

Quality Management:

The importance of the collaboration between Focal Firm and First-tier Supplier(s)

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Abstract <p>The objective of the thesis is to find out the role of Quality and how important it is to the focal firm and supplier(s) relationship by dissecting Quality theory and studying Cases. The aim of the thesis is to guide the audience on how to recognize the role and the quality management strategies which are being used in each case. With the help of the explorative method of studying, both from case study and literature study, the important to have a proper quality system in place is also mentioned.</p> <p>Reader will be able to identify the effects of quality management collaboration between the company and suppliers and how the relationship could affect the customers' consumption and satisfaction. Another aspect which the partnership usually forgets is the effects of setting up criteria for product design assessments and specifications. The necessity to have a leader in a partnership to guide the business to move forward, and the urge to develop a never-ending process of continuous improvement to Quality to maximize the advantages that it could bring onto the table is also pointed out.</p> <p>3 Cases are presented: Tata Nano 1 lakh car, GM's CEO vision of a fully automatic manufacture and zero defect cars components. Two of the cases will show what would happen if an aspect of quality which were overlooked and how it could affect the customer's satisfaction but also the company image. The last case will display the continuous improvement characteristics of Quality and how could firm and suppliers' collaboration effort could utilize their relationship to ameliorate the quality.</p>		
Keywords/tags (subjects) quality, quality control, quality management, quality cost, quality standard, supply-chain, supplier coordination, customer satisfaction, strategic management, product design		
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1 Introduction

1.1 Preface

This thesis is dedicated to explore and study an aspect of the relationship between focal company and first-tier supplier: Quality Management and the importance of the relationship. What is Quality and Quality Cost? What is Quality control? What is the importance of Quality Management and how to improve it? By going through this thesis, hopefully readers will be provided with sufficient knowledge to fully understand the term Quality itself, from the history of it to the grounded level of theory.

This thesis will be divided into two parts: theory and case study. In the theory part, Quality and Supply Chain will be defined. Audience will first be introduced to the history, the concept and the role of Quality Management in the Supply Chain. What is Total Quality Management? What does it bring to the table in the current situation? The reader will also be explained what is a Supply Chain, Supply Chain Management, what does it consists of. Guidance on how to identify Quality in the Supply Chain will also be presented in this writing. As for the case study, readers will be offered several unique cases concerning about the relationship between companies and their suppliers, and the role of their collaboration to manage the Quality of their products and services.

1.2 Aim of the thesis

In this thesis, readers will be guided on how to recognize the role and the quality management strategies which are being used in each case. In addition, the audience can find out the effects of quality management collaboration between the company and suppliers and how the relationship could affect the customers' consumption and satisfaction. The effect of setting criteria for product design assessments and specifications of each party are also going to be mentioned in this thesis. Another objective of this writing is to identify the necessity to have a leader in these cooperation, and does it benefit the party involved. These findings will help bringing a broader view on quality management elements and in both manufacturing and service sectors.

1.3 Study method

The literature review with the exploratory method of research is deployed in this thesis. The nature of the method is still qualitative, but more concentrated on findings information that was not clearly visible or has just been touched on the surface. Cases are found on books and online articles, which will be dissected. The grounded theory will provide the audience with enough information on what is Quality and its role in Supply Chain, which would lead them to a better understanding on the findings.

2 History of Quality

The evolution of the word Quality has been tremendous throughout the history of humankind. It revolutionizes the business and manufacturing industries in the way they thinking and behave. From being considered as a dragging force in the cost-profit equation of the business, Quality is now considered as a value-added opportunity. But what is the story behind these transitions?

The origin of the word Quality can be traced back to the 13th Century, coming from Old French "qualite" and Latin "qualitas", meaning "of what sort", which emphasise an object's nature. So, Quality can be understand as a trait, a feature, or a characteristic of a thing. Since the introduction to English, the word has never stopped evolving, and come along its evolution, it has gained more and more meaning. The term Quality in business is coiled back in the 13th Century in medieval Europe, when guilds are found. The use of quality at that time is basically to set up a standard which needs to be followed in product inspection. Guild is a union of craftsmen which follow the same guideline to make quality products. These products will be inspected individually before they become available in the market. If a product is deemed not good enough, it will be removed or destroyed. There are usually marks or symbols to mark the product which comes from the guild, which represent the craftsmanship of their workers and the reputation of the guild. This is considered the foundation of Quality in business.

3 Concept of Quality in Business

There are so many ways to define what Quality in Business is. From qualitative to quantitative perspectives, people view it differently. But from a technical point of view, Quality can be defined so many ways. Quality could be explained as “the characteristic of a product or service that bear on its ability to satisfy stated or implied needs.” (Quality Glossary, ASQ). From manufacturing perspective, Quality is a fulfillment of requirements that was assigned to. But from customer’s perspective, it is the standard which they set up and require to be appeased, meaning, the performance of the product or service compare to their expectation. One of the most notable quality management author, Phil B. Crosby, in his book “Quality is Free” (1979), he viewed Quality as “conformance for requirements” and its requirements are coming from both producers and customers. To simplify, Quality could be explained as follow:

$$Q = \frac{C}{R}$$

Where:

Q = Quality

C = Conformance

R = Requirements

The meaning of this quantification can be understood as a product or service quality can work better or worse than requirements or expectation. If a product or service achieved a score greater than 1, it indicates that the product or service quality is acceptable. This could be our basis to explore the world of quality although the equation does not tell the whole story on what lies underneath these perceptions. To fully understand the concept of Quality and how it could impact the way we manage its actual impact, it is useful to start looking at the managerial approach to quality from the beginning of time to this day.

4 The Never-ending Development of Quality

The development of Quality in modern era could be divided into 4 phases according to D. Garvin (1988) Inspection, Statistical Quality Control, Quality Assurance and Strategic Quality Management. Each of these eras have their own characteristics and the latter is the development of the previous one. Table 1 will provide an overview on the main characteristics in each of these evolutions.

Table 1. Evolution of Quality throughout time (D. Garvin, 1988)

STAGE OF QUALITY MOVEMENT				
IDENTIFYING CHARACTERISTICS (DATE OF INCEPTION)	Inspection (1800s)	Statistical Quality Control (1930s)	Quality Assurance (1950s)	Strategic Quality Management (1980s)
PRIMARY CONCERN	Detection	Control	Coordination	Strategic impact
VIEW OF QUALITY	A problem to be solved	A problem to be solved	A problem to be solved, but one that is attacked proactively	A competitive opportunity
EMPHASIS	Product uniformity	Product uniformity with reduced inspection	The entire production chain, from design to market, and the contribution of all functional groups especially designers, to prevent quality failures	The market and consumer needs
METHODS	Gauging and measurement	Statistical tools and techniques	Programs and systems	Strategic planning, goal setting, and mobilizing the organization
ROLE OF QUALITY PROFESSIONALS	Inspection, sorting, and counting, and grading	Troubleshooting and the application of statistical methods	Quality measurement, quality planning and program design	Goal-setting, education and training, consultative work with other departments, and program design
WHO HAS RESPONSIBILITY FOR QUALITY	The inspection department	The manufacturing and engineering departments	All departments, although top management is only peripherally involved in designing, planning, and executing quality policies	Everyone in the organization, with top management exercising strong leadership
ORIENTATION AND APPROACH	"Inspect in" quality	"Control in" quality	"Builds in" quality	"Manages in" quality

Let's go through it of these era and clarify the change to the Quality concept.

4.1 Inspection Era

The 19th Century marked the start of the use of Quality Control tool in industrial works, when industrialization starts to growth and the production gets centralized and its scale gets larger. The industrial revolution requires products to be manufactured identically in mass with the implementation of Fordism and Taylorism in early phase, it is hard to guarantee final products are flawless, since human error was still a huge issue then. This also mean that the old method of checking every single product which was using during the medieval time is proved to be irrelevant since it consumes too much time. Owners also starts to gain awareness on how their products quality could affect their sale numbers. So, a new method, mass inspection, is introduced, where measuring system is used by supervisors to find out if there are any unqualified products. Those products are then reworked to fit the requirements, else removed. So, the liabilities then are lying in the inspectors, not in the production managers like it used to be, which could cut down a lot of time before products are available in the market. Still, the process at that time was just basically trying to fix the issues that already occurred, not trying to proactively find the root cause of all the issues.

1922 marked a key point in the history of Quality where the first document mark formally linked inspection to quality control. In his paperwork, "The Control of Quality in Manufacturing", G.S Radford started to recognize Quality as a standalone function from the manufacturing process. He considered "the control of quality is the correct starting point for the economy" and inspection is used as a mean to control the set-up standards of quality control (p.35). Even though the study was still in early stage, where quality control was simply about inspection, sorting, counting and grading, but Radford's works had set up some fundamentals to modern Quality Management, like coordination between multiple departments, uniformity is the essence of quality, quality first and quantity to follow, and the early involvement of product design in manufacturing process.

4.2 Statistic Quality Control Era

Based on the first form of Taylorism, also known as scientific management, in 1931, Walter A. Shewhart put his hallmark on being the first to consider using statistics to

control quality. Starting his work from mid-1920s, the statistician from Bell Laboratories views quality is “the same kind of product differ among themselves, or, in other words, the quality of a product is expected to vary”. (1931) This concept is totally new since before that time, quality is only considered after the product is finish, and to apply mathematic analysis to control quality is an innovative approach. Shewhart pointed out that there is a statistical distribution in almost all things, and by observing them it would be possible to identify the variable and stabilize the quality. He creates a quality control tool called statistical process control chart (SPC Chart) to control the variabilities of the product. This acknowledgement is the platform to establish criteria which indicate the acceptance level of quality control.

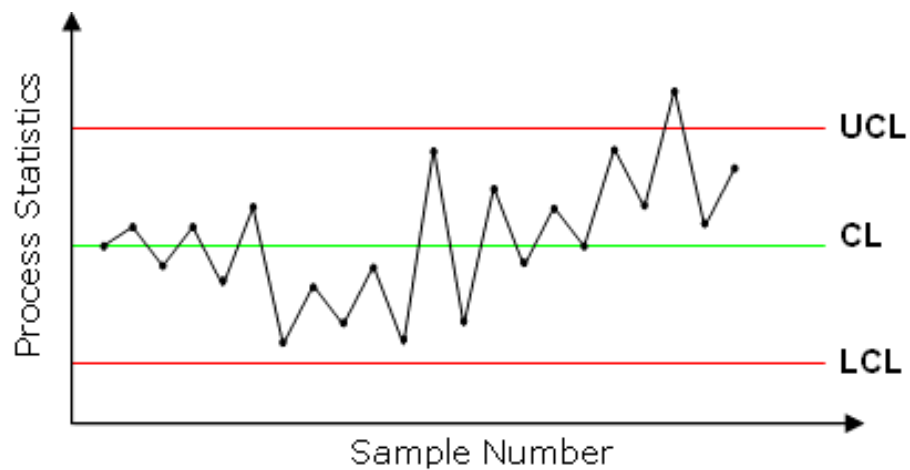


Figure 1. Example of a Statistical Process Control Chart

The problem with Shewhart early development is he still considering full inspection on all finished products, which at that time is proven to be time-consuming and too inefficient. So later, in 1941, two other mathematicians who also comes from Bell Laboratories, H. F. Dodge and H. G. Romig, in their paper: Single Sampling and Double Table Inspection, made a proposal that by divide the products into small lot and checking several products in each lot to see if the number of defects is acceptable or not by using probability sampling tables. This method is called acceptance sampling. Even though this method is no longer suitable for use in the world today, which will be discussed later, acceptance sampling was useful at that time where it is acceptable if there are defects that could get out.

