

Full Length Research Paper

Evaluation of performance in manufacturing organization through productivity and quality

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Enhancement of productivity in the field of manufacturing production is of very great importance to an organization's ability to compete and make profits over time. An organization which fails to efficiently utilize its resources in creating value for its customers will not survive in the competitive business environment of today. Key performance indicators are found to affect the productivity of manufacturing organizations, but quality and productivity plays main part in establishing Total Quality Model (TQM). This will be discussed in this work, with special emphasis on processes and equipment in respect of "Evolution of Performance in Manufacturing Organization". At the same time there will be thorough investigation on used terms like "Productivity and how to improve with respect to Quality". The benefits have been highlighted. The quality control aspects e.g. error free manufacturing process according to the specification have been discussed at length, which is the main concept of Total Quality Model. During the implementation phase of quality concepts, the sorting techniques have been adopted and suggested in the environment of manufacturing company. The 'Analysis of study' has been discussed to summarize the whole paper.

Key words: Productivity, quality, total quality model, manufacturing company, process.

INTRODUCTION

The production rate of manufacturing organization is linked with many factors, critical among them is higher productivity with minimum defects in their process and products, which is not possible without higher rate of quality. Productivity and quality are two factors to competitive advantage. Without sound productivity no company can think of achieving their goals; higher rate of productivity is rather a main content for improving quality and reducing defects, increasing profitability and decreasing costs. Manufacturing organizations that continuously produce high-quality products and are most productive have lower costs, higher profit margins, and monopolize a larger and larger share of the market. The guidance from recognized productivity and quality leaders provides a general framework for making improvement in quality efforts successful. These are general guidelines, and not rigid rules. Deming (1900-1993) is considered to be the Father of Modern Quality. He advised that to achieve the

highest level of performance requires more than a good philosophy. The production organization must change its behavior and adopt new ways of doing business. Deming's approach was amply summed up in his famous 14 points.

These lessons have to be creatively adapted to meet the unique situation of each company. Managers must recognize that productivity and quality improvement efforts require major changes in company philosophy, culture, and operating systems. Performance is conceptually defined with respect to its 'Key Performance Indicators' (KPI) e.g., lead time, cost, quality, efficiency, effectiveness and dependability, to be a function of independent concepts. This has been explained in this paper as 'Performance Productivity and Quality'. These changes are difficult and require a major commitment and effort. Production constraints are particularly related to the production processes concerned.

The ability to improve productivity and quality has little to do with resources, programs, and techniques, but depends more on attitudes, corporate philosophy, and operating systems of those companies that are interested in these indicators. It is true that government can do a

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great deal to improve the climate within which enterprise operates, but we cannot wait for government to act to help facilitate productivity improvement.

DESIGN OF STUDY

In this research paper productivity concept and quality issues are mainly seen from a manufacturing organizations perspective, but accurate analysis will reveal that all elements of society gains are from productivity improvement. Important key factor for achieving higher rate of production is establishing quality culture environment. No business, organization or manager can dream of higher productivity without total commitment, without adhering two facts "To be quality conscious and productivity conscious". To motivate workers in order to achieve higher rate of production, we have to first establish team of quality and productivity oriented line managers who are actually working on shop floor. It is safe to say that one line manager or middle manager is better than having many non-quality/productive conscious persons.

This paper is streamlined thus in the following sections:

- a. Productivity and its improvement
- b. Quality and its usage as a key performance indicator
- c. How to improve performance measurement system using quality and productivity as key performance indicator.
- d. Analysis of study.

PRODUCTIVITY AND ITS IMPROVEMENT

This brings us to the first point: *What is productivity?* It is the relationship of outputs of goods and services in real physical volume with inputs of the basic labor and non-human resources used in the production process, also measured in physical units such as hours worked, machine hours, and so forth. If output is related to all the inputs (which could be the most desirable kind of measure), output per unit of total input is basically the productivity formula: O/I . "Production units must realize that enhancement in productivity is one of their major techniques to achieve cost and quality edge over their competition.

