Chapter 2

Defining and Characterizing Quality

CHAPTER PREVIEW

This chapter is aimed at everyone with an interest in quality, students, consultants, auditors, professionals, and in particular managers formulating and executing strategies that impact the organization's outputs. As the achievement of quality is the raison d'être for the ISO 9000 family, no reader should pass by this chapter without getting an insight into the meaning of quality.

If you are thinking about ISO 9001, you can't get past the front page of the standard without noticing the title in which the first word is *quality* and the second word is *management*. Therefore, it would be unwise to go further without a clear understanding of what quality is and how the achievement of quality is managed. It is also vital that managers have a unified understanding of quality in order to build a coherent strategy for its achievement.

However, in discussions in which the word quality is used, people will differ in their viewpoint either because the word quality has more than one meaning or that they have different perceptions of what the word quality means or because they are drawing conclusions from different premises or concepts. Some of the people are perhaps thinking that quality means goodness or perfection or that quality means adherence to procedure, following the rules etc. or that fewer defects means higher costs or that quality means high class and is expensive. Others might be thinking that controlling quality means rigid systems, inspectors in white coats or that if they push production, quality suffers, or that quality management is what the quality department does.

You may consult ISO 9000 which is invoked in ISO 9001 to gain some appreciation of the concepts and the terms used but this is a rather clinical treatment that does not allow for the wide variation in their application and usage in the real world and this is what this chapter aims to provide.

We examine:

- The different meanings of the term quality in general use; how quality is perceived relative to cost, price, design, reliability and safety and we examine some of the misconceptions that surround the term.
- How differences in design are expressed by class and grade and how they relate to quality
- The characteristics used to measure quality.
- The three dimensions of quality that define a range of meaning through product quality, business quality and enterprise quality.

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WHAT IS QUALITY?

Definitions

We are likely to know what quality is when we see or experience it. We are also more likely to ponder the real meaning of the word when we buy something that fails to do what we originally bought it to do. We thus judge quality by making comparisons, based on our own experiences, but defining it in terms that convey the same meaning to others can be difficult. There are dictionary definitions that express how the word *quality* is used but they don't help when we try to take action. When we set out to provide a quality product, formulate a strategy for quality, produce a quality policy, control the quality of something or are faced with an angry customer, we need to know what quality means so that we involve the right people and judge whether the action to be taken is appropriate.

There are a number of definitions in use, each of which is valid when used in a certain context. These are summarized below and then addressed in more detail in the sections that follow.

- A degree of excellence (OED) – The meaning used by the general public.
- Freedom from deficiencies or defects (Juran) – The meaning used by those making a product or delivering a service.
- Conformity to requirements (Crosby) – The meaning used by those designing a product or a service or assessing conformity.
- Fitness for use (Juran) – The meaning used by those accepting a product or service.
- Fitness for purpose (Sales and Supply of Goods Act 1994) – The meaning used by those selling and purchasing goods.
- The degree to which a set of inherent characteristics fulfils requirements (ISO 9000:2005) – The meaning used by those managing or assessing the achievement of quality.
- Sustained satisfaction (Deming) – The meaning used by those in upper management using quality for competitive advantage.

Handling Misunderstanding

It is easy to be deluded into believing there is an understanding when two people use the same words. If you have a disagreement you firstly need to establish what actions and deeds the other person is talking about. Once these are understood, communication can proceed whether or not there is agreement on the meaning of the words. (J. M. Juran)

It therefore becomes important to establish the context of a statement in which the term quality is used, e.g., it would be wrong to say that quality doesn't mean freedom from defects but if the context is a discussion on corporate strategy, it would be foolish to limit ones imagination to that meaning of the word when the purpose of the discussion is to devise a means of gaining a competitive advantage. Even if your products were totally free of deficiencies, you would not gain a competitive advantage if your products lacked the latest features or were not innovative.

Dictionary Definitions

The Oxford English Dictionary (OED) contains 17 meanings, most of which relate to personal characteristics but the following three are relevant to the quality of product:

- A particular class, kind, or grade of something, as determined by its character, especially its excellence. (This meaning is addressed further under Classification of products and services.)
- The standard or nature of something as measured against other things of a similar kind.
- The degree of excellence possessed by a thing.

