Statistical Process Control (SPC) and Quality Management Systems as a Specialty of Quality Management and Case Turkey

Semih Dönmezer

Anadolu University, Turkey

Abstract

Concept of quality, quality assurance, quality policy and quality management have long since become indispensable in economic aspects. Quality management systems and their meaning are no longer discussed every now and then they have become reality and economic necessity. Also, in public administration, in politics, in education and in the non-profit sector, declarations of quality and their steering and securing are of fundamental importance. The general trend is higher expectations as to the quality of the most diverse products - whether physical products or services - is accompanied by the growing awareness that only through continuous and consistent improvements. A high product quality adds to satisfy the needs of the population. Therefore, the extraction of high-quality information based on the measurement technology. The measurement technology is integrated into the production process maximally strongly.

Keywords: Total Quality Management, Quality in Industry, Quality Management Testing

Introduction

Among the competitive factors of industrial companies, quality has one particular importance. It was used over longer periods as a property for which had to be paid extra or longer delivery times. This change was only possible through corresponding developments in the production processes. With that comes the Product or process quality a central role in industrial operation; quality control has become the original task of company management and one comprehensive quality management (Total Quality Management) is one of the primary leadership functions. Among the competitive factors of industrial companies, quality has one particular importance. It has been used over longer periods as living conditions and environment have been through the centuries again influenced and changed by new production methods.

Understanding Quality

The customer' s perception of quality on products varies between customers and it could also vary for the same product of organization. Hence, it would be difficult to

evolve a generic definition of quality. Understanding quality is more relevant than defining it. The philosophical description of quality is appropriate for understanding quality and some of the descriptions are:

- The pursuit of perfect that never ends,
- Quality is the fulfilment of needs,
- Quality is the degree of feeling happiness,
- Quality is the way of life.[1]

Quality Management System

Quality management system (QMS) is planned and established by documenting procedures for the processes of organization to fulfill the needs and expectations of internal and end customers. The international standard, ISO 9001, specifies the requirements of quality management system (QMS) to consistently provide products that meet customer and applicable statutory and regulatory requirements[2]. The standard is applied by many organizations throughout the world. ISO 9001 QMS processes are organized representing the four steps of Plan-Do-Check-Act (PDCA) cycle. Documented procedures and product related engineering documents are established for the processes integrating the needs and expectations of internal and end customers[3].

Evolution of Total Quality Management

The historical evolution of Total Quality Management has taken place in four stages.

They can be categorized as follows:

1. quality inspection

2. quality control

3. quality assurance

4. Total Quality Management.

With further industrial advancement came the second stage of TQM development and quality was controlled through supervised skills, written specification, measurement and standardization. During the Second World War, manufacturing systems became complex and the quality began to be verified by inspections rather than the workers themselves. Statistical quality control by inspection—the post-production effort to separate the good product from the bad product—was then developed and Total Quality Management. The development of total quality management from 1950 onwards can be credited to the works of various American experts. Among them, Dr

[1] Slack N, Roden S (2015) internal customer–supplier relationships. Wiley Encyclopedia of Management
[2] Borawski P (2011) Toward a definition of quality, American society for quality. Future of quality study
[3] Dhanasekharan Natarajan, ISO 9001 Quality Management Systems, Springer International Publishing AG 2017

Edward Deming, Dr Joseph Juran and Philip Crosby have contributed significantly towards the continuous development of the subject.

According to Deming (1982), organization problems lie within the management process and statistical methods can be used to trace the source of the problem. In order to help the managers to improve the quality of their organizations he has offered them the following 14 management points.

1) Constancy of purpose: create constancy of purpose for continual improvement of product and service.
2) The new philosophy: adopt the new philosophy. We are in a new economic age, created in Japan.
3) Cease dependence on inspection: eliminate the need for mass inspection as a way to achieve quality.
4) End 'lowest tender' contracts: end the practice of awarding business solely on the basis of price tag.
5) Improve every process: improve constantly and forever every process for planning, production and service.
6) Institute training on the job: institute modern methods of training on the job.