If you include all of the inputs, this measure will get at the net saving of cost elements or inputs per unit of output achieved over time as a result of technological change and the other factors that make it possible to increase production with a given volume of resources. Since this input is a composite measure, including human and non-human resources, you can look at it as weighted. Nowadays, firms are using new terminology: (CIF) Continuous Improvement Firm.

What is a Continuous Improvement Firm (CIF)?

It is a firm that continuously improves on customers' value

due to improvements in productivity initiated by the members of the general work force to get cutting edge. The definition of productivity in CIF will include all facets of product quality as well as output per worker. A basic operating principle of the CIF is that improvements in product quality often produce simultaneous reductions in costs to achieve high rate of production. In this paper, productivity is mainly seen from a manufacturing firm's point of view; at the department level, productivity is relevant to profitability and survival.

Productivity measurement in manufacturing organization

Considering the important role that productivity plays for a manufacturing company, a question that immediately comes to mind is how a company should work to be able to improve its productivity in an effective and sustainable way? Productivity improvement is a multidisciplinary issue and must therefore be addressed from several different angles at the same time. From a holistic point of view it is easy to come across many different means that can be used for this work. One way to improve productivity in a company could, for example, be to focus on the reduction of waste and implement strategies like Just-In-Time (JIT) or Lean Production, which makes it possible to use resources more efficiently. Another way could be to introduce new Advanced Manufacturing Technologies (AMT), which enables a company to manufacture its products faster and more effective. Productivity is also highly dependent on having an effective and responsive supply chain.

Productivity measurement cycle

The list of available means for productivity improvement is extensive and the best approach for a particular company to improve its productivity will indeed differ from case to case. Nevertheless, in this study, one of these means has been focused in detail, namely the use of productivity measurement. The choice of focusing on this particular research area does not imply that measurement should be considered to be a better approach for productivity improvement than other means. Though, it has been advocated for by numerous authors in literature such as Slack et al. (2001), Sumanth (1994) and Drucker (1974). However, as described by Wilson (1994), the knowledge in productivity measurement is still not satisfactory.

As illustrated in Figure 1, productivity measurement can be placed as an important part of a continuous cycle, where productivity development is based on the four phases of the productivity management cycle (Sumanth, 1994). One should be aware that there is no such thing as a correct universal definition of productivity.

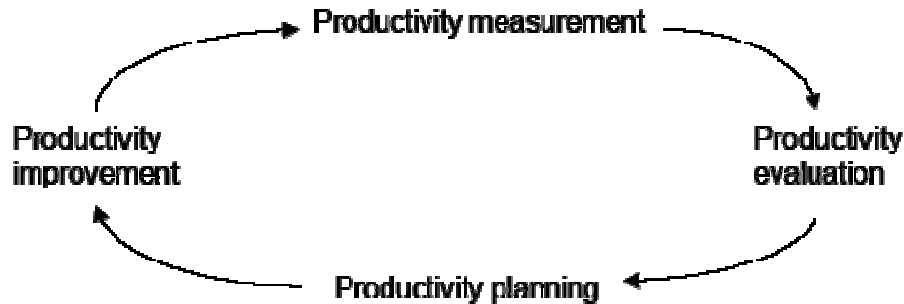


Figure 1. The productivity management cycle (Sumanth, 1994).

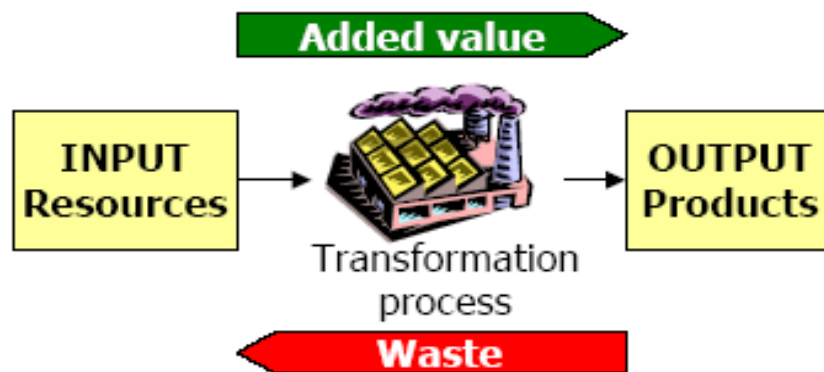


Figure 2. Productivity improvement: a value adding and waste reducing process.

