Optimisation of Operational Cost of Tool Sensor by Kaizen

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***Abstract*—Productivity improvement is an everlasting continuous activity in manufacturing. Continuous improvement is the need of the hours which can be achieved by incorporating flexibility in layout, design and processes. This project aimed to improving productivity of production system of manufacturing industry through modification of tool sensor suiting the needs of the company and fitting their budget. The objective of the project work is to increase capacity/productivity of PB line by reducing the breakdown time of the tool sensor and making them more efficient. The carburetors are manufactured on the PB line where various drilling and reaming operations take place. Tool sensors are used to check whether these operations are performed successfully. In this project report we have mentioned the problems faced by the company with the existing FEM tool sensor and the countermeasures we havetaken to design a new tool sensor.**

Key words-Productivity, Capacity, Tool sensor, reed switch.

I. INTRODUCTION (HEADING 1)

In this project, we are going to increase productivity of machining line for manufacturing of carburetors. We will be focusing on modifications of the mainstream tool sensor to optimize their performance and cycle time and reduce the operational cost of manufacturing for the same. Due to the minute tool (drills) involved in the operations of manufacturing of carburetors. We are planning to reduce the cycle time with help of Japanese productivity improvement techniques like Kaizen, poke yoke etc. The tool sensor has to be imported hence the cost is high. With localization of tool sensor, cost of the product is reduces significantly.With the decrease in the cycle time of the machining line productivity of the line in increased.

II. PROBLEM FORMULATION

Over the past few months manycompanies are trying to boost up its production capacity to accommodate the rising demand. So after survey, it was seen that about 76% of total expenses is for Maintenance department. Further the results showed that 55% of total Maintenance department expense was only for spares. And finally we concluded that about 23% of total cost was given for imported tool sensor.Therefore, we got our task of reducing maintenance department expenses by doing some modifications in tool sensor. We need to make a tool sensor which fulfill all theactivities carried by old FEM sensor, but it should be more efficient and of low cost.

III. OBJECTIVES

Objectives are as follows:
To design, modify and manufacture a tool sensor.

- To reduce cost.
- To improve life cycle.
- To reduce tool sensor cycle time.
- To ensure proper utilization of company resources.

IV. POSSIBLE OUTCOMES

1. Changeover imported tool sensor which is very expensive.
2. Reduction in maintenance expenses of company.
3. Increase in productivity due reduction in breakdown time.

V. LITERATURE REVIEW

Need of tool sensors:

Machine Tool monitoring system is flow of information and system processing in which the information selection, obtaining data, processing of information and decision making on the refined information are integrated. The aim of tool condition monitoring is to detect early the disturbances in the machining process and wear of machine tool components. The condition of tool has been researched extensively in the past and has focused on detection of tool wear, tool breakage and the estimation of remaining tool

life. It is very important for on-line identification of tool condition in machining process for enhanced productivity, better quality of parts and lower costs for unmanned, automated manufacturing systems.

Need for tool break sensors

In today's competitive manufacturing environment, the Attention of manufacturer has been driven on automation of manufacturing systems for reducing the operating cost and improving product quality. The effective detection of tool breakage is a very important task in automated manufacturing. End drilling, especially finishing drilling, often acts as the final operations creating the final surface finish in the multi-stage manufacturing processes and thus has a direct effect on the quality of the final Optimisation of operational cost of tool sensor by Kaizen.

TYPES OF TOOL BREAK SENSORS:

There are two types of tool break sensors namely,

1. Contact type tool break sensor.
2. Non-contact type tool sensor.

Specification of old tool senor:

CONTROL BOX	UL approved. DIN rail grooves.
POWER	24V AC/DC (10%) 150mA
INPUT(Start)	Contact Capacity DC 24V 11mA
OUTPUT SIGNALS(OK, NG, POS)	NPN .PNP Transistor-Open Collector DC 24V 150mA
SELF MONITOR	A circuit to detect any irregularities in the sensing head.
INDICATORS	Luminous LED
TYPE	Contact type

VI. ANALYTICAL WORK

Productivity

Productivity describes various measures of the efficiency of production. A productivity measure is expressed as the ratio of output to inputs used in a production process, i.e. output per unit of input. Productivity is a crucial factor in production performance of firms and nations. Increasing national productivity can raise living standards because more real income improves people's ability to purchase goods and services, enjoy leisure, improve housing and education and contribute to social and environmental programs. Productivity growth also helps businesses to be more profitable.