Dr. Joseph Juran (1980) through his teaching was stressing the customer's point of view of products' fitness for use or purpose. According to him a product could easily meet all the specifications and still may not be fit for use or purpose. Juran advocated 10 steps for quality improvements as follows:

1) Build awareness of the need and opportunity for improvement.
2) Set goals for improvement.
3) Organize to reach the goals (establish a quality council, identify problems, select projects, appoint teams, designate facilitators).
4) Provide training.
5) Carry out projects to solve problems.
6) Report progress.
7) Give recognition.
8) Communicate results.
9) Keep score
10) Maintain momentum by making annual improvement part of the regular systems and processes of the company.

However, Crosby (1982) on the other hand was not keen to accept quality which is related to statistical methods. According to him quality is conformance to requirement and can only be measured by the cost of non-conformance. Crosby provides four absolutes and the 14 steps for the quality improvement process. His four absolutes are:

1. Definition of quality—conformance to requirements.
2. Quality system—prevention.
3. Quality standard—zero defects.
4. Measurement of quality—price of non-conformance[1].

Quality Control Definition.

Describing the quality control process. "Quality control" is a universal managerial process for conducting operations so as to provide stability—to prevent adverse change and to "maintain the status quo." To maintain stability, the quality control process evaluates actual performance, compares actual performance to goals, and acts on the difference.

Quality control is one of the three basic managerial processes through which quality can be managed.

Joseph M. Juran stands for a management-oriented corporate philosophy, in a systematic, continuous improvement process in three stages which is referred to as a quality trilogy or Juran trilogy. The Trilogy consists of the step's quality planning, quality control and Quality improvement.

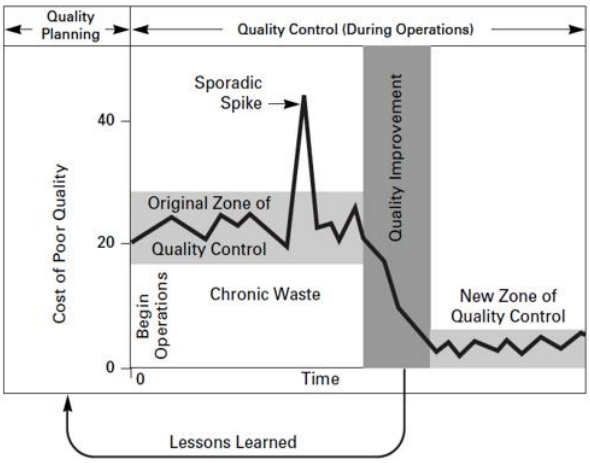

Figure 1; The Juran trilogy diagram[2]. (Juran Institute, Inc., Wilton, CT.)

[1] Dahlgaard Jens J, Fundamentals of Total Quality Management Process analysis and improvement, Taylor & Francis 2002
[2] Juran M. Juran, Juran's Quality Handbook, 5e. Mc Graw Hill Professional

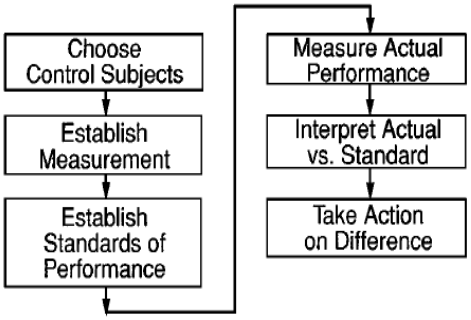

Figure2. The input-output diagram for the quality control process.

Quality goals may also be established for departments or persons. Performance against such goals then becomes an input to the company's reward system. Ideally such goals should be:

Legitimate: They should have undoubted official status.
Measurable: So that they can be communicated with precision.
Attainable: As evidenced by the fact that they have already been attained by others.
Equitable: Attainability should be reasonably alike for individuals with comparable responsibilities.

Control Subject	**Goal**
Vehicle mileage	Minimum of 25 mi/gal highway driving
Overnight delivery morning	99.5% delivered prior to 10:30 a.m. next day
Reliability service	Fewer than three failures in 25 years of service
Temperature	Minimum 505°F; maximum 515°F
Purchase-order error rate	No more than 3 errors/1000 purchase orders
Competitive performance	Equal or better than top three competitors on six factors
Customer satisfaction	90% or better rate, service outstanding or excellent
Customer retention	95% retention of key customers from year to year
Customer loyalty	100% of market share of over 80% of customers

The Process. In all of the preceding discussion we have assumed a process. This may also be human or technological or both. It is the means for producing the product features, each of which is a control subject. All work is done by a process which consists of an input, labor, technology, procedures, energy, materials, and output. For a more complete discussion of process. The PDCA Cycle. There are many ways of dividing the feedback loop into elements and steps. Some of them employ more than six elements; others employ fewer than six. A popular example of the latter is the so-called PDCA cycle (also the Deming wheel). Deming
(1986) referred to this as the Shewhart cycle, which is the name many still use when describing this version of the feedback loop.