There are other ways in which we think of quality. Masaaki Imai in his book on Kaizen[1] writes that "when speaking of quality one tends to think first of product quality" and this is indeed the most common context for quality. But Imai goes on to write "when discussed in the context of KAIZEN® strategy the foremost concern is with the quality of people".

Then there is the quality of mercy,[2] the quality of life, the quality of education etc. and in all these cases we are invoking a definition of quality that leans more towards the degree of excellence that is expressed in the OED. It is helpful to remember that dictionaries record common usage and implied meanings not legally correct definitions or definitions resulting from the deliberations of a team of experts. The latter two meanings above are embodied in the more formal definitions that follow.

Freedom from Defects or Deficiencies

The idea that quality means freedom from defects or deficiencies is based on the premise that the fewer the errors, the better the quality so a product with zero defects is a product of superior quality. A defect is *nonconformity with a specified requirement*. Therefore, if the requirement has been agreed with the customer, a defect free product should satisfy the customer. However, at the level where decisions on nonconformity are made, the requirement is likely to be the supplier's own specification and might not address all product characteristics necessary to reflect customer needs; therefore, a defect free product might not be the one with characteristics that satisfy customers.

Juran[3] contrasts two definitions of quality that of freedom from deficiencies and product features which meet customer requirements. He observes that:

- Product features impact sales so higher quality in this sense usually costs more;
- Product deficiencies impact costs so higher quality in this sense usually costs less;

In the eyes of the customer, they see only one kind of quality. The product has to satisfy their needs and expectations and this means that it should possess all the necessary features and be free of deficiencies. It would be foolish to simply focus on reducing defects as a quality strategy because as Deming remarked,[4] reducing defects does not keep the plant open. Innovation is necessary to create new product features to maintain customer loyalty.

Conformity to Requirements or Specification

The idea that quality means conformance or conformity to the requirements is based on the premise that if a product conforms to all the requirements for that product, it is

[1] Imai Masaaki (1986) Kaizen The key to Japanese competitive success.
[2] Shakespeare William. Merchant of Venice Act IV Scene 1.
[3] Juran J.M. (1992) Juran on quality by design. The Free Press, Division of Macmillan Inc.
[4] Deming W. Edwards (2000) The New Economics. MIT Press.

a *quality product*. This was the view of the American Quality Guru, Philip B. Cosby[5] in his book 'Quality is Free'. It became one of his four absolutes of quality.[6] This approach depends on the customer or the supplier defining all characteristics that are essential for the product or service to be fit for its use under all conditions it will be used. However, it removes the subjectivity associated with words like goodness, perfection, excellence and eliminated opinions and feelings. It means that no one is in any doubt as to what has to be achieved.

The implication with this definition is that should a product not conform to the specified requirements it will be rejected and deemed poor quality when it might well satisfy the customer. It led Rolls Royce aero engines to declare in the 1980s its Quality Policy as *"Meet the requirements or cause them to be changed"* in order to prevent products being rejected for trivial reasons. There was and still is a tendency with this definition to pursue ever more detailed requirements in an attempt to capture every nuance of customer needs by defining what is and what is not acceptable. Where customer requirements are very detailed it means that the simplest decision on fitness for use has to be deferred to the customer rather than being made locally. However, the specification is often an imperfect definition of what a customer needs. Some needs can be difficult to express clearly and by not conforming, it doesn't mean that the product or service may be unsatisfactory to the customer.

Conformance to the requirements can be an appropriate definition at the operational level where customer needs have been translated into requirements to levels where acceptance decisions are made such as receipt inspection, component test, assembly inspection. Crosby was credited with a 25% reduction in the overall rejection rate and a 30% reduction in scrap costs[7] so understanding quality as conformity to the requirements can bring significant benefits for the supplier and the customer.

It is also possible that a product that conforms to requirements may be unfit for use. It all depends on whose requirements are being met. Companies often define their own requirement as a substitute for conducting in depth market research and misread the market. On the other hand, if the standards are well in excess of what the customer requires, the price may well be much higher than what customers are prepared to pay – there probably isn't a market for a gold-plated mousetrap, except as an ornament perhaps!

The conformance to requirements definition relies on there being requirements with which to conform. The definition does not recognize potential requirements or future needs or wants so as a strategy; it is rooted in the present.

Fitness for Use

The idea that quality means fitness for use is based on the premise that an organization will retain satisfied customers only if it offers for sale products or services that respond to the needs of the user in terms of price, delivery and fitness for use. Juran[8] defined fitness for use as the extent to which the product or service successfully serves the

[5] Crosby Philip B. (1979) Quality is Free. McGraw-Hill Inc.

