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Principles and Contributions of Total Quality Management (TQM) Gurus on Business Quality Improvement

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Abstract: *Over the past few decades, Total Quality Management (TQM) gurus have been developed certain theories in the area of business quality improvement, which caused a huge paradigm shift in improving the quality of products and services. The main aim of this paper was to discuss regarding the key roles of TQM gurus such as Deming, Crosby, Juran, Feigenbaum, Ishikawa, and others in improving business quality within different organizations in 20th Century. Thus, a systematic literature review was performed to specify the concept of TQM principles and philosophies from the aforementioned TQM gurus. However, the literature review was provided invaluable insight on the understanding of the main ideas and philosophies proposed by these TQM gurus.*

Keywords: *Contributions, Quality Management, TQM Gurus, Total Quality Management (TQM), and Principles.*

INTRODUCTION

Total quality management (TQM) is a set of opinions and ideas for improving the quality of products or services, which widely called "management philosophy". Its main aims are to satisfy customers and survive in the market [20]. Without doubt, quality experts (gurus) had the significant roles to expand and transform the concept of quality from a mere technical system to a broader body of knowledge known as total quality with management implications in production [18]. Historically, TQM was first emerged by the contributions of quality gurus, such as Deming and Juran in Japan after Second World War. Then Crosby, Feigenbaum, Ishikawa, and others had developed this powerful management technique for improving business quality within the organizations. During the period 1980s to 1990s,

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many national and international quality awards (QAs) have been established to provide guidelines for implementing TQM based on the suggestions and theories of TQM gurus [19], [20].

Guru means a "respected teacher", "spiritual leader", "good person", a wise person who in his field has not only made a great contribution and innovation, but also a large-scale revolution. People who have established themselves and profiled philosophical trends in quality, are the gurus of quality [1]. The gurus extensively made substantial contribution to quality management by their theories in improving quality. TQM techniques and tools could be innovated by these theories [2]. As demonstrated in Table 1, each of these pioneers provided foundational building blocks for a systematic method to focus on total quality management [4].

Table 1: TQM Gurus [4]

Pioneer	Year	Quality Management
W.E.Deming	1950	14 Principles in Quality, 7 deadly sins and diseases / PDCA.
AV. Feigenbaun	1961	Concept: Make it right at the first time (One Basic TQM).
Koaru Ishikawa	1979	Statistical Approach in Quality Control and Fishbone.
Philip B. Crosby	1979	Top Management in Quality, 14 steps for quality improvement .
Joseph M. Juran	1988	Cost of the quality, SPC Quality, and Juran's quality triangle.

Deming [9] worked with statistical sampling to improve quality and also introduced the concept of "Variance" to the Japanese and a systematic approach to problem solving which eventually was called the Plan, Do, Check, Act or PDCA Cycle. Joseph Juran expanded the tool set available for producing quality products and managing organization-wide quality by introducing the Pareto Principle as an application of statistics to prioritizing process improvements [15]. Philip Crosby popularized the Cost of Quality concept [6]. Feigenbaum was the first guru, who defined "Total Quality Control" as an effective system for integrating the quality-development, quality-maintenance, and quality-improvement efforts of the various groups in an organization to enable marketing, engineering, production and service at the most economical levels which allows for full customer satisfaction [10]. Kaoru Ishikawa is considered by many researchers to be the founder and first promoter of the 'Fishbone' diagram (or Cause-and-Effect Diagram) for root cause analysis and the concept of Quality Control (QC) circles [14]. These theorists are regarded as the key founders of TQM philosophy, and the origin of TQM concept evolves mostly from their work. Therefore, to understand TQM content and its process in improving business quality, this paper reviewed literature and discussed concerning the works and principles of five influential gurus [6], [9], [10], [14], [15] had a considerable influence on the development of TQM in the organizations.