Although these findings gain a lot of recognition throughout America, starting from 1942, but it had not been applied to other industries except for the telephone company itself. But World War II came and changed everything. The US with their policies of dealing arms and ammunition to Countries at war required weapon to be mass produced in a quick and efficient way. Bell Laboratory mathematicians are being used to set up new sampling tables for government inspectors to use. The result is the creation of the concept of acceptable quality levels (AQL). AQL is defined in ISO 2859-1 as the “quality level that is the worst tolerable”, meaning the percentage of defects to total outputs which still satisfy supplier control standards. This resolved the issue of having to use too many inspectors, and relieve the pressure on them. This practice soon spreads into other industries.

Another turning point of this era is the formation of American Society for Quality Control. The organization was formed in 1946, is an aggregation of individuals and smaller societies who are enthusiasts about quality, sharing their studies and publications to each other, hosting conferences about the matter. The organization still operate until today, keeping the same mission that it has carried since the establishment, to promote the use of quality control in practice.

Up until WW II, the American is the leader in the Quality Control field, but post WW II, the Japanese started to catch up and identify some key elements on how to standardize quality. Their development was heavily influence by W. Edwards Deming, who is a student of Shewhart. He gave several lectures to engineers and top-managers concerning the control processes, notably the first lecture, where CEOs represent 80 percent of Japan capital showed up. The lectures which he gave in 1950 to the Japanese Union of Scientists and Engineers (JUSE) has helped Japan adapting beyond what Acceptance Quality Levels can do. Deming presented to them a new direction on how to tackle the Quality issue by showing them the Shewhart’s Cycles, later being referred to as Deming’s Cycles or PDSA Cycles, suggested that the Quality needs to be continuously control and improve. PDSA stands for Plan-Do-Study-Act, a series of step by steps learning method with the goal is to continually enhance a product or service.

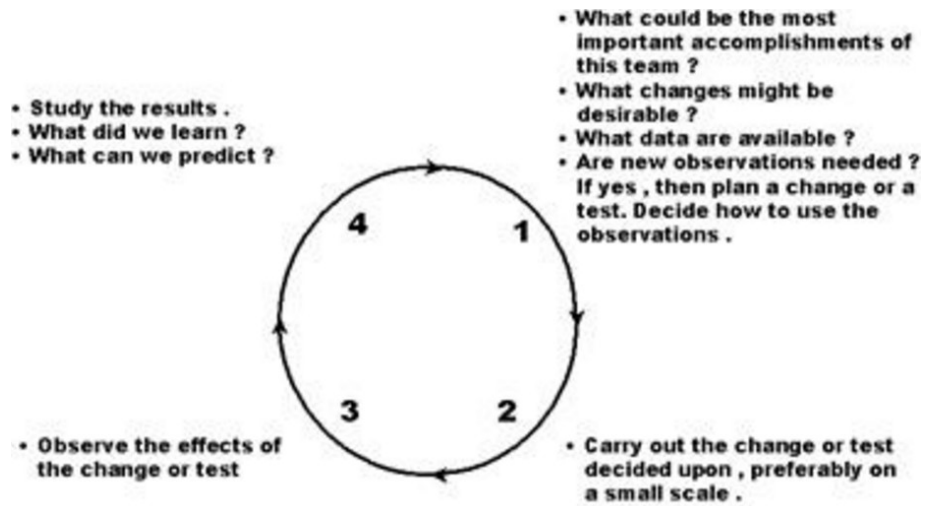


Figure 2. Shewhart Cycle – Deming Cycle

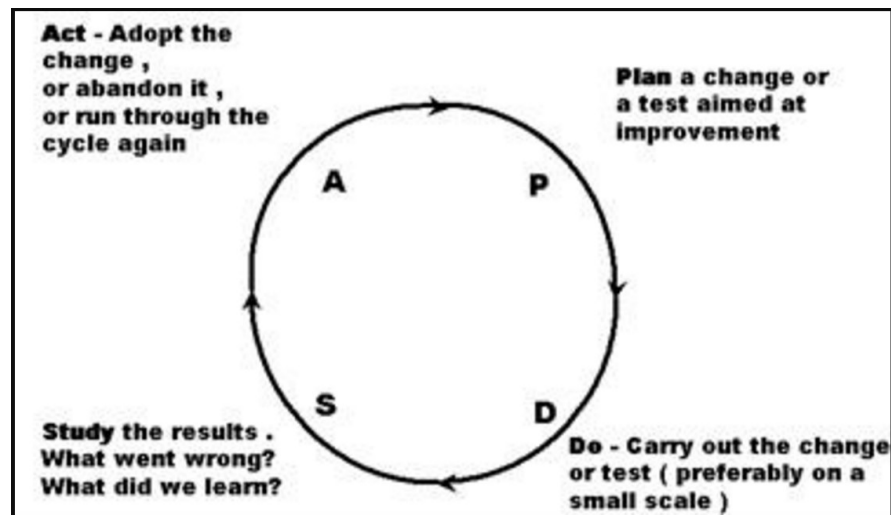


Figure 3. Japanese Plan-Do-Study-Act Cycle

By refining and researching the American approaches, they identify the need to tackle problems concerning Quality Control from right from the start and not until the issue has already occurred. One of the leader of these quality initiatives in Japan is Kaoru Ishikawa (石川 馨) with his development of the cause/effect diagram, also known as fishbone diagram.

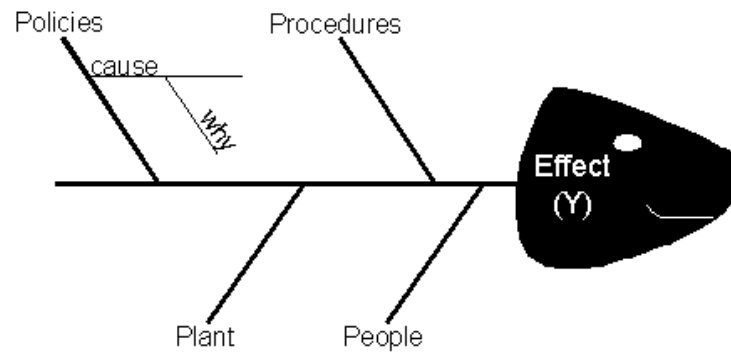


Figure 4. Cause and Effect diagram (Fishbone diagram)

To summarize, Quality Control at this point is only recognized in engineers and workers, but not on the top level. They still need to change the perception that has been around for decades. But we cannot deny that the acknowledge of the Japanese to these theories has set up the country itself to become the powerhouse in quality standards post World War II.

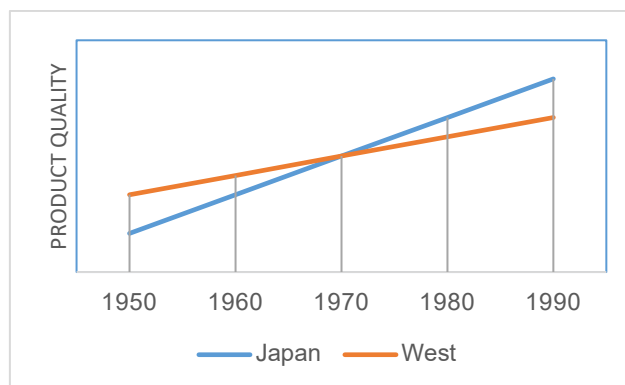


Figure 5. Quality Improvement: Japan vs the West

4.3 Quality Assurance Era

1950s marks the beginning of a new quality era, where the concept of quality evolved from being controlled to being guaranteed. As mentioned, the view of quality at the time was narrowed down to the factory level, and there is no communication or coordination between departments, making the quality control process only happen on the work floor. The process of quality control is remaining in on trying to find defects, which mean it is a reactive process. So by proactively looking at the problem concerning quality, the Quality Assurance era brings a new breed of tooling and

approaches into play, with the four key elements: Cost of Quality, Total Quality Control, Reliability Engineering and Zero-defect.

4.3.1 Cost of Quality: Production-focused

Joseph M. Juran first came to Japan in 1954. Little did he know, his contribution to the growth of Japan's concept of quality is the turning point. His 1951's Quality Control Handbook, he moved the responsibilities to ensure quality to all departments with the emphasis on the top management being the driving force. This is the first time, the importance of relationship between multiple divisions to maintain good quality is mentioned in a publication. Enterprises are aware of the need to implement a quality control system to reduce the impact on profits. And by asking top manager a question that never been mentioned before: "How much quality is enough?", he gives them a whole new perspective on the issue. This is the cornerstone of the concept of quality cost.

At that time, the fact almost all companies are only looking at the quality spectrum as a way to satisfying customers demand by provide good products or services meaning that there are so many hindering issues concerning the cost of quality which were not underlined, and those problems usually are being dealt only when visible. So if management would get a hang on the lack of quality beforehand and continuing to improve their quality process, it could translate into competitive advantage, survival in a market or even being a market leader. Juran understands this problem, and by trying to divide the cost of quality into two groups and define them, could give the management team a better analogy on their situations.

According to Juran, Quality Cost can be divided into two type: unavoidable costs and avoidable costs. Unavoidable costs are the type of cost that cannot be impacted. Usually those costs are coming from tasks and processes such as inspection, sampling, sorting. Meanwhile, avoidable costs are the cost that we can get around if the quality of the product and service is good enough. This cost consists of resources that required from the process of scrapping, reworking and the work required to do those tasks. Juran also identified the costs of loss sales can also be included as a part of avoidable cost. He also noted that if these avoidable costs are minimized, it could lead to a sustainable increase in profits, thus calling avoidable costs "gold in the mine" of quality.

Juran's proposal is considered a contradiction to the belief of where quality lies, and open a new portal on how to solve the problem related to expenditures to lower cost and increase quality.

This approach is deemed antithetical and redesigned later, since at that moment, there are no ways to get around the unavoidable costs. We will go through this further on.

4.3.2 Total Quality Control

Total Quality is the term that was coined by The New York Times. Its definition is to achieve and maintain the highest quality throughout all levels of operation within a company by working efficiently and producing high-quality products and services.

Juran's ideology later is expanded by Armand Feigenbaum, suggested that the standard of quality can be achieved if more emphasis is put into managerial duty and on collaboration between multiple departments, or as Feigenbaum called, "inter-functional teams" (1961). He argued that if a product is controlled starting from the designing process to the point where customer received it, the quality of the product would achieve the perfect status, thus "Quality is everybody's job". He proposed to form cross-functional teams from multiple departments to control the product design and manufacture process with the intention to satisfy customers before and after. The problem of Feigenbaum's proposal is, as pointed out by Garvin (1987), he does not consider the strategic aspect of Quality and only focused on the preproduction aspects of product design's manufacturability.