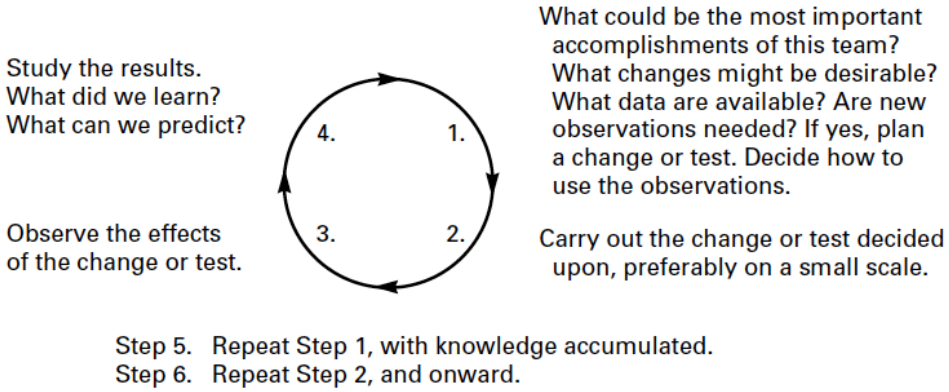

Figure 3. The PDCA cycle. (Deming, 1986.)

These steps correspond roughly to the six steps discussed previously:

“Plan” includes choosing control subjects and setting goals.

“Do” includes running the process.

“Check” includes sensing and umpiring.

“Act” includes stimulating the actuator to take corrective action.

Statistical Process Control (SPC).

The term has multiple meanings, but in most companies

it is considered to include basic data collection; analysis through such tools as frequency distributions, Pareto principle, Ishikawa (fish bone) diagram, Shewhart control chart, etc.; and application of the concept of process capability. Advanced tools, such as design of experiments and analysis of variance, are a part of statistical methods but are not normally considered to be a part of statistical process control[1].

[1] Juran M. Juran, Juran’s Quality Handbook, 5e. Mc Graw Hill Professional

Deming's Fourteen Points for Management.

1. Create constancy of purpose for improvement of product and service.
2. Adopt the new philosophy.
3. Cease dependence on mass inspection.
4. End the practice of awarding business on the basis of price tag alone.
5. Improve constantly and forever the system of production and service.
6. Institute training.
7. Adopt and institute leadership.
8. Drive out fear.
9. Break down barriers between staff areas.
10. Eliminate slogans, exhortations, and targets for the work force.
11. Eliminate numerical quotas for the work force; eliminate numerical goals for people in management.
12. Remove barriers that rob people of pride of workmanship.
13. Encourage education and self-improvement for everyone.
14. Take action to accomplish the transformation.

Deming's Deadly Diseases.

1. The crippling disease: lack of constancy of purpose
2. Emphasis on short-term profits
3. Evaluation of performance, merit rating, or annual review
4. Mobility of management
5. Running a company on visible figures alone (counting the money)
6. Excessive medical costs
7. Excessive costs of liability[1]

ISO 9000

The International Organization for Standardization (ISO) is a global body headquartered in Geneva, Switzerland, that develops consensus standards for worldwide use. The organization's short title "ISO" is not a fractured acronym, but rather an adaptation of the Greek word isos, which translates to English as "equal." The American National Standards Institute (ANSI) is the U.S. member of ISO. The American Society for Quality (ASQ) is a member of ANSI and is responsible for quality management standards. It publishes standards in the ANSI/ISO/ASQ-Q9000 series that are the U.S. equivalent of standards published by ISO. The ISO 9000-series of standards addresses quality management systems.

The series includes three standards:

1. ISO 9000, Quality management systems—Fundamentals and vocabulary
2. ISO 9001, Quality management systems—Requirements

[1] From Deming, W.E., Out of the Crisis, The MIT Press, Cambridge, MA, 2000, pp. 97–121.