[6] Crosby Philip B. (1986) Quality without tears – The art of hassle-free management. McGraw-Hill Inc.

[7] http://en.wikipedia.org/wiki/Phil_Crosby.

[8] Juran J.M. (1974) Quality Control Handbook 3rd Edition. McGraw-Hill Inc.

purpose of the user during usage (not just at the point of sale) and rather than invent a word for this concept settled on the word 'quality' as being acceptable for this purpose.

Extract from UK Sale and Supply of Good Act 1994, Chapter 35, Section 1

Where the seller sells goods in the course of a business, there is an implied term that the goods supplied under the contract are of satisfactory quality.

For the purposes of this Act, goods are of satisfactory quality if they meet the standard that a reasonable person would regard as satisfactory, taking account of any description of the goods, the price (if relevant) and all the other relevant circumstances.

For the purposes of this Act, the quality of goods includes their state and condition and the following (among others) are in appropriate cases aspects of the quality of goods:

- fitness for all the purposes for which goods of the kind in question are commonly supplied,
- appearance and finish,
- freedom from minor defects,
- safety, and
- durability.

It is interesting to note that Juran did not sit down and ponder on what the word quality meant. He had identified a concept then looked around for a label he could use that would adequately convey his intended meaning. It is only in the ensuing decades that the word quality has been abused and misused.

Juran[9] later recognized that fitness for use definition did not provide the depth for managers to take action and conceived of two branches: product features that meet customer needs and freedom from deficiencies. Nonetheless, as a strategy this definition is also rooted in the present and does not take into account the future needs of customers.

Fitness for Purpose

The UK Sales and Supply of Goods Act 1994, Chapter 35, makes provision as to the terms to be implied in certain agreements for the transfer of property and other transactions. An extract from this Act is contained in the boxed text. This definition for quality appears to be based on the premise that quality is a standard that a reasonable person would regard as satisfactory, taking account of any description of the goods, the price (if relevant) and all the other relevant circumstances. The only notion excluded is that of delighting customers but that is where some organizations develop a competitive advantage.

Internationally Agreed Definitions

In 1987, ISO 8402 defined quality as *the totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs.* Although superseded by the definition in ISO 9000:2005 below, in principle it remains relevant even if a little verbose.

[9] Juran J.M. (1989) Juran on Leadership for quality. The Free Press, Division of Macmillan Inc.

The problem with it was the term 'entity' which was partially overcome by the new definition in 2000 which is:

The degree to which *a set of inherent characteristics fulfils requirements (ISO 9000:2005).*

This new definition appears to be a retrograde step as it mentions requirements rather than needs, thus arching back to an era where conformity to requirements was the accepted norm. However, we can remove the implied limitation, by combining the definition of the terms *quality* and *requirement* in ISO 9000:2005, and therefore quality can be expressed as *the degree to which a set of inherent characteristics fulfils a need or expectation that is stated, generally implied or obligatory*''.

This implies that quality is relative to what something should be and what it is. The something maybe a product, service, decision, document, piece of information or any output from a process.

This means that when we talk of anything using the word quality it simply implies that we are referring to the extent or degree to which a need or expectation is met. It also means that all the principles, methodologies, tools and techniques in the field of quality management serve one purpose, that of enabling organizations to close the gap between the standard required and the standard reached and if desirable, exceed them. In this context, performance, environmental, safety, security and health problems are in fact quality problems because an expectation or a requirement has not been met. If the expectation had been met there would be no problem.

The definition appears to be rooted in the present because it makes no acknowledgement as to whether the 'needs' are present needs or future needs but if we imagine that customers expect continual improvement including innovation, then the definition is sound.

Sustained Satisfaction

Deming wrote that *a product or service possesses quality if it helps somebody and enjoys a good and sustainable market*.[10]

If organizations produce products and service that satisfy their customers and a satisfied customer is deemed as one who does not complain, then the customer may choose a competitor's product next time, not because of dissatisfaction with the previous organization's products but because a more innovative product came on to the market. Even happy customers and loyal customers will switch to suppliers offering innovative products. This does not arise from meeting present customer needs and expectations; it arises from not recognizing that markets change.