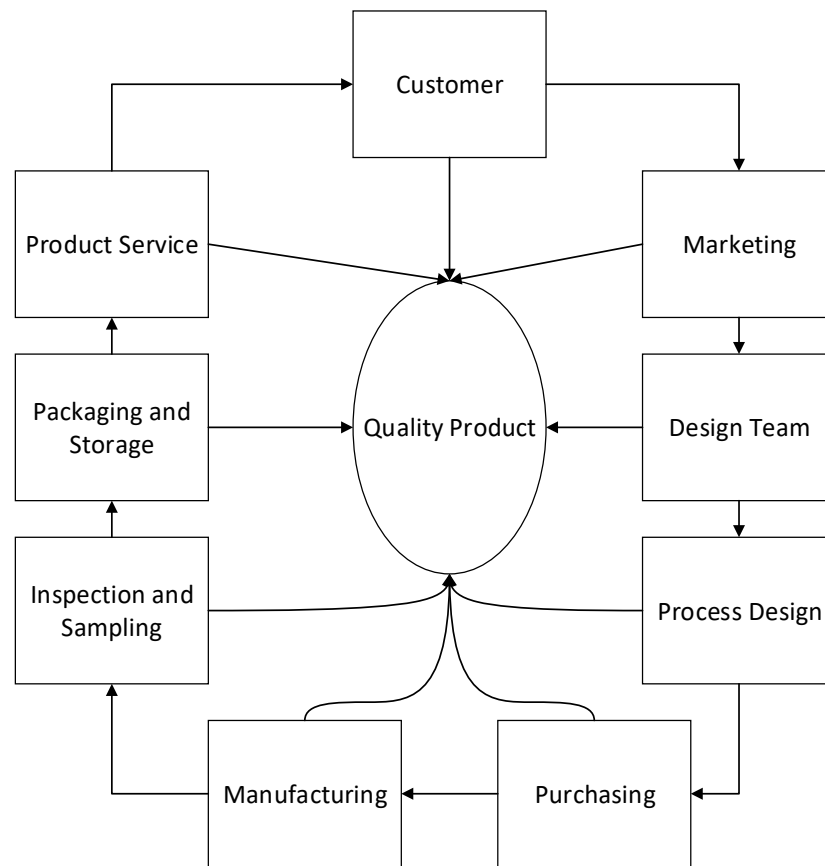


Figure 6. Flow of Quality Responsibility

Feigenbaum also identified that when a product is made, it had to move through 3 stages: design control, incoming material control and shop floor control. This means the whole supply chain system are involved in the process, so every single department are responsible for the outcome of their products. For design control, it is the marketing which collect the requirements from customers, then pass it to design team to make a prototype and set up specifications. Process design will determine what parts and components required to be bought and planning the manufacturing process. Shop floor control include inspection and sampling, packaging and storage.

Still, Feigenbaum still heavily favors to put more responsibilities to the Quality Control department as we can see in his Matrix and Relationship Chart below.

Table 2. Total Quality Control Matrix or Relationship Chart applied to Product Quality (Feigenbaum, 1961, p. 61)

Area of responsibility	General manager	Finance	Marketing	Engineering	Manager-Manufacturer	Manufacturing Engineering	Quality Control	Materials	Shop operations
Determine needs of customers			(R)						
Establish quality level for business	(R)		C	C	C				
Establish product design specs				(R)					
Establish manufacturing process design				C	M	(R)	M	M	C
Produce products to design specs			M	C	C	C	C	C	(R)
Determine process capabilities					I	C	(R)	M	C
Qualify suppliers on quality							C	(R)	
Plan the quality system	(R)		C	C	C	C	(R)	C	C
Plan inspection and test procedures						C	(R)	C	C
Design test and inspection equipment						C	(R)		M
Feed back quality information			C	C	I	M	(R)	C	C
Gather complaint data			(R)						
Analyze complaint data			M	M			(R)		
Obtain corrective action			M	C	C	C	(R)	C	C
Compile quality costs		(R)	C	C	C				
Analyze quality costs		M					(R)		
In-process quality measurements							(R)		C
In-process quality audit				C		C	(R)		
Final product inspection			C	C	M	C	(R)		

Code: (R) = Responsible; C = More Contribute; M = May contribute; I = Is informed

Feigenbaum has started to realize the important of finding a quality suppliers to control the quality of the firm, but it is still limited to the view of the Procurement process and the Quality control department.

A few years later, during 1960s, a branch of Total Quality Control started to develop in Japan by latching onto Feigenbaum's concept. The approach was similar to American's Total Quality Control, and some parts are even more developed than the American one. This approach is often referred to Company-Wide Quality Control. The two concept are still being used as criteria for their own national quality award, the Malcolm Baldrige National Quality Award for American, and the Deming Prize for Japanese.

4.3.3 Reliability Engineering

Although, Juran and Feigenbaum's work focused more on the infrastructure of the company and the collaboration and cross-functional works, they thought applying statistical control into production is important. So, by adapting the military maintenance and logistics method in performance checking during the Korean Civil Wars, the US Engineers had adopted the method of Reliability Engineering. It is the study of the dependability of a product or service during its lifetime. By testing the product, engineers could identify the probability of failure, using statistics model to theory craft and predict the performance of the product under different interval of time and conditions. Several techniques are used at the time, some of which is still widely use in maintenance management these days, such as:

- Failure mode and effect analysis (FMEA): how systematically a product could fail.
- Individual components analysis: whether to remove or fix the components.
- Derating: require items to be used under their specifications level.
- Redundancy: parallel replacement to important components

4.3.4 Zero Defect

Zero defect is a management method of rallying and motivating workforce to achieve defects-free production and manufacturing. Before this, Quality Control is the study of how to reduce the number of defects, but there are no attempts whatsoever on trying to achieve perfect results. So, in 1961, at Martin Company, a missile company, tryout an ambitious plan of not relying on inspecting but rather on raising their worker's morale and awareness, to produce perfect missiles, which carried out successfully. The CEO of Martin Company, James F. Halpin, later in his book Zero Defects: A New Dimension in Quality Assurance, he explained that if perfection were never to be expected in the first place, and mistakes are being treated as inevitable, then defects will happen. So, if the mindset can be changed, it is possible to achieve zero defects.

Halpin's words are heavily based on philosophy and motivation, concentrated on the importance of the workforce. The CEO thinks that the old method of acceptance quality level, which is the direct paradoxical theory to zero defects, are not constraining

the measurements good enough, which bring up a lot of debates and arguments and challenged the old way on not putting enough remarks on Quality. Zero Defects later is emphasized by Philip B. Crosby where he asserted that the only performance indication is Zero Defects. In his book "Quality is Free" (1979), he dismissed the thinking that Zero Defects is a motivation based program. Instead, he thought that when Zero Defects are reached, the Cost of Quality will be the Quality of the product itself, thus urged that everybody should have the mindset of "doing the job right the first time", since people still think that they cannot avoid the inevitable error.

Quality Assurance era has set up a bridge of connection between company divisions on how to achieve the standard goal. People start to recognize how costly it is if Quality is ignored. But the approach to achieve Total Quality is still very reactive and only revolved around Defects. The next era moves away from that approach and focus more on gaining competitive edges through Quality.

4.4 Strategic Quality Management Era

From late 1970s to early 1980s, Quality is being looked at proactively and the general thought of achieving Quality always comes with a cost has disappeared. With the contributions coming from all preceding eras, Strategic Quality Management era marked the shift from product focus to customer focus, making Quality a competitive advantage. The Total Quality Control soon evolved into Total Quality Management, also known as Total Productive Maintenance, after incorporate all the previous quality elements into one whole new paradigm. The responsibility is still lying on everybody's shoulder, but the process had transformed control to management. This evolution started to occur when managements started to realize the connection between profits and quality.

4.4.1 Total Quality Management

Looking at Japanese perception, by changing the way the top manager thinking is the best way to impact the company they have gained huge successes from Post World War II period to early 1970s. By competing head to head against American even in their domestic's market, Japanese firms have gained significant consumer awareness

and benchmarked as superior products with lower prices and better customer services. Americans started to realize that their lower quality products can no longer compete with the Japanese unless there are changes in how they approach. This makes them aware that their market share can be affected by the quality of their products or services, and if they do not have competitive advantages over their opponent, they will lose their sales. So, they are driven to make changes. Total Quality Management was born based on the concept of Japanese's Company-Wide Quality Control, but the roots can still be traced back to American since most of Japanese developments are based on previous American Quality gurus. According to Schmidt and Finnigan (1992), the roots of TQM include:

- Scientific Management: Finding the best one way to do a job.
- Group Dynamics: Enlisting and organizing the power of group experience.
- Training and Development: Investing in human capital.
- Achievement Motivation: People get satisfaction from accomplishment
- Employee Involvement: Workers should have some influence in the organization.
- Sociotechnical Systems: Organizations operate as open systems.
- Organization Development: Helping organizations to learn and change.
- Corporate Culture: Beliefs, myths, and values that guide the behavior of people throughout the organization.
- The New Leadership Theory: Inspiring and empowering others to act.
- The Linking-Pin Concept of Organizations: Creating cross-functional teams.
- Strategic Planning: Determining where to take the organization, and how and when to get there.

Schmidt et al. (1992) also proposed some outdated and incompatible theories which managements need to get rid of:

- Bureaucratic Management: Direction from top management, compliance from the lower divisions.
- Caveat Emptor: Let the buyer know beforehand.
- MBO and MBR: Management by objectives and management by results.
- Internal Competition: Encourage each department to be number one.
- The Strategy of Organizational Stability: "If it ain't broke, don't fix it."
- Antagonism toward Unions: Workers' interests are basically different from managers' interests.
- Bottom-Line Driven: Profit leads to decision and action.

Total Quality Management operate based on 8 principles, according to Westscott (2013):

- Customer-focused: During previous era, managers are the one who decide the level of quality of the product. But in the end, customers are the one who is using the product or service, so they are the one who determine if the product or service is good enough. This mean more emphasis must be placed onto customer if you want to achieve quality.
- Total employee involvement: Continuing the Total Quality Control approach where it requires all the workforce to aim toward a common goal, by giving powers onto employees' hands, it could increase their commitment and performances.
- Process-centered: Focus on step by step process thinking on how to produce a product or service and deliver it to customer and how to monitor process to ensure quality.
- Integrated system: Continuously improving the functions of organization with the aim to exceed the expectations of customers and the firms.

- Strategic and systematic approach: strategic planning on how to integrate quality dimensions.
- Continual improvement: always making changes in order to not fall behind.
- Fact-based decision making: datamining and analysis to achieve best results.
- Communication: effective exchanges between cross-functional teams should keep employees in check with all critical changes.

Compared to the old era, Total Quality Management provides quality product or service to customers with the purpose to gain competitive advantage in the marketplace. Besterfield (1998) called the transformation from the old “a cultural change” and compared this new era with the previous one, which is summed up in Table 3.