3. ISO 9004, Quality management systems—Guidelines for performance Improvements.

ISO 9001 is a specification standard. If an organization wishes to become certified or registered—the terms mean the same thing, only the conventions of use differ—it would have to conform to the requirements in ISO 9001. Organizations can self-declare conformance or can hire a third-party registrar. Third-party certifications are generally viewed as more objective. ISO 9004 is a guidance standard. It provides additional, useful information about quality management. Nothing in it is required for certification. Generally, ISO 9004 contains elements on which international consensus could not be reached and, therefore, could not be included in ISO 9001. Neither ISO 9001 nor ISO 9004 are performance standards[1].

Control Chart

Total number of defects, total number of samples taken, and the average defects per sample (the mean) are taken directly from the chart. Sample size was predetermined. Other numbers are calculated as follows:

Total number of observations = Sample size times total number of samples taken

Defect proportion of total = Total number of defects divided by total number of observations

In an np chart, control limits are derived according to the following formula: The mean plus or minus three times the square root of the mean times one minus the proportion or

Mean ± 3 $\sqrt{}$mean (1 – proportion)

The mechanics of control chart construction have been completed, evaluation of the data can begin. Control charts are described as the "voice of the process" because they indicate how the process is performing. The project manager's question about what kind of results can be expected is answered by the control limits. These values are derived statistically to show the range of normal process performance. As the process is currently performing, any sample of fifty reports may be expected to include one to eighteen defective reports. This range of defects will not change in the future unless the process is changed. Any repeatable process includes variation. Results are not precisely the same; results will vary. How much will they vary? The control chart defines the upper and lower extremes. It tells managers what they may reasonably expect from the process[2].

[1] Kenneth H. Rose, Project quality management: why, what and how, PMP. Second edition, 2014
[2] Kenneth H. Rose, Project quality management: why, what and how, PMP. Second edition, 2014

Process Capability Analysis, Formulas**, Definitions**

Process capability analysis is a set of tools used to find out how well a given **process** meets a set of specification limits. ... Sometimes it compares to a specification target as well. **Process capability** indices are usually used to describe the **capability** of a **process**. **Cp and Cpk**. **Cp and Cpk**, commonly referred to as process capability indices, **are**used to define the ability of a process to produce a product that meets requirements. ... Specifications: Specifications define product requirements. In other words, they define what is expected from an item for it to be usable. **Cp** and **Cpk** are statistical tools that are used to measure how good a process is (how capable it is) to produce parts within a specified tolerance. **Cp** is called Process Capability and **Cpk** is called Process Capability Index. ... **Cp** and **Cpk** are two important parameters in Statistical Process Control.

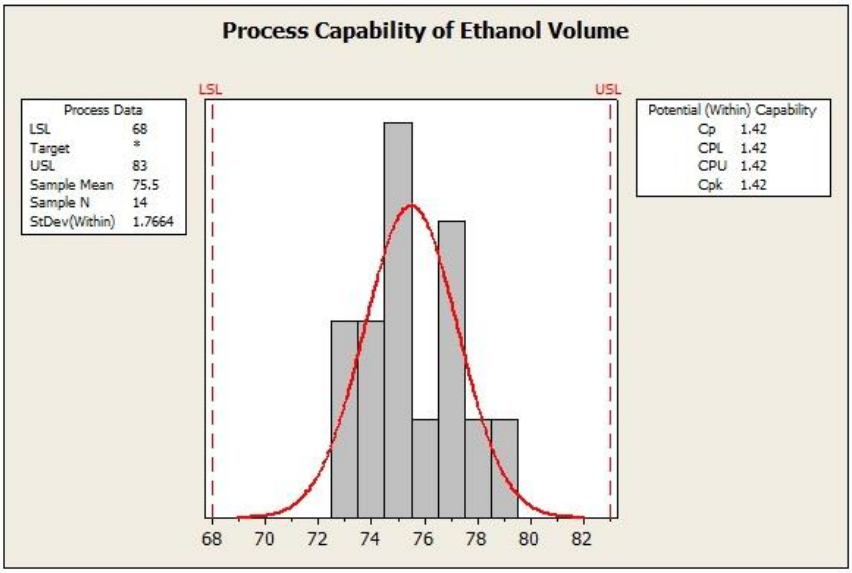

Figure 4. Process Capability

The two statistics have a lot in common. The smaller the standard deviation, the greater both statistics are. In fact, under the right conditions, Cp and Cpk have exactly the same value. Here's some data about the volume of ethanol in E85 fuel, which I've manipulated so that Cp and Cpk are the same. Minitab's capability analysis output shows both statistics together[1].

