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Quality, a Key Value Driver in Value Based Management

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ABSTRACT

Il VBM riconosce che la performance finanziaria - basata sul profitto e sul valore del capitale - dipende in modo *causale* dal livello di qualità dei prodotti e dei processi e che, quindi, la qualità è la condizione per produrre valore per il cliente e valore finanziario per gli azionisti. La qualità è un concetto "elusivo", ma per il VBM credo ci siano tre nozioni di qualità da considerare nel processo di produzione del valore:
– *qualità funzionale*, secondo cui il prodotto deve essere idoneo per soddisfare i bisogni e le aspirazioni del cliente;
– *qualità progettuale*, in base alla quale il prodotto deve, in ogni caso, conformarsi a un design, un prototipo o standard;
– *qualità ambientale*, in base alla quale il prodotto non deve solo soddisfare i clienti ma essere compatibile con l'ambiente.
Questo studio si propone un duplice obiettivo. Cerca, innanzitutto, di analizzare i diversi modi in cui VBM deve considerare la qualità come un *driver di valore*; in secondo luogo, si propone di indicare le linee guida in base alle quali il VBM può sviluppare una strategia di Total Quality Management, o Company-Wide Quality Control che si integri con le altre "strategie di creazione di valore".

VBM recognizes that financial performance – based on profit and the value of capital – depends in a causal way on the level of quality of products and processes, and that therefore quality is the condition for producing value for the client and financial value for shareholders. Quality is an "elusive" concept, but for VBM I hold there are three notions of quality to consider in the value production process:
– *functional quality*, according to which the product must be appropriate for satisfying the needs and aspirations of the clients;
– *design-based quality*, according to which the product must, in any case, conform to a design, prototype, or standard;
– *environmental quality*, according to which the product must not only satisfy the clients but be compatible with the environment.
This paper has a twofold objective. It seeks above all to analyze the different ways VBM must use to consider quality as a value driver; and, secondly, to indicate the guidelines based on which VBM can develop a strategy of Total Quality Management, or Company-Wide Quality Control, which is integrated with the other "value creating strategies".

Keywords: functional quality, design-based quality, environmental quality, Value Based Management (VBM), value perceived by the customer, profit as a function of quality, quality and productivity as value drivers, quality assurance, company-wide quality control, quality drives loyalty, confidence and reputation of the firm

1 – Introduction

The spread of Value Based Management (VBM) is relatively recent. Only since the 1990s have many large firms turned to this managerial technique, whose objective is to direct management toward the primary goal of creating shareholder (owner) value.

For Arnold, VBM does not represent a new management technique, a specific method, or a new system of control; rather, it is a mental attitude toward the systematic maximization of shareholder value: "*Value-based management is a managerial approach in which the primary purpose is long-term shareholder wealth maximization. The objective of a firm, its systems, strategy, processes, analytical techniques, performance measurements and culture have as their guiding objective shareholder wealth maximization*" (Arnold, 2000, p. 9).

To understand the logic of VBM, some further brief considerations are useful (for a more detailed discussion, see (Arnold and Davies, 2000; Mella and Pellicelli, 2008), though a detailed analysis of the system of strategic entrepreneurial performance objectives is not possible here.

In small- and medium-sized firms, where equity is concentrated in the hands of one or few "owners", the highest-order managerial objective can be considered to be the achievement of the *maximum flow of profits* from the most limited use of equity possible. The *return on equity* (roe) becomes the main indicator of economic performance, as long as it is in line with the institutional goals and compatible with the financial constraints regarding the raising of the capital necessary for survival and organizational growth, while also respecting the monetary constraint of a balanced cash management. For large corporations, where the capital is controlled by a large number of shareholders who can exchange their shares on the capital markets, the maximum objective of corporate governance becomes the pursuit of a continual increase in shareholder value; this objective translates into the *managerial objective* of obtaining profitability levels that maximize the *Economic Value of the Firm* (EVF), since the EVF defines the theoretical value of share trading.

In short, recalling that the value of an amount of non-redeemable capital, K, corresponds to the present value of its future average income, R, discounted at a chosen rate "*i*" based on the well-known formula for discounting a perpetual income stream (K = R / i), then, in a totally analogous manner, the *Economic Value of the Firm* can be calculated as follows:

$$EVF = P^* \,/\, ce^* \qquad [1]$$

where:

– P^* represents the *expected future average profit* of the firm before taxes (EBT), calculated with reliable and realistic multi-year plans;

– ce^* signifies the *cost of equity*; that is, the *expected financial interest* or *dividend yield* that would convince the shareholder to invest equity in the firm, a *yield* the company must guarantee in order to keep intact the shareholder's investment; thus, for the firm, ce^* theoretically represents the cost of attracting and maintaining equity.

The objective of *monetary profit* gives way to that of the maximum *return on the shares*, and thus to the maximization of *shareholder value*; as a result, the need *inevitably* arises for management to move toward a *value based approach*, continually changing the composition of the businesses in the portfolio, abandoning the low profit ones for new ones with higher returns in order to maximize the EVF, which translates into maximizing the *return on equity* (roe) and the *return on invested capital* (roi) (Copeland, Koller and Murrin, 2000, p. 87). This can easily be demonstrated by indicating E as the amount of the original *equity* investment which is assumed to produce P^*, which results in the following ratio:

$$roe^* = P^* \,/\, E \text{ (return on equity)} \qquad [2]$$

representing the highest-order *managerial performance objective* of the firm, since it allows us to quantify EVF, as can be seen from the simple comparison of *roe** and *ce**. In fact, substituting P* from [2] into [1] we get:

$$EVF = E\ (roe^* \ /\ ce^*) \qquad [3]$$

If $roe^* = ce^*$, then EVF = E; only if $roe^* > ce^*$ does it follow from [3] that EVF > E and the firm produces value for the investor. The difference: G = EVF – E is defined as the synthetic value of *goodwill*, representing the *capital gain* to the capitalist if the firm is sold.

Morin and Jarrel consider VBM from an organizational point of view, arguing that VBM "*is both a philosophy and a methodology for managing companies. As a philosophy, it focuses on the overriding objective of creating as much value as possible for the shareholders. ... As a methodology, VBM provides an integrated framework for making strategic and operating decisions*", Morin and Jarrel, 2001, p. 28).

As a philosophy and a methodology for managing companies, VBM has three basic principles:

1. spread shared ethical values, thereby developing trust in the intrinsic value of each individual, whether the latter is a partner in the company, a client, a supplier, or an employee;

2. distribute the results obtained for the benefit of all internal members of the organization that have contributed, directly or indirectly, to the production of value as part of a team, as a worker, or even as an owner or shareholder;

3. not to limit itself only to producing and distributing value internally, but also to achieving the maximum external value for the client, assuring him the maximum *value for money function* (Wellemin, 1990), understood as the maximum quality at the lowest price:

$$\text{value perceived by the customer} = \text{quality} \ /\ \text{product price} \qquad [4]$$

These principles represent the main elements that guide the formation of the "value creating strategies" of firms adopting VBM (Rappaport, 1998). "*Once the company develops strategies, a number of operational drivers that are key to implementing the strategy have to be identified. By focusing on these operational drivers, the company's strategy is successfully implemented, which in turn improves the value drivers, creating aggregate value*" (Morin and Jarrel, 2001, p. 343).

While the first two principles have been widely treated in the literature (Serven, 1998; Rappaport, 1998; www.cesj.org/vbm/vbmsummary.htm), the third deserves further treatment since the production of value for the client not only is an objective to pursue but also represents a fundamental driver for profitability, and thus shareholder value. Therefore, this study seeks to analyse the ways in which VBM must consider quality as the value driver and the guidelines for controlling this driver from the perspective of "value creating strategies". After introducing three basic notions of quality and analysing the relevant literature, the paper will deal with the strategic approaches VBM must adopt to control those economic aspects of quality which most impact profitability.