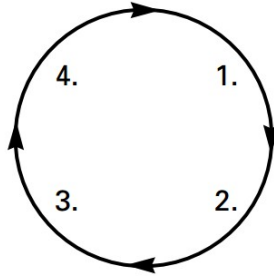
Deming's Contribution and Principles

Dr. W. Edwards Deming has emerged as the most influential guru of quality management in the United States and Japan, he is best known for the "Deming Cycle", his "Fourteen Points", and "the Seven Deadly Diseases" [12]. Deming was graduated in engineering and physics at the University of Wyoming and Yale University. He was influenced by Dr. Shewhart's philosophical idea for quality in developing control chart and PDSA cycle (Shewhart cycle), when he was working for Western Electric. Deming had developed and adopted PDSA cycle (Shewhart cycle) to "clerical tasks" after leaving Western Electric. During the period 1927 to early 1940, he had pioneered the utilization of statistics and sampling methods successfully at the U.S. Department of Agriculture. During Second World War, Deming was hired by the War Department and the Census Bureau to implement control charts and sampling techniques [16], [17]. After war, he helped Japanese companies to improve the quality of their products by his quality principles and guidances as a consultant.

In early 1950s, Japanese products were burdened with defects and were known as poor quality products with the product of other countries in contrast. He emphasized to Japanese that the most of the troubles in production are with the "process" and "that statistics can be used to control that process" [23]. The results of the consultancy of Deming was exceedingly positive to the products and industries of Japan. He became as a hero there soon. To appreciate of Deming's efforts in Japan, JUSE established the "Deming Prize" in 1951. He was awarded "the Second Order Medal of the Sacred Treasure by Emperor Hirohito" in 1960 [24].

As mentioned earlier, Deming [9] developed the Shewhart cycle (PDSA) as an important framework to lead improvement for quality and productivity, his four steps for Improvement, or Plan-Do-Check-Act, are often called the PDCA cycle, as demonstrated in Figure 1. Nowadays, "Deming's cycle" has been extensively apply in the development and deployment of quality policies, DMAIC (Six Sigma) and DMADV (DFSS) have added the rigour of project life-cycle (PLC) to the implementation and close-out of Six Sigma projects, RADAR (EFQM Excellence model) has been used for assessment of organizational performance [25]. Furthermore, management system standards such as ISO 9001 can improve the efficiency of the processes of the organizations through "Plan-Do-Check-Act" (PDCA) methodology to achieve successfully the satisfaction of customer and quality objectives [21].

Study the results.
What did we learn?
What can we predict?



Observe the effects
of the change or test.

What could be the most important
accomplishments of this team?
What changes might be desirable?
What data are available? Are new
observations needed? If yes, plan
a change or test. Decide how to
use the observations.

Carry out the change or test decided
upon, preferably on a small scale.

Step 5. Repeat Step 1, with knowledge accumulated.
Step 6. Repeat Step 2, and onward.

Figure 1: The PDCA cycle [9]

Also, Deming [9] drew his "famous system diagram" that has shown the importance of assuming of the production in "terms of a system". He argued how good quality should be begun from requirements of customers that need to obtain resources by the suppliers first, and after processes of producing products, the products will be delivered to the customers finally. This idea that considers the supplier and customer as a part of the production system was quite revolutionary at the time. Figure 2 shows the production as a system that interrelates to internal and external activities.

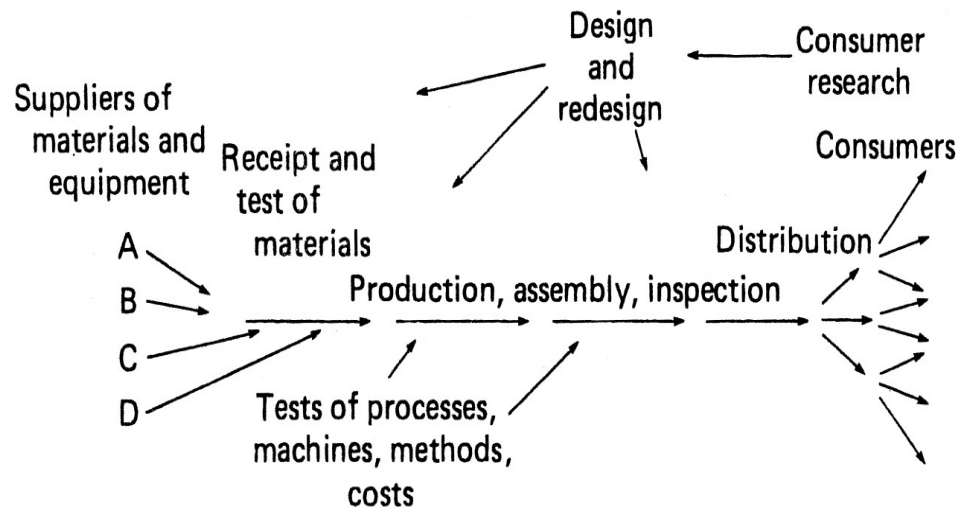


Figure 2: Production viewed as a system [9]

However, Deming did not specify quality in a single phrase. As mentioned in his "famous system diagram", the customer is the one who should define quality concept only. In his system diagram, customer is the first and last part of system [3]. The ideas and principles of Deming adopted to

development of the ISO 9000 series of quality standards [11], and even evolved a new era concerning supply and chain management.