In fact, this concept can be defined in a number of ways strongly depending on what context it is going to be used in. Nevertheless, productivity in industrial engineering is generally defined as the relation of output (that is produced goods) to input (used resources) in the manufacturing transformation process.

The two conceptual relationship of productivity

- i) The economist concept: It reflects to achieving goals with minimum resource allocation; the efficiency of ratios of outputs to the inputs used in its production.
- ii) The engineering concept: the correlation between the actual and the potential output of a process.

Productivity and waste transformation process

As earlier mentioned, productivity is closely connected to the value-adding activities in the manufacturing transformation process (Figure 2). However, every activity that does not add value for the customer represents a waste of resources. In order to achieve high productivity, it is therefore essential that waste is eliminated or reduced.

The concept of Toyota Production System (TPS) has often been described in the literature as “the absolute

elimination of waste”. Waste and non-value added activities in a manufacturing system are of different kind, but at Toyota the following seven forms of waste were identified (Shingo, 1989).

- i) Waste of overproduction – components and products made in excess of immediate needs.
- ii) Waste of waiting – materials or information stalled, not flowing.
- iii) Waste of unnecessary transport – movement of materials over distances.
- iv) Waste of processing – unnecessary operations.
- v) Waste of stocks and buffers – materials beyond immediate needs.
- vi) Waste of motion – unnecessary human activity.
- vii) Waste of making defective parts and products.

Benefits from productivity

There is a always misunderstanding about productivity in the minds of the workforce. To the workers, higher productivity means higher work load, higher efforts, more profits to owners and unemployment and threat to security. These are not the correct observations.

Productivity integrates the objectives of owners and workers. Productivity contributes towards increase in production through efficient utilization of resources and inputs

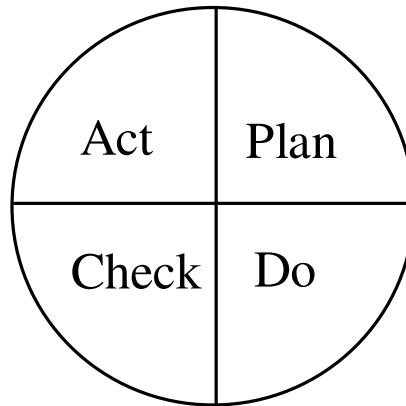


Figure 3. PDCA cycle.

inputs rather than making workers to work hard. Productivity strives to minimize human hazards and human efforts with a view to utilizing them to those areas where they can contribute maximum to the output. In fact, dynamism is achieved through productivity in any organization and path towards excellence is achievable (Figure 5).

DYNAMICS OF PRODUCTIVITY CHANGE TO EVALUATE PERFORMANCE MEASUREMENT SYSTEM

Quality and its usage as key performance indicator

The quality evaluation can be explained if specifications are being followed religiously with minimum process error. This is only possible when product at every stage is checked and whole process of that product is monitored very closely by all line and shift managers in charge according to the drawing and given sample.

The concept of quality is often used in a very wide context, which means that it concerns both processes and products as well as it includes both tangible and intangible factors. Quality usually has different meanings to different people; however, in this paper quality is used according to the manufacturing-based approach discussed by Slack et al. (2001). This approach relates to quality as the making of products that are free of errors and conform precisely to their design specification. It is, of course, not appropriate to consider faulty products as output of a manufacturing process when measuring productivity. However, improvements in quality, besides that more products are being correctly manufactured, ought not to be included in the concept of productivity. Quality and productivity often come hand in hand, but they are two separate concepts.