2 – Theoretical Framework. The Three Forms of Quality

The concept of quality is not easy to define (Plunkett and Dale,1987). It is "elusive", and understanding it is normally left to intuition. Several scholars have proposed giving up the attempt to precisely define the concept, viewing it as an intuitive, non-definable, almost primitive, philosophical, even *metaphysical* notion derived from the concepts of differentiation, excellence, perfection and consistency. For (Tuchman, 1980), quality means "*investment of the best skill and effort possible to produce the finest and most admirable results possible....You do it well or you do it half-well....Quality is achieving or reaching for the highest standard as against being satisfied* *with the sloppy or fraudulent....It does not allow compromise with the second-rate*" (p. 38). Pirsig (1974), in his book "Zen and the Art of Motorcycle Maintenance: An Inquiry into Values", introduces the idea of the Metaphysics of Quality, where quality is a direct experience independent of and prior to intellectual abstractions. "*Quality is the continuing stimulus which our environment puts upon us to create the world in which we live. All of it. Every last bit of it. Now, to take that which has caused us to create the world, and include it within the world we have created, is clearly impossible. That is why Quality cannot be defined. If we do define it we are defining something less than Quality itself.*" (Pirsig, 1974, p. 114).

Quality must be ensured for the customer as a condition of survival for the firm, since it influences the efficiency of the production and market processes, both in terms of revenues, by influencing the selling price and demand level, and costs, since a variation in quality levels causes a variation in the cost of quality certification, protection and restoration (see: section 4 and following).

From a managerial perspective, the quality of goods or services produced by firms is defined in the UNI EN ISO 9000 as: "*Whatever the customer perceives good quality to be*", referring not so much to the intrinsic features of the product as to consumer tastes and experiences. In 1983, the American Society for Quality Control (ASQC) proposed a more specific definition: "*A subjective term for which each person or sector has its own definition. In technical usage, quality can have two meanings: 1) the characteristics of a product or service that bear on its ability to satisfy stated or implied needs; 2) a product or service free of deficiencies. According to Joseph Juran, quality means "fitness for use"; according to Philip Crosby, it means "conformance to requirements*." (ASQ, 1991, online). In addition to being general, these definitions are also generic (Russell and Miles, (1998). Some definitions emphasize several characteristics of "quality" products or the extent to which these characteristics are perceived by the customers as being present in the products. Leffler (1982) states: "*Quality is based on the presence or absence of a particular attribute. If an attribute is desirable, greater amounts of that attribute, under this definition, would label that product or service as one of a higher quality*" (Leffler, 1982, p. ??).

For Feigenbaum (1951): "*Quality is "best for certain customer "conditions*" (p. 10). In a similar vein, Flood (1993) states that: "*Quality means meeting customer (agreed) requirements, formal and informal, at the lowest cost, first time every time*" (p. 48). Kemp (2006) views the customer as the main evaluator of quality, which represents: "*all elements of our product that add value for the customer or stakeholders, or are required for our product or service to meet relevant standards and regulations*" (p. 331). Hoyle (2007) states that "*Quality is the extent to which a product or service successfully serves the purposes of the user during usage (not just at the point of sale*)" (p. 10).

Garvin's analysis (1984) goes deeper. He highlights eight basic dimensions of quality: l. Performance: a product's primary operating characteristics; 2. Features: the "bells and whistles" of the product; 3. Reliability: the probability a product will operate properly over a specified period under stated conditions of use; 4. Conformance: the degree to which physical and performance characteristics of a product match pre-established standards; 5. Durability: the amount of use one gets from a product before it physically deteriorates or until replacement is preferable; 6. Serviceability: the speed, courtesy and competence of repair; 7. Aesthetic: how a product looks, feels, sounds, tastes, or smells; 8. Perceived Quality: subjective assessment resulting from image, advertising, or brand name.

Taking into account these various meanings of "quality", in order to give coherent definitions I propose identifying three distinct, though connected, notions that sum up the majority of definitions found in the literature and allow us to focus on quality from a threefold perspective: the customer, the product and the environment: *functional*, *design* and *environmental* quality.

FUNCTIONAL (OR MARKET) QUALITY defines the set of characteristics which, from the customer's point of view, make the *product* appropriate for *use*; that is, capable of satisfying a specific *use* *or utility function* of the good or service (Band and Huot, 1990; Band, 1991) – in other words, the relationship between the user's needs and aspirations and the merchandising characteristics of the product – taking into account a desired standard of *reliability* (the product must provide use that is not interrupted due to imperfections) and *safety* (the product must be capable of use without damage or risks), as specified in ISO/IEC 9126:1991 (Ebeling, 1997; Krishnaiah and Rao, 1988; Oakland, 1989). In this sense, for Ryall and Kruithof (2001): "*Quality is consistently meeting the continuously negotiated needs and expectations of Customers, in the context of the needs and expectations of other interested parties, in ways that create value and satisfaction for all involved*" (p. 20). ISO 8402: 1994 (Quality Vocabulary) specifies the concept as "*the totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs*". In ISO 8402:1986, version 3.1, the definition is: "*The totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs*", very similar to that proposed by ASQC: "*The total features and characteristics of a product or a service made or performed according to specifications to satisfy customers at the time of purchase and during use*". *Functional quality* is the basis for *customer satisfaction* (Wellemin, 1990) as defined in ISO 9001:2000 (8.2.1), known as "Vision", which in fact emphasizes functional quality: "… *if before Quality meant satisfying all the Customer's expectations, now the concept of "expectations" is broadened and enriched through adjectives such as "explicit*" and, above all, "implicit", with regard to both the external Customer – the recipient of the products – and the internal Customer – the department that receives the components and services of the other departments. In this sense, quality refers to the concept of 'fitness for use': that is, "*the extent to which a product successfully serves the purposes of the user*", (Juran, 1999) and of "attractive quality", which defines what the customer desires even though he is not yet aware of this (Kano et al., 1984).

DESIGN (OR *INTRINSIC, PRODUCTIVE*) *QUALITY*, or conformance to specifications, is the set of characteristics that, from an internal point of view (in terms of production processes) make all the product units *conform to a standard of reference* (prototype, sample, model, design), as stated by Crosby (1979), who defined quality as "conformance to requirements or specifications" (Shewhart, 1931; Levitt, 1972). To Crosby, any product that falls within its design requirements is a quality product (Garvin & March, 1986), and for this reason the message to managers is "*do it right the first time (DIRFT). Requirements are the "it*"" (Crosby, 1979, p. 127). As a consequence, *the performance standard is zero defects*. "*What cost money are the unquality things – all the actions that involve not doing jobs right the first time.*" (Crosby, 1979, p. 2). The standard of reference can be represented by the unit of product introduced in the market in the past (temporal comparison).

Normally, the standard of reference is the initial project and the specifications provided therein. Each company, whether large or small, must continually verify that the intrinsic quality of its products always conform to set qualitative standards or improves over time. For firms that produce on commission, these standards can even take the form of regulations inserted in the procurement contract that provide a detailed description of the work to be carried out accompanied by one or more technical designs or even a scale model. For mass production companies, the certification of quality over time is essential to avoid future complaints and returns from customers; and, in the final analysis, to avoid damaging the product image and losing market share (which is clearly linked to the control of the functional quality of the product). The need to at least distinguish between functional and design quality is explicitly recognized by Nelsen and Daniels (2007), according to whom: "*quality has two meanings: 1. The characteristics of a product or service that bear on its ability to satisfy stated or implied needs; 2. a product or service free of deficiencies*" (p. 54). The *intrinsic quality* refers not so much to the product as to the *production*; that is, to the flows of production units obtained during a process. This is the notion that is considered in UNI EN ISO 9000:2000, which defines quality as the "*degree to which a set of inherent characteristics fulfils requirements*".