Before the age of mobile phones customers were not hammering on the door of the telephone companies demanding mobile phones, before we had video recorders that could pause live TV we were watching, we were not demanding digital video recorders with hard drives; these innovations arose because the designers looked for better and different solutions that would make life easier for their customers. The innovations do not have to involve high technology. It has now become common place in the UK for restaurants to provide chocolate mints after a meal. For a while it delighted customers as they were not expecting it but once it became the norm, its

[10] Deming W. Edwards (2000) The New Economics, page 2. MIT Press.

power to delight has diminished and so the restaurant trade has to look to other innovations to keep the customers coming through the door. In business-to-business relationships a quality service is not simply satisfying customers, but enabling your customers to be more successful with their business by using your services. At Lockheed Martin, they say that the core purpose of their corporation is to achieve mission success which they define by saying that *"mission success is when we make our customers successful"*.

Sustained satisfaction therefore takes the meaning of quality beyond the present and attempts to secure the future.

Satisfactory and Unsatisfactory Quality

The definition of quality in ISO 9000:2005 contains the notion of 'degree' implying that quality is not an absolute but a variable. This concept of 'degree' is present in the generally accepted definition of quality in the Oxford English Dictionary and is also implied in the UK Sales and Supply of Goods Act through the phrase 'satisfactory quality'. The concept of 'degree' is illustrated in Fig. 2-1. The diagram expresses several truths:

The Customer Decides

In the final analysis it is the customers who set the standards for quality and they do this by deciding which products to purchase and whom to buy them from.
(From Kaizen by Masaaki Imai)

- Needs, requirements and expectations are constantly changing;
- Performance needs to be constantly changing to keep pace with the needs;
- Quality is the difference between the standard stated, implied or required and the standard reached;
- Satisfactory quality is where the standard reached is within the range of acceptability defined by the required standard;
- Superior quality is where the standard reached is above the standard required;
- Inferior quality is where the standard reached is below the standard required,

FIGURE 2-1 The meaning of quality.

We need to express our relative satisfaction with products and services and as a consequence use subjective terms. When a product or service satisfies our needs we are likely to say it is of *good quality* or *satisfactory quality* and likewise when we are dissatisfied we say the product or service is of *poor quality* or of *inferior quality*. When the product or service exceeds our needs we will probably say it is of *high quality* or *superior quality* and likewise if it falls well below our expectations we say it is of *low or unsatisfactory quality*.

Products or services that do not possess the right features and characteristics either by design or by construction are products of poor quality. Those that fail to give customer satisfaction by being uneconomic to use are also products of poor quality, regardless of their conformance to specifications. Often people might claim that a product is of good quality but of poor design, or that a product is of good quality but it has a high maintenance cost. A product may not need to possess defects for it to be regarded as poor quality, for instance it may not possess the features that we would expect, such as access for maintenance. These are design features that give a product its saleability. Products and services that conform to customer requirements are considered to be products of acceptable quality. If an otherwise acceptable product has a blemish – is it now unacceptable? Perhaps not because it may still be far superior to other competing products in those features and characteristics that are acceptable.

For companies supplying products and services, a more precise means of measuring quality is needed. To the supplier, a quality product is the one that meets in full the perceived customer requirements. To the customer, a quality product is one that meets in full the stated customer requirements and it is the supplier's responsibility to ensure that the perceived and stated requirements are within the range of acceptability.

Satisfaction and dissatisfaction are not necessarily opposites as observed by Juran[11] and Deming.[12] There are many products that conformed to requirements and were fit for use and free of defects when produced but no longer satisfy customers because they target a market that has changed, magnetic tape recorders, carburettors, carbon paper, valve radios are a few examples. They did satisfy large numbers of customers at one time but have been replaced by devices offering different functionality and greater satisfaction. Therefore, when judging the quality of a product you need to be sure you are judging competing alternatives (for further discussion see Classification of products and services).

Attainment Levels of Quality

The definitions we have examined all have their place. None of them is entirely incorrect – they can all work but they suggest that there are levels of attainment with respect to quality as shown in the text box.

If we perceive quality as freedom from deficiencies or defects we are limiting our understanding of quality to the current and local requirements. We will lose customers if the local requirements don't align with the customer requirements. We will also reduce costs with this mindset but we will only retain customers for as long as our products are valued.