Table 3. Cultural change after TQM adapted

<i>QUALITY ELEMENT</i>	<i>PREVIOUS STATE</i>	<i>TOTAL QUALITY MANAGEMENT</i>
DEFINITION	Product-oriented	Customer-oriented
PRIORITIES	Second to service and cost	First among equals of service and cost
DECISIONS	Short-term	Long-term
EMPHASIS	Detection	Prevention
ERRORS	Operations	System
RESPONSIBILITIES	Quality Control	Everyone
PROBLEM SOLVING	Managers	Teams
PROCUREMENT	Price	Life-cycle costs
MANAGER'S ROLE	Plan, assign, control and enforce	Delegate, coach, facilitate and mentor

Let's figure out how those elements are implemented to the system.

4.4.2 Concept of Quality Cost: Customer-focused

Earlier, in the Cost of Quality section, we have go through the Juran way of dividing the cost into two type of costs: avoidable and unavoidable. But after the development of Zero Defects and Total Quality Management, managers and authors start to realize that if the Quality is improved enough, the unavoidable cost can also be controlled. A new way of how to divide the quality cost is established. Considering that the Quality cost is part of the Quality management, it is used as a tool for management to identify how to improve quality and optimize profits. So, we can define that Quality Costs “represent the difference between the actual cost of a product or service and what the reduced cost would be if there were no possibility of sub-standard service, failure of products, or defects in their manufacture.” (Jack Campanella, 1990)

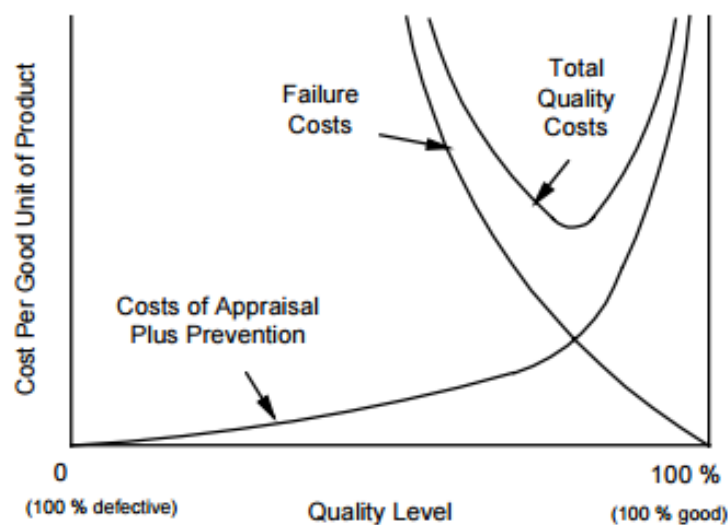


Figure 7. Juran's Optimum Quality Costs (1979)

To quantify this, Quality costs consist of: prevention costs, appraisal costs, and failure costs. Failure costs can come from Internal or External.

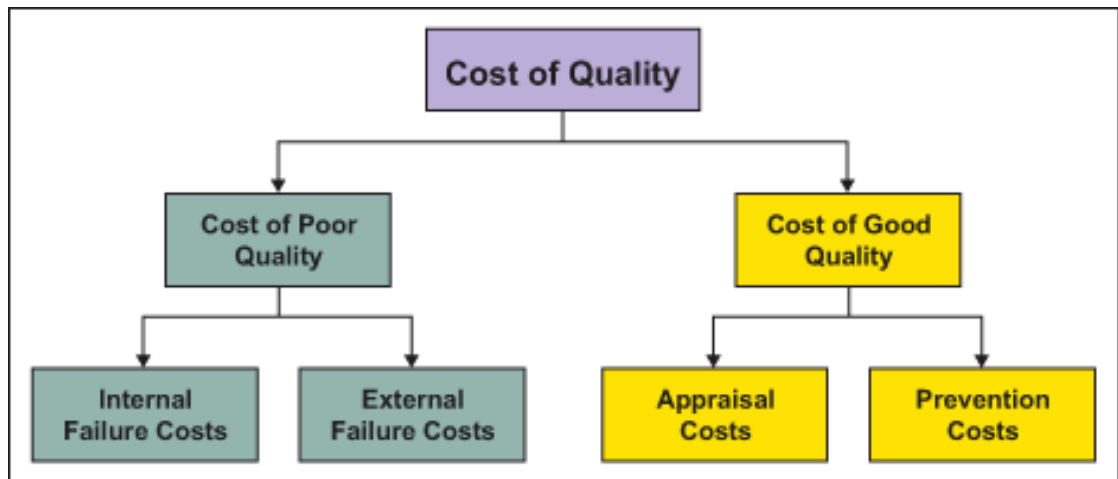


Figure 8. Quality Costs Diagram

While prevention costs are concerning the costs to prevent low standard products or services, appraisal are dealing with how to guarantee products or services will reach their standards. Both of those costs are usually the additional costs to ensure the product or service quality is in a good place, which are close to the definition of unavoidable costs. On the other hand, failure costs are the cost of defects in products or services, which is the avoidable costs. Each of these branches has their own issues so we need to take a closer look on the impact of Good Quality Costs and Bad Quality Costs.

4.4.3 Cost of Poor Quality

There was a time where managers are the one who decide the quality of their products. If the customers' demand does not fall within the line, they products are not going to sell. So, they need to improve their quality conformance to fit in with their customers' needs. This drives the cost of production to a level if they continue their production, they will make no profits whatsoever. This is when top managers start to realize conformance of quality is not enough to achieve profitability.

During the Quality Assurance era, Juran only recognized the true failure cost are coming from scrap and rework and the amount of time needed to do those tasks, so called tangible costs, while other activities are not considered. Those hidden costs, such as labor time, lost sales... are way bigger compared to these obvious costs. Because they are hidden, it is even harder to determine how big the actual impact of those costs is. The increase of these costs can affect the company in both way: loss of sales and higher costs. These two combination can spell doom to the company if it is not being taken a

careful look at. So, to minimize the failure costs, management must fully understand their supply chain.

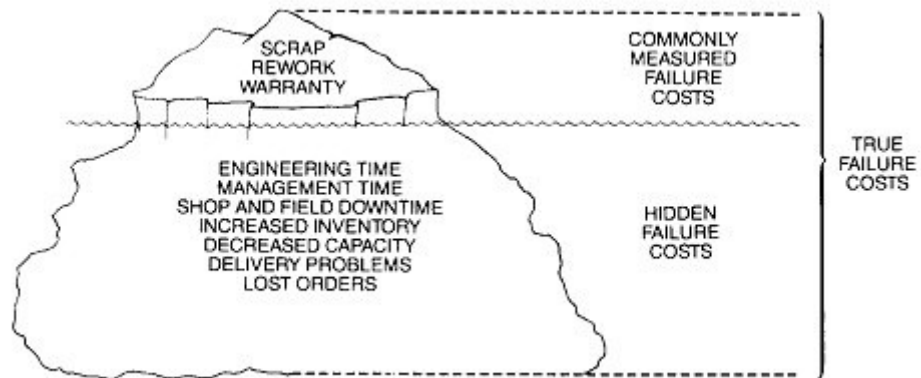


Figure 9. Hidden costs of quality iceberg (20-80)

However, understand the problem does not always come with capable of solving one. Tangible costs are visible, so it is possible to calculate the exact expenditures. On the other hand, hidden ones are not easy to measure. So, methods of approximating these costs are developed by Genichi Taguchi (田口 玄) called Quality Loss Function. Let's look at the function:

$$L = k(y - T)^2$$

- Where L = Quality Loss
- k = Cost coefficient
- y = Value of quality Characteristics
- T = Target Value

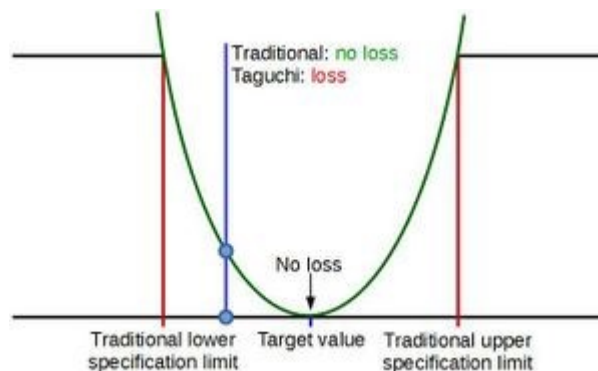


Figure 10. Quality Loss Function vs Traditional Loss Function

Unlike previous Quality gurus, Taguchi approach to Quality is a little different when he disagrees with Crosby's definition of Quality: "conformance for requirements." In his

own words, he defines quality as “the loss imparted to society from the time the product is shipped.” So, everything related to added value or dissatisfaction are considered a loss of quality in long-term run, and there are always losses which cannot be mitigated. Using the Quadratic Function, Taguchi shown the loss is the area of the region constrained by the Upper and Lower Specification limits and the parabola. This is shown by the nature of the quadratic curve as shown in Figure 8. Loss already occurs when Quality Characteristics is not marching the Target. Compared to the traditional approach, where only defects are accounted, Taguchi’s approach means that even when the product is not considered a defect, it is still causing loss if only the product is made according to target value. This is not the case for the traditional approach, when it only counts defects as the loss of quality, which can be seen with the blue line in Figure 10. Also, the further the product Characteristics (y) from the Target (T), the costlier the product is. And the product can achieve the state of zero losses only when the performance standard reached the state of “Zero Defects”. This is why Quality Loss Function can determine the Quality Hidden Costs since it does not only reflect the common measure failure costs but the hidden costs also.

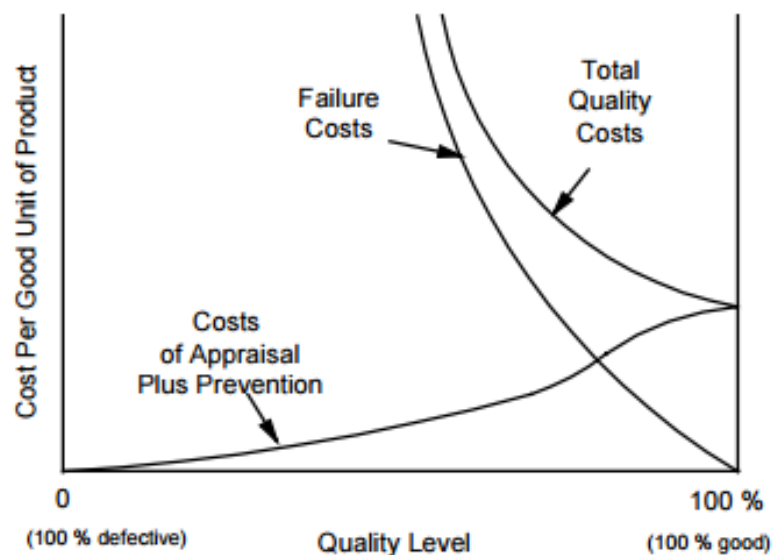


Figure 11. Crossby’s Optimum Quality Costs

Another issue that Quality Loss Function can tackle is the variation of acceptance products. The function Quality Loss will be decreased if the variation of the operation is reduced. If firms are not taken are careful look at how to control these variation, and if the deviation from the target keeps getting bigger, the loss will be larger and larger. This is why the drive for continuous improvement of the quality in supply chain are

created with the intention to maintain the stability of the operation and increase possible benefits.