ENVIRONMENTAL (*OR CONTEXT*) *QUALITY* is the set of characteristics which, from the point of view of external impact, make the product compatible with the environment, both in terms of pollution, waste disposal, environmental risks, or suitability for introduction into the context in question. The perception of environmental quality as defined in the ISO 14000 standards – which obliges firms to identify how the firm's activities, processes and products can have an "impact" on the environment – gives rise to the idea of the adequacy of the products relative to the environmental context in which they are employed during their life cycle. Today, in our highly interconnected society, no product can avoid a *judgment of adequacy*: some cars are too polluting; some homes scar the landscape; some packages are too cumbersome; some scooters too noisy; some motorcycles too dangerous; some railway lines too invasive, and so on (Claret, 1981).

Moreover, these notions of quality consider the products as *fit for a purpose*: "*One of the possible criteria for establishing whether or not a unit meets quality, measured against what is seen to be the goal of the unit*" (Campbell and Rozsnyai, 2002, 132). "*Fitness for purpose sees quality as fulfilling a customer's requirements, needs or desires*" (Harvey and Green, 1993; Juran, 1999; Crosby, 1979). Considering the product as fit for a purpose, it seems clear that the three forms of quality outlined above apply to the product, including packaging and distribution logistics (Myers and Shocker, 1981). A product with intrinsic quality may be judged negatively if its packaging makes its use less efficient and/or it is necessary to resort to inadequate logistics to acquire it. Abbot (1989) points out that packaging has four fundamental roles: containment, protection, communication and utility (Singh J. and Singh S., 2013), and thus plays a fundamental role in the value chain (Underwood, 2003; Gofman, et al., 2010; Young, 2008). For example, an exquisite perfume in a bottle that is inconvenient or aesthetically unappealing, heavy and difficult to dispose of can be viewed negatively on the whole from a functional and environmental point of view. In the same way, a point of sale considered to be of high design quality (attractive, providing a full range of products, can be functionally inadequate if the product must be purchased only at that place, which, however, is far from the town center and difficult to reach (Winston and Mintu-Wimsatt, 1995). "*Some of the services ultimately desired by consumers include bulk-breaking (as previously discussed), spatial convenience (being able to buy milk in the supermarket rather than having to drive out to a farmer to get it), timing of availability (having someone—the retailer and other channel members—plan to have toothpaste available in the store when the consumer needs it), and providing a breadth of assortment (the same store will carry different kinds of food and other merchandise from different suppliers*." (Perner, 2018, online). Similar considerations pertain to after-sales service (assistance, repairs, maintenance, etc.) when these are an integral part of the main "product". "After sales service quality affects satisfaction, which in turn affects behavioural intentions. Hence, after sales services affect the overall offering, and thus the quality of the relationship with customers." (Rigopoulou et al., 2008, p. 522).

3 – VBM Must Control the Quality of the Product

The control of the three forms of quality is essential for every VBM system because quality *represents* the set of product characteristics – function, design and environmental impact – that *contributes in a relevant way to the purchase decisions, taking into account the selling price* (equation [1]) and the general and specific economic conditions. Since quality conditions the prices and the market, acting on economic efficiency mainly from the revenue side, it is a fundamental driver for value production (together with productivity, which conditions value from the cost side) since the level of quality perceived by the customer contributes in a relevant manner to purchasing decisions and the customer's propensity to pay the price (equation [4]).

It is vital for VBM to set up a reliable system of *quality management* as part of the general strategy for value production (Shetty, 1987); this system should set appropriate "quality" objectives for the product and adopt a system to control the achievement and progressive surpassing of these objectives (Mella, 2014), as called for in the application of the Deming Cycle (Deming, 1989). "*Practising quality control means developing, designing, producing and supplying quality products and services which are the most economical and most useful for the consumer, providing him continual satisfaction.*" (Ishikawa, 1990).
As Figure 1 shows, the perception of consumers regarding the *value* of the overall supply of goods and services (eq. [4]) is directly dependent on the three forms of quality, which produce *loyalty,* increase *trust*, justify the *proposed selling price*, and sustain the level of demand by impacting *market share* (Eccles and Pyburn, 1992).

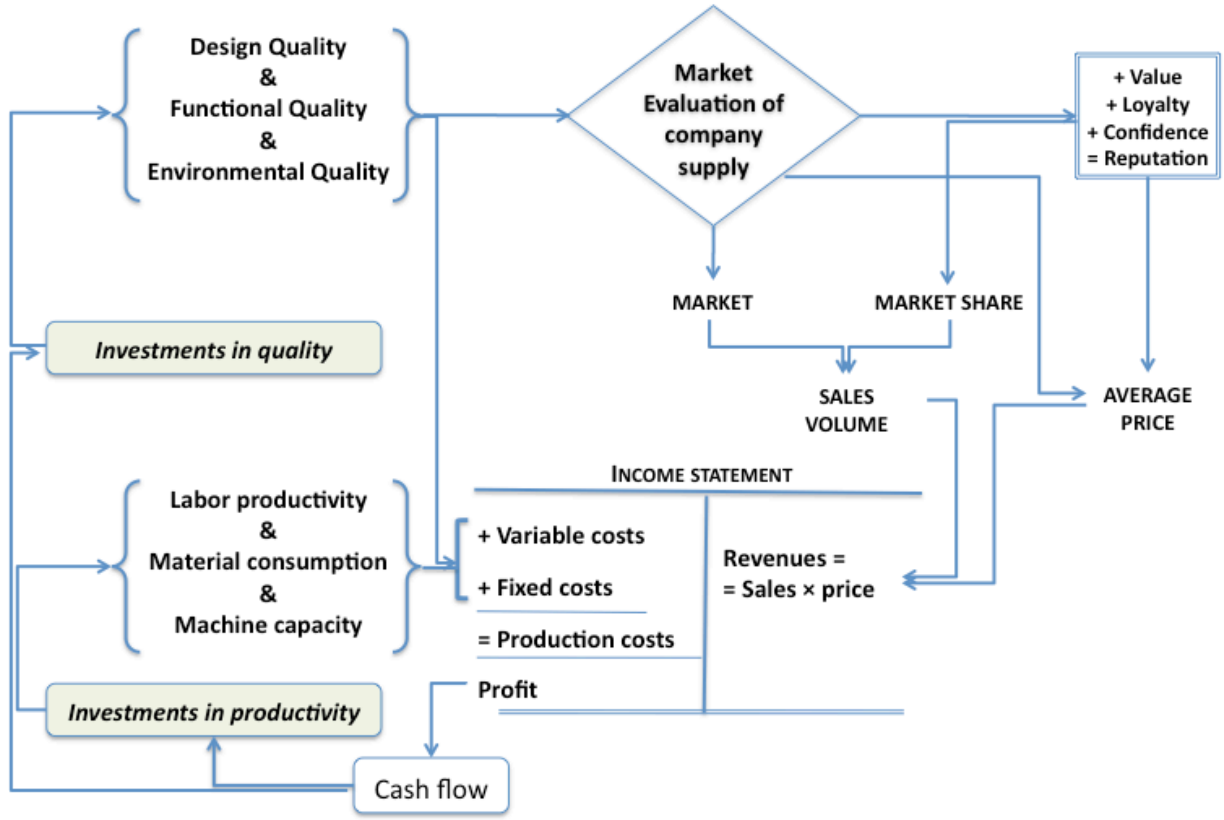


Figure 1 – Quality and productivity as a profit, and thus value, driver

Quality is also a fundamental driver of marketing efficiency, which is expressed by the following equation:

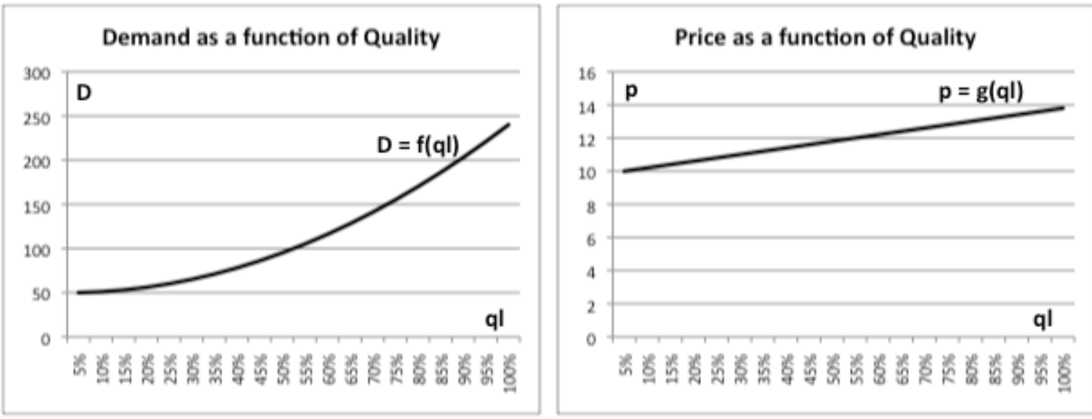
$$\text{sales} = \text{market} \times \text{market share} \qquad [5]$$

Quality influences the *market* itself by creating goods to satisfy new needs and aspirations or by varying the capacity of goods to satisfy high-level needs or aspirations in order to create, or increase the share in, an attainable market. However, quality also impacts costs, since the improvement in quality levels causes a reduction in *non-quality costs*, which are linked to certifying, preventing or restoring quality (see below).
Profit creation generates cash flow that can favour new investments to improve quality and productivity. Investments for the improvement of quality should thus represent a relevant factor in the overall strategy through its effect on marketing and production. After these general considerations, let us examine the methods VBM must follow to control the three forms of quality.

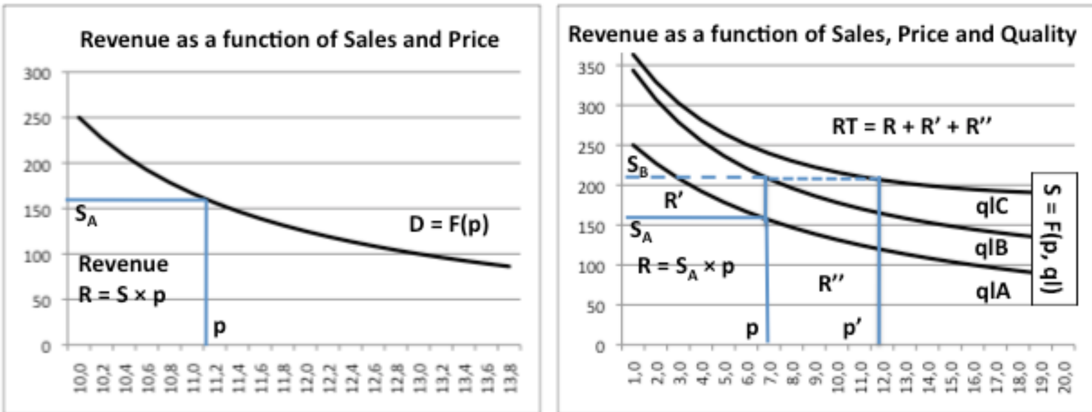
4 – VBM Must Control Functional Quality and Quality Revenues

According to the concept of *functional quality*, every product has its own *use function*; that is, a *mix* of needs and aspirations – "expressed or implicit", agreeing with ISO 8402:1986 – which a product can satisfy contemporaneously.

2-A) demand (D) and price (p) as functions of functional quality (qlP)



2-B) variations in revenue (R) as a function of functional quality (plP)



2-C) quality revenues as a function of functional quality (plP)

Figure 2 – Functional quality, demand and price

VBM must manage quality by controlling that the product maintains, and if possible increases over time, its overall use function, which is the condition for controlling prices in some manner and producing economic value. Keeping functional quality under control is important since the revenue curve of the firm (Figure 2-C). depends on the form of activity (Ojasalo, 2006). In fact, functional quality (ql) influences both the demand curve and prices (Figure 2-A). If we express demand as a function of both price and functional quality, we observe how the curve varies with variations in this type of quality (Figure 2-B).

Curve A in the graph on the left in Figure 2-B indicates the normal relation between demand (x-axis) and price (y-axis), assuming there is normal elasticity and the curve depends on the pricing manoeuvres of the firm. The product of sales volume (indicated by S on the x-axis) and price level (indicated by p on the y-axis) expresses the revenue (R) attained for each (p, S) pair, which can be represented as the area of the rectangle whose vertex is at point (p, S) and whose opposite vertex is at the origin.

The graph on the right in Figure 2-B shows the theoretical effect of increasing the level of functional quality, which causes:

a) an upward shift of the demand curve, so that, at each price, the sales volumes are indicated on curve B, rising from S_A to S_B; total revenue (TR) thus becomes TR = R + R′.

b) an increase in prices as well at each level of demand; this means that the slope of the demand curve is reduced and can be represented as the curve C, which shows that for each price level the quantity demanded is greater than what it would have been without the increase in quality. Total revenue is now TR = R + R′ + R′′.

The trend in revenues as a function of the quality level can be shown by the curve in Figure 2-C, from which we can hypothesize that there is a minimum level of functional quality (ql min) below which revenues are not defined, as well as a maximum level (ql max) above which total revenues cannot increase as a result of further increases in quality (they can increase, of course, due to other causes that are not pertinent to a study on quality).

VBM carries out functional quality controls in the form of *Quality Function Deployment*, which proposes the development of new products or processes and the improvement of existing ones, as defined in the official site: *"Quality Function Deployment (QFD) was developed to bring this personal interface to modern manufacturing and business. In today's industrial society, where the growing distance between producers and users is a concern, QFD links the needs of the customer (target quality) with design, development, engineering, marketing, manufacturing, service and other organizational functions through its systematic deployment. 1. QFD seeks out spoken and unspoken customer needs from fuzzy Voice of the Customer verbatim; 2. QFD uncovers the "true" customer needs and "positive" quality that wows the customer; 3. QFD translates these into designs characteristics and deliverable actions; and 4.QFD builds and delivers a quality product or service by focusing the various business functions toward achieving a common goal: customer satisfaction"* (QFD, 2019, online).)

Quality Function Deployment *"is a method for developing a design quality aimed at satisfying the consumer and then translating the consumer's demand into design targets and major quality assurance points to be used throughout the production phase. ... [QFD] is a way to assure the design quality while the product is still in the design stage"* (Akao, 1990; see also: Akao and Mizuno, 1978; Kano et al. 1984; Woodhouse, 1996). The phases of a QFD system can be summarized as follows (Bossert, 1991; NPD solutions, 2016):

1. evaluating the strengths and weaknesses of the use functions of existing products, verifying consumer tastes in order to identify the consumer's real needs and aspirations, thereby creating, if possible, new forms of aspirations;

2. searching in particular for the characteristics that can visibly distinguish the product from a quality perspective, identifying the priority decisions (deployment) for the product and the process that will maximize the customer's perception of value;

3. designing a "customer focused" product manufacturing process while trying to match

the attributes desired by the customers to the design specifications and production methods, even adopting *target costing*;

4. coming up with new features that can visibly differentiate the product to create a product "image" that serves as an instrument for satisfying consumer aspirations (brand, trademark, imitation effect, etc.).

The successful firms today are those that have introduced a pro-active VBM system capable of anticipating variations in the use function of products, which thus allows them to achieve a timely *marketing strategy* that enables them to set higher prices due to the perception of a change in the products' use function.

