The leading edge in QFD: past, present and future

Yoji Akao
Asahi University, Tokyo, Japan, and
Glenn H. Mazur
QFD Institute, Ann Arbor, Michigan, USA

Keywords *Quality function deployment, Product development, Quality assurance, Japan*

Abstract *Quality Function Deployment (QFD) has been practiced by leading companies around the world since 1966. Its two-fold purpose is to assure that true customer needs are properly deployed throughout the design, build and delivery of a new product, whether it be assembled, processed, serviced, or even software, and to improve the product development process itself. This paper describes the evolution of the method, its current best practice, and proposals for future direction, not only to log its history and key players correctly, but also to convey the richness and depth of the applications throughout multiple industries.*

Introduction

Throughout its financial doldrums of the 1990s, Japan has retained its position as the second largest economy in the world. Even a decade of zero and negative growth with interest rates hovering at 0 per cent has not denied Japanese manufacturers the ability to make products that are the envy of the world in quality, reliability, customer satisfaction, and value. Despite an aging population, Japanese workers are arguably among the most skilled, dedicated, and hard-working in the world. How can this be?

While many of these problems can be attributed to the need for governmental and financial reform, it can be argued that it has been Japanese management systems that have kept the country at the forefront of global trade and productivity. Among the most visible of these management systems, because it pertains not to managing their cultural idiosyncrasies but to the design of the physical products they sell world-wide, is Quality Function Deployment (QFD). This article traces the roots of QFD from Japan to the USA and eventually, throughout the world, to the future as more companies find it an essential part of their product development strategy.

The past

QFD was conceived in Japan in the late 1960s, during an era when Japanese industries broke from their post-Second World War mode of product development through imitation and copying and moved to product development based on originality. QFD was born in this environment as a method or concept for new product development under the umbrella of total quality control (TQM). The subtitle *An Approach to Total Quality Control* added to *Quality Function Deployment* (Mizuno and Akao, 1978), the very first

International Journal of Quality & Reliability Management
Vol. 20 No. 1, 2003
pp. 20-35

0265-671X
DOI 10.1108/02656710310453791

book on the topic of QFD written by the late Shigeru Mizuno and Akao, illustrates this relationship.

After the Second World War, statistical quality control (SQC) was introduced to Japan and became the central quality activity, primarily in the area of manufacturing. Later, it was integrated with the teachings of Dr Juran, who during his 1954 visit to Japan emphasized the importance of making quality control a part of business management, and the teaching of Dr Kaoru Ishikawa, who spearheaded the company-wide quality control movement by convincing the top management of companies of the importance of having every employee take part. This evolution was fortified also by the 1961 publication of *Total Quality Control* (Feigenbaum, 1961) by Dr Feigenbaum. As a result, SQC was transformed into TQC in Japan during this transitional period between 1960 and 1965.

It was during this time that Akao first presented the concept and method of QFD. The Japanese automobile industry was in the midst of rapid growth, going through endless new product development and model changes. At that time, the following two issues became the seeds out of which QFD was conceived:

(1) People started to recognize the importance of designing-in quality, but how it could be done was not found in any books available in those days.

(2) Companies were already using quality control (QC) process charts to inspect for quality, but the charts were produced at the manufacturing site after the new products were being churned out of the line.

Akao questioned:

> By the time design quality is determined, there should already exist critical quality assurance (QA) points that are needed to ensure certain qualities. Why, then, could we not note these critical points on the QC process chart as predetermined control points or check points for production activity, prior to production start-up?

In 1966, a process assurance items table was presented by Kiyotaka Oshiumi (Oshiumi, 1966) of Bridgestone Tire Corp. This table showed the links from the substitute quality characteristics, which were converted from true qualities, to the process factors. It gave a clue to my quest for the QC process table, a table that should be created prior to production start-up. To this process assurance items table, Akao added a field called "design viewpoints" and tried to get the new table used in new product development.

The idea was taken to various companies for trials, but it did not generate much public attention. In 1972, Akao assembled this concept and his experiences in a publication (Akao, 1972) where the approach was described with the term "*hinshitsu tenkai*" (quality deployment) for the first time. This established a method to deploy, prior to production start-up, the important quality assurance points needed to ensure the design quality throughout the production process. The approach at the time, however, was still inadequate in terms of setting the design quality.

What resolved this inadequacy was the quality chart (Nishimura, 1972; Suzuki, 1972) that was created and made public by the Kobe shipyards of Mitsubishi Heavy Industry. Their table was defined the following year as a table that:

> . . . systematized the true quality (customers' needs) in terms of functions, then showed the relationship between these functions and the quality characteristics, which were the substitute quality characteristics (Takayanagi, 1972).