To conclude, Taguchi's philosophy can be summed up by these 4 statements:

- We cannot reduce cost without affecting quality.
- We can improve quality without increasing cost.
- We can reduce cost by improving quality.
- We can reduce cost by reducing variation. When we do so, performance and quality will automatically improve.

Taguchi's Quality Loss Function does not only open a new way to look at Quality Costs, but also explore new dimensions of Quality that has not been exposed yet. The view that Quality is the conformance by Phil Crosby is just coming from his view as a supplier. But how does from customer perspective, what does it look like? To dig deeper, we need to identify what modern Quality is consist of. Besterfield (1998), adapted from David Garvin 1987's proposal, suggested that Quality can be described by 9 core dimensions, which will be explained in the table 4 below.

The two traditional elements of quality: conformance and reliability are now being included into a bigger and broader framework. Each dimension can be independent on its own, but some are going along well with each other, creating competitive edges if cooperate well. However, a product does not need to excel in all nine dimensions to be called quality product. In fact, it could increase the cost to implement such. Trade-offs are need to be considered. But still, it is a good baseline to set up new sources of innovation.

Table 4. Quality Dimensions

DIMENSION	MEANING
Performance	Primary operating characteristics of a product or service
Features	Additional characteristics which improve the attractiveness of a product or service
Conformance	The tolerance level of a product or service compares to specifications and standards
Reliability	The consistence level of outputs that a product or service can operate without failure in a window of time.
Durability	Product or service lifespan, usually when it is not economical to operate
Service	Respond time when product or service breakdown
Response	The communication behaviour of the sale serviceperson and how competence they are
Aesthetics	The impression from the users to a product or service, using 5 common senses. Usually based on personal bias.
Perceived Quality	Indirect measurements based on past performance of a product or service, or branding

4.4.4 The Kotler nine quality-price matrix

When a company introduced a new product or service, a company need to consider its actual value to determine the selling price. By comparing the Quality of the firm's product with its competitors, company could consider which market segment it wants to tackle and how should it product be priced. If your product is not priced appropriately, chances are you are going to lose sales and profits. There are cases when a product with lower quality can be more profitable than product which has higher standard

simply because the lower quality one has better perceived quality, or the higher quality product was being sold at a lower price, making customers thinking that the product quality was lower than its actual quality. This means that if the quality is not placed into the correct correlation to the price, the profits will be severely reduced. Therefore, firms need to know their brand positioning in correlation to competitors and their customer target group to select the correct strategy to use in every single situation. This is well-explained by Philip Kotler's Quality-Price Matrix, where he identifies the 9 variations of pricing strategy based on these two metrics.

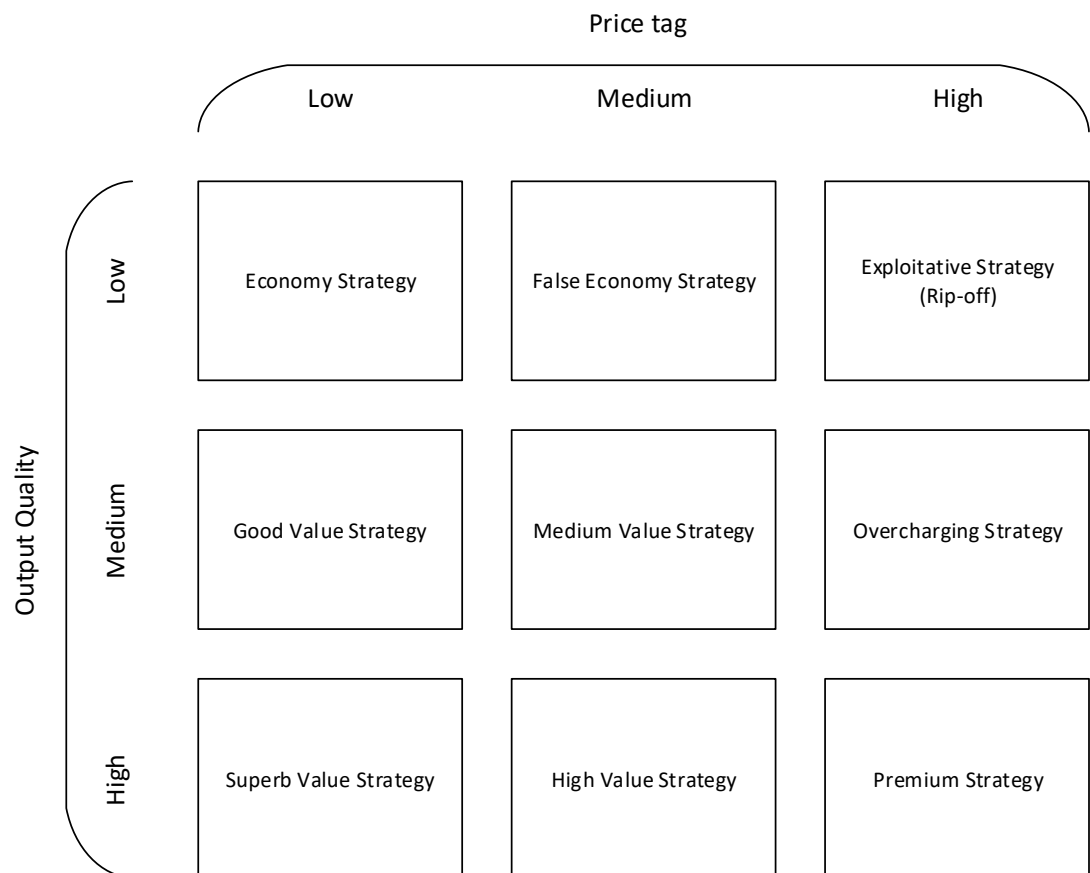


Figure 12. Kotler's Nine Quality-Price Matrix

Firms need to balance and optimize these two metrics to achieve a sustainable business model by deploying the correct pricing strategy. If not managed carefully, the quality and relationship can destroy a brand's perceived quality, thus creating a stigma which is hard to wash off.

4.4.5 Continuous Quality Improvement

In order for a firm to stay relevant to their counterparts, their products and services need to constantly be improved. The improvement can occur in multiple part of the supply chain, but the main goal of these implements is the satisfaction of the customers.

Juran in 1989 mentioned the possibility for improvement of quality by improving the customer satisfaction, product quality and delivery time. He reckoned if the communication between multiple departments can be improved, so can the Quality costs of the product and service. With that in mind, Juran Trilogy's approach to macro process, or cross-functional system, are a combination of three processes: planning, control and improvement. This approach is based on the financial management processes which was being used for a long time, making the implementation of the approach easier conceptually.

The planning process is the activity of establishing the requirements for product or service in order to satisfy customers' needs. By identify the target group and developing the feature based on the characteristics of that group and the operation capabilities, the planning process will maximize the chance to meet the customers' requirements. Also, the planning process will set the control points for the process, which will be moved to the manufacturing team to begin the production.

The control process is based on the standards which are set during the planning period. During this process, products are examined and evaluated. If there are differences in performance (sporadic spike), usually unplanned maintenance or system failure, troubleshooting for problems are required, and based on the problems, suitable actions are deployed. Changes in this case are usually corrective actions or maintenance process. This mean that the time consumed for these kind of actions is useless and does not add value to the product or service, hence Juran deemed these kind of actions "chronic waste." The end result is the resolve of the error and the operation level come back to the original setting.

The control process only help stabilize the quality, but to improve the Quality and increase its value, we need to ameliorate it. The improvement process is aiming to reduce the time taken for control the quality. In order to achieve such advancement

in quality, Juran suggested the establishment of infrastructure is required to actively secure continuous improvement. This required top managers to identify the area which need to be improved, and afterward, back the project with time and personnel to diagnose the root of the problem. The end results is the improvement of the quality, bringing quality closer and closer to zero defects status. This later can be referred to Research and Development process.

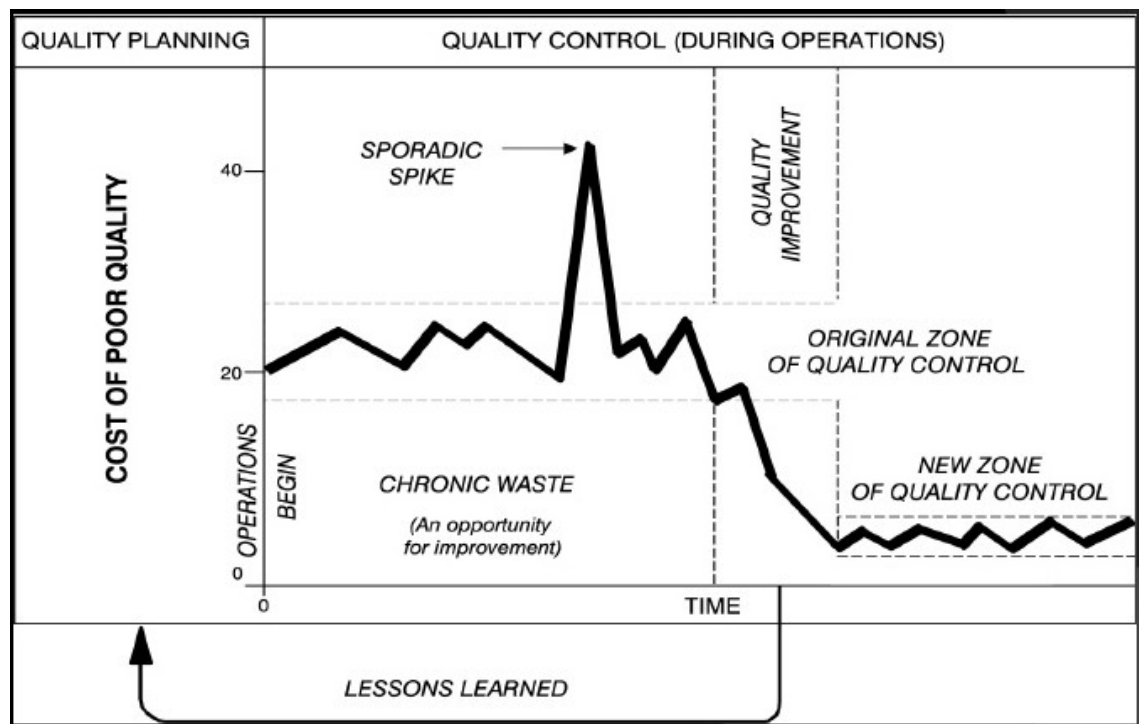


Figure 13. Juran's Trilogy diagram

According to Masaki Imai (今井 正明) (1986), there are two types of improvement: breakthrough or incremental. Breakthrough is a big leap innovation, which happens radically. This type of improvement usually happens in the West, while in the East, top managers usually want to implement new change slowly, in small steps. This process is called Kaizen. The figure below will explain more about the features of these two patterns of improvement.