Deming believed deeply that "85 percent" of all quality problems is belonged to management, "quality improvement" can just be happened by management action to change the process. The rest is "15 percent" of the quality problems that can be led to solve by the "workers on the floor or operator level" [16], [17]. He published a book entitled "Out of the Crisis" in 1986, that revealed his "14 points of system at all levels" or steps to achieve quality. In his book stressed the importance of top management, and the quality improvement is impossible to be done without effort of top management to organizational changes [13], [24], [22]. The 14 points of Deming's management principles help leading companies in obtaining quality improvement, that are summarized as follows [9]:

1. "Create constancy of purpose for improvement of product and service": this point is considered sustainable promotion the product and service by long term strategy.
2. "Adopt the new philosophy": Adopting new methods and ways for improving quality;
3. "Cease dependence on mass inspection to achieve quality": The point is emphasized on the maintenance and improvement quality than inspection only;
4. "End practice of awarding business on price tag alone": It argues that basis of bid awarding must be on quality, not price;
5. "Constantly and forever improve system of production and service": The point guides that it is duty of management to find and remove quality continually on the system;
6. "Institute modern methods of training on the job": The intention of point is to upgrade every employee that could be equipped by enough knowledge and skills;
7. "Institute modern methods of supervision": The responsibility of foremen must be changed from numbers to quality;
8. "Drive out fear": That staffs can have enough relaxation and motivation to do their works effectively;
9. "Break down barriers between staff areas and departments": The point is intended for the importance of teamwork;
10. "Eliminate numerical goals for the workforce": Removing slogans, posters and exhortation for the workforce asking for new levels of productivity without providing methods;

11. "Eliminate work standards, management by objective and numerical quotes": This point is purely emphasized on quality concept and its improvement than techniques and standards;

12. "Remove barriers that stand between the hourly worker and his right to pride of workmanship": Eliminating defective materials, low level of equipments and machinaris, inefficient techniques, and lack of management support, and etc.;

13. "Institute vigorous programme of education and training": The aim of this point is to update the employees for being ready to improve quality continuously, and;

14. "Create a structure in top management that will push every day on above 13 points": This point emphasizes on high responsibility of top management commitment to lead others for quality.

Deming [9] believed his fourteen points of management principles is a good instruction for the companies to improve quality and reduce their expenses, because low quality makes rework, defects, and to loss the ability of the company to compete in the market. As mentioned Deming always emphasized to reinforcement of top management and management members to overcome. That is why he noted many times regarding "Seven Deadly Diseases" of management that can cause hug challenges and problems for the companies [12]. Deming argued that "each disease was a barrier to the effective implementation of his philosophy" [17]. His "Seven Deadly Diseases" can be described as follows [9]:

1. Lack of constancy of purpose to plan product and service that will have a market and keep the company in business, and provide jobs;
2. Emphasis on short-term profits;
3. Employing personal review systems, or evaluation of performance, merit rating, annual review, etc. for people in management, the effects of which are devastating;
4. The mobility of management (Job-Hopping by managers);
5. Use of visible figures only for management, with little or no consideration of figures that are unknown or unknowable;
6. Excessive medical costs, and;
7. Excessive costs of liability driven up by lawyers who work on contingency fees.