Shigeru Mizuno and Yasushi Furukawa provided guidance to Akira Takayanagi at the company in developing this table.

All these ideas and developments were integrated and eventually shaped into quality deployment (QD). QD is defined as a methodology that:

> . . . converts user demands into substitute quality characteristics (quality characteristics), determines the design quality of the finished good, and systematically deploys this quality into component quality, individual part quality and process elements and their relationships (Akao *et al.*, 1989).

Simultaneously, there was another methodology flow that merged into QFD from value engineering. Value engineering showed a way to define functions of a product. It was Katsuyoshi Ishihara who expanded this thinking to business process functions. Business process function deployment subsequently became linked to what we later called narrowly defined QFD. Mizuno described narrowly defined QFD as a:

> . . . step-by-step deployment of a job function or operation, that embodies quality, into their details through systematization of targets and means (Mizuno and Akao, 1978).

It is useful when creating a "quality assurance activity table," a part of the quality assurance (QA) system documentation.

The term broadly defined QFD refers to the combination of the QD described earlier and the narrowly defined QFD. What we call QFD today was molded and took shape through these multiple flows and concepts. These include the initial flow that showed how to map out QA control points, the flows from quality deployment and value engineering, the narrowly defined QFD, and the quality chart.

In 1975, the Computer Research Committee (headed by Akao and later named the QFD Research Group in 1978) was appointed by the Japanese Society for Quality Control (JSQC). The committee devoted the next 13 years to ongoing research of QFD methodology. In 1987, it published a final survey report on the status of QFD application among 80 Japanese companies (Akao *et al.*, 1987; Akao and Ohfuji, 1989). The companies surveyed listed the following as the purpose of using QFD:

- setting design quality and planned quality;
- benchmarking competitive products;
- new product development that sets the company apart from competitors;

- analyzing and accumulating market quality information;
- communicating quality-related information to later processes;
- deploying design intent into manufacturing;
- identifying control points for the *gemba* (a Japanese term that refers to the place where source information can be learned);
- reducing initial quality problems;
- reducing design changes;
- cutting development time;
- reducing development costs; and
- expanding market share.

Figures 3 and 4 in Akao's (1990b) *History of Quality Function Deployment in Japan* show the changes in the number of QFD-related articles and papers published in the QC-related Japanese specialty magazines and books every year for 20 years from 1967. QFD received very little interest in the beginning until 1972 when the publication of the articles by Mitsubishi Heavy Industry and Akao paved the way for more QFD-related articles to be published later. Following the 1978 publication of *Quality Function Deployment* (Mizuno and Akao, 1978), the first book on the topic, the number of QFD applications leaped. In recent years, about 50 to 60 application case studies in new product development have been publicly reported and put in print each year in the specialty books and magazines. By the mid-1990s, more than 1,000 case study reports were published.

In 1987, the Japanese Standards Association published a book focused on QFD case studies. This book was later translated and published in the USA and Germany (Akao, 1988). An introductory QFD book and work books were published in 1990 and 1994 (by JUSE) (Akao, 1990a,c; Ohfuji and Ono, 1990, 1994). These are used by many Japanese companies today. Elements of these books are included in the QFD Institute's training materials used in North America and elsewhere in the world.

The introduction of QFD to the USA and Europe began in 1983 when an article of Akao's was published in *Quality Progress* (Kogure and Akao, 1983) by the American Society of Quality Control. At the same time, he was invited to give a four-day seminar in Chicago on "Corporate-wide quality control and quality deployment". Later, Bob King of GOAL/QPC in Massachusetts invited Akao to give annual QFD lectures to US audiences from 1986-1990.

At the same time, the American Supplier Institute (ASI) in Dearborn, Michigan and its past chairman Larry Sullivan began disseminating QFD to the automotive industry, mainly the "big three" car manufacturers. Akashi Fukuhara of the Central Japan Quality Control Association led these efforts. Additionally, Don Clausing brought his QFD knowledge from his Xerox days to MIT when he became a professor there, thus contributing to the education and dissemination of QFD. Also in the USA, Robert M. Adams spearheaded the

North American QFD Symposium in 1989, contributing greatly to the advancement of QFD in the USA by providing a place for QFD research and case study reports to be widely viewed. In order to bring together all these activities, the QFD Institute was founded by Glenn H. Mazur in 1994 together with Richard Zultner and John Terninko. The QFD Institute later instituted the Akao Prize in 1996, which has since been awarded to 25 recipients for their excellent work in developing and disseminating QFD.