According to Al-Darrab (2000);

$$\begin{aligned} \text{Productivity} &= (\text{Output} / \text{Input}) \times \text{Quality} \\ &= \text{Efficiency} \times \text{Utilization} \times \text{Quality} \end{aligned}$$

This has led performance objectives, especially quality, to be seen as *a part* of the concept of productivity by some researchers (Al-Darrab, 2000). This is not always a true assumption.

Total quality management

Total Quality Management brings the following features like products that fulfill customers' needs, control of processes to ensure their ability to meet designed requirements, quality improvements and continuous enhancement of quality.

Evaluation of quality management

Quality inspection

Sorting, salvage investigating, corrective actions, identifying sources of non-conformity and dealing with them

Quality planning

Developing quality manuals, producing process performance data, planning for quality.

Quality management

Statistical process control, third party approval, quality system audit, use of quality costs, linkage of non-production activity.

TQM - Concept and Philosophy

The famous Deming's wheel defines the process plan, which ensures documentation and sets measurable objectives against it. In the wheel (Figure 3) every word depicts some actions. The "Do" executes the process and

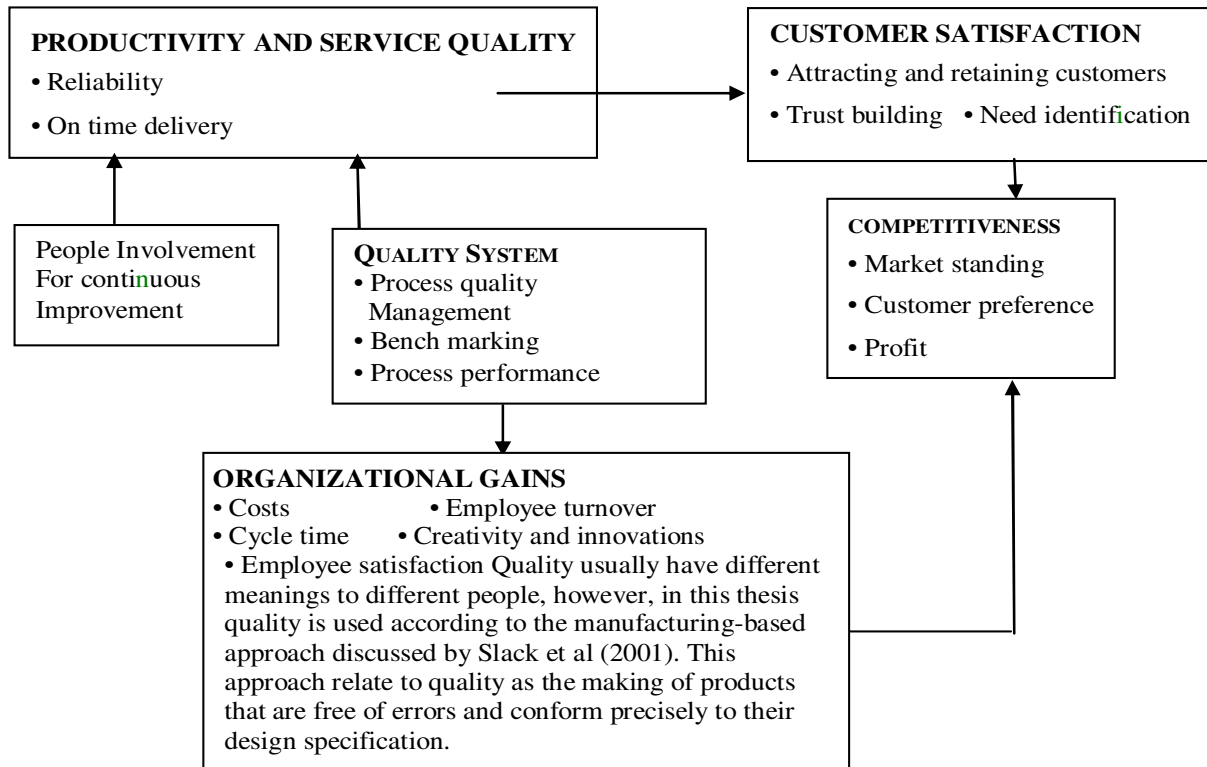


Figure 4. Total Quality Management Model.