Among the instruments used to control functional quality, *Value Analysis* deserves mention. This instrument starts from the principle that the value of a product will be interpreted in different ways by different customers in terms of a high level of performance, capability, emotional appeal, style, etc., relative to its cost. This can also be expressed as maximizing the function:

$$\text{Value} = (\text{Performance} + \text{Capability}) \,/\, \text{Cost} = \text{Function} \,/\, \text{Cost} \qquad [6]$$

Value analysis consists of a series of techniques and studies aimed at finding the best product composition in terms of the form and structure of the components and the necessary manufacturing processes, with the aim of minimizing the drawbacks resulting from the product's use (Crow, 2002). "*Value analysis is a problem-solving system implemented by the use of a specific set of techniques, a body of knowledge, and a group of learned skills. It is an organized creative approach that has for its purpose the efficient identification of unnecessary cost, i.e., cost that provides neither quality nor use nor life nor appearance nor customer features. When applied to products, this approach assists in the orderly utilization of better approaches, alternative materials, newer processes, and abilities of specialized suppliers. It focuses engineering, manufacturing, and purchasing attention on one objective-equivalent performance for lower cost*" (Miles, 1989).

While the analysis of value is a technique that encompasses the design and manufacturing phases, the *quality circles* (Ishikawa, 1980; Hutchins, 1985) are organizational instruments for the control and improvement of quality as part of the Quality Function Deployment. "*Quality Circles are (informal) groups of employees who voluntarily meet together on a regular basis to identify, define, analyse and solve work related problems*" (http://quality-circles.blogspot.com/). Who better than the workers involved in the production process to identify the problems in assembling, stocking and distributing materials, component parts, subassemblies and other items at any stage in the manufacturing process? Who better than these workers to suggest solutions to eliminate such snags?

While the *quality circles* rely on the *opinions* of persons *inside* the firm, the *panel of consumers* technique directly seeks out the opinions of *customers*, forming a panel of consumers who are chosen based on statistical sampling techniques and then asked to try out the product – usually a new one – so that they can use it and express an opinion on its quality (and, in general, also on the price/quality relationship).

5 –VBM Must Control Design Quality

VBM must also verify that the *design quality* of the firm's production is at least equal to that of the competitors and remains constant or improves over time (Merrill, 1997).

Controlling design quality means (Kume, 1985):

a. maintaining a uniform technical standard in space and over time

b. preventing or eliminating defects and maintaining or increasing reliability,

c. setting up a service to carry out: inspections, revisions, repairs or substitutions.

For firms that produce to order, the standards are usually included in the contract in the form of detailed specification of the work to be carried out, accompanied by one or more technical designs or even a scaled model, in addition to Gantt and Pert Charts. For firms with *mass production,* quality verification over time is essential to avoid future complaints and refunds, substitution or reparation costs, and, in the last analysis, to maintain the product's image and market share; this verification is combined with the control of functional quality (which typically concerns itself with effectiveness), though it remains a distinct activity.
Design quality control covers three areas:

1) *control of supplies*, within the Supplier Management function (Benoit et al. 2006; CIPS, 2007), which aims at the *quality of materials and components*. It is necessary to undertake a process that, through defined control cycles, verifies that the input materials respect the product's required specifications; the outcome of the verifications determines the updating of the stock (unloading verification and warehouse loading) and the continual evaluation of the supplier's reliability, as stated in the *Quality Management System section* of the ISO 13485 standard , which includes requirements for the process of supplier control (Gardner, 2018).

2) *control of the manufacturing process undertaken to produce and move the product*; this activity controls the manufacturing standards and decides whether to maintain the process or to modify the parameters which do not conform to the standards, and it involves the production function (Mrugalska and Tytyk, 2015). We can further divide this control activity into:

a) *production control*: this focuses on the *manufacturing processes* and, in turn, includes two phases: *monitoring* or *inspection*, in order to gather, file away, process and present data on productivity, the utilization of the means of production, and the progress of production: number of pieces produced, excess production, production times, losses, etc. "*Being a key element of quality control, Product Inspections allow you to verify product quality on site at different stages of the production process and prior to its dispatch. Inspecting your product before it leaves the manufacturer's premises is an effective way of preventing quality problems and supply chain disruptions further down the line*" (QIMA, online); (ii) *diagnostics*, in order to verify the state of the production process and the data collection, which serves to identify and signal functional anomalies in the plants and their causes;

b) *logistics control*: this aims at verifying the punctuality and accuracy of the deliveries and whether or not the selling procedures have been respected; in effect, "*Logistics refers to the art of managing the flow of materials and products from the source to the user. The logistics system includes the total flow of materials, from the acquisition of raw materials, to the delivery of the finished product, to the ultimate users, and the related counter-flows of information that both control and record material movement*" (Virolainen, 1991, online).

3) *control and testing of the finished product*; this verifies that the products respect the standard specifications; for this control as well, the director of production or the product manager (if called for) is usually in charge, and the process involves two phases:

a) *testing*, a typical control of *efficiency*, when the functionality of the product is verified along with its suitability for providing the performances for which it has been designed; the outcome of the testing determines whether product quality is certified, whether the product is remanufactured, or whether it is discarded (Directive 75/318/EEC, 1991, online);

b) *revision*, when consumer observations, complaints and refunds are analysed to identify the origin of the defects and prevent their future occurrence.

At times the entire production must be controlled; at other times a sample control is carried out based on sophisticated statistical instruments (Smith, 1998; Kaye and Frangou, 1998; Oakland, 2014). This latter control is called the Statistical Quality Control, or Statistical Process

Control (SQC or SPC) (Xie and Goh, 1999; Montgomery, 2007; Sharma and Kodali, 2008; Raheem et al. 2016). More detailed analysis of these controls can be found in the ample bibliography in Industrial Statistics and Quality Control (Duncan, 1986; Ryan, 2000).

6 – VBM Must Control the Quality Costs

Design quality, as far as it represents the product unit's conformity to a prototype or sample of reference, is mainly expressed as "*absence of defects*" or "*zero defects*". (Zemke, 1990). While *functional quality control* mainly impacts revenues, the control of design quality is of economic importance mainly from the *cost side* (Albright and Roth, 1994a), since there is a clear inverse relation between the control of design quality and defectiveness (Rosenfeld, 2009). (Figure 3). To control defectiveness, it is fundamental to structure an effective *defect prevention, appraisal and failure process* (Ferretti et al., 2013; Dhar and Nandi, 2016) that will eventually result in the Six Sigma Quality Management control system (Bellows, 2004) (see the following section).

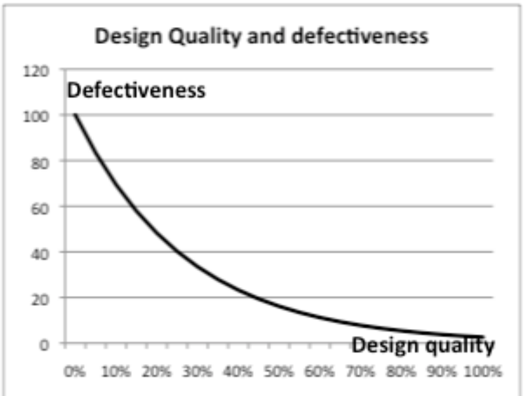


Figure 3 – Design quality and defectiveness

If we assume we are controlling a given *parameter* that refers to finished products for all output units of the production process over a given interval, then we can become aware of the "design quality" of this same process in terms of *defectiveness*, as shown in Figure 4 at the left (Albright and Roth, 1994b). The control chart on the right shows the same process after the design quality control, which leads to an improvement which, on the one hand, reduces the standard average level of defectiveness, and on the other reduces the number and duration of "out of control points".

