



ISSN 2278 – 0211 (Online)

Applying Total Quality Management Fundamentals to Research and Development Activities

Dr. Mahmoud Mohamed Ahmed Sayed

Assistant Professor, Industrial Engineering Department, Canadian International College, Cairo, Egypt

Abstract:

Quality systems provide a lot of benefits for customers and all the members of the family of the product's organization and facilities. Research and Development (R&D) activities are involved in the early stages of the product life cycle. Quality of the product is achieved through the thoroughly applying of the Total Quality Management (TQM) fundamentals on all the value added activities representing the life cycle of the product. This paper indicates the role of TQM to optimize the R&D activities (processes) and suggest the proposed model to attack the problem facing the R&D activities (processes).

Keywords: TQM (Total Quality Management), R&D (Research and Development)

1. Introduction

TQM is a philosophy, a set of tools, or a process whose output yields customer satisfaction and improvement. TQM combines cultural – changing tactics and structured technical techniques whose focus is on satisfying the needs of the internal customers and, external customers. TQM's scope covers all functions within a company from sales and marketing through design, production, and service [1]. The present paper is defined TQM as method or effective process (internally and externally) to cover the life cycle of the product or service from the generation of idea until marketing or customer service. Also, it is gained process, internally to increase the skills and experiences of everyone in the organization, externally to increase the customer satisfaction and market share.

Research is the process used by organization to acquire new knowledge and understanding. It is divided into some types as following:

- “ Basic “ (or “ fundamental “) research consists of original experimental and / or theoretical investigations conducted to advance human knowledge in scientific and engineering fields.
- “ Applied “ research is an investigation directed toward obtaining specific knowledge related to existing or planned commercial products, processes, systems or services [2].

Development: using the results of applied research in the design of new or improved products or manufacturing process to development or improvement [3].

2. The Framework of R&D

Some companies (organizations) give R&D first priority, which studying, analyzing, and designing the subjects. R&D studies the customer needs, complaint, special needs, technical problems and new phenomena throughout using activities (people, process, and tool or equipment).

The R&D work is the first step of the product life cycle. The output of R&D has a major effect on the product's quality, cost and success in the market. Today's technological innovations and changing markets make the competition necessary for the new or development of product (service) and improvement of the product (service). Competition for any product (service) will increase with the time as ways are found; it is better to meet the customer needs. People in R&D must have a deep understanding of natural phenomena and an independent drive for creativity. New technology is generated by a combination of needs, concepts, and tools. Then, the effective R&D area in any organization (company) must be provided the information, knowledge, and technology to carry out the goal with optimization the time and cost.

3. The Outline of R&D Process

Fig. (1) illustrated R&D process. The input includes raw material, people (employee and customer), tools and equipments. The output (product) includes specifications, instructions, procedures, drawings, software, or servicing.

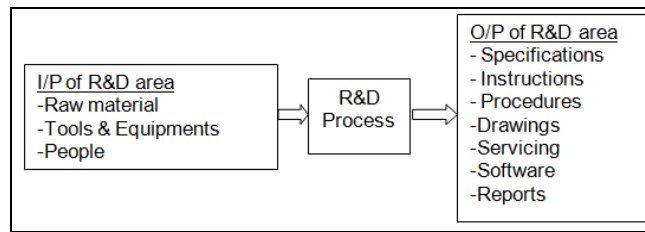


Figure 1: The Outline of R&D Process

4. The input of R&D process

The input R&D area that includes the new idea, information, knowledge, customer needs, special requirements, results of other researches, complaint or technical problem depicted in Fig. (2).