[1] Kenneth H. Rose, Project quality management: why, what and how, PMP. Second edition, 2014

$$CPU = \frac{(USL - \mu)}{(3 * \sigma_{Within})} \qquad PPU = \frac{(USL - \mu)}{3 * \sigma_{Overall}}$$

$$CPL = \frac{(\mu - LSL)}{(3 * \sigma_{Within})} \qquad PPL = \frac{(\mu - LSL)}{3 * \sigma_{Overall}}$$

$$Cpk = \text{minimum}\{\text{CPU, CPL}\} \qquad Ppk = \text{minimum}\{\text{PPU, PPL}\}$$

The goal of capability analysis is to ensure that a process is capable of meeting customer specifications, and we use capability statistics such as Cpk and Ppk to make that assessment. If we look at the formulas for Cpk and Ppk for normal (distribution) process capability, we can see they are nearly identical:

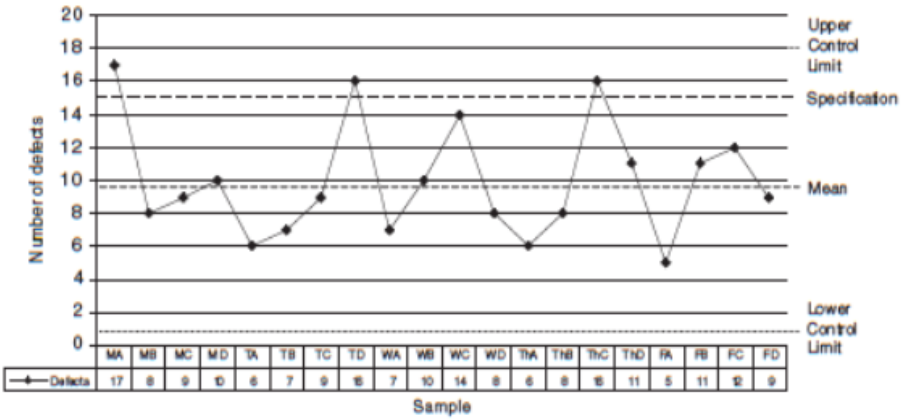

Figure 5. Control Chart with specification[1]

Quality Costing

Quality costing is not an exercise which is going to solve organizational problems or have an impact on performance. Quality costing can be considered as a means to an end, to help improve quality and help companies reach their quality targets. Quality costing is a process-related exercise rather than for product control. The intention of quality costing is to spur some positive action as has been acted; There are two approaches to quality costing:

The traditional model or PAF mode1 where the pattern of quality costing includes Prevention, **Appraisal and Failure:** These tend to decrease as quality improvement becomes more and more an integral part of business operations. PAF costs include the

Prevention costs: Costs of quality systems, quality training and education;

[1] Durakbasa. N. Total Quality Control in Industry- TU Wien

Appraisal costs: Costs of performing quality inspection and audits in-house as well as audits of suppliers;

Failure costs (external): Costs associated with failures discovered outside the plant. These affects both cost and reputation;

Failure costs (internal): Costs associated with failures discovered inside the plant.

Process-based costing: A more radical approach to costing is one which considers the Cost of Quality (COQ) to be made up of two distinct components the price of conformance[1].

Multivariate Process Control

Statistical process control charts are well developed for univariate cases. By univariate case we mean treating one variable at a time. However, in many real industrial situations, the variables to be controlled in the process are multivariate in nature. For example, in an automobile body assembly operation, the dimensions of subassemblies and body-in-white are multivariate and highly correlated. In the chemical industry (Masonand Young, 2002), many process variables such as temperature, pressure, and concentration are also multivariate and highly correlated. A multivariate control chart that is based on the **T**2 statistic, which is a multivariate statistic similar to the **t** statistic in the univariate case, can be used to develop control charts for process control in multivariate cases[2].

Applications of Multivariate Statistical Methods in Business and Industry

Though the quantity of literature available on applying multivariate statistical methods in quality engineering area is limited, multivariate statistical methods have been playing important roles in many areas of business and industrial practice. The most noticeable include data mining, chemometric, variation reduction in automobile manufacturing process, Mahalanobis Taguchi system applications, and multivariate process control in chemical industry. In this section, brief reviews will be given to applications in these areas[3].

