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Robotham, AJ; Guldbrandsen, M

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What is the new paradigm in product quality?

A.J. Robotham & M. Guldbrandsen

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Abstract

The current product quality paradigm is founded upon a customer-focused product development process, in which the functionality and behaviour of a product are designed to fulfil the needs of customers, and technological innovation is used to expand the capability and enhance the performance of the product. However, this view of product quality does not reflect the current practices of today's leading manufacturers, who now offer "total solutions" based upon an integrated package of products and services with well defined characteristics tailored to individual needs. Concepts such as globalisation, mass customisation, product branding, e-commerce, and sustainability suggest that a new product quality paradigm is evolving. This paper will discuss our current understanding of product quality issues and outline our vision of the new quality paradigm for product developers.

1. Introduction

The necessity to maintain competitive advantage demands that a product developer creates innovative products that customers perceive to be of the highest quality, are good value for money and can be differentiated from the products of its competitors. Consequently, product quality continues to be a key driver of the product development process. But this is not new news to any self-respecting manufacturer - product quality has been high on the product development agenda now for many years.

Today, it is almost impossible to find a manufacturer that has not been significantly influenced by the quality culture, but it is evident that some are doing more to improve their product quality than others are. We believe that the current product quality paradigm is defined in terms of customer needs satisfaction and creating value in the product and that it remains an operational target for most companies to aspire to.

So what are the key elements of the current product quality paradigm?

1.1 The current product quality paradigm

The current product quality paradigm is the result of over forty years attention to quality initiated by Juran, Deming and Feigenbaum. Embraced by the Japanese manufacturers, quality has been the driver for their product development activities since the 1950's. North American and European manufacturers only really woke up to the importance of product quality in the 1970's - the trigger being large losses of sales in home markets, where consumers were exhibiting a preference for the superior quality of Japanese products. Since

then, the principles of Total Quality, and the methods and tools used by Japanese manufacturers have been studied, adapted and implemented by Western manufacturers. Although attention was initially directed at improving production quality (e.g. manufacturing cost, process organisation and control, waste reduction), the significance of design on product quality and the imperative to focus upon satisfying customers were quickly recognised. Consequently, more attention is now given to improving the upstream activities of the product development process to ensure that products have "designed-in" quality.

The current product quality paradigm is founded upon a customer-focused product development process, in which the functionality and behaviour of a product are designed to fulfil the needs of customers, and technological innovation is used to extend capability, enhance performance, and ease the use of the product. A life cycle oriented design approach [1] attends to the needs of all the stakeholders who interact with the product in some way and aims to ensure that each is fulfilled by the product in a manner that maximises the value to the customer. The quality models of Kano [2] and Andreasen and Hein [3] (Figure 1) show us that products have different classes of quality characteristics, that new generations must have new features to delight the customer and give market differentiation, and that the quality expectations of customers are continually rising. Quality assurance procedures and tools, e.g. ISO9000, QFD, FMEA, DFMA, reinforce the "built-in" quality ethos of the current paradigm.

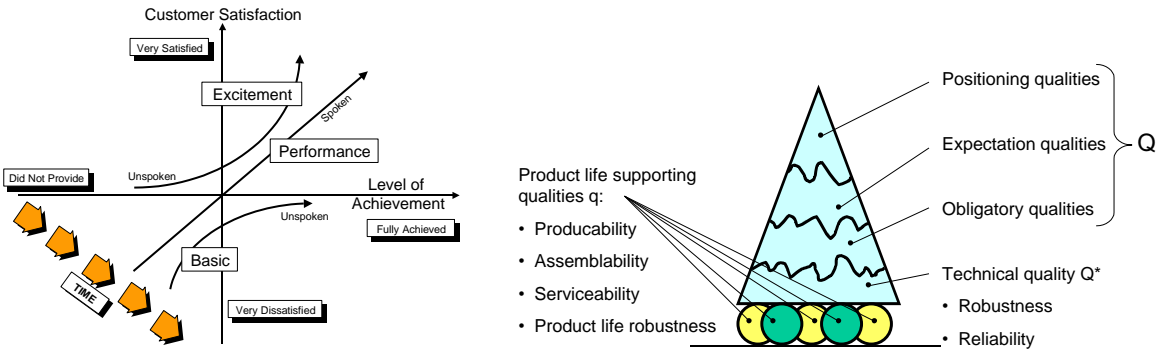


Figure 1a: Classes of quality (after Kano [2]) Figure 1b: Classes of quality (after Andreasen & Hein [3])

