost per component = Rs. 0.21

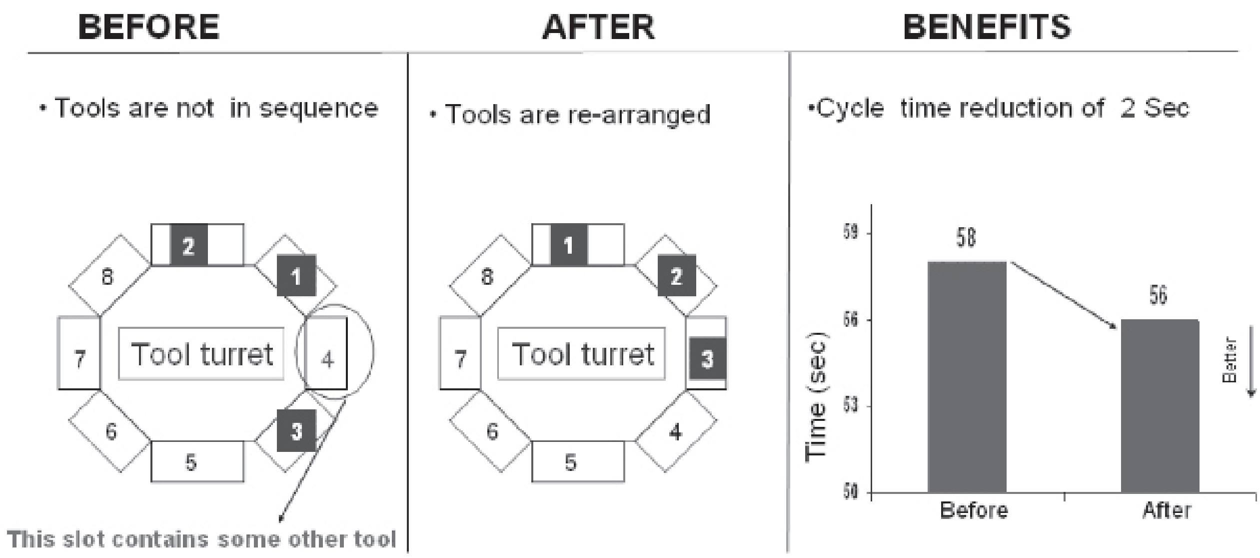
Speed = 3000rpm
Feed = 0.2m/min
Tool life = 4750nos

Cycle time reduction



SOLUTION 3 : CYCLE TIME REDUCTION

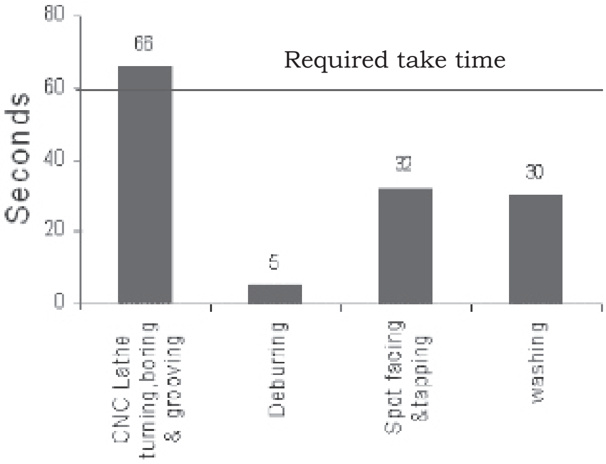
Rearrange tool layout :



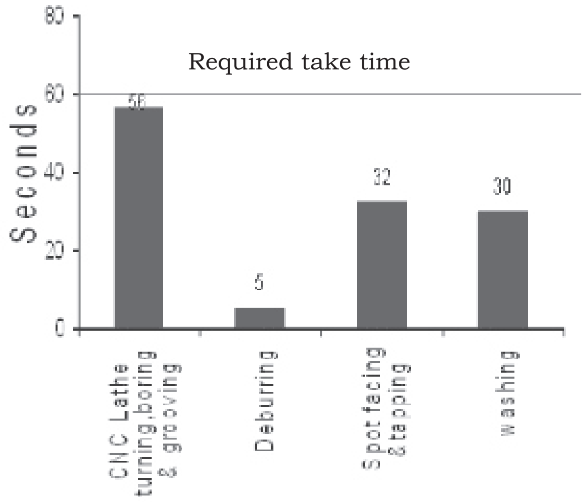
According to the company procedure Try out conducted details of Experimental Job order for modified tools, all the dimensions are with in limit.