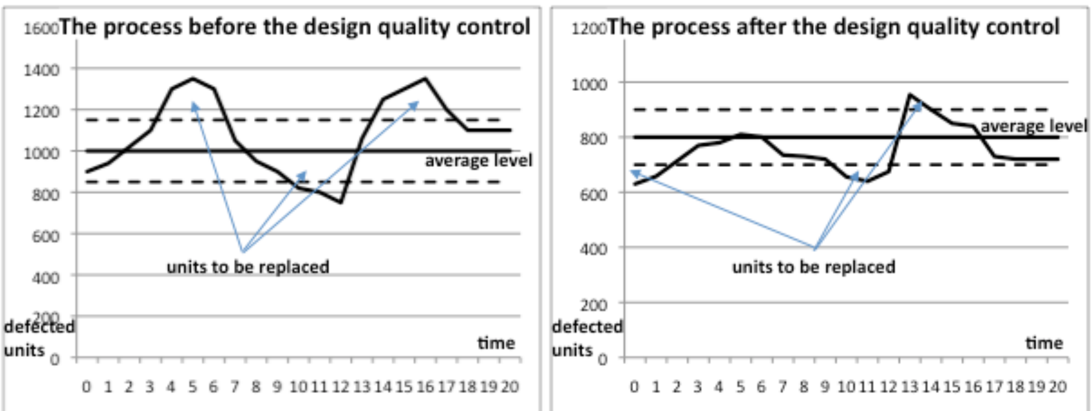


Figure 4 – Effects of design quality control

The costs of design quality concern both the products and the managerial system and can be divided into (Morse, 1983; Campanella, 1999; Tang et al. 2004; Mohanty and Tiwari, 2007):

A – *costs of internal and external non-conformities* (or full non-quality costs) linked to the *absence of control* (Schneiderman, 1986; Harrington, 1987; Love and Irani, 2003);

A.1 – *internal failure costs*: these derive from the need to eliminate anomalies and defects that occur in the production units *during* the manufacturing process (Abdul-Rahman, 1993);

A.2 – *lack-of-rationality costs*: these are connected to the lack of rationality in production, in the product, and in the marketing and post-sales organization due to the presence of defects;

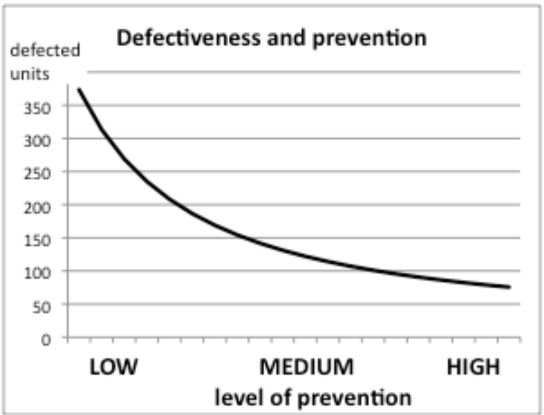
A.3 - *external failure costs*: these arise from the repair or substitution of the product *after* sale;

B – *investment quality costs*, linked to the *procedures for implementing controls*;

B.1 – *prevention costs*: these arise from the attempt itself to *prevent* defects;

B.2 – *appraisal and assessment costs*: these arise from procedures to *verify* product defects;

C - *opportunity quality costs* (*customer-incurred cost*, loss of productivity, *customer-dissatisfaction cost*, dissatisfaction shared by word of mouth, *loss-of-reputation cost*, customer perception of firm (Harrington, 1987), resulting in lower revenue due to the reduction in functional quality. In effect, design quality has a notable impact on the product's use function since, on the one hand, design quality damages and discourages the consumer (reduction in sales), and on the other forces the firm to lower prices; in general, the intangible costs are thus identified with the failed earnings caused by low levels of quality (Morse, 1983; Zemke, 1990). *Indirect* costs and opportunity quality costs obviously derive from the lack of *verification* and *prevention* of defects (Kume, 1985, Taguchi, 1988). Taguchi (1986) considered quality in a "social loss approach" as "*the loss a product causes to society after being shipped, other than any losses caused by its intrinsic functions. This loss can be caused either by variability in the product's function or by adverse side effects*" (Taguchi, 1986, p. 1). The two graphs in Figure 5 clearly show the importance of *prevention* and *inspection* activities and their effect on defectiveness.



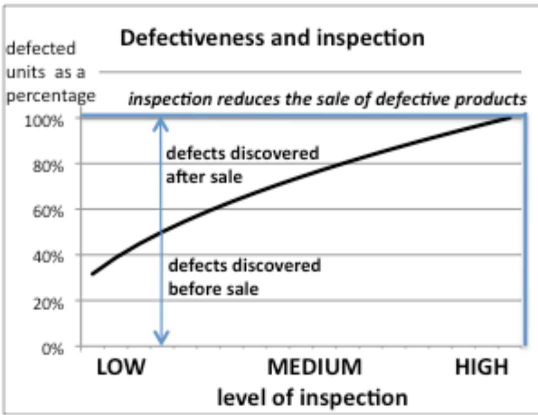


Figure 5 – Control of quality through prevention or inspection

We can assume there is an optimal level of design quality that minimizes *total quality costs*, which is the sum of the direct and indirect costs, as shown in Figure 6 (left).
We can now modify the graph in Figure 6 (left) by also adding "intangible costs" arising from the *lack of quality*. Such costs cause a shift to the right of the minimum point of the total cost

curve, which indicates that the optimal level of quality is higher in the presence of intangible costs, as shown in Figure 6 (right). VBM must develop a highly efficient system of quality control, since both *functional* and *design* quality jointly impact economic efficiency.
Figure 7 shows, in the same graph, the *total revenue curve* as a function of the level of *functional* quality and the *total quality cost* curve as a function of the level of *design* quality, where the quality levels are expressed on a uniform scale.

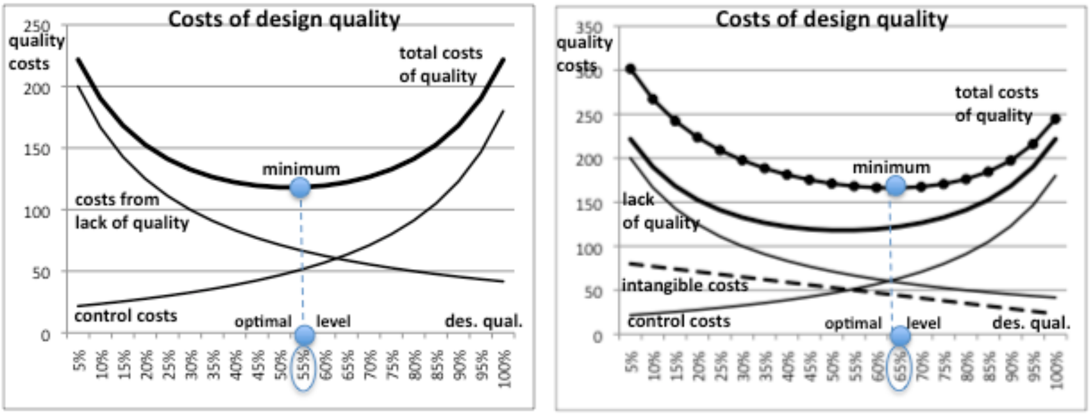


Figure 6 – Costs of design quality

This graph shows that the optimal level of overall quality – functional as well as design – can be determined as the level of overall quality that corresponds to the maximum profit, equal to the difference between only those revenues and costs connected to quality, which we assume can in principle be determined.