Regrettably, the first QFD book published in Japan in 1978 (Mizuno and Akao, 1978) did not get translated into English until much later (Mizuno and Akao, 1994). As a result, incorrect historical facts seem to be widely accepted. The authors would like to take this opportunity to provide an accurate account in this paper:

- *Incorrect: Quality deployment originated at the Kobe shipyards of Mitsubishi Heavy Industry*. What Mitsubishi Heavy Industry (MHI) devised was the quality chart. It is true that this chart has become the core of QFD methodology. Akao first wrote about quality deployment, however, in an article published in April 1972 (Akao, 1972) which described both the terminology and the procedure. This article was a compilation of what Akao had taught and experimented with at various companies over a six-year period beginning in 1966. The writing of this article took place before the MHI quality chart was made public in May 1978 (Nishimura, 1972; Suzuki, 1972). It should be noted that the MHI paper, where the first quality chart appeared, covered only as far as setting the design quality; the terminology "quality deployment" was not used there.
- *Incorrect: Quality deployment originated with Toyota*. Please be aware that quality deployment had already a ten-year history preceding the application by the Toyota Group. As chronicled by Akao (1990b), the first companies in the Toyota Group to try quality deployment were Hino Motors under Akao's guidance and Toyota Auto Body under the guidance of Nobuo Takezawa who learned the method from Akao's papers. Yabuta, general manager of Toyota Motors, attended one of the QFD lectures Akao gave at JUSE (Japanese Union of Scientists and Engineers, the organization that awards the Deming Prize) and expressed a desire to introduce the method to the entire Toyota Group. It was around 1979 when a seminar was put together for about 100 QA managers from Toyota affiliates. Following Akao's keynote speech, a lecture was given by Takezawa and case studies from Hino Motors were presented. After this event, QFD was more quickly disseminated among the group affiliates than at the parent Toyota Motors itself, largely because of its size. When the name "Toyota" is cited in QFD history, most readers usually assume it is Toyota Motors, but that is not correct. It was actually Toyota Auto Body where Akashi Fukuhara was Quality Assurance manager. Fukuhara, who later joined the Central Japan

Quality Control Organization, was eventually dispatched to ASI where he spread his QFD knowledge in the USA and made other contributions.

- *The true reason why the quality chart is called "house of quality" in the West*. The quality chart, topped with a triangular peak, a shape that became a standard in the USA, was the brainchild of Toyota Auto Body. The table of this shape was already in use by Tsuneo Sawada when they were working on the reliability of the Light Ace van. It was at a JSQC research presentation conference (Sawada, 1979) when the table was for the first time referred to by the name "house of quality" because of its shape. Fukuhara later introduced the table in the USA using this name. This is believed to be the true origin of how this nickname came to be popular.

The origin of the term Quality Function Deployment

Quality Function Deployment is a literal translation of the Japanese words *hinshitsu kino tenkai*, but was initially translated as quality function evolution in 1978 (Mizuno and Akao, 1978). When Akao was a visiting scholar at Kansas State University in 1972, an associate researcher, L.T. Fan, had suggested that name. Having looked up the word *tenkai* in his dictionary, of the words development, deployment, and evolution listed evolution seemed the most creative, he thought.

At the first QFD seminar in the USA (Akao *et al*., 1983), our sponsor Masaaki Imai felt that the term evolution inappropriately connoted the meaning of "change" and that *hinshitsu tenkai* was better translated as quality deployment. Although deployment had militaristic implications in Japanese, in this usage, it was entirely acceptable. And so the term Quality Function Deployment was born.

The use of the word "function" in QFD also has been misinterpreted. It refers to a function analysis of the business process phases in order to improve the quality of the product development process itself. The origins of this are described above in reference to Mizuno's narrowly defined QFD. It does not refer to product function in this context. It is regrettable that this part of QFD, which is essential to gaining long-term buy-in, implementation and compliance, has been completely overlooked by most QFD practitioners outside Japan. This type of function analysis and process mapping has recently found a renewed use in the so-called "swim-lane" charts used in Six Sigma.

The present: QFD's dissemination to a global best practice

With the proof that QFD could be successfully implemented in non-Japanese companies, the method began to spread world-wide. Conference papers and dedicated courses began to appear with great regularity.