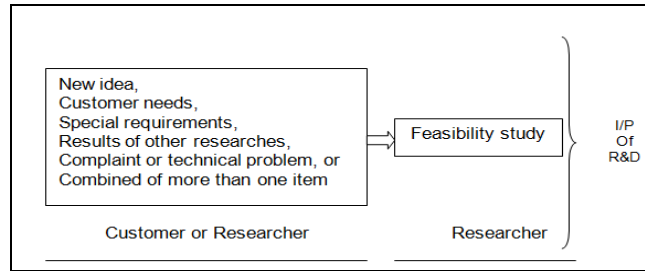


Figure 2: I/P of R&D Process

5. The Output (product) of the R&D Process

The product of the R&D depends upon the type of data collection, source of data (employee or customer), tools and equipments in R&D area, communications activities among the employees (researchers, designers, etc.) and the customers (internally and externally). Then, it must be preparing data in suitable form to decrease the time and effort which lead to reduce the cost during data collection from the customers

6. Phases of R&D Process

The process of R&D is beginning with the generation of idea through different phases until plan of product (service) illustrated in Fig. (3).

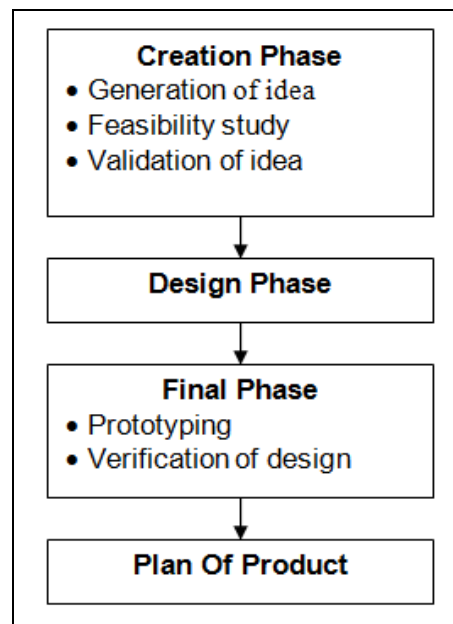


Figure 3: Phases of R&D Process

The idea comes from the customer or the researchers, sometimes not clear, and initial ideas can appear in nonscientific ways. Ideas can be generated during reading, using (machine or tool...), watching or observing something, conversations with someone outdoor (customer), indoor (producer, engineer...), or from other research results. The idea comes from image, or according some needs and

requirements, or from problems which appear during production or usage it. Starting time of this phase may be limited or not, then, the starting time has two probabilities as following:

-Limited, when the researcher receives the report, or survey, or the order.

-Unlimited, when the researcher or customer watching or using something and don't care about it at that time, it represented by dashed line at the beginning of creation phase. in Fig. (4).

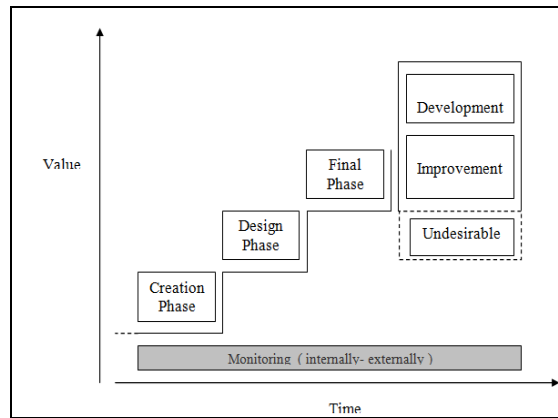


Figure 4: Time – Value Relation in R&D Process.

The Fig. (4) is representing the relation between the value (degree of effectiveness of R&D to produce the product) and. Normally, the value increases with time but, in some cases the value decreases due to lacking of information which used in planning its represented as undesirable zone.

7. Applying TQM in R&D

Experience with the introduction of quality management to R&D is considered positive, confirming the hypothesis that the approach is relevant to R&D. Quality management has only recently been applied to R&D transferring quality concepts and methods-developed over 40 years-to R&D is not an easy process. If the introduction of quality to the field of R&D is poorly managed, it can lead to an initial shock, because of the special nature of R&D activities. R&D is unique in that:

- Scientists are often isolated from final consumers. Internal “near client” are not the customer who bring in corporation's revenues, but rather internal participants in the innovation process. Satisfying these internal near clients exclusively can redirect R&D efforts toward short – term concerns.
- Quality management proponents are often organizational development specialists, and they sometimes lack credibility among scientists and engineers [4].