If we perceive quality as conformity with customer requirements, we recognize that a conforming product is one that is free of deficiencies and meets all local and customer

[11] Juran J.M. (1992) Juran on quality by design. The Free Press, Division of Macmillan Inc.

[12] Deming W. Edwards (2000) The New Economics, page 9, MIT Press.

requirements. We are however, limiting our understanding of quality to the current customer requirement and not future needs. With this mindset we will reduce costs and retain more customers but again only as long as our products are valued.

Attainment Levels of Quality

I. Freedom from deficiencies which require better controls and result in lower costs but does not necessarily retain satisfied customers.
II. Conformity with customer requirements which requires capable processes and results in lower costs but does not necessarily retain satisfied customers.
III. Satisfying customer's needs and expectations which requires innovation as well as capable processes and results in lower operating costs and higher development costs but in return creates and retains satisfies customers and leads to sustained success.

If we perceive quality as satisfying customer's needs and expectations, we recognize that a quality product is the one that is free of deficiencies, conforms to customer requirements and satisfies customer needs and expectations. We are not limiting our understanding of quality to current requirements and thus take in future needs and expectations. For example, the customer may not have a requirement to pause live TV but once you make him aware that this is now available, it becomes a customer need and after a month or two, he finds he can't live without it and any other supplier that cannot offer this feature is not even considered. With this mindset we will reduce production costs but increase research and development costs but the bonus is that we will also create and retain more customers for as long as we can continue to innovate.

QUALITY IN CONTEXT

Noun or Adjective

Ordinarily, quality is a noun but is often used as an adjective. The used car dealer displays the placard 'Quality Used Car' on every vehicle to indicate that their condition is of a high standard; the carpet warehouse advertises 'Quality Carpets' indicating that they stock a range of carpets that are suitable for different uses. The seller neither designed nor manufactured the product but nonetheless claim their products to be quality products. These are examples where the word 'quality' comes before the noun and is thus being used as an adjective to give the impression that the products are superior in some way.

Where the word 'quality' comes after a noun, it describes the condition or properties of something. For example, 'air quality' describes the condition of the air in a particular place and time, reflecting the degree to which it is pollution free; 'water quality' described the chemical, physical, and biological characteristics of a particular water-body, usually in relation to its suitability for a particular use.[13]

[13] A Dictionary of Environment and Conservation (2007) Oxford University Press.

Classification of Products and Services

If we group products and services by type, category, class and grade, we can use the subdivision to make comparisons on an equitable basis. But when we compare entities we must be careful not to claim one is of better quality than the other unless they are of the same grade. Entities of the same type have at least one attribute in common. Entities of the same grade have been designed for the same functional use and therefore comparisons are valid. Comparisons on quality between entities of different grades, classes, categories or types are invalid because they have been designed for a different use or purpose.

Let us look at some examples to illustrate the point. Food is a type of entity. Transport is another entity. Putting aside the fact that in the food industry the terms *class* and *grade* are used to denote the condition of post-production product, comparison between *types* is like comparing fruit and trucks, i.e., there are no common attributes. Comparisons between *categories* are like comparing fruit and vegetables. Comparisons between *classes* are like comparing apples and oranges. A comparison between grades is like comparing eating apples and cooking apples.

Now let us take another example. Transport is a type of entity. There are different categories of transport such as airliners, ships, automobiles and trains; they are all modes of transport but each has many different attributes. Differences between categories of transport are therefore differences in *modes* of transport. Within each category there are differences in class. For manufactured products, differences between classes imply differences in *purpose*. Luxury cars, large family cars, small family cars, vans, trucks, four-wheel drive vehicles etc. fall within the same category of transport but each was designed for a different purpose. Family cars are in a different class to luxury cars; they were not designed for the same purpose. It is therefore inappropriate to compare a Cadillac with a Chevrolet or a Rolls Royce Silver Shadow with a Ford Mondeo. Entities designed for the same purpose but having different specifications are of different grades. A Ford Mondeo GTX is of a different grade to that of a Mondeo LX. They were both designed for the same purpose but differ in their performance and features and hence comparisons on quality are invalid.

A third example in the service industry would be; accommodation. There are various categories, such as rented, leased and purchased. In the rented category there are hotels, inns, guesthouses, apartments etc. It would be inappropriate to compare hotels with guesthouses or apartments with inns. They are each in a different class. Hotels are a class of accommodation within which are grades such as five stars, four stars, three stars etc. indicating the facilities offered not quality levels. It would therefore be reasonable to expect a one-star hotel to be just as clean as a four-star hotel.