Juran's Contribution and Principles

Doubtlessly, Dr. Joseph M. Juran has had the most influence on the theory of quality management after Deming among other gurus. His emphasis was more on managerial aspect in quality. Juran is best known as "the father of modern quality management", and the publication of his book "Quality Control Handbook" for first time in 1951 [8]. In 1924, he was begun his contribution with Shewhart's team at the Bell System as an engineer, his career was more regarded quality improvement there, he left Western Electric after the war, for establishing his own institute [17]. After Deming, he was also the second American guru who invited by JUSE to teach and guide "quality control courses" to Japanese industry leaders in 1954. His lectures were introduced and emphasized on the managerial dimensions of planning, organizing, and controlling, and focused on the responsibility of management to achieve quality and the need for setting goals [24], that is why he emphasized managerial approach to similar analogy for better quality results by three basic processes or "Juran's Trilogy" that make a successful framework for TQM to obtain quality goals, and improving quality [12], "Juran's Trilogy" is summarized and illustrated in Table 2.

Table 2: Universal Processes for Managing Quality (Juran's Trilogy) [15]

Quality planning	Quality control	Quality improvement
<ul style="list-style-type: none"> - Establish quality goals. - Identify who the customers are. - Determine the needs of the customers. - Develop product features that respond to customers' needs. - Develop processes able to produce the product features. - Establish process controls; transfer the plans to the process. 	<ul style="list-style-type: none"> - Evaluate actual performance. - Compare actual performance with quality goals. - Act on the difference. 	<ul style="list-style-type: none"> - Prove the need. - Establish the infrastructure. - Identify the improvement projects. - Establish project teams. - Provide the teams with resources, training, and motivation to: <ul style="list-style-type: none"> . Diagnose the causes, and; . Stimulate remedies. - Establish controls to hold the gains.

Meanwhile, Juran drew "a graph with time on the horizontal axis and cost of poor quality on the vertical axis", to describe the zones and areas that belong to the parts of "Juran's Trilogy". As depicted in Figure 3, the graph illustrate the three processes of the "Juran's Trilogy" are interrelated. The first zone is "quality planning", that planners should find the requirements of customers by accurate information. Next zone is quality control planners have

to design a proper process to produce the product/s accordant to the needs of customers. In the third zone of "Juran's Trilogy", the planners turn the plans over to the operating forces: "You run the process, produce the product features, and meet the customers' needs" [15].

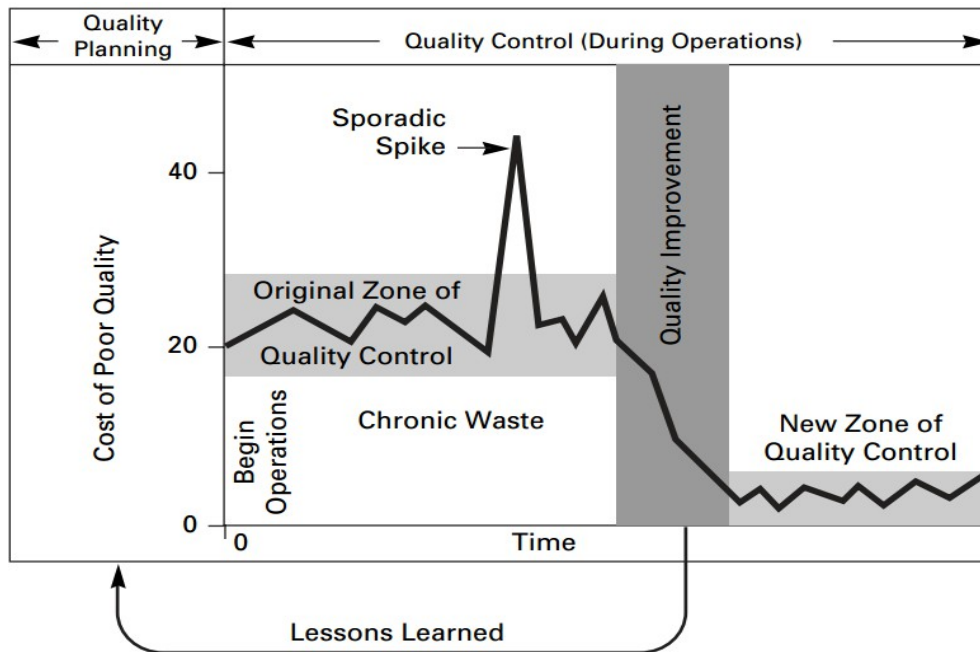


Figure 3: The Juran trilogy diagram [15]

Juran viewed TQM as "fitness for use" or fitness for customer. On the other hand, he believed like Deming that customer has to define quality, if the company wants to be successful, it should use proper indicators to determine the needs of customers accurately. And focusing on "fitness for use" helps the company to prevent the under or over-specification of products and services [13], [11], [7]. Therefore, he believed quality has a direct relationship with the satisfaction of customers with the products or services. He introduced "Ten Steps to Quality Improvement" for improving the satisfaction of customer, these steps are listed below [15]:

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, and;
10. Maintain momentum by making annual improvement part of the regular systems and processes of the company".