CHECK :

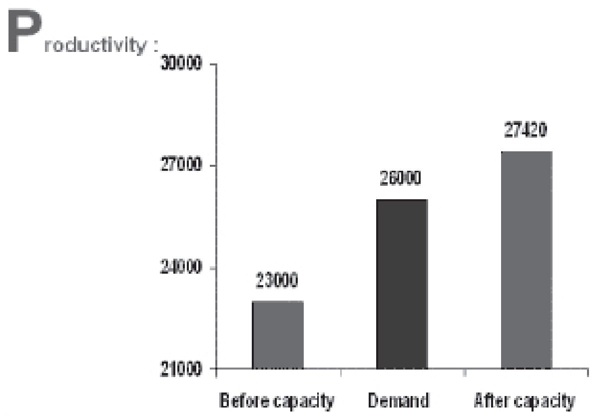
Before QCC Cycle time = 66 sec



After QCC Cycle time = 56 sec



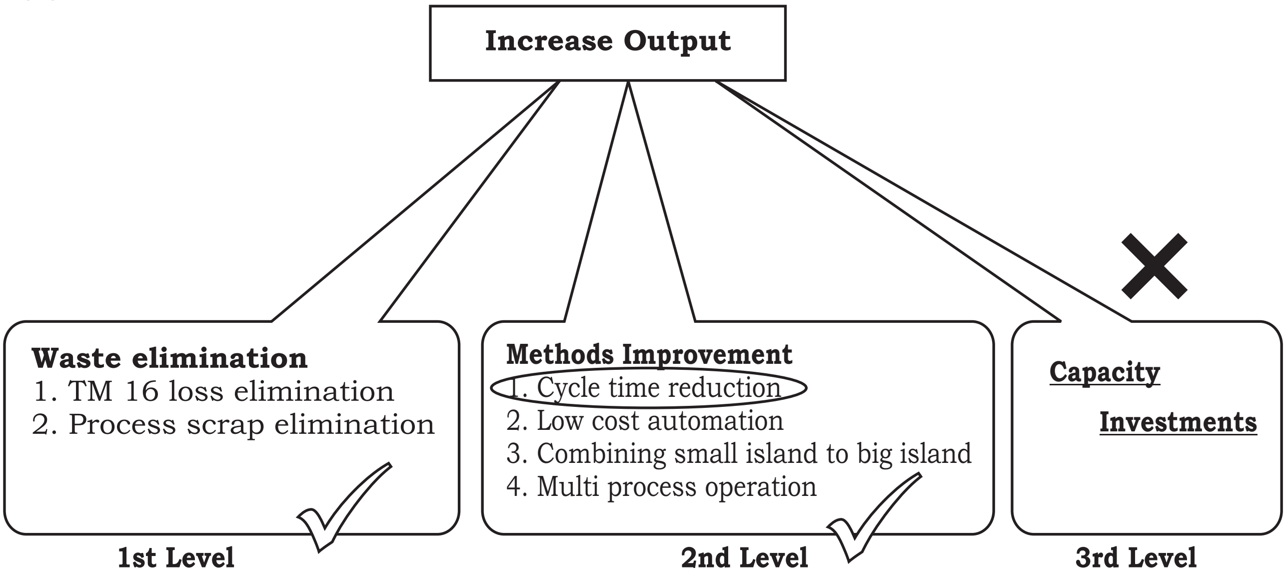
BENEFITS :



Quality :