You can legitimately compare the quality of entities if comparing entities of the same grade. If a low-grade product or service meets the needs for which it was designed, it is of the requisite quality. If a high-grade product or service fails to meet the requirements for which it was designed, it is of poor quality, regardless of it still meeting the requirements for the lower grade. There is a market for such differences in products and services but should customer's expectations change then what was once acceptable for a particular grade may no longer be acceptable and regrading may have to occur.

Where manufacturing processes are prone to uncontrollable variation it is not uncommon to grade products as a method of selection. The product that is free of

imperfections would be the highest grade and would therefore command the highest price. Any product with imperfections would be downgraded and sold at a correspondingly lower price. Examples of such practice arise in the fruit and vegetables trade and the ceramics, glass and textile industries. In the electronic component industry, grading is a common practice to select devices that operate between certain temperature ranges. In ideal conditions all devices would meet the higher specification but due to variations in the raw material or in the manufacturing process only a few may actually reach full performance. The remainder of the devices has a degraded performance but still offers all the functions of the top-grade components at lower temperatures. To say that these differences are not differences in *quality* would be misleading, because the products were all designed to fulfil the higher specification. As there is a market for such products it is expedient to exploit it. There is a range over which product quality can vary and still create satisfied customers. Outside the lower end of this range, the product is considered to be of poor quality.

Quality and Price

Most of us are attracted to certain products and services by their price. If the price is outside our reach we don't even consider the product or service, whatever its quality, except perhaps to form an opinion about it. We also rely on price as a comparison, hoping that we can obtain the same characteristics at a lower price. In the luxury goods market, a high price is often a mark of quality but occasionally it is a confidence trick aimed at making more profit for the supplier. When certain products and services are rare, the price tends to be high and when plentiful the price is low, regardless of their quality. One can purchase the same item in different stores at different prices, some as much as 50% less and many at 10% less than the highest price. You can also receive a discount for buying in bulk, buying on customer credit card or being a trade customer rather than a retail customer. Often an increase in the price of a product may indicate a better after-sales service, such as free on-site maintenance, free delivery, and free telephone support line. The discount shops may not offer such benefits.

The price label on any product or service, regardless of the inherent features should be for a product or service free of defects. If there are defects the label should say as much, otherwise the supplier may well be in breach of national laws and statutes. Price is therefore not an inherent feature or characteristic of the product. It is not permanent and as shown above varies without any change to the inherent characteristics of the product. Price is also a feature of the service associated with the sale of the product. Price is negotiable for the same quality of product. Some may argue that if you want 'quality' you have to pay for it but what you are paying by a higher price is likely to be a product that is more reliable, more durable and has a longer life or a service providing more comfort, more luxury and greater convenience.

Quality and Cost

Philip Crosby published *Quality is Free* in 1979 and caused a lot of raised eyebrows among executives because they always believed the removal of defects was an in-built cost in running any business. To get quality you had to pay for inspectors to detect the errors! What Crosby told us was that if we could eliminate all the errors and reach zero

defects, we would not only reduce our costs but also increase the level of customer satisfaction by several orders of magnitude. In fact there is the cost of doing the right things right first time and the cost of *not* doing the right things right first time. This is often referred to as *quality costs* or the cost incurred because failure is possible.

Using this definition, if failure of a product, a process or a service is not possible, there would be no *quality costs*. It is rather misleading to refer to the cost incurred because failure is possible as *quality costs* because we could classify the costs as avoidable costs and unavoidable costs. We have to pay for labour, materials, facilities, machines, transport etc. To some extent these costs are unavoidable but we are also paying in addition some cost to cover the prevention, detection and removal of errors. Should customers have to pay for the errors made by others? There is a basic cost if failure is not possible and an additional cost in preventing and detecting failures and correcting errors because our prevention and detection programmes are imperfect. We can reduce the basic cost by finding more economical ways of doing things or cheaper materials. However, there is variation in all processes but it is only the variation that exceeds the tolerable limits that incurs a penalty. If you reduce complexity and install failure-prevention measures you will be spending less on failure detection and correction. There is an initial investment to be paid, but in the long term you can meet your customer's requirements at a cost far less than you were spending previously.