For a business to be more profitable various methods to cut cost have to achieved. To cut down on cost the detailed study of various expenditure is necessary to find the scope for cut cutting.

Japanese Productivity Improvement Techniques

a) KAIZEN Techniques
b) Poka yoke technique
c) 5S Technology.

CALCULATED DATA

a) Current productivity
b) Potential productivity
c) Utility and its consumption

Cycle time study

Cycle time analysis is a technique that examines the total length of time an activity needs to complete its cycle. It is measured by the amount of time that an input to a business activity requires to be transformed to an output. Where a process consists of multiple activities, the cycle time for any given activity is the time between previous activity completion and current activity completion including any time between the completion of one activity and the start of the next activity.

Purpose The purpose of cycle time analysis (CTA) is to identify opportunities for breakthrough and the achievement of continuous process improvement in value streams, using time as a core measure.

Benefits:The benefits of cycle time analysis are that it provides a structured method for identifying non-value adding activities in an activity work flow. It provides for the identification of current time-to-completion measures for an activity work flow, enabling a comparison of current to theoretical or desired measures.

Time Line Study

A timeline is a way of displaying a list of events in chronological order. It is typically a graphic design showing a long bar labelled with dates alongside itself and usually events. Timelines can use any time scale, depending on the subject and data. Most timelines use a linear scale, where a unit of distance is equal to a set amount of time. This time scale is dependent on the events in the timeline.

a) Ideal cycle time
b) Actual cycle time

Loss Timewhen a manufacturing process stops for an unplanned event (e.g., a motor failure) it accumulates loss time. While loss time is most often associated with equipment failures (breakdowns), it actually encompasses any unplanned event that causes your manufacturing process to stop.

a) Setup and adjustments
b) Reduced speed
c) Process defects
d) Natural fatigue

VII. **Experimental Validation**

Found out the problem details, distribution of these problems in terms of the percentages and reason for the particular problem.

- Tool sensor related problems.
- Working conditions of tool sensors.
- Cycle time.
- Sensor related problems.
- Failures in sensors and frequency of failing.
- Capital involved in repairing them.

After identifying these problems we have carried out few counter measure and modifications to tackle these problems and come with an optimum solution.

The final version consisted of the following components:

1. SMC cylinder:

A SMC rotary cylinder is used as a base. The tool sensing unit is coupled on the rotary cylinder along with reed switch. The tool sensing unit is connected to the PLC input through the SMC cylinder. The cylinder is put in operation when air at 5 bar is passed through the cylinder the rotary cylinder.

2. Reed Switch

The reed switch contains a pair (or more) of magnetisable, flexible, metal reeds whose end portions are separated by a small gap when the switch is open. The reeds are hermetically sealed in opposite ends of a tubular glass envelope.

Advantages

1. Low operating power
2. Precise Magnetic Sensitivity Switch points
3. Compact in size
4. Simple in construction
5. Flexibility is better than proximity switch

3. Tool sensing unit:

The tool sensing unit is a device that detects the presence of a tool in front of them and sends a feedback signal to the PLC input. It is very effective while designing a machine with feedback loop. It helps reduce the errors caused on the machining line and can be used to achieve zero error in manufacturing.

VIII. CONCLUDING REMARKS

Our task of reducing operational cost of tool sensor by kaizen has been achieved. The cost saving per carburetor is Rs.114000. And life cycle improved from 2 million to 4.5 million. Reduction of cycle time was by 0.2sec. The result can be summarized as shown below

Sr.no	Content	Imported Tool sensor	In House Tool sensor
	Make	FarEast Japan make	KFI make (used SMC make. Parts)
1	Cost In Rs	120000	6000(approx.)
2	PLC card	Required	Not required
3	Life	02Million	05 Million
4	PLC program	Hard Programming	Easily programmable
5	Cy. Time in cycle	0.5 sec	0.3 sec
6	Operation	Electrical operated	Pneumatic operated
7	Size	Dia.22 × L100	H12×B20×L40
8	Direction of use	Works only one direction	Two direction operate
9	Maintenance	Non repairable	Repairable.
10	Accessories	Controller based	Not required controller

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