Crosby's Contribution and Principles

Philip Bayard Crosby is best known for his concept of "Zero Defects", he believed that an efficient quality management must be "based on prevention-based system", and claimed that mistakes can be happened because of lack of knowledge and the attention of employees in the organization [6]. He emphasized when the quality improvement can be happened that the management of the firm focuses more on prevention by the attention and awareness of employees, reduction of the cost, the emphasis on controls rather than the inspection efforts, and finally "Doing them right the first time" [13]. Crosby realized that the cost of not "doing things right the first time" could be estimable. In production, "the price of nonconformance averages 40 percent of operating costs" [16], and the expenses of poor quality can be about 20% of revenues of a average firm, "most of which could be avoided by adopting good quality practices" [24].

He had experiences for many years to work at Martin Marietta and then, in the 1970s, as Quality Director of ITT [22]. By his valuable experiences, Crosby (1979) published his first book, which was entitled "Quality is Free". His book has emphasized that concept of "Zero Defects" for quality improvement. He stressed "Zero Defects" as basis of quality is not synonymous that the products or services quality must be "perfection", its meaning is the product or service must be exactly the same as specified requirements of the customer and the supplier. In other words, "the customer deserves to receive exactly what the supplier has promised to produce" [11].

Crosby stated that "quality is not comparative and that there is no such thing as high quality or low quality, or quality in terms of goodness, feel, excellence and luxury" [7]. According to his Zero Defects definition, Crosby [6] described his 4 absolutes that are based on his TQM philosophy, these absolutes are listed below:

1. Quality is defined as "conformance to requirements", (not "goodness" or "elegance");

2. Quality comes of the system that is based on prevention, (not appraisal): Prevention can cause by good quality management (TQM practices);
3. Quality performance standard is is "Zero defects" not that is close enough. (not "that's close enough): Errors is not acceptable, and;
4. Quality measurement is the price of non conformance, (not index).

Also, Crosby [6] emphasized the role of management for improving quality, he believed 80% of the quality problems of the organizations are belonged to the management. Thus, Crosby recommended 14 steps to lead the companies as Deming and Juran suggested some tips for improving quality, Oakland [22] has summarized Crosby' 14 steps as follows:

1. "Management commitment": To Make clear that management is undertaken to quality;
2. "Quality improvement team": To improve quality of teams with representatives from each department;
3. "Quality measurement": To measure of performance for making sure that there is quality improvement;
4. "The cost of quality": To measure the quality cost of the company as a tool for management;
5. "Quality awareness": To promote the quality awareness and knowledge of employees;
6. "Corrective action": To provide a systematic method for problem solving;
7. "Zero defects action": To have a strong commitment for the zero defects program;
8. "Employee education": To determine what kind of the trainings are needed to increase quality for supervisor training;
9. "Zero Defects day": To let all employes feel and touch the message of "Zero Defects" (Do right things right time) every day;
10. "Goal setting": To let every body establish improvement goals at the workplace for themselves and others;
11. "Error-cause removal": To let properly all staffs communicate to the management for describing existing problems face quality, and finding efficient solution for problems;
12. "Recognition": To appreciate those who have nicely done their duties regarding quality;

13. "Quality councils": To establish quality councils to communicate on a regular basis, and;

14. "Do it over again": To show the employees that quality improvement is continuously.

Furthermore, Crosby [6] specified the different levels of the quality management maturity, which is useful to assess the degree of quality management maturity into the organization. The five levels of quality management maturity are namely: Uncertainty, awakening, enlightenment, wisdom and certainty. These stages can be used to assess progress in a number of measurement categories such as management understanding and attitude, quality organization status, problem handling, cost of quality as percentage of sales, and summation of firm quality posture.