Figure 7 – Profit as a function of quality

7 – Six Sigma Quality Management

"Six-Sigma" is a term coined by Bill Smith, an engineer at Motorola, who was the first to study the method ("Six Sigma®" is, in fact, a registered trademark of Motorola), which is part of the methods for the quality assurance of *design quality*, which aims at the greatest reduction possible in *average defectiveness* (Wheat et al., 2003; Taghizadegan, 2006; Pyzdek, 2003). The objectives of the control of defectiveness in flow production is defined by Motorola as follows: "*A defect rate of no more than 3.4 per million; statistically, allowing for some variation in mean, this*

approaches zero defects ... At Motorola, we actually have a measure for quality which we call "Six Sigma" , and this literally affects everybody and everything we do, every minute, of everyday. Six Sigma is basically a target based on zero defects per million manufactured parts. At present we are hitting 99.9996%, which is so close to perfection that we are now using a parts-per-billion measure for defects." (quoted by Bellows, 2004, p. 3). Therefore, Six-Sigma introduces as a general measure of defectiveness the number of defects per "million" units. A nearly perfect process, or at least one of excellent quality, is one that produces no more than 3.4 defects per million units: in other words, the production flows must have an admissible tolerance between the normal average value +/- 6σ, where "σ" is the standard deviation of the *normal distribution*.
A defect rate of 3.4 units *per million* appears to be quite low, but we must judge it based on the number of elements that can present a defect. For example, according to recent data from Apple, around 1,000 million iOS devices have been sold. Assuming we are observing a single component that can present "fatal" defects, according to the Six-Sigma method the production processes should be so accurate as not to leave more than 3,400 defective units to be replaced. If we assume each device has 100 potentially defective components (keys, scroll bars, batteries, led lights, etc.), then according to Six-Sigma the potential number of devices to replace would still be 340,000. Six-Sigma must not be considered as only a process of statistical measurement but above all as a well-tested set of instruments and sophisticated techniques aimed at reducing the variability (tolerance) and defectiveness of a product-process: that is, a powerful managerial tool to improve overall quality. This instrument is referred to as *Lean Six-Sigma* (George, 2003; Näslund, 2008; Basu, 2009; Voehl et al., 2016), and it entails 5 phases in the DMAIC form (Henshall, 2017; Beemaraj and Prasath, 2018), as described in Figure 8, and in the DMADV form.
"The fundamental objective of the Six Sigma methodology is the implementation of a measurement-based strategy that focuses on process improvement and variation reduction through the application of Six Sigma improvement projects. This is accomplished through the use of two Six Sigma sub-methodologies: DMAIC and DMADV. The Six Sigma DMAIC process (define, measure, analyze, improve, control) is an improvement system for existing processes falling below specification and looking for incremental improvement. The Six Sigma DMADV process (define, measure, analyze, design, verify) is an improvement system used to develop new processes or products at Six Sigma quality levels. It can also be employed if a current process requires more than just incremental improvement" (ISIXSIGMA, 2019, online).
I end this section by mentioning the Control Systems that rely on long-term structural levers in the form of organizational restructuring and the re-engineering of processes, organs and functions that can increase the potency of process Control Systems (Davenport and Stoddard 1994). Equally as powerful, though more gradual in its interventions to achieve the desired objectives, is the "kaizen", a term indicating the concept of continuous improvement; that is, the gradual, ongoing improvement in the performance of processes through the involvement of workers at all the organizational levels to achieve the quality and productivity objectives (Deming, 1982; Imai, 1986; Tanaka, 1994).

8 – VBM Must Control the Environmental Quality

The environmental compatibility of products must be continually monitored, taking account of the possibility that the search for functional and design quality is often in contrast with the objective of safeguarding the environment. The lack of environmental quality impacts revenues in the form of reduced demand and the costs needed to safeguard the environment. Nevertheless, the control of environmental quality is not easy to achieve, since the standards of environmental compatibility are not absolute but depend on several variables: first of all, the state of *scientific and technical knowledge* (the history of the use of asbestos is instructive here); secondly, the *prevalent social culture*.

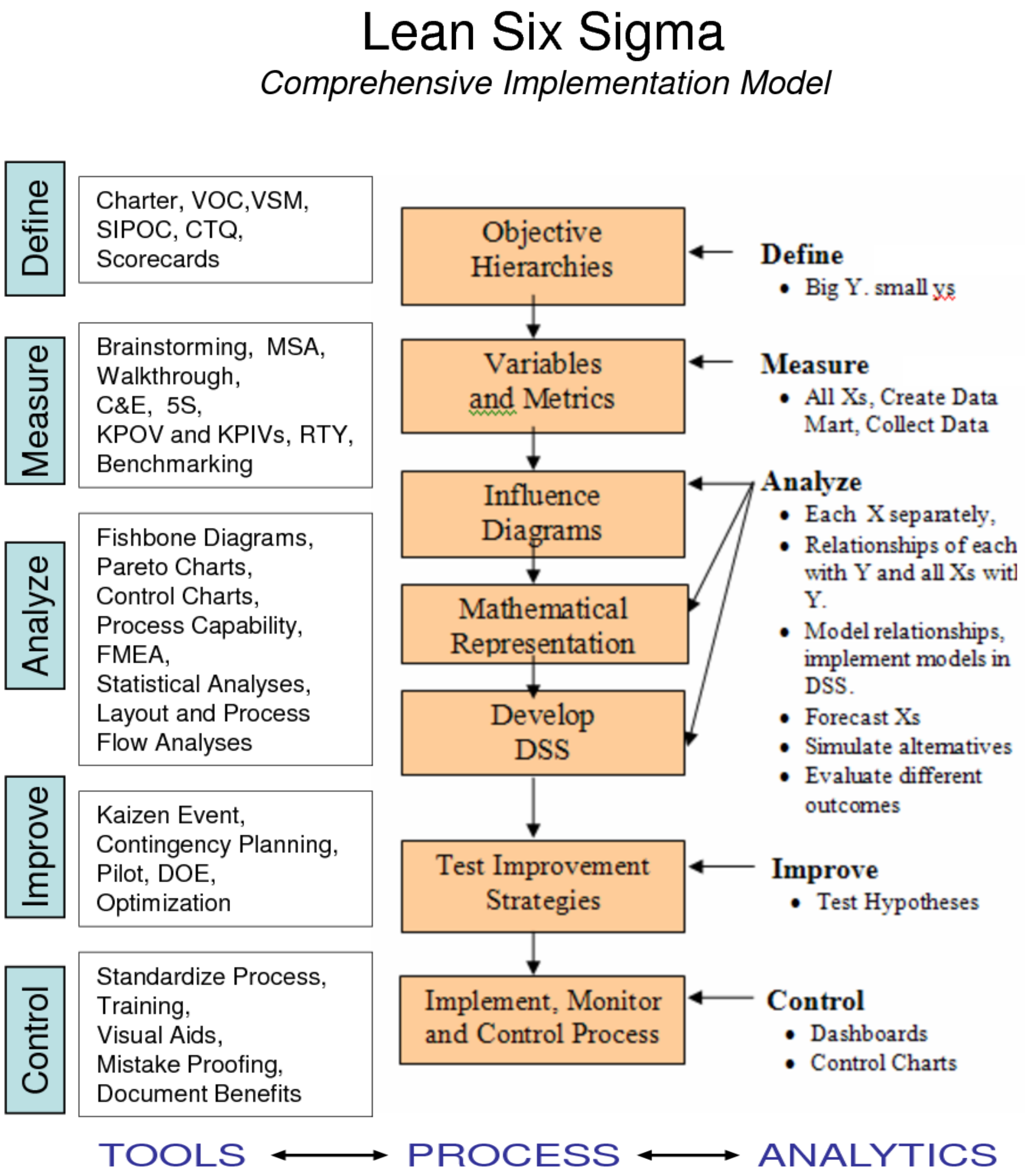


Figure 8 – DMAIC process and Lean Six-Sigma (source:

The *forms* of control of *environmental quality* are not simple to identify, since the standards of environmental compatibility are not absolute but depend on several variables:

a) the state of *scientific and technical knowledge*. Up until the discovery of its terrible polluting power, asbestos was considered a key component of all fire-resistant material, providing such material with a high functional quality; and upon discovery of Mad-Cow Disease, even t-bone steaks, whose functional quality is not open to discussion, were temporarily banned;

b) the *prevalent social culture*, since sensitivity toward environmental problems is not the same in all countries (the refusal to abandon the use of polluting products in several countries is indicative here). During the industrialization phase, the construction of residential "clusters" on the periphery of large cities was deemed essential for the internal migration of manpower; once this migration ended, each new "cluster" was, and is still, viewed negatively as a source of social degradation; and the energy crisis changed opinion toward nuclear power plants, which are widespread in industrialized countries; however, today this source of energy supply is increasingly rejected in favour of wind or solar energy;

c) special economic needs. Gas refrigerators worsen the hole in the ozone layer, and automobiles with polluting engines but low prices are viewed favourably in industrializing countries, even if their environmental quality is questionable.