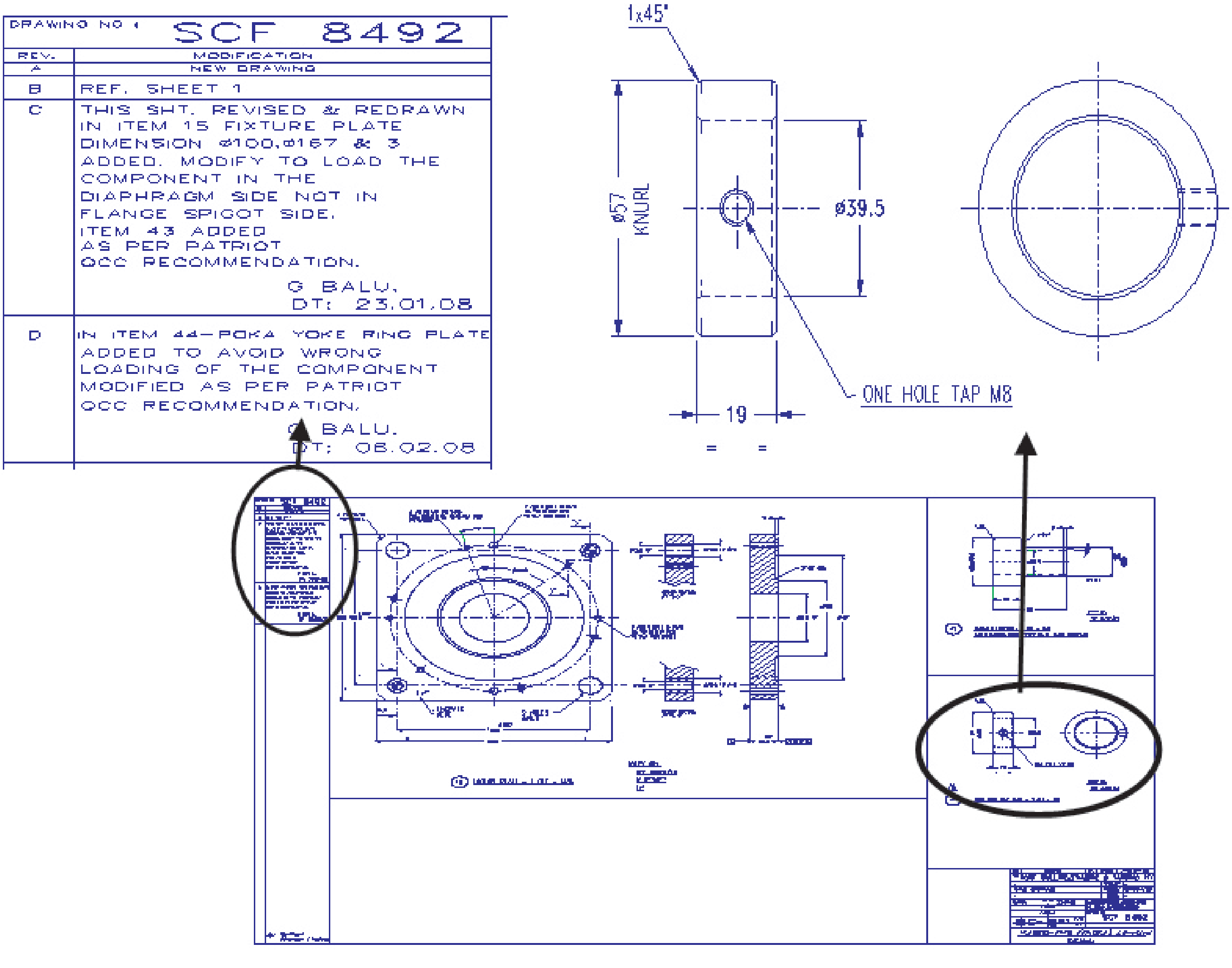
1. **Process capability remains same after improvement**
2. **Process scrap becomes zero**

RESULT :