Table 1. TQM concepts.

Principle	Action
The approach	Management led
The scope	Company wide
The scale	Everyone is responsible for quality
The philosophy	Prevention not detection
The standard	Right first time
The control	Cost of quality
The theme	Continuous improvement
The dimensions	Human, technical and cultural

collects the information required. The CHECK analyzes the information in suitable format. The ACT obtains corrective action using TQM techniques and methods and assesses future plans. At the end of each cycle the process is either standardized or targets are adjusted based on the analysis and the cycle continuous.

The TQM approach is both a practical working process and a quality philosophy for the organizations committed to growth and survival. TQM approach begins with a vision that a consistent management action can improve the quality of service and products of the organization at a very competitive cost satisfying customer's need and increasing the market share.

Stages of Implementation of TQM

The Implementation phase of TQM in Manufacturing Organization can be organized in the following four stages (Table 1):

Identification and preparation: This stage is concerned with identifying and collecting information about the organization in the prime areas where improvement will be most effected on the organization's performance and preparing the detailed basic work for the improvement of the organization's activities. This process is carried out

according to the priority, the calculation of cost of quality, which incorporates the total cost of waste, error correction, failure appraisal and prevention in the organization.

Management understanding: It is to ensure that management understands the objective and methodology of TQM and is ready to adopt them all the time. Wrong concepts exist that TQM means a major change in the management practice and it is difficult to implement over a short period of time, however, to make a significant change in management practice, it is necessary to educate the workers about practice of TQM. The managers can then demonstrate their total commitment and take the initiatives in the quality improvement process.

Scheme for improvement: This stage is concerned with identifying quality issues and effect a resolution of them by management led improvement activities. Quality improvement scheme can be developed for which, it is necessary to identify the quality problems in each division, in each department and throughout the whole organization. A scheme of training for improvement can be established after the realization of the following aspects of the organization. They are:

- i) Objective of the manufacturing setup.
- ii) Customer's and supplier's interactions.
- iii) Fulfilling customer needs
- iv) Problem causes and best solutions
- v) Prevention from day to day problems
- vi) Customer satisfaction

Critical analysis: This phase indicates the complete improvement process to everybody indicating supplier and customer links in the quality chain. It also obtains information about progress and consolidates success. To focus quality aspects, everybody in the organization must assess the TQM process. The minimum level would start from stage inspection. In manufacturing company, this will automatically enhance the productivity and culture of doing first time right will be promoted.

List of techniques for TQM

1. Customer's perception survey (Pertains to latest market trend)
2. Cost of quality statement (Economy in designing)
3. Top team workshops (Continuous training by top middle and at all level)
4. Total quality seminars
5. Quality training
6. Improvement action team

7. Quality circles
8. Suggestion such
9. Process management
10. Statistical process analysis
11. Fool proofing
12. Just in Time Manufacturing (JIT)
13. Business Process Reengineering (BPR)
14. Quality Improvement Team (QIT} J

Productivity vs. Quality

There is a claim: is quality related to productivity and whether these performance variables reinforce each other or are they mutually exclusive? Must improved quality come at the expense of productivity? (January 18, 1992 at 2:05 am. Filed under Industrial Engineering). Production engineers have analyzed quality and productivity essentially as tradeoffs. To achieve improvements in one, some deviation in the other must be accepted. Quality could only be improved at the expense of productivity and vice versa. Still some firms today function under the philosophy that improved quality results in improved productivity.

During the process of quality improvement and equating quality with absolute excellence or tighter tolerances, it may indeed be difficult to improve quality without added cost. On the other hand, quality is viewed as conformance to specifications; a relationship to productivity becomes more apparent. Any product if produced with defects, then it must be reworked, reprocessed, or reproduced. Resultantly, more resources mean more people, material, and equipment. The path leads to the concept of process quality, which has a clear and direct relation with productivity. While our finished products may ultimately conform to specifications, the quality of the process that produced those products can vary widely and will have a major bearing on the productivity of the organization.