Feigenbaum's Contribution and Principles

Total quality control, known today as total quality management (TQM) is virtually equivalent with Feigenbaum's name [11], and he was one of the foundations of modern management and has been widely accepted as a viable operating philosophy in all economic sectors. It could be developed by Feigenbaum's work significant [8]. Dr. Armand V. Feigenbaum was an American quality guru, his valuable ideas revealed by his experiences working at General Electric (GE). During this period, he had contributed for many years with world-class companies such as Hitachi and Toshiba in Japan. He investigated quality procedures at these companies, and understood "total approach to quality" is the best way to solve quality problems. He advocated the inspection for quality control "after the fact rather than build it in at an earlier stage of the process". Feigenbaum adopted an approach for quality that was different from Deming and Juran [24], his approach has a three-step to improving quality that are included "quality leadership, quality technology, and organizational commitment" [10].

Feigenbaum was the first guru who introduced the concept of "Total Quality Control" (TQC) first time, and published his first book "Quality Control Handbook" in 1951 [17]. This philosophy was adapted by the Japanese and the concept of "Company Wide Quality Control" (CWQC) later [12]. His philosophy is more on the "prevention-based system by emphasis on product, service and process design and by streamlining the source activities". The mechanism of this system is based on the documentation and auditing to make sure that the products are conformed with "pre-defined standards" (e.g. ISO 9000) [13]. Likewise, Feigenbaum [10] emphasized on the significant roles of all members of the organization, including office staff, engineers and shop-floor workers in the improvement of business quality.

Feigenbaum's principles describe that for manufacturing the product with high level quality, TQC should be considered instead of the implementation of the production quality control alone. These ideas and principles caused total quality movement that the companies understood that responsibilities for quality are company-wide, and stayed with the leadership hierarchy [12], [5]. The fundamental ideas of Feigenbaum's systematic approach for quality as follows [10]:

- "Quality is a company-wide process;
- Quality is what the customer says it is;
- Quality and cost are a sum, not a difference;
- Quality requires both individual and team zealotry;
- Quality is a way of managing;
- Quality and innovation are mutually dependent;
- Quality is an ethic;
- Quality requires continuous improvement;
- Quality is the most cost-effective, least capital-intensive route to productivity, and;
- Quality is implemented with a total system connected with customers and suppliers".

Feigenbaum [10] argued that the term "total quality" are related to broader issues such as planning, organization and direction, and "quality assurance" cannot be able to improve efficiently quality products, if it just focus on production process [1]. Therefore, Feigenbaum [10] defined Total Quality (TQ) as "an effective system for integrating the quality development, quality maintenance, and quality improvement efforts of the various groups in an organization so as to enable production and service at the most economic levels which allow customer satisfaction", he emphasized "a system approach to quality" or "TQC" as an efficient quality management is included four main steps, as follows [10]:

- "Setting quality standards;
- Appraising conformance to these standards;
- Acting when standards are not met, and;
- Planning for improvement in these standards".

Ishikawa's Contribution and Principles

Dr. Kaoru Ishikawa was a Japanese quality guru, who “pioneered quality management processes in the Kawasaki shipyards, and in the process, became one of the founding fathers of modern management” [12]. Ishikawa is best known to introduce and develop many quality tools like cause-and-effect diagrams (called fishbone or Ishikawa diagrams) and the utilization of the “Seven QC tools”, he believed 95% of quality problems can be solved by these tools. Thus, Ishikawa [14] has been associated with the development and advocacy of universal education in the seven QC tools, which are namely:

- Pareto chart;
- Cause and effect diagram (Ishikawa diagram);
- Stratification chart;
- Scatter diagram;
- Check sheet;
- Histogram, and;
- Control chart.

Its “Fishbone” diagram was an effective method tool in reducing and preventing the errors and mistakes in the organization. The effect or incident being investigated is shown at the end of a horizontal arrow. Potential causes are then shown as labelled arrows entering the main cause arrow. An example of a fishbone diagram is presented in Figure 4.