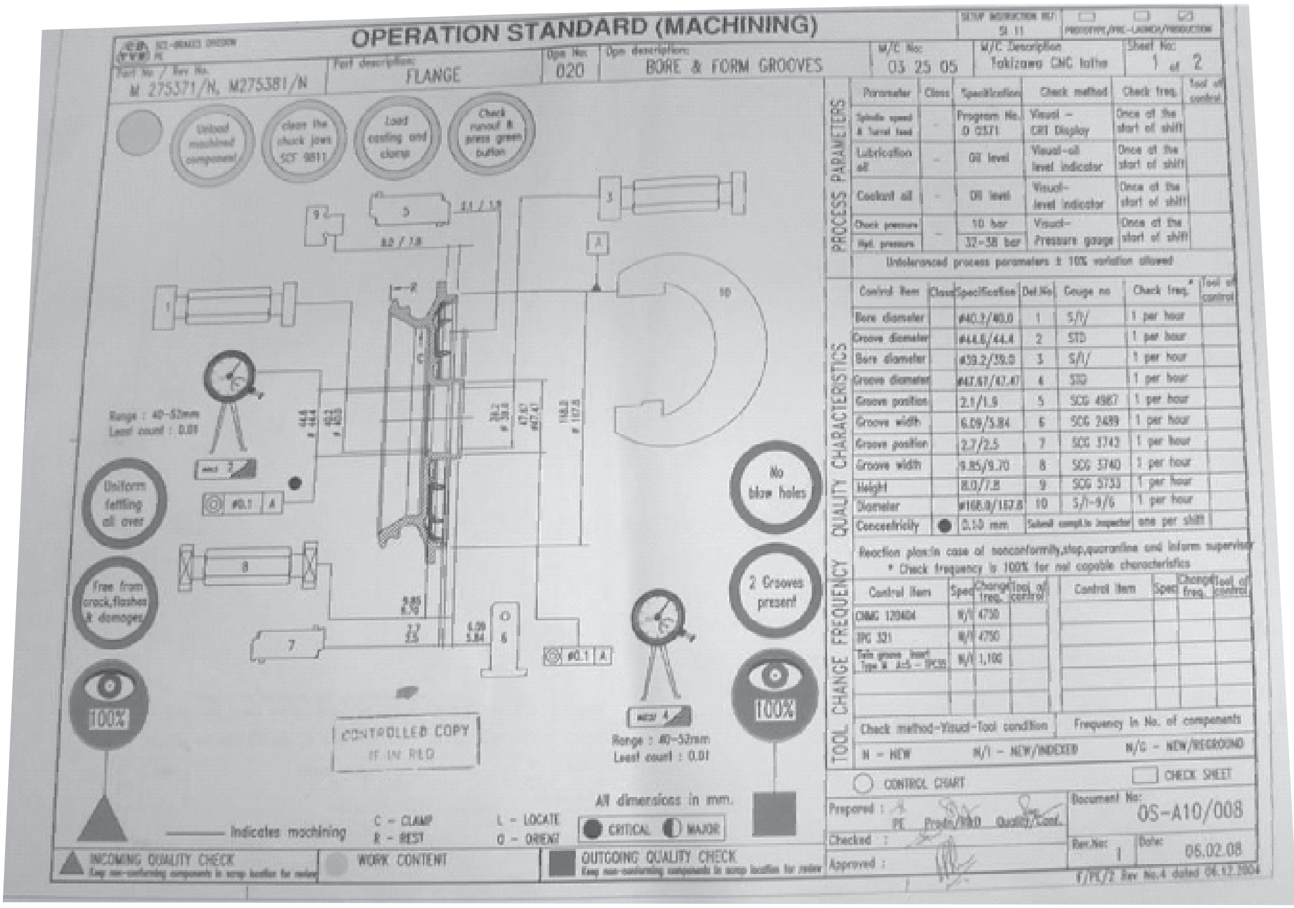
Inference : Productivity increased without Capital Investment

FOLLOW UP / REVIEW & RECURRENCE PREVENTION :
Modification of fixture drawing with poka-yoke standardisation :



FOLLOW UP / REVIEW & RECURRENCE PREVENTION :

Tools Standardisation in Operation Standard :



Q C TOOLS USED :

1. Check Sheet
2. Pareto diagram
3. Cause & effect diagram
4. Graph
5. Histogram
   + Poka - yoke

CONCLUSION :

❖ By eliminating waste and improving the methods we can achieve higher productivity without any capital investment.

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NIQR - India Pistons Life time Achievement Awardee -
Prof. Yasutoshi Washio, President of Japanese Society for Quality Control.

Audience participated in the Felicitation Function

Professor Kazuyuki Suzuki

University of Electro-Communications, Tokyo,
Specialist in Reliability Engineering
Winner of Deming Individual Prize - 2014