Low quality performance increases the inputs required to produce a given amount of good output. Rework, labor and capital certainly increase as well as energy inputs. Waste and scrap increase the need for tighter inspection and controls, which of course require added resources. Low quality leads to a substantial amount of organization's resources that must be devoted to correcting defects and handling wastes rather than producing goods. With the improvement in quality improvement (Figure 4) the resources required for producing a given amount of output decrease, and that translates to improved productivity.

Quality cannot be inspected into the product. According to Edward Deming, "You do not get ahead by making products and separating the good from the bad, because that is wasteful" (Kaizen, Technical Newsletter of Pond's (India) Ltd., January 18th 1992).

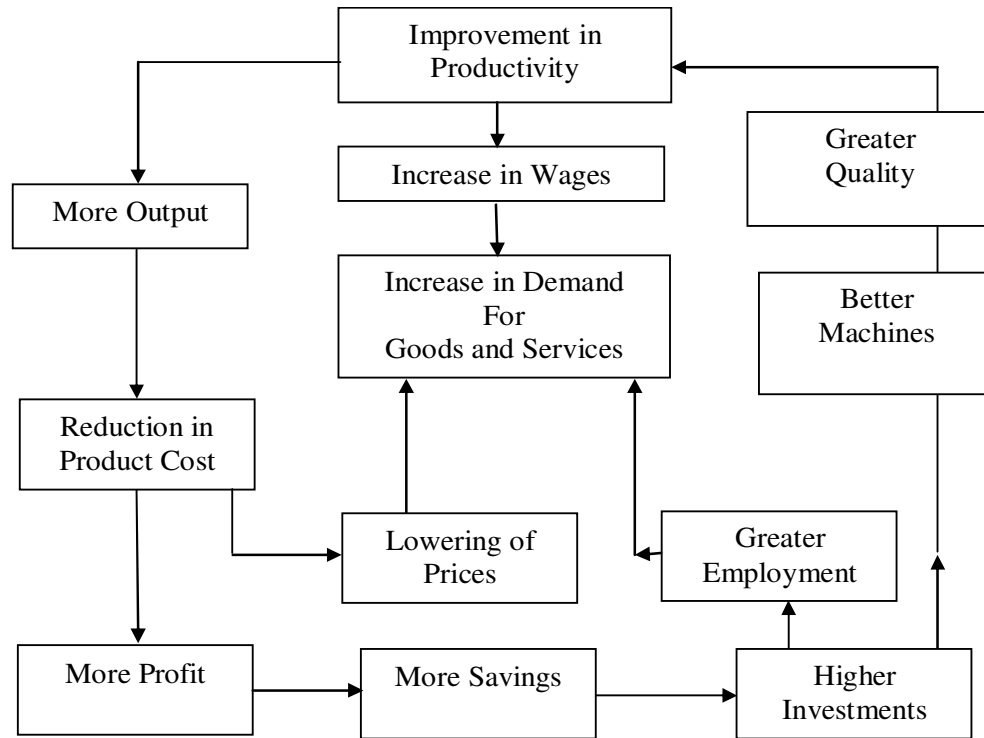


Figure 5. Flow diagram (a).

HOW TO IMPROVE PERFORMANCE MEASUREMENT SYSTEM USING INDICATORS LIKE PRODUCTIVITY AND QUALITY AND PERFORMANCE EVOLUTION

The process of evolution in any organization cannot be completed without its performance not being optimum, which is not possible without measuring it. Organizations are mainly mission oriented and goals are assigned according to the time constraints (delivery time). The performance is measured with reference to time, material labor and resource allocation. While discussing productivity, in fact, we are actually looking at the more general issue of performance (Thomas and Baron, 1994). Although strongly related, performance is a much broader term than productivity. Cost is a central part of performance, but it also involves almost any other non-cost objective of competition and manufacturing excellence such as dependability, flexibility, quality and speed, while productivity is a fairly specific concept related to the ratio between output and input.