1.2 Moving to a new quality paradigm

The current product quality paradigm continues to be important. We are conscious that many companies are *still* striving to "close-the-loop" on product quality and meet all the expectations of the current paradigm. However, we also observe that leading manufacturers are already implementing new quality related practices. We believe that the changes are so significant that product development practice must move to a new quality paradigm.

In the following sections we will discuss our observations of the changes in quality related practices and consider the implications for product developers. We will then proceed to outline our interpretation of the new quality paradigm, which will be important to all product developers.

2. Observations of developments in quality related practice

The following observations of the product development practices of leading manufacturers result from reviews of literature and discussions with a small number of manufacturers and researchers. We have not undertaken any systematic validation of our observations and, therefore, our interpretation of current trends and speculation about the future importance of the issues discussed is based upon deductive reasoning.

2.1 Limitations of the Product Focus of the Current Quality Paradigm

The key characteristics of the current product quality paradigm are still relevant and important. But the *kaizen* principle of continuous improvement ensures that within the paradigm higher levels of achievement are still desirable. Therefore, it is inevitable that we observe manufacturers improving product quality by using the tactics of the old paradigm. For example, product value can be improved by increasing functionality to enable more tasks to be performed. Or else, existing functional behaviour can be improved - the metrics typically being faster, quieter, lighter, easier to use, bigger, smaller, more flexible, better, less wasteful. Reducing cost makes the product better value for money.

Consequently, we can observe familiar patterns of product development in which there is a continuous improvement of product quality based upon the continued development of product and process technologies. One sequence of product improvement might be:

1. New function introduced by the addition of an additional mechanical system.
2. Enhance reliability, accuracy, speed, etc., of the mechanical system.
3. Reduce cost by DFMA, use of new materials and production processes, etc.
4. Make product easier to use and further enhance reliability, accuracy, speed, etc., by using an electro-mechanical system.
5. Introduce secondary functionality, e.g. adjustability, alternative modes of operation.
6. Improve functionality and flexibility by using mechatronic system with a programmable, adaptive, self-learning, and intelligent capability.

In this scenario, competitive advantage is maintained by technological innovation in the product or production processes. The continued pursuit of technological innovation may be inappropriate, however, if the customer has no perception of the improvement or considers it to be unimportant to them, i.e. better quality is not valued.

We also observe that in the pursuit of technological innovation, products are more complex and increasingly utilising technologies shared by competitors. For example, manufacturers of personal computers will use the same microprocessor and operating system software, and car manufacturers share engine and transmission systems. Equally, as products mature and follow the S-curve of technological innovation, they eventually reach a plateau of product quality performance that can also be reached by others. In either case, the consequence is that the functional behaviour of the product is going to be similar to the behaviour of other products in the market and customers may be unable to differentiate between them.

Whilst, we understand that continuous improvement of product and product related processes will continue to be fundamental to product development practices of the future, we consider the focus on product quality is a defining characteristic of the current quality paradigm.

2.2 Total Solutions and User Experiences

The current product quality paradigm very much puts the emphasis upon the product as being the sole carrier of quality. This is changing as a consequence of the very nature of what a manufacturer provides the customer and rather than think in terms of a single product, we must think in terms of "total solutions". Total solutions are the consequence of innovative, life cycle oriented thinking by manufacturers who have taken a greater responsibility of the whole product life cycle and now provide an integrated system of related products and services.