Some customers are now forcing their suppliers to reduce internal costs so that they can offer the same products at lower prices. This has the negative effect of forcing suppliers out of business. While the motive is laudable, the method is damaging to industry. There are inefficiencies in industry that need to be reduced but imposing requirements will not solve the problem. Co-operation between customer and supplier would be a better solution and when neither party can identify any further savings the target has been reached. Customers do not benefit by forcing suppliers out of business.

Quality and Design

In examining the terms design and quality, we need to recognize that the word design has different meanings. Here we are not concerned with design as a verb or as the name we give to the process of design or the output of the design process. In this context we are concerned with the term design as an aesthetic characteristic of a product or service rather than a quality characteristic. The quality characteristic embraces the form, fit and function attributes relative to its purpose. The attributes that appeal to the senses are very subjective and cannot be measured with any accuracy, other than by observation and comparison by human senses. So when we talk of quality and design we are not referring to whether the design reflects a product that has the correct features and functions to fulfil its purpose, we are addressing the aesthetic qualities of the product. We could use the word appearance but design goes beyond appearance. It includes all the features that we perceive by sight, touch, smell and hearing.

If the customer requires a product that is aesthetically pleasing to the eye, or is to blend into the environment or appeal to a certain group of people, one way to measure the quality of these subjective characteristics is to present the design to the people concerned and ask them to offer their opinion.

Quality *of* design is a different concept and is *the extent to which the design reflects a product or service that satisfies customer needs and expectations for functionality, cost*

of ownership and ease of use etc. All the necessary characteristics should be designed into the product or service at the outset.

Quality, Reliability and Safety

There is a school of thought that distinguishes between quality and reliability and quality and safety. Quality is thought to be a non-time-dependent characteristic and reliability a time-dependent characteristic but the aspect of quality being addressed is the quality of conformity which is the *extent to which the product or service conforms to the design standard*. The design has to be faithfully reproduced in the product or service.

If we take a logical approach to the issue, when a product or service is unreliable, it is clearly unfit for use and therefore of poor quality. If a product is reliable but emits toxic fumes, is too heavy or not transportable when required to be, it is of poor quality. Similarly, if a product is unsafe it is of poor quality even though it may meet its specification in other ways. In such a case the specification is not a true reflection of customer needs. A nuclear plant may meet all the specified safety requirements but if society demands greater safety standards, the plant is not meeting the requirements of society, even though it meets the immediate customer requirements. You therefore need to identify the stakeholders in order to determine the characteristics that need to be satisfied. The needs of all these parties have to be satisfied in order for *quality* to be achieved. But, you can say, ''This is a quality product as far as my customer is concerned''.

QUALITY CHARACTERISTICS (PRODUCT FEATURES)

There are three fundamental parameters that determine the saleability of products and services; they are price, quality and delivery. Price is a function of cost, profit margin and market forces, and delivery is a function of the organization's efficiency and effectiveness. Price and delivery are easily defined because they can be quantified. Price can be quantified in terms of a number of units of currency and delivery can be quantified in terms of units of time. Quality on the other hand describes the condition or properties of the product which can be quantified in many different ways. Price and delivery are both transient features, whereas the impact of quality is sustained long after the attraction or the pain of price and delivery has subsided.

A product is the output from a process and in describing an output; we express it in terms of its characteristics or features. (In his Quality Control Handbook of 1974 Juran used the term ''quality characteristics'' but in his later work he abandoned this term as it was only used in the manufacturing industries and preferred the term ''product features'' as it is more widely used. However, ISO 9000:2005 still defines the term quality characteristic).

To comment on the quality of anything we need a measure of its characteristics and a basis for comparison. Any feature or characteristic of a product or service that is needed to satisfy customer needs or achieve fitness for use is a *quality characteristic*. These characteristics identify the measures of quality, i.e., what we measure to determine that our needs and expectations have been satisfied, fresh bread, hot tea, the promptness of the train service, the softness of a leather chair, the security of an investment etc. When dealing with products the characteristics are almost always