Despite these difficulties, VBM can control the environmental quality of its processes and products thanks to the use of increasingly sophisticated techniques in Environmental Impact Assessment and Sustainability Appraisal, whose application is obligatory for many production processes (Smith et al., 2010; Thérivel and Minas, 2012).

9 – From Quality Assurance to Company-Wide Quality Control

Being both a philosophy and a methodology for managing companies, VBM cannot limit itself to controlling economic efficiency but must integrate such methodologies and instruments into a single system to achieve the gradual involvement of all corporate functions in the control of quality, transforming the quality control *function* into a Quality Assurance *policy* with the aim of guaranteeing the total satisfaction of the final user (Tempus, 2001, Vlăsceanu et al., 2004). "*Customer satisfaction determines the success of a new product and only products at high value meet needs of clients who expect them to perform correctly in their whole life cycle. In order to fulfill such requirements the minimum of variation of parameters should be assured within the manufacturing processes and the product itself. From an elementary part to compound parts, they must be designed and manufactured on high quality level and be reliable and safe in use*" (Mrugalska and Tytyk, 2015, p. 2730). "*Quality Assurance (QA) is a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. Reviews, preferably by independent third parties, are performed upon a completed inventory following the implementation of QC procedures. Reviews verify that measurable objectives were met, ensure that the inventory represents the best possible estimates of emissions and removals given the current state of scientific knowledge and data availability, and support the effectiveness of the QC programme*" (Winiwarter et al., 2006, p. 6.5). This definition highlights the fact that VBM must achieve the involvement of the entire organization in the Quality Assurance policy (Taguchi, 1986). This necessitates "*a positive attempt by the organizations concerned to improve structural, infrastructural, attitudinal, behavioural and methodological ways of delivering to the end customer, with emphasis on: consistency, improvements in quality, competitive enhancements, all with the aim of satisfying or delighting the end customer.*" (Zairi , 2010, p. 74).

Quality Assurance cannot be only a production, marketing or economic need but must become the objective of a true Total Quality Management (TQM) strategy (Deming, 1982) or one of *Company-Wide Quality Control* (*CWQC*) (Ishikawa, 1985; Ishikawa and Lu, 1989) – considered the Japanese version of TQM – which represent the operational interfaces of VBM with regard to quality.

The TQM strategy must involve the entire production, personnel and marketing structure (Oakland, 1989, 2014; Samson and Terziovski, 1999) in the control and improvement of product quality and production, involving top management, directors, supervisors and workers from all activity areas of the organizational group, such as market research, research and development, planning, purchases, sales management, production, inspections, selling, and personnel services (Saxena, 2009).

Also of importance is the relationship with customers and suppliers, who are viewed as the engines for quality improvement; the customers make suggestions for the improvement of functional quality, and the suppliers must be the guarantors of design quality. The culture of quality spreads from the suppliers to their own suppliers, so as to permeate the entire production line and entire business sectors.

Feigenbaum (1991) has developed a ten-point framework to implement Total Quality Management, which is parallel to the 14 points proposed by Deming (1982). A constant underlies the vision of these authors: the firm must create a system to manage quality which is aimed at customer service. It must reach every sector of the organization and be understood by all personnel, who then must truly believe in it and enthusiastically participate in its implementation by proposing the creation and spread of the *quality circles* (Hutchins, 1985; Ishikawa, 1980). In Feigenbaum, Deming and Ishikawa's conceptual framework, quality is not achieved through a discrete process, through innovations, often temporary, in products and processes, but through a continual process of "small steps", the *kaizen* (Tanaka, 1994), which produces a considerable evolution even in the way of conceiving of the relationships among the various operational departments or centers within the firm. Each center must guarantee the maximum quality to the center downstream – its "customer" – and demand the maximum quality from the center upstream – its "supplier".

10 – Conclusion. VBM Must Transfer Quality to the Entire Organization and Generate Trust and Reputation

VBM must develop a policy of 'transformative' quality in order to segment the three forms of quality within an organization (Harvey and Green, 1993) and produce an improvement in the internal processes and products for the customer's benefit, thereby creating a holistic model of quality management (Srikanthan and Dalrymple, 2005).
Whatever the nature of the products offered, their *utility*, *value* and *suitability* are the drivers of consumer *loyalty*, which, together with *trust*, build up the *reputation* of the firm, on which market share depends, which in turn impacts revenues, taking into account the role of design and functional quality on prices (Figure 1).
The first and most general action VBM must undertake is to transfer the three notions of quality from the products to the organization, which, in turn, is viewed as the object of judgment by the market. VBM must develop:

A. the *functional quality of the firm*, by adjusting the characteristics of the firm so that it is *judged* by the market as suitable for producing value for all the external stakeholders and assigned a value as a single entity; that is, the firm is characterized by the same "fit for purpose" concept that we have examined for products: *"fitness for purpose" is a definition of quality that allows institutions to define their purpose in their mission and objectives, so "quality" is demonstrated by achieving these"* (Woodhouse, 1999, 29–30);

B. the *design quality of the firm*, by adjusting the characteristics of the organization to carry out production processes which conform to standards considered suitable (with respect to sanitary and safety norms at the workplace; secure and useful products); a high quality in carrying out the company processes (seriousness, consistency in the procedures, manufacturing uniformity, etc.) generates *reliability* for consumers (Robertson, 1971; Pupius and Steed, 2005);

C. the *environmental quality of the firm*, by conforming the qualitative features of products to create the vision of a firm capable of playing a positive role in the environment, both from the social point of view (employment, housing improvement, consumer utility, etc.) and the environmental one (non-polluting, respect of safety regulations, etc.). The perception of environmental quality leads to *appreciation* of the firm by both economic stakeholders and social ones (the political community, unions, territorial agencies, etc.).

Figure 9 shows the joint effect of VBM on product and company quality:

1. the three forms of *product* quality, expressed in terms of *utility, value* and *suitability,* are the drivers of customer loyalty (Dick and Basu, 1994) and brand store loyalty (Chaudhuri and Holbrook, 2001; Story, and Hess, 2006);

2. the three forms of *company* quality, in terms of *evaluation, reliability* and *appreciation,* produce *consumer confidence* (Acemoglu and Scott, 1994) and positive *customer sentiment* toward the firm as an operating entity in the environment (Bennett and Harrell, 1975; Rust et al., 1999; Bearden et al., 2001);

3. *loyalty,* together with *confidence,* enhance the firm's *reputation,* which represents the fundamental value driver on which market share, price level and, as a consequence, revenues and added value depend (Figure 9).

TYPE OF QUALITY	PRODUCT	FIRM	PRODUCT & FIRM
FUNCTIONAL	Value, Satisfaction	Evaluation	
DESIGN	Utility, Image	Reliability	
ENVIRONMENTAL	Suitability	Appreciation	
Effects	LOYALTY	CONFIDENCE	REPUTATION & EXCELLENCE

Figure 9 – The effects of product and corporate quality

Product and company quality thus represent the two components of the firm's total quality as well as the fundamental element in the *value equation* of the product and the firm (Sweeney and Soutar, 2001). This clearly shows that the VBM and Total Quality Management approaches can be viewed as complementary, since there can be no production of value for the firm and its shareholders without the production of value for the customer (Mc Taggart et al., 1994). Value is the object of both approaches, but financial shareholder value represents the most important driver through the value it provides the customer. According to this logic, "*The leverage of a strong brand name can substantially reduce the risk of introducing a product in a new market by providing consumers the familiarity of and knowledge about an established brand. Moreover, brand extensions can decrease the costs of gaining distribution and/or increase the efficiency of promotional expenditures* (Morein 1975)" (Aaker and Keller, 1990, p. 27).

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