For example, no longer is it good enough just to make a mobile phone - today's mobile phone should provide Internet access, interface with a lap-top computer, and come with a variety of billing rates. Cars are being designed to integrate with a plethora of communication systems, enabling it to become an on-road office, and are purchased with company finance packages and service contracts. Hospital analysis equipment is linked to the central computer system to allow analysis results to be automatically recorded in the patient records. And after making an airline flight reservation, customers are offered preferential hotel and car-hire rates at their destination.

The consequence for the product developer is that strategic alliances must be formed with other manufacturers and service providers. The product is no longer a stand-alone entity, but rather one that integrates with other products to form complex systems supported by complementary customer services.

The focus is still on the customer, but the emphasis is shifting to providing customer value by giving a total "user experience". The user experience can best be illustrated by a metaphor of bicycling. What is important to the customer (the biker) and valued by them is the activity of *bicycling*, for which the bicycle (the product) is the means to the end. By focusing attention on the activity, rather than on the product, the bicycle manufacturer will also have the chance of identifying new opportunities for adding value and new products, e.g. specialist clothing, protective equipment, child seats, and trailers.



Figure 2: The user experience of bicycling

This move towards total solutions seems particularly important where the product is mature and operating in highly competitive markets. Here technological innovation is at the top of the "S-curve" where, for example only small gains in product performance can be realised, and product differentiation is difficult for customers to perceive. Consequently, integration with other systems is a relatively simple means to innovate, create new functionality, and offer the customer better value.

2.3 Product Branding

Product branding is not new, but historically associated more strongly with non-durable consumer products. However, it is evident today that manufacturers are placing a lot more

emphasis on the brand identity of their consumer-durable and business-to-business products. We believe this is a consequence of products becoming mature and having very little to differentiate them from competitors in technical terms. A strong brand identity will enable customers to differentiate one product from another.

The significance of product branding is summarised by Richard Parry-Jones of the Ford Motor Company as follows [4]:

"Brand is an absolute key when we discuss customer choice. The more sophisticated customers become, the more they rely on brands as a surrogate for summing up all the benefits of the product or service they have bought. Consistent, strong, meaningful brands need to be at the core of any consumer company for the 21st century."

Brand identity is based upon the reputation of the company and its products, the embedded characteristics of past products, and common values and aspirations that are shared by the customer. Although the product is the prime carrier of the brand identity, the actions, behaviour, and attitude of the company that are perceived by the customer towards the environment, its customers, its workforce, and society at large are critical to its continued development. Although it is feasible to conceive a brand identity very quickly using, say, a marketing campaign, we perceive that manufacturers are placing more importance on mature brand names. Historically, these brands have well-known characteristics, which have been evident in past products and which distinguish them from other brands in the market.

The Ford Motor Company, as a case in point, has acquired several different car companies (Mazda, Lincoln, Jaguar, Aston-Martin, Volvo, Land-Rover) with distinctive vehicle portfolios and has purposely maintained their individuality. The company recognises the importance of product quality for building brand image and creating competitive advantage [4]. Knowing the so-called "Brand DNA" of these companies allows Ford to concentrate upon the things that really are important to the quality of their product portfolio. Creating "surprise and delight" features build the brand and ensure differentiation from the products of their competitors (and those of others in the Ford family). For example, the Jaguar XK8 and Aston Martin DB7 technically are quite similar sports cars, and yet the selling price of the DB7 is much higher than that of the XK8. The difference can, in part, be attributed to the heritage of the Aston Martin brand - *"DB7 is a natural evolution of all the classic cars that have gone before it - a re-statement of Aston Martin's deepest and most revered values and ideals"* [5]. Furthermore, the exclusivity of the brand is underpinned by Aston Martin's commitment to low-volume production of its vehicles. Similarly, the Volvo Brand DNA is built upon protection of life and the reputation of its cars for innovation in safety. Ford utilises its knowledge of the core DNA of each of its brands to drive advertising, vehicle design, engineering, platforms and product cycle planning processes.