Data Mining

Data mining is a process of analyzing data and summarizing it into useful information. In business application of data mining, useful information derived from data mining can be used to increase revenue, cut costs, or both. Data mining is primarily used by companies with strong customer focus such as retail, financial, communication, and marketing organizations. It enables these companies to determine relationships among internal factors such as price, product positioning, or staff skills, and external factors such as economic indicators, competition, and customer demographics. Data

[1] Mohamed Zairi, Total Quality Management For Engineers, Woodhead Limited, 1991
[2] Mohamed Zairi, Total Quality Management for Engineers, Woodhead Limited, 1991
[3] Mohamed Zairi, Total Quality Management for Engineers, Woodhead Limited, 1991

mining enables companies to determine the impact of these factors on sales, customer satisfaction, and corporate profitability, and to develop marketing and sales strategy to enhance corporate performance and cut down losses[1].

Business Process

There are two somewhat different interpretations of business process among the process movements. One is of a process as a workflow, a series of activities aimed at producing something of value, the other, of a process as the coordination of work, whereby a set of skills

and routines is exploited to create a capability that cannot be easily matched by others. A business process is defined as a collection of activities that takes one or more kind of inputs and creates an output that is of value to the customer. A process is a structured, measured set of activities designed to produce a specified output for a particular customer or market.... A process is thus a specific ordering of work activities across time and space, with a beginning, an end, and clearly identified inputs and outputs: a structure for action.

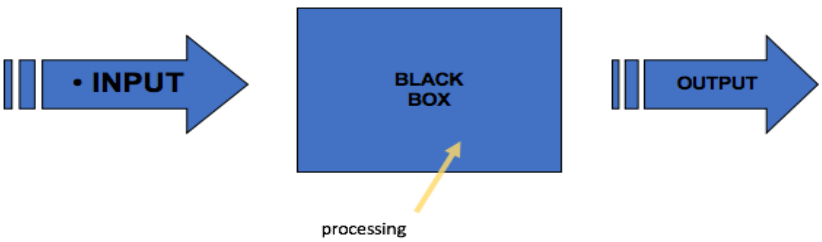

Figure 6. What is process?

A process is a series of steps and decisions involved in the way work is completed. We may not realize it, but processes are everywhere and in every aspect of our leisure and work. A process consists four major elements:

Steps and decisions — the flowchart. A series of steps and decisions describing the way work is completed. Variability of processing time and flow — the pattern of processing times. Timing and interdependence — when the arrivals happen, when people work, etc. Assignment of resources — how many and where are they assigned.

[1] Kai Yang, Multivariate Statistical Methodsand Quality, Mc Graw Hill, Engineering Reference

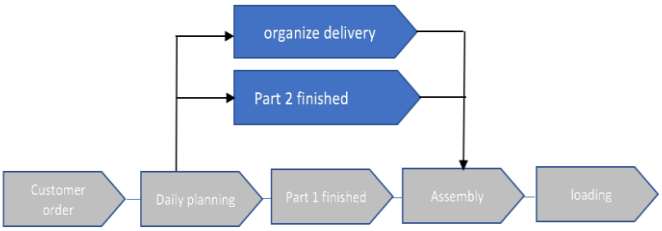

Figure 7. Parallel process

Parallel activities in process; A Parallel node represents a point in a business process at which a number of activities are executed in parallel. By default, parallel nodes contain an AND join condition. In this case, the activities on all branches must complete before the flow of execution proceeds to the node following the parallel node[1].

Total Quality Management Application in Small-Sized industry in Turkey

Small and medium-sized enterprises or small and medium-sized businesses are businesses whose personnel numbers fall below certain limits. The abbreviation "SME" is used by international organizations such as the World Bank, the United Nations and the World Trade Organization. Under the difficult competition conditions imposed by globalization; It is now a must for large-thinking SMEs. Total Quality Management approach will make a significant contribution in overcoming the managerial problems of SMEs. In this respect, it is necessity a customer-oriented management style is becoming increasingly important in the activities of SMEs.

It contributes to the reduction of unemployment in the country due to the employment of SMEs with using labor-intensive technology. They are able to adapt and produce demand changes and variations in a shorter period of time, using inputs such as raw materials, semi-finished materials, operating material used by large-scale enterprises. producing SMEs in order to complete their development and thus to create a supplier industry in the economy and to produce the same goods and services produced by large-scale enterprises and to revitalize the economy by attracting them to the competitive environment makes SMEs very important for the country.