Table 5. Kaizen vs Innovation (p. 24, M. Imai, 1986)

	KAIZEN	INNOVATION
1. Effect	Long-term and continuous, but undramatic	Short-term, but dramatic
2. Speed	Small steps	Big Steps
3. Timeframe	Continuous and rising	Interrupted and limited
4. Chances of success	Always on a high level	Abrupt and unsettled
5. Protagonists	Every single employee	The chosen few
6. Approach	Collective spirit, teamwork, system	Individual ideas and efforts, ruthless
7. Motto	Preservation and improvement	Demolition and reconstruction
8. Recipe for success	Conventional Know How and today's state of the art	Technological achievements, new inventions, new theories
9. Practical preconditions	Small investment, big effort to preserve the status quo	Big investment, small effort to preserve the status quo
10. Success orientation	Men	Technology
11. Criteria for evaluation	Performance and Processes for better results	Profit
12. Advantages	Best suited for slow growing economies	Best suited for fast growing economies

There are clear strengths and weaknesses in both types of improvement, for example, while Kaizen requires long-term investment into the company, which means the results do not come out instantly, Innovation requires technological breakthrough in order to work, and does cost a significant amount of money when implemented. However, both of these approaches still pursue the same goal: upgrade the performance of the system. Also, Imai realized that if combine these two patterns to form a symbiotic approach, that would be the best possible solution to any problems. Imai named this approach "continuous improvement".

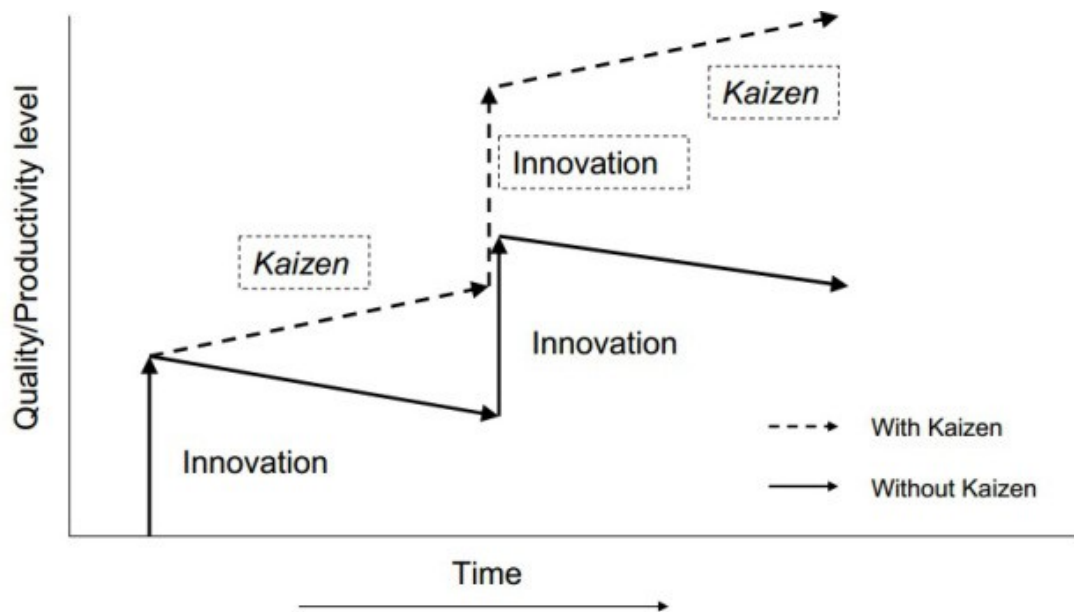


Figure 14. Innovation vs Continuous Improvement (Knuchen, 2015)

This diagram shows that, if human resource is well-trained, the Quality level will increase with time while the company waits for an innovation breakthrough. This combination of two process offsets both of the disadvantages of the two approaches but required top management responsibility to set up goals and directions in order to achieve that status.

4.4.6 Quality Standard

Knowing the benefits from collaboration is one hand, finding the suitable partnership that could continuously improve with each other is another hand. It is vital for the firm to find out the suitable supplier which can provide the necessary product or service quality required, so does supplier who seeking the perfect firm who could award them the most with the quality they offer. By set up a universal standard for quality, the process of identifying the correct partner will be easier. This is why certification for quality system standard are created. Some of the most notable certificate are ISO 9000 standard series, QS-9000, VDA 6.1, Malcolm Baldrige National Quality Award (BNQA), Deming Prize...

ISO 9000 family are a number of quality standards which specify the quality system capability to provide products or services which meet the customers and regulations requirements on a regular basis and the ability to achieve continuous improvements. Officially published in 1987, the standard origin is dated in 1980, where the technical

committee 176 is formed with the purpose of “Standardization in the field of quality management (generic quality management systems and supporting technologies), as well as quality management standardization in specific sectors at the request of the affected sector and the ISO Technical Management Board.” The standard has gone through multiple revisions, and the latest version is in 2015. EN-29000 European standard and Q9000 American standard are considered the same to ISO 9000. ISO 9000 family standard series contain 4 standards:

- ISO 9001:2015: Quality management systems - Requirements
- ISO 9000:2015: Quality management systems - Fundamentals and vocabulary (definitions)
- ISO 9004:2009: Quality management systems – Managing for the sustained success of an organization (continuous improvement)
- ISO 19011:2011: Guidelines for auditing management systems

While ISO 9000 are not available for individuals and organizations to certify, and ISO 9001 is the only standard which can be registered, we will focus more on the ISO 9001 standard.

The concept of the ISO 9001 standard is based on MIL-Q-9858A standard, which was published in 1963 by United States’ Department of Defense. The standard can be applied to any organizations which are qualified, regardless of their scale and where they operate. In order to acquire the certificate, organizations must prove that they follow the seven quality management principles: customer-oriented, management responsibility, employee engagement, process approach, continuous improvement, evidence-based decision making, relationship management. The relation between these principles can be related to the process-based plan-do-check-act model below.

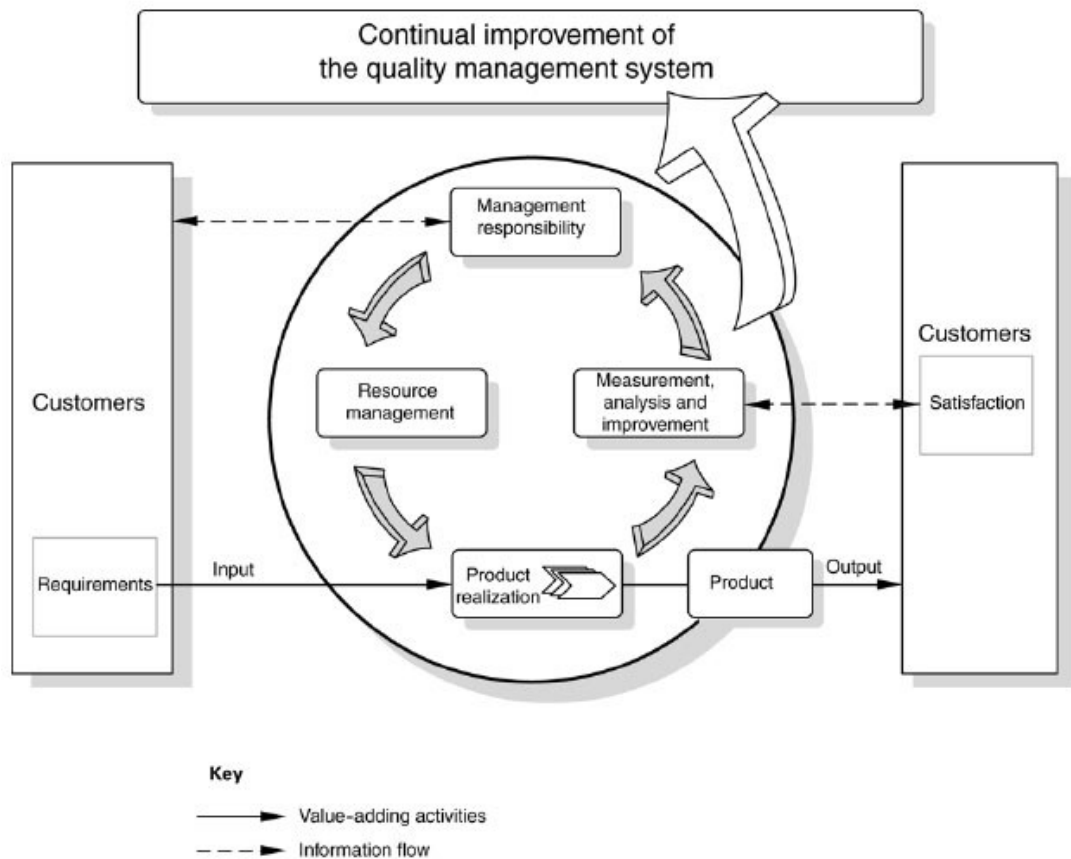


Figure 15. ISO 9001:2015 Process Model

Even though not all of the principles are shown on the model, it still demonstrates the emphasis on customers and the involvement of all departments. These seven principles are pretty similar to the Malcolm Baldrige criteria for performance excellence, except for the process approach, which is replaced by results, making the award focuses more on performance and innovation, moving toward benchmarking rather than being a world-wide recognition standard for quality system. Driven by Feigenbaum's ideology, Malcolm Baldrige National Quality Award are going further than ISO 9000 when taking into account the customer satisfaction, while ISO 9000 only put emphasis on the results of their system.

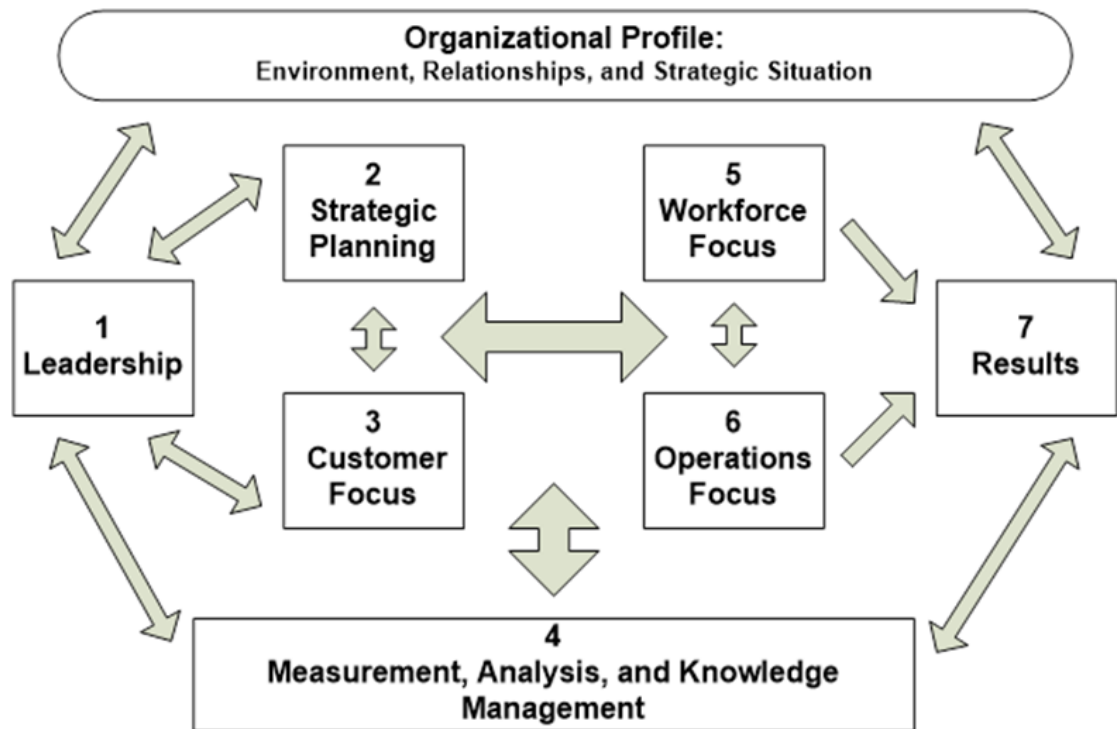


Figure 16. Malcolm Baldrige National Quality Award Criteria Framework (Hammar. 2015)