The need to surprise and delight customers with new features implies that the brand identity is modified in some way with each new generation of products. However, the defining characteristics of a product, i.e. the Product DNA, must be carried over between each generation to ensure the sustainability of the brand. Whilst some features may be transient items of fashion, which are excluded in later generations, others will become embedded into the product and become the expectation qualities stipulated by customers. The challenge for product developers is to fully comprehend the DNA of their products, build future generations

of products that reflect its distinguishing characteristics, and ensure it continues to fit the values of the customer.

Finally, Jesper Kunde [6] emphasises the role of the company in product branding:

"In the future, building strong market positions will be about building companies with strong personality and corporate soul."

2.4 Mass customisation, globalisation and e-commerce

Mass customisation, globalisation, and e-commerce are high profile concepts and strategies that cannot be avoided in any discussion of modern product development practice. Whilst a full discussion of their relevance will not be presented here, in the context of this paper their importance serves merely to underline the attention manufacturers are placing upon satisfying the customer and tailoring products to the individual, wherever they are in the world.

Mass customisation can be fulfilled by the adoption of product structuring strategies, e.g. modularisation and product family platforms, which allow the manufacturer to create a family of products by combining common parts with variant specific parts. Consequently, the specification of a product can be tailored to the specific needs of an individual customer by using a unique configuration of the parts. In the automotive industry, this strategy extends across brands, e.g. *"A Texan rancher can ride around in his F-series Ford pick-up, while a banking vice president can enjoy his Lincoln Navigator SUV. Under the skin ... you will find the same basic vehicle."* [4]. The tactic employed is for vehicles to share parts that the customer does not directly interact with, e.g. engine, transmission, suspension, and chassis. Those parts the customer does interact with, e.g. external body, interior trim, and the way they are configured determine the differentiation between variants in a family and brands. Although, car makers have the capability to customise products to the individual customer, it is estimated that only 20-30% of European buyers custom-order their car [7].

The additional challenge of global product vending is to tailor products to customers with different cultural influences, educational backgrounds, and environmental contexts. Consequently, what might be acceptable in one culture may be inappropriate in another. However, if manufacturers are to compete in the global market place, their products, services and brands must reflect the values of all its customers and at no expense to others.

E-commerce is seen as a possible way of enabling more direct access to customers via the Internet, wherever they may be in the world. The company can show the customer the variants on offer and allow them to explore all the consequences of different configurations. It seems quite feasible to support both configuration and purchase using the Internet. However for some purchase decisions, we believe that customers will continue to prefer the direct interaction with the product, which occurs in a showroom. Only through direct contact with the product will the customer be able to make a thorough evaluation of its properties.

3. The new quality paradigm

In Section 2, we have discussed some our observations about current or emerging practices related to product quality. Here, we will summarise the key elements, which we believe define the new quality paradigm, and consider some of the implications for product developers.

3.1 Key elements of the new quality paradigm

The new quality paradigm does not focus on product quality but rather on creating *customer value*. The attention moves up the value chain, away from the product, and concentrates on *user experiences*. The manufacturer aligns themselves more closely to the customers by providing *total solutions*, in which complementary *products and services* are integrated into a seamless system. Furthermore, the behaviour and attitude throughout the company in all that they do will mirror the customer's own behaviour and attitudes, in both individual and societal contexts. The *brand* will represent these collective values and signify to customers that the company and its products are sympathetic to their individual needs. *Closeness to the customer* will result in *tailored products* that continue to distinguish themselves from those of the competition whilst maintaining the core characteristics expected of the brand. The carriers of quality will be a range of products and services which support the customer throughout their lives, adapting with them as their needs change, and which build the brand through the innovation of *sustainable characteristics*.

3.2 Implications of the new quality paradigm

There are several implications of the new quality paradigm and, although it is not feasible to provide an exhaustive discussion of each in this paper, we will outline the main themes.