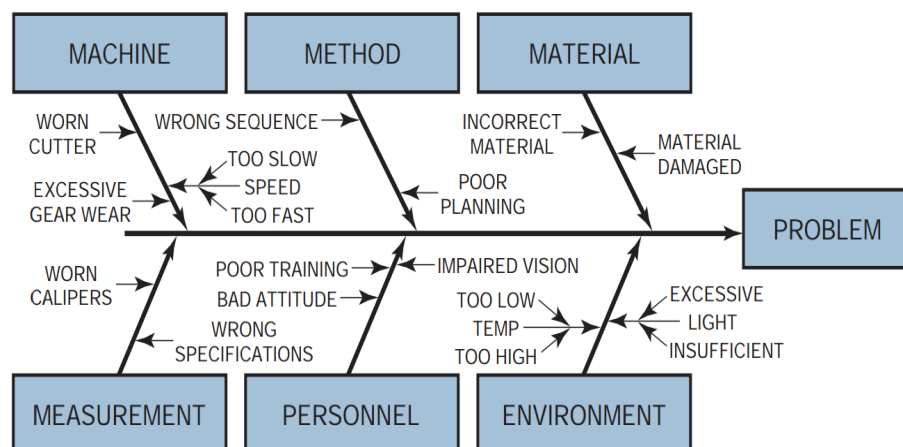


Figure 4: The cause and effect diagram or Fishbone Diagram [16]

He was belonged to those Japanese gurus, who had eagerness to study new things from Deming and Juran to improve quality products in Japan's industries, and his ideas shaped by them. His role is mostly outstanding and significant to develop quality management among other quality experts in Japan [1]. In addition, Ishikawa was developed the concepts of "Quality Circles" (QC) that introduced by his book, "What is Total Quality Control?" in Japan, that changed significantly the American "TQC" to company "Wide Quality Control" (WQC) or TQM, that argued total quality control on whole company instead of total quality control on products and services only [8]. Therefore, his thoughts and philosophies regarding the TQM can be described in the following principles [14]:

- "Quality first-not short-term profits first;
- Customer orientation-not producer orientation;
- The next step is your customer-breaking down the barrier of sectionalism;
- Using facts and data to make presentations-utilization of statistical methods;
- Respect for humanity as a management philosophy, full participatory management;
- Cross-functional management".

Ishikawa [14] justified on strongly about the proper use of problem solving tools in the improvement of quality. His concept of the Quality Control (QC) circle was to bring production workers, maintenance, design engineers and managers together in organized meetings to solve problems. The quality control circles were critical in the complete root-cause analysis of any problem. The quality control circles were responsible for diagnosing problems and developing permanent solutions for problems. Thus, he stressed that every member of the organization is responsible to quality issues, and he suggested Japanese companies to apply "Quality Circles", in order to solve their quality problems. Quality Circles" are a small number of employees (Usually is 5-10 staffs) that discuss about quality problems of their workplace, by the investigation, identification of problems, and finding solutions for quality problems. In addition, he emphasize the importance of management to draw and show proper "strategic goals" for improving quality, also his idea regarding "internal customer" was interesting. Ishikawa argued customer is not a purchaser only, he defined "customer is next person in the process" [13]. Likewise, Ishikawa [14] recommended that the evaluation of customer's requirements is a best way to foster "cross-functional cooperation", and "cross-functional teams" can be an appropriate method to specify and eliminate the quality problems.

Summary

As discussed previously, these five quality gurus made significant contributions to understand the essence and nature of the TQM. But they had different approaches, definitions, opinions and perceptions about total quality management [16], as summarized and illustrated in Table 3.

Table 3: The comparison of guru's approaches [16]

Guru	Definition	Emphasis	Dominant Factors
Deming	Customer led	Process	Control of variation
Juran	Customer led	People	Fitness for purpose
Crosby	Supply led	Performance	Zero defects
Feigenbaum	Customer led	Process	Total quality control
Ishikawa	Value led	People	Company wide quality control/circles

Although, the explanations of TQM gurus concerning quality and quality management were in different ways, but their messages and aims are the same and "common points" for improving the quality of products and services within the organization in 20th Century. These "common points" are namely [3], [6], [9], [10], [14], [15], [17], [24]:

- 1) Management commitment;
- 2) The strategy, policy, and firm-wide control;
- 3) Employee education and training;
- 4) Employee's award;
- 5) Improvement of process, quality system, and product design;
- 6) Designing system based on on prevention;
- 7) focusing on quality improvement instead of the inspection;
- 8) Customer orientation and;
- 9) Quality is first and schedules are secondary.

In summary, they shared a common emphasis, which is the continuous improvement of the business quality performance based on establishing proper system for leading effectively the whole organization, in order to meet customer requirements.

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