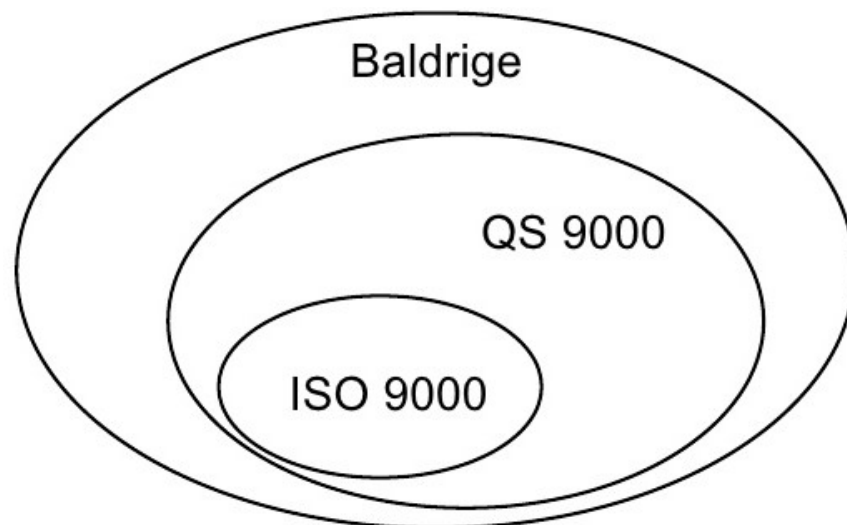


Figure 17. Quality Standards relationship.

There are also quality standards which are dedicated for the automobile industries such as VDA 6.3, QS-9000, SAE,... but these quality standards still serve one goal, which is to award organizations which has prominent quality management system in place.

5 Supply chain Management

When the term “supply chain management”, coined in 1982 started to gain popularity in 1990s, it has gained the popularity status of becoming one of the most used buzzword in operation managers. There are so many definitions for the term itself since there are so many perspectives on how to define it. But we will use this definition below to explain what supply chain management is:

“Supply chain management is the systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole”. (John T. Mentzer, 2001)

Since the definition is rather broad, we can shorten it up as an inter-organisational system working toward the same goal, increase profitability and gaining competitive edges. This make Supply Chain Management a small branch of Logistics and Transportation. Since Feigenbaum set up the cornerstone for Quality in Supply Chain, when mentioned the necessity to have collaborations between multiple departments to achieve better quality, the involvement of the whole supply chain process to quality has always been emphasized in literatures. But back then, his emphasis concentrated more on the internal supply chain, and has not considered the external one. When the concept of supply chain management started to gaining its recognition, people started to realize the interconnectivity of the two subject, thus marked the start of the supply chain quality management. Since the objective of supply chain management is gaining competitive advantages by collaboration and quality management is the continuous improvement of internal process to satisfy customer needs, we can define Supply chain quality management as the management of the supply chain collaboration to gain competitive advantages by continuously improving the operation standard and products/services standard to satisfy customer’s requirements.

Prior to the 1980s, procurement decisions in the West were still stuck in the mentality of the cheaper the better, thus they still aiming to buy raw materials, components and services from the lowest contract bidder. This could be one of the contribution to the

rise of Japanese products and services during that time, when the Japanese has already developed the aphorism of "Highest Quality is Lowest Cost". Therefore, when the practice of continuous development and improvement start to blossom in the West, suppliers and firms start to realize the price without basing it on quality does not reflect the true cost to the business ecosystem. In W. Edward Deming's 14 points on Quality Management, he also suggested that company should not award business based solely on price, and should try to minimize the total cost by working with one supplier, making the relationship evolved from short-term to long-term, which is the key point to measure the performance of the supply chain. If both side are going toward a sustainable collaboration where mutual are benefit from the partnership, it is easier to achieve a total quality control where joint efforts and shared knowledge are keys to success. Better collaboration means that the alliance will have more edges in the competition. Therefore, the urge to form a relationship between companies is increasing.

From the firm perspective, consider 40% of the production cost comes from purchased material, by securing a good supplier means they could mitigate some of the cost. Therefore, firm should set up very strict criteria for supplier selection. Firm should expect their vendors to understand the requirements and to have some knowledge in the sector. They need to find out the capability of their suppliers, quality wise and quantity wise. Another criterion which is important is the accessibility of the suppliers, how they can be reached when unexpected event occurred. Occasionally, suppliers might have to show their credibility since there might be events where trader's secrets or unreleased technologies are shared and need to be kept in the dark. But the most crucial criterion must be the standard of the quality system, or the supplier certification. ISO 9001 standard should at least be some criteria when judging a supplier since it is universally accepted. There are also situations where automobile company need its suppliers to have certain standard certificates but overall these standards will help firms reduce the amount of time identifying the right partners. Another overlooked advantage of collaboration is firm can omit investing on fixed assets which may become irrelevant after some time.

From supplier perspective, by having a good firm which accept their products or services capability means they can have a long-term partnership which they can rely on

and share their vision with. Collaboration between two companies will lead to shorter amount of time spending on inspections or random checking, meaning they can perform ship-to-stock scheme. Still periodic audits are usually required to ensure their capability.

Supplier can also come in forms of providing services such as transportation, contract manufacturer, co-packer ... these are a form of outsourcing. If company and supplier is looking to collaborate with their supplier using this strategy, they need to find out if their quality standards and management system are appropriate and follow each other guidelines.

It's argue that whether vendor or supplier should be the one who lead the charge. But to author's opinion, the leader role should not be too importance since the partnership is based on mutual interests and both party are beneficial.

To sum up, to ensure products and services quality and maintain a good relationship between firm, in this case, the vendee and the vendor, Kaoru Ishikawa has set up 10 principles, translated by Hinshitshu Kanri, in 1967, which both parties need to follow:

- Both vendee and vendor are fully responsible for applications of quality control with mutual understanding and cooperation between their quality control systems.
- Both vendee and vendor should be independent and respect each other.
- The vendee is responsible to the vendor for offering the demand that the vendor clearly understands what he should manufacture.
- Both vendee and vendor should sign a rational contract when they begin trading regarding with quality, quantity, price, and the data of delivery, etc.
- The vendor is responsible for the assurance of quality that will give satisfaction to the vendee, moreover complying with a request for providing the objective data needed.
- Both vendee and vendor should decide the method how to evaluate the products for both being satisfied.

- Both vendee and vendor should decide the systems and procedures for the trouble resolution when the contract is established.
- Both vendee and vendor, should exchange necessary information to carry out quality control taking into consideration the other parties' standing.
- Both vendee and vendor should keep sufficient on control ordering, production, inventory planning, paperwork and organization, etc. to maintain their smooth relationship.
- Both vendee and vendor should always take the consumers' advantage into account at the transactions

These principles set up the basis for a long-term relationship of working together to achieve common goals, to satisfy customers' requirements by continuous quality improvement and to form a beneficial symbiotic partnership.

6 Summary

"Quality is a people business." But when everybody think that they are responsible for quality, they feel that they are not accountable for the quality job, so stating that it is everybody's job is not enough. If people do not believe quality is important, it is a war to achieve quality. Therefore, Quality must come from the top and need to be spread to the lower divisions. As Phil Crosby stated in his "The Quality Crisis in America" article (2010), "The product looks like the management", managers, CEOs or even supervisors, workshop leaders are the one who ultimately guide the supply chain to reach their Quality goal, since they are the authorization. So, the responsibility for quality must come from managements, prior to it being placed on the workers.

Throughout the development of modern industry, the way people viewed Quality has also evolved. Different people from different eras have different perspectives toward the subject, which can be seen in table 6. But in general, all of them agree that top managements should be the guiding light to the Quality issues. They also demonstrate Quality as a game changer, which if one could get a hold of it will not only save money but also gaining competitive advantages over the others. Never-ending improvement

is also stressed, and is urged to become the main motivation to produce a quality product or services.

Table 6. Quality Gurus' Philosophy – Summary of Approach

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
TAGUCHI	Supply led	Process/Design	Quality loss function Value to Society
ISHIKAWA	Value led	People	Company-wide quality control/quality circles

7 Cases Study

7.1 Tata Nano: One Lakh Rupees Car.

7.1.1 An Innovative Approach

March 2009 marks the launch of the Tata Nano, the world cheapest car. Announced in 2006, the final product is the result of the collaboration between Tata Motor and its suppliers to create an affordable production car with such a tight budget. (₹100,000 ~ \$2000-\$2500 at the publish time) Tata is the biggest auto manufacturer in the South Asia, producing mainly commercial vehicles, vans, coaches and passenger cars. Ratan Tata, Chairman of India's Tata Group made a promise to realize his dream of providing the masses of India with the "people's car". He is directly involved in the project, take part in making the decision of how should the car be benchmarked.

The design team had to face so many challenges while creating the car since with such limited resources, as Krishna G. Palepu et al. (2011) pointed out, breaking the price-quality barrier. This revolutionary decision created such a unique situation where the Nano design is not solely based on Tata's design, but are the contribution of their suppliers. Tata gives their 1vendors free will to do whatever they want with their components, but must be within a certain weight and cost objectives.

The design of the car, from systems to interiors are simplified and due to it limited budget, the car must be made as light as possible. Therefore, the car two-cylinder engine design is inspired by two-wheel scooters, where both the weight and cost of the car will be lower. In additional, installation of air-conditional and radio on cars required additional fees, thus making Nano's sole purpose is for commute, and targeting the poor families who wants to have a car to travel around the city instead of having 4 people riding a scooter.

The introduction of the car created much hype surround it. Promised to be a "safe, affordable alternative" for Indians who struggle daily to commute around the crowded cities, hyping the car and raised it to fame status in just a short period. But not for long...

7.1.2 Quality Crisis

By giving almost full authorities to the suppliers on how to design car's components, Tata are given their suppliers some difficult challenges and expected their partners to pull it off. Although this is an innovative approach to the problem, it creates too many risks for both parties to deal with.