Total Quality Management is not only a system for quality but also covers all aspects of the enterprise and its activities with a system approach. It is an understanding based on change in human behavior, methods and techniques applied in processes, work environment, product or service, and thus continuous development in organizational culture. Therefore, Total Quality Management is a process that shows itself in all areas of technical and managerial areas, from personnel to all processes in

[1] Durakbasa. N. Total Quality Control in Industry- TU Wien

which raw material is used. It can be considered the basic elements of Total Quality Management as leadership of senior management, human understanding first, full participation, continuous improvement-development and customer focus.

Due to the fact that the structures of large-scale companies are not flexible at the moment and they cannot move fast according to development exactly, so they have increased the number of medium-sized firms by breaking out of the service and production departments.

Increasing in import and export activities due to the obligations of internal and external agreements and regulations it became more important[1].

How to implement by the new form of management and it will be consisted of every step must be carefully planned. In the implementation of Total Quality Management, plan should be established and implemented with seriousness[2].

Strengths of SMEs in TQM Applications

In order for the Total Quality Management application to be successful, the leadership of the senior management should play a very important role. SMEs have a great advantage in this regard. Because in SMEs, owner manager or general manager in the organization can apply in the importance of quality. The decision-making process will be shorter since SMEs have little management layer. In addition, the decision-making power will be high due to the small number of decision-makers. On the other hand, the easy communication and coordination between the employees and the easy access of the employees to the managers will facilitate the organization of multifunctional activities. Employees in SMEs generally have a sense of responsibility and sensitivity about the profitability of the enterprise. Therefore, it will be easy to direct them to develop their business. Because employees are aware of the direct effect of the results themselves and can easily observe that their labor is transformed into visible results. In general, SMEs operate as a single enterprise and they are not dispersed facilitates the implementation of Total Quality Management.

Weaknesses of SMEs in TQM Applications

Significant majority of SMEs cannot reach their expectations due to difficulties in the transition phase. To see the quality of quality circles applications as the ultimate purpose, to try to implement the system without changing and develop the system in full time or to get the ISO 9000 standard certificate, to consider the process development as the only development of production processes and to ignore the development of management processes, persons and units The competition between the internal communication and the flow of information are important factors preventing the development of the system. To see the enough the quality of quality

[1] Gücelioğlu, Ö. Küçük Ölçekli İşletmelerin KOSGEB'den Beklentileri. Ankara: Tes-Ar Yayınları, No.13, 1994.
[2] Geylan, F., Gerem, T. "KOBİ'lerde Toplam Kalite Yönetimi-GİLAN", 6. Ulusal Kalite Kongresi Toplam Kalite Yönetimi ve Ekonomi Yönetiminde Kalite. İstanbul: TÜSİAD Yayını, 1997.

circles applications as the ultimate purpose, to try to implement the system of JIT without changing their system. Sometimes it is enough to get the ISO 9000 standard certificate. The other reasons are that ignoring the development of process management processes as the development of production processes, ignoring the development of management processes, preventing the internal communication and the flow of information between individuals and units are important factors that prevent the development of the system[1].

The lack of professional managers in the top management in SMEs, lead to new managerial problems within the knowledge gained by experiences, the failure to delegate power and not working with an expert / consultant outside the organization cause irreparable errors. Problem solving (quality circles) or process development (kaizen) groups created by subordinates in SMEs can disturb experts / engineers to solve some problems with their work. As a result, there is a tendency not to help groups and to provide information.

The existence of a competition due to the sharing of managerial power or the ambition of promotion among middle level managers and engineers and experts negatively affects the success of Total Quality Management. Implementation of Total Quality Management in SMEs will help to improve the competitive position of enterprises as well as achieving superior goods and service quality. In addition, the success of quality improvement activities of large enterprises generally depends on the efficiency of SMEs, who are supply providers, in quality improvement.

Nowadays, businesses have to know what the customer wants, how, how, when and at what price. SMEs want to implement Total Quality Management, which develops as a customer satisfaction-oriented system, need to carry out an understanding exchange. This change of understanding requires the redefinition of objectives, product-service quality, the role of management, the role of employees, the relations with environmental elements such as suppliers, customers and the society in general, in line with the principle of continuous change. It is a prerequisite for SMEs to accept Total Quality Management as a tool, not a goal, in achieving quality. However, it may not correct to apply the approaches applied in large enterprises directly to SMEs. Total Quality Management for Large-Thinking SMEs with a continuous change and development goal should be seen as an investment with long-term returns.