The creation of brand identity cannot be achieved overnight. Brand identity arises from the interplay between product presentation and market reaction. The enduring qualities of the product that the customer values will only be found after several iterations of the loop. The so-called core product DNA will have to be embedded in future generations to ensure the continuity of the brand identity. However, the brand is not found in the product alone but also in the customer supporting services and of the actions and behaviour of the company as a whole. According to Jesper Kunde [6], the company must create a "Corporate Religion" in which a balance must exist between the internal and external perceptions of the company (Figure 3).

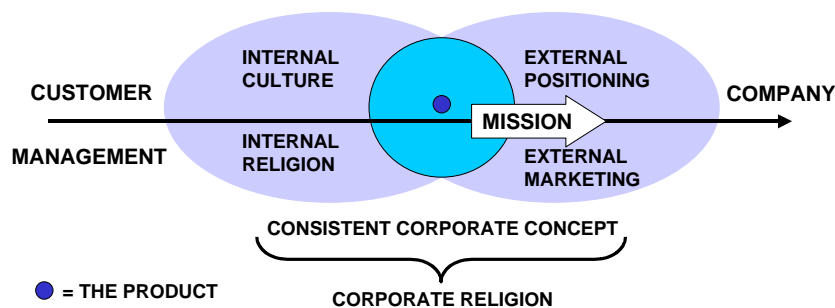


Figure 3: Corporate Religion (After Kunde [6])

From a product development viewpoint, product families must reflect the variation demanded by customers but have brand qualities embedded in their characteristics. The designer needs to be conscious of the historical and cultural context of the product line, and ensure that the enduring characteristics are identified and carried to the next generation. Close working relationships with the customer will allow accurate feedback of their quality reactions and insight into the changing nature of their needs, culture and environment. With this knowledge, the designers will still need to seek the "surprise and delight" factors that are essential to new

products. However, the designer needs to be more conscious of creating innovative features that will evolve the brand DNA and develop the brand value. This necessarily demands that designers (like everyone else in the company) are immersed in its culture and have clear understanding of the business strategy for developing an intimate and sustainable relationship with their customers. The designer's task is to truly reflect the customer values in new products. They will need to work with others to create complementary services, which together with the product build the portfolio of brands. Consequently, we believe that product development in the new quality paradigm must look well beyond the product and embrace the total business activity of products, services, supporting functions, social and environmental actions, attitudes, etc. Product development outcomes need to properly mirror the individual customer, so that when they look at the company and its provision of total solutions, it is as if they were seeing a complete reflection of their own personality, values, culture, social aspirations, and product expectations. Such attention to the brand portfolio should enhance competitive advantage and lead to customer satisfaction, preference and long-term loyalty.

5. Conclusions

The current product quality paradigm of continuous product improvement does not sufficiently reflect emerging practices in product development. Therefore, we have argued that a new quality paradigm is required to fully describe the trends we observe. The new quality paradigm takes a holistic view of products and services, which together provide customers with individually tailored solutions. Furthermore, a strong brand identity ensures the customer can choose products with well-known characteristics and enduring qualities that will lead to delightful user-experiences. The brand identity must be enhanced not only by the product, but also by the totality of the company's activities in reflecting the values of the customer. The new quality paradigm demands that manufacturers mirror the values, aspiration and expectations of their customers.

We believe that the new quality paradigm outlined in this paper is the new "guiding star" for value giving product developers.

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A. J. Robotham
Associate Professor
Dept. of Control & Engineering Design
Technical University of Denmark
Building 358
DK - 2800 Lyngby
Denmark

Tel: 00 45 4525 6259
Fax: 00 45 4588 1451
Email: tony@iks.dtu.dk

M. Guldbrandsen
Dept. of Control & Engineering Design
Technical University of Denmark
Building 358
DK - 2800 Lyngby
Denmark

Tel: 00 45 4525 6270
Fax: 00 45 4588 1451
Email: mguldbrandsen@get2net.dk