From the supplier's perspective, by having them in charge of the design, meaning they must invest upfront in developing their own technology to produce a brand-new component without any previous references. In addition to that, the component design specifications are also constrained by the weight and the cost, making it difficult for suppliers to come up with the proper designs and materials for the parts or components, which might decrease the conformance, performance and durability aspect of quality of the final product. Not only that, Tata's Nano is the combined work of nearly 100 suppliers, which should be on the same page to complete this challenge. (Ashish

Kumar Mishra, 2010) This put a lot of suppliers out of their comfort zone, thus causing the production delay throughout the supplier chain and more severely, their final product, the Nano itself, catching fire while operating on the road. (Matt Eyring, 2011)

There is multiple reason why such incident happens, low quality components such as combination switches and banjo bolt, poor choice of materials... but whatever the reason is, it has cause serious consequences. The fire problems did not do company any favors, instead, it created a bad impression that the car is not as safe as it was hyped to be, thus reduce the sale significantly (from 9000 in July 2010 to 500 in January 2011). (Matt Eyring, 2011)

The released car also faces problems concerning the actual market segment which Tata was targeting. Self-proclaimed "People's Car", the car hardly achieved any sales in its targeted customer group, scooter-riders, and only attracted those who want to invest in a second car or curious about what the cheapest car in the world could offer. Their targeted group simply does not want to upgrade their scooters, which is convenient to commute in the infamous traffic of India, to a car which does not have any utilities. They would rather buy a secondhand car such as Maruti 800 or Suzuki Alto, which cost roughly the same price as a brand-new Nano which has air-conditional, a feature which is important considering India is a tropical country. Or they would order a customized Nano which has additional features, increasing the total price of the vehicle, making it more expensive, thus bringing the price closer to a brand-new Suzuki Alto. (~\$500 cheaper) The product quality does not meet what customers required, which going against the main idea of total quality management.

So why does this happen? There are lots and lots of paperwork pointed out that the problems come from the innovative approach of the company. But when thinking carefully on what is the actual problem of the car, it is simply because the car's components failed to deliver its expected quality value: performance and durability. This comes from the lack of coordination between the firm and their suppliers, total quality control to be exact. Managements did not provide the necessary specifications, only cost and weight are considered. This make the process of product design more complicated, thus when parts are coming together for assembling, low quality components still being used.

For example, the combination switches of the Nano were initially provided by Shutham Electric, a notable supplier of switches for many company such as Mahindra & Mahindra, Fiat, Nissan and Tata itself. (Ashish Kumar Mishra, 2010) After some cars bursting into flames, they changed the supplier to UNO Minda. The change somewhat mitigates the issues, but then a second wave of cars getting smoked, indicate that the issue does not simply come from the suppliers. This indicate there are flaws in the way Tata handles the collaborative design processes. The idea needs only 3 years to realize, a short amount of time to introduce a new automobile. By taking charge of the whole supply chain system, Tata should know their supplier better, capacity and capability wise, and putting too much responsibility and pressure on their supplier, both time and money wise, making the quality of the Nano lower than expected, thus causing the company to take a huge blow to recover from.

7.2 GM Automation Transformation

7.2.1 The start of something Wonderful...

Late 1970s marked the prosperous growth of industrial robotic in the US. Companies started to show interests in using robots in production. One of the first company who showed such enthusiasm toward the new paradigm shift is the automobile heavy-weight General Motors. By 1980, GM has been using around 300 robots serving multiple purposes in their manufacturing plan. And when the company appointed their new CEO, Roger Bonham Smith, a pro-technology applier, he brought his vision of a fully-function-by-robot production line to the company as well. To realize his ambition, in 1982, GM joint venture with Fujitsu-FANUC to make them their supplier for high-tech robot for manufacturing purposes and trying to gain competitive advantages over their rivals. By 1995, GM received a total of 14000 robots which was supplied by FANUC, costing the company \$40 billion, bringing hope and expectation to that the change can help the company compete head to head with their Japanese counterparts.

7.2.2 ... Or Not?

Roger Smith's vision was not realized, instead, it does not only jeopardize the attempt to create competitive advantages over their rivalries, but also hampered his company. Poor quality assembly lines, robots malfunctioned plus the different design models and product differentiation created difficulties for GM to adapt to such radical change, causing the company factories production rates and costs to increase significantly, eroded the company's perceived quality. (Alex Taylor, 1992). This started the company's disaster, when robots were being left out of the equations because workers cannot properly operate them and the company failed to deliver a proper assembly plan. The company automation system productivity cannot compete with the Japanese's lean production method, which was proven to be superior due to the lower initial investment, lower costs and less employees.

The blame can be put onto the industrial robot manufacturer for producing glitchy robots, but if the company does not provide a quality assembly line to establish such expensive automation system, the company is also the one to blame. When the partner does not have an asynchronous pattern of development, this could lead to complications and could affect the supply chain. The consequences can be clearly seen in the number of robots GM owned throughout the time.

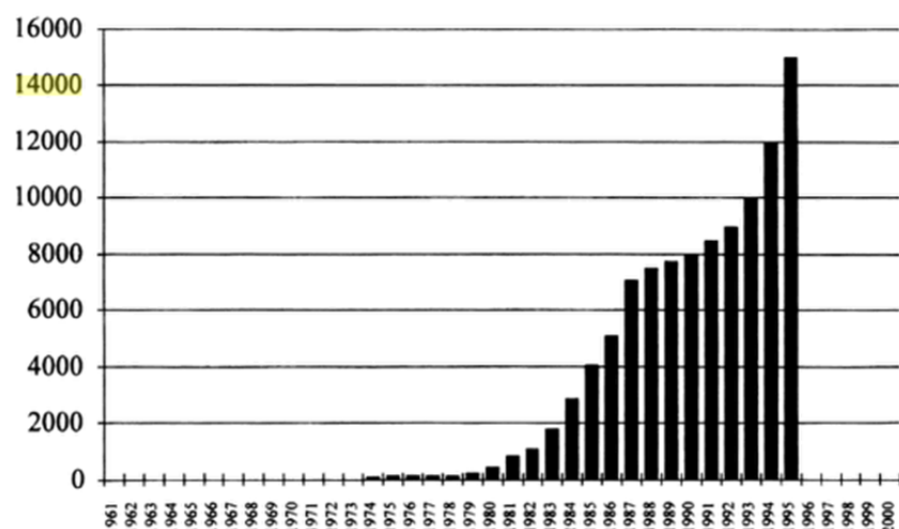


Figure 18. GM's Robot Usage over time. (Shimon Y. Nof, 1999, p. 34)

14000 robots were never fully utilized mean billions of dollars poured into the development process are flushed down the drain, and to make it even worse, during the

economic recession. Consequences? Roger Smith, the one who start the downfall of GM, got fired and being deemed by CNBC as the “Worst American CEOs of all time”. The company market share took a huge blow, shrinking from 46% when Smith arrived to 35% when he left, losing their customers to other US automobile manufacturers and Japanese counterparts. The perfect way to describe the company’s loss is to quote one of GM finance executive comment that the amount of money spent on the robot project “could have bought both Toyota and Nissan”.

7.3 Zero Defect assembly line

7.3.1 Juran’s Optimum Quality Costs vs Crosby’s Optimum Quality Costs

Each Quality Guru has their own philosophy on how they view Quality. While Juran defines Quality based on customer’s expectation and emphasize on people with the fitness for purpose approach, Crosby tackles it via supply chain, putting emphasis on performance and approaching the Quality with Zero Defects. Their differences can be seen in the way they perceive quality costs.

In Figure 6, Juran’s approach implied that the total quality cost will be minimized if the quality of the product is increasing, to the point where the appraisal and prevent costs is too big compared to the failure costs, making the total quality costs increase again, to the point where the quality reach 100%, the cost of good quality will be infinite. This mean there is a zone where the quality of the product is good enough, which does not require further investment on cost of good quality anymore. This contradicted the Crosby’s approach where he does not accept anything that is below perfection (100% Quality), and advocated that Zero Defects can only be reached by having continuous improvement, meaning that at some point, the cost of good quality is the actual total quality costs. Still a lot of company considered products which fall within their constraint limits (<100%) as Zero Defects product.

7.3.2 Weiplas Zero Defect programme

Weiplas is a first tier Plastic Technology Company located in Switzerland. The company main operation is to manufacture plastic parts and components for automobile companies. The company want to achieve Zero defects status by applying lean

processes to their assembly line by manually assembling and inspecting their product in each workstation, reducing the total amount of inspection time for both vendor and manufacturer and also help reduce the cost of scrapping and rework, making the process more efficiency. In order to do so, the company collaborate with Flexible Montagetechnik GmbH, a Bosch Rexroth framing distributor to create a perfect workstation which can help reduce the output time and automatically compare the measurements of the product to the specifications value using suitable measuring systems. The light indication will decide if the final product is qualified or not by showing green and red light respectively, help ensuring the Quality of the product right at early stages. (Jim Camillo, 2015)

This process applied the breakthrough innovative approach to the quality assurance problem where each individual product quality is determined. Any faulty components will be identified and removed right away, meaning inspection process is not necessarily needed further down the process design. But can the total quality cost be lower? Quality improvement is a continuous process, so achieving Zero Defects does not necessarily mean that the company has reached its highest peak in terms of quality. When taken into account the process time, human factor can also be improved, meaning there are always room to improve efficiency. Training workforce to use the system can reduce the output time significantly, thus saving time and increase the process productivity, lower the total cost even more.

8 The importance of Quality to the collaboration between focal firm and first tier supplier(s)

Going through 3 cases, it is noticeable that a collaboration cannot succeed if both parties do not pay close enough attention to Quality of their product.

Tata supplier management system is an exemplar among those of automobile industries, having a 3-step supplier auditing process, but they still manage to mess up their components due to the lack of communications with their suppliers and simply does not put themselves into their suppliers' shoes. They think giving their partner instructions and specifications is enough to receive the result that they were expecting. It is common in businesses that you assess your partner based on their

previous work, but when taking on a completely new product with such challenge requires the firm to become the voice of the project. Tata was not having the right mentality. Exchanging information, let your partner know the challenge you are facing, and mutually making decisions and adaptations to the problem is the best way to achieve the objective of satisfying end-customer needs. After all, the goal of Quality is to execute what customer requires from you, turning it into a process, and balancing the quality, cost and timing factors.

General Motors approach in the new paradigm is innovative and ambitious, but not in sync with their suppliers. The robot quality was off, the actual manufacturing plan was not capable of handling the hi-end robot due to poor assembly line quality. If they downscaled it, trained their worker properly and partnering with FANUC to produce a perfect framework for everything to operate, the plan could have worked. GM's approach is also an issue. They place too much emphasis on how to improve their productivity but not efficiency, focus on mass production and not on customer's requirement. Japanese automobile strongholds did the opposite, focused on producing a more lean manufacturing, which see them taking over part of GM's marketshare. The timing of entry was also unfortunate, right when the economic recession was happening, thus put the company in such a grim spot. If their high-end automation system was implemented and utilized successfully, who would have known where the position of the company would be today.

Weiplas is able to apply the zero defects program into their production, which is the end-game Quality strategy. But it does not mean that their Quality cannot be improved. They can still reduce the output time by cooperate with their supplier to produce a better framework, adding services into the product to increase the product quality value. Continuous Quality improvement always needs to be happening, and collaboration needs to consider every single aspect carefully.

Quality plays a pivotal role in deciding the collaboration is effective or not. If Quality is not assured by one of the party involved, the cost for poor quality would be devastating. This is why it could be vital for firm and suppliers to partner up with each other to motivate and push the level of Quality from one another up. Ultimately, Quality is the people's business. Make it or break it, all depends on your products and services Quality.

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