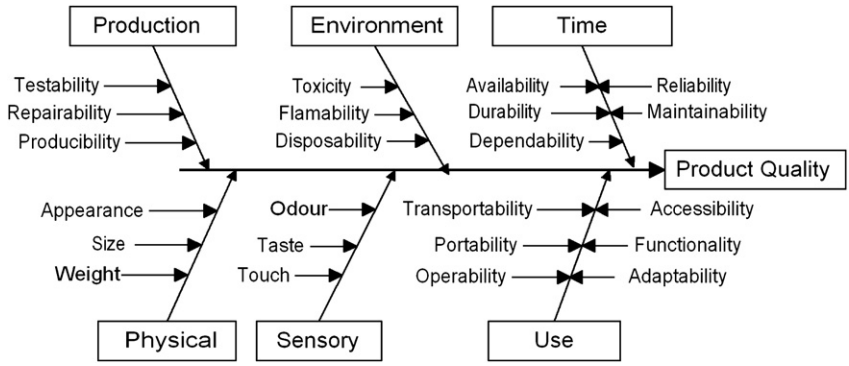

FIGURE 2-2 Some characteristices of product quality.

technical characteristics, whereas service quality characteristics have a human dimension. They may be known as product requirements or service requirements which express the characteristics the product or service needs to exhibit for it to be acceptable. When qualified by units of measure these characteristics become acceptance criteria such as weight 10 kg +/−10 g. Some typical quality characteristics are shown in Fig. 2-2.

Such characteristics need to be specified and their achievement planned, controlled, assured, improved, managed and demonstrated. These characteristics form the subject matter of the product or service requirements referred to in a contract, specification or indeed ISO 9001. When the value of these characteristics is quantified or qualified they are termed *product requirements or service requirements*. We used to use the term *quality requirements* but this caused a division in thinking that resulted in people regarding quality requirements as the domain of the quality personnel and technical requirements being the domain of the technical personnel. All requirements are fundamentally *quality* requirements – they express needs or expectations that are intended to be fulfilled by a process output. We can therefore drop the word *quality*. If a modifying word is needed in front of the word requirements it should be a word that signifies the subject of the requirements. Transportation system requirements would be requirements for a transportation system, audio speaker design requirements would be requirements for the design of an audio speaker, component test requirements would be requirements for testing components, and management training requirements would be requirement for training managers. The requirements of ISO 9001 and its derivatives are often referred to as *quality requirements* as distinct from other types of requirements but this is misleading. ISO 9001 is no more a quality requirement than is ISO 1000 on SI units, ISO 2365 for ammonium nitrate or ISO 246 for rolling bearings. The requirements of ISO 9001 are *quality management system requirements* – requirements for a quality management system.

DIMENSIONS OF QUALITY

There are three *dimensions of quality* two of which extend the perception beyond the concepts outlined previously:

The product quality dimension. This is the extent to which the products and services provided meet the needs of specific customers. Enhancement of product features to satisfy more customers might yield improvement in product quality.

The business quality dimension. This is the extent to which the business serves the needs of all customers (present and future) and is the outward facing view of the organization. Customers are interested in better products and services, delivering greater value and greater benefits. Changes in business strategy, direction or policies might yield improvement in business quality.

The enterprise quality dimension. This is the extent to which the *enterprise* meets the needs of all stakeholders, maximizes its efficiency and effectiveness and is both an inward and outward facing view of the organization. Efficiency is linked with productivity which itself is linked with the motivation of personnel and the capability or processes and utilization of resources. Effectiveness is linked with the utilization of knowledge focusing on the right things to do, taking account of the needs of all stakeholders. The stakeholders are not only interested in the quality of particular products and services but also judge organizations by their potential to create wealth, the continuity of operations, the sustainability of supply, care of the environment, care of people and adherence to health, safety and legal regulations. Seeking best practice might yield improvement in enterprise quality. This directly affects all aspects of quality. Viewing the organization as a system would redefine this dimension as, *the system quality dimension*.

We must separate the three concepts above to avoid confusion. When addressing quality, it is necessary to be specific about the object of our discussion. Is it the quality of products or services, or the quality of the business in which we work, or the enterprise as a whole, about which we are talking? If we only intend that our remarks apply to the quality of products, we should say so.

Many organizations only concentrate on the product quality dimension, but the three are interrelated and interdependent. Deterioration in one eventually leads to deterioration in the others.

Organizations may be able to produce products and services that satisfy their customers under conditions that put employees in fear of losing their jobs, that put suppliers in fear of losing orders and put the local community in fear of losing their quality of life. However, society has a way of dealing with these – through representation in government, laws are passed that regulate the activities of organizations. As we will show in Chapter 3, such organizations are eventually put out of business but there may be a lot of pain all round before this event occurs.