R&D is first stage of the life cycle. Then, it is preferred to apply TQM in R&D, which increase the market share and competition. Proposed model illustrated in Fig. (5). shows the factors affecting on TQM in R&D research and Development. It is discussed as the follows.

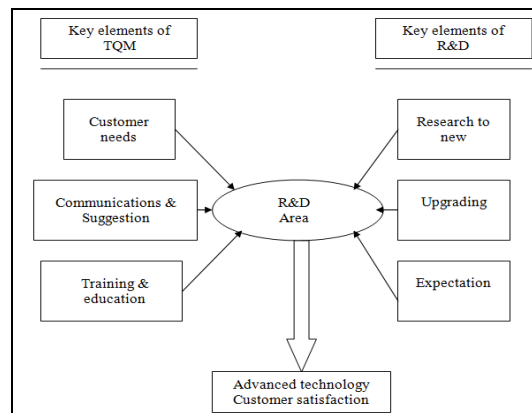


Figure 5: Proposed Model for Applying TQM In R & D

8. Key Elements of TQM

Keith Beasley specifies the factors affecting in TQM as the following:

- Customer care, all business is beginning to recognize the importance of satisfying customer demands.
- Total cost, the cost of the production, maintenance, and any other design – design changes, repairs or work needed to satisfy the customer.

- People first, openness and willingness to communicate must exist at all levels and on all topics [5].

But, this paper suggests the important factors affecting on TQM as the following:

- Customer needs, don't wait the customer. It must be studied and analyzed to reach the customer satisfaction.
- Communication and suggestion, it is important to open channels with the customers (internally – externally) for knowing the opinion.
- Training and education, updating the technology and using tools or equipments will need some courses for training and education.

9. Key Elements of R&D

- The nature of a scientist, the scientist has following characteristics: intelligent, creative, independent, and objects to being managed.
- “State of the art “research, key features of research in many sectors of industry are that it is often “ State of the art “ and at the limits of human understanding [5].
- This paper depicted the main elements affecting on R&D as the following:
- Research to new, main task to the researcher is “ how to get the new “.
- Upgrading, it is important to put all employees (decision makers – designers – developers – engineers – etc.) in front of the recent information about customer needs, new techniques, skills of people, and benchmarking with others.
- Expectation, by studying and accurate analyzing of customer needs, benchmarking, and mentioned factors above it, can be expected.

10. Resulting Elements from Applying TQM in R&D

Keith Beasley, summarized the resulting factors affecting from applying TQM in R&D as the following:

- Communications.
- Flexible use of tools and controls.
- Right first time, the need to redesign a product or to re-engineer a process between original design and production is a sign of failure. Both process and specific designs should be “ right first time “ [5].

Paper summarized the resulting factors affecting from applying TQM in R&D as the follows [11]:

- Using advanced technology or methods; due to co-operation between levels in R&D, communication and suggestion (internally – externally), and good training & education for using advanced technology or methods which lead to produce the product with high quality.
- Customer satisfaction; it comes from communication and suggestion with the customers and suppliers, continuous improvement (process and product), and using the new technology to produce the product with high quality.

11. Some Benefits from Applying TQM in R&D

Applying TQM in R&D will facilitate the obtaining the available information about customer needs, advanced technology, software, and standards which lead to the reduction of consumed time in R&D process to produce the product with high quality as the following:

- Existence of the upgrading the data and information that reduce the consumed time for creation of idea.
- Available of software can help the designer to reduce the time of design process as possible, e.g. CAD.
- Available of software can help the engineer to reduce the time of production of prototype or model as possible, e.g. CAM.
- Decreasing the distance between the scientist and technician or avoiding the isolation of the scientists during the production of the prototype which reduction or elimination the time consumed for design changes.

12. Conclusion

It is important to apply TQM in R&D area that facilitates the communication between the people (researcher, developer, customer, and...) to got the information, the knowledge, and advanced technology. Also, decreasing or eliminating the barriers and distance between the scientist and technician.

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