Different performance objectives often have a significant impact on the productivity of an operation (Slack et al., 2001):

- i) Excellent -quality operations do not waste time or effort having to re-do things, nor are their internal customers inconvenienced by flawed service.
- ii) High speed operations reduce the level of in-process inventory between micro operations, as well as reducing administrative overhead. Products can also be delivered

earlier to the customer.

Performance should be described at a broad spectrum other than productivity for all concepts that consider the success of organization and its activities. Nevertheless, the overall performance of companies is a complex phenomenon and *the type* of performance that a particular company strives to fulfill is usually very case specific. In order to be able to measure the overall performance of a company, one must therefore first consider the company's strategic objectives.

ANALYSIS OF STUDY

This part of the study is the ingredient of the whole paper. In fact, in this section the paper has been critically analyzed and any suggestion/recommendation left is either added or criticized based on the factory environment. The "Process of Evaluation" can only be successful when indicators like quality and productivity gains are implemented in shop floor, where any product or production is undergoing.

Evaluation process of productivity improvement

- a) The major deficiencies which have not been covered include delay in supplies, equipment, and management routine flaws e.g. lack of coordination between subsections, particularly when one section is customer and user

of one another of same organization.

b) Policies that create bureaucratic blockade e.g. project director's policies not in line with top management; this creates delay in decision making and line and skill worker remain in fluid stage on shop floor.

The absence of reward and recognition: - workers will not feel like doing their best and will settle for mediocrity when they feel that their employers' policies in terms of reward and recognition are lacking. People will not give their best.

(l) Dead-end jobs. Demotivation is created when work does not offer opportunities for growth and promotion; this is one of the greatest reasons for employees' demotivation and non-commitment. A recent study carried out by "The Loyalty Institute" of AON consulting in USA found out that jobs which deprive employees from self-development and growth opportunities lead to high dissatisfaction and employees' disloyalty.

i) Some of the salient features, which have already been covered in above study but again highlighted in point form.

ii) What are the techniques to evaluate, plan, implement, manage and maintain improved results with lower cost.

c) Controlling input and improving throughput to enhance output

Find status of your departmental performance through question survey.

Evolution process of quality improvement

a) By merely understanding the definitions of quality is not enough because implementation phase is always difficult and should be practiced to get result. The losses are always caused by substandard quality. Efficiency is always possible when quality should be Job no 1. Quality Improvement should always be prime impotence. Importance should be given to customer surveys and quality scorecards quality Gurus like Deming's TQM approach should be kept as role model. Some of the points are given as follows;

i) No work should be beyond the workers control

ii) Causes of complaints should be found and recorded with remedial actions.

iii) Control charts to monitor progress e.g. 'Puerto Charts'

iv) Importance of setting standard to identify and imitate best practices

v) Techniques in training workers to develop an eye for detail

vi) Steps to solve major defects

Conclusion

Competitiveness is the keyword being used in every field

of economy. The unique and innovative ideas followed by process of evolution are immediately materialized by smart organizations through quality and productivity tools. At the same time customer is no more buyer of previous century, his demands and expectations are on the rise and he has vast choice of brand name available. The type of industrial revolution brought by yellow race has jeopardized many industrial countries markets. The economy on every product line has become the prime importance factor. The competition in the market is tremendous and manufacturing organizations have to be very innovative, and thoughtful. These facts have created a great challenge for creator and manufacturer to produce best quality at right time and with minimum cost to be competitive in this aggressive market era. These demands on increase are challenges for productive efficiency of the organization. The high rate of production can only be achieved by increasing the productivity and quality aspects. Various key performance indicators (KPI) are analyzed to improve the work method and achieve excellence through productivity. To improve process of evaluation through quality and productivity tools, it is necessary to eliminate waste by implementing TQM and utilization of resources is essential. Any production unit that is not able to efficiently utilize its resources in creating value for its customers will not survive in the competitive business environment of today.

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