Why Total Quality Management Practices in Turkey cannot reach to the expectation?

Not practice on planning? Production planning, product planning, dynamic budget planning is missing or at the lowest level.

[1] Türkmen, İ. "KOBİ'lerde Toplam Kalite Yönetimi Amaçlı Katılımcı Yönetim ve Örgüt Geliştirme Uygulamaları", 6. Ulusal Kalite Kongresi Toplam Kalite Yönetimi ve Ekonomi Yönetiminde Kalite. İstanbul: TÜSİAD & KAL-DER Yayın, 1998.

Economic stations: The economic environment of the Turkey varies so much as to prevent the results of scientific management, and does not allow the analysis and estimations to provide the resources for the development of the right strategies and plans.

Insufficient quality education: The resources and funds for education is not allocated for in small and medium sized organizations in our country.

Not working with the consultant:

• The most effective way to implement quality systems is to work with consultants.

• Consultants play the role of reliable referee.

• Companies that cannot allocate time to work in the quality system should get help from consultant companies.

Lack of technological infrastructure: planning and statistics habits facilities required by our age of computer technology for the acquisition and settlement in Turkey are required to provide a total quality management application.

Communication Problem: One of the important problems of Turkey is disconnection of communication between universities and the business world.

Non-professional management structure and leadership:

• Management has not got rid of the traditional structure in which the authority in the capital owner has been centralized.

• Persons at management level should lead and participate in TQM[1].

Conclusion

How is success succeed?

• Applications of companies with successful business results should be examined

• TQM models suitable for our country should be developed.

• TQM should not be applied to receive documents but should be maintained.

• All employees of the firm must own quality work.

Borawski P (2011) Toward a definition of quality, American society for quality. Future of quality study

[1] https://receportakaya.wordpress.com/2016/05/25/turkiyede-toplam-kalite-yonetimi-uygulamalarindan-istenilen-verim-neden-alinamiyor/

References

[1] Dahlgaard Jens J, Fundamentals of Total Quality Management Process analysis and improvement, Taylor & Francis 2002
[2] Dhanasekharan Natarajan, ISO 9001 Quality Management Systems, Springer International Publishing AG 2017
[3] Durakbasa. N. Total Quality Control in Industry- TU Wien
[4] Durakbasa. N. Total Quality Control in Industry- TU Wien
[5] Geliştirme Uygulamaları", 6. Ulusal Kalite Kongresi Toplam Kalite Yönetimi ve Ekonomi Yönetiminde Kalite. İstanbul: TÜSİAD & KAL-DER Yayın, 1998
[6] Geylan, F., Gerem, T. "KOBİ'lerde Toplam Kalite Yönetimi-GİLAN", 6. Ulusal Kalite
[7] Gücelioğlu, Ö. Küçük Ölçekli İşletmelerin KOSGEB'den Beklentileri. Ankara: Tes-Ar
[8] Kai Yang, Multivariate Statistical Methodsand Quality, Mc Graw Hill, Engineering Reference
[9] Kenneth H. Rose, Project quality management: why, what and how, PMP. Second edition, 2014
[10] Kenneth H. Rose, Project quality management: why, what and how, PMP. Second edition, 2014
[11] Kenneth H. Rose, Project quality management: why, what and how, PMP. Second edition, 2014
[12] Kongresi Toplam Kalite Yönetimi ve Ekonomi Yönetiminde Kalite. İstanbul: TÜSİAD Yayını, 1997.
[13] Mohamed Zairi, Total Quality Management For Engineers, Woodhead Limited, 1991
[14] Mohamed Zairi, Total Quality Management for Engineers, Woodhead Limited, 1991
[15] Mohamed Zairi, Total Quality Management for Engineers, Woodhead Limited, 1991
[16] Slack N, Roden S (2015) internal customer–supplier relationships. Wiley Encyclopedia of Management
[17] Türkmen, İ. "KOBİ'lerde Toplam Kalite Yönetimi Amaçlı Katılımcı Yönetim ve Örgüt Yayınları, No.13, 1994.