Japan and Asia

The first QFD seminar (a two-day seminar) in Japan was organized in 1983 by the Japan Productivity Center, and was followed by many others. Today QFD

classes are available through the Japan Standards Association (a two-day seminar), Central Japan Quality Control Organization (a three-day seminar), and Union of Japanese Scientists and Engineers (a four-day seminar). Over the past ten years, Akao has also been regularly invited to lecture on QFD in JUSE's basic QC course and in their middle management course.

Following the creation of the QFD Research Group by JSQC, another QFD Research Committee was organized in 1987 by JUSE, which Akao chaired until Yoshizawa succeeded him in 1997. This Committee, which celebrated its tenth anniversary this year, has held five meetings every year with research focuses on these topics:

- methods for identifying demanded quality and its relationship with marketing;
- *kansei*;
- seeds and needs in technology deployment;
- quality deployment methodology;
- cost deployment;
- reliability deployment;
- QFD in software development;
- narrowly defined QFD;
- comprehensive QFD; and
- QFD as development management engineering.

These topics were discussed in a series of articles in *Quality Control* journal for a period of one year beginning in 1996 (Akao, 1996). Japan hosted the 1st and 7th International Symposia on QFD. The 1st International Symposium on QFD was attended by 174 people, including 63 from overseas, notably 39 from Korea and 21 from Brazil.

QFD lectures were also given in Korea from 1978 through 1985 at the Korean Standards Association, but these did not lead to actual applications. In recent years, however, the country is showing heightened interest in QFD. In January of last year, a QFD Research Committee was created in Korea.

Taiwan was also introduced to QFD from 1982 through 1986, but actual applications have just begun recently. The Chinese Productivity Center is the leading force in dissemination of QFD in the country.

In China, where the importance of new product development is gaining attention, the Quality Bureau from the State Bureau of Technical Supervision, a national agency of The People's Republic of China, has invited the author to give QFD seminars in Peking and Shanghai since 1994.

India has shown a strong interest in QFD both in its world-class software industry and in manufacturing industries such as trucks, automobiles, and farm tractors. India has hosted several QFD Green Belt[sm] and QFD Black Belt[sm] courses in both public and private forums.

Case studies have been presented at various QFD conferences from organizations in Malaysia, Thailand, Singapore, and Indonesia.

In Australia, the 1st Pacific Rim Symposium on Quality Deployment was organized in 1995 by Bob Hunt. In 1998, Australia hosted the 4th International Symposium on QFD and, subsequent to that, the Queensland Manufacturing Institute began offering QFD as a part of its product development series to small and medium enterprises throughout Australia and New Zealand. Attendees were engaged in a wide variety of businesses from telecommunications, automobile manufacturing, and slot machines to such local products as kangaroo jerky, emu oil cosmetics, and spinning-wheels.

USA and the Americas

Utilization of QFD by US companies became particularly noticeable. Its early days were reported by Mr Bob King (King, 1987). Further developments were presented by Glenn Mazur in 1994 at the 4th Japanese QFD Symposium sponsored by JUSE (Mazur and Morishima, 1994). Mazur also detailed the historical development of QFD since 1983 and the dissemination in the USA in his Japanese paper titled "QFD inroads to North America and the first ten years" (Mazur, 1994). At the 1st ISQFD, a speech made by Harold M. Ross of General Motors, "QFD status in the US automotive industry" (Ross and Paryani, 1995) revealed to what extent and in how many vehicle models QFD is actually used in the USA, drawing a strong interest from the audience.

The QFD Institute has continued Bob Adams' tradition of annual Symposia, which continue to show-case the best of QFD and related methods, as well as its relevancy to the ever-changing business environment. Now in its 15th year, recent papers have addressed the issues of:

- e-business;
- environmental balance;
- homeland security and defense;
- shorter cycle times, and integration with Six Sigma; and
- design for Six Sigma.

The 2nd ISQFD was held in Novi, Michigan, a suburb of Detroit, in the USA and was attended by about 250 people from all over the world, with 36 papers presented from 16 different countries. The organizers of the 2nd ISQFD reported that the number of papers submitted was actually double the number allowed to be presented. The USA has also hosted the 6th International Symposium on QFD in 2000.

Under Akao's direction, the QFD Institute has begun offering improved QFD training and facilitation with a series of courses for beginners (two-day QFD Green Belt^{sm}), facilitators (four-day QFD Black Belt^{sm}), specialist (five-day QFD Master Black Belt^{sm}), and expert (ten-day QFD Grandmaster Black Belt^{sm}). These courses have been taught world-wide since 2000 and

over 750 people have received QFD certificates. Certificate holders are able to train others to the level below their certificate, thus assuring better dissemination of best practice QFD. In conjunction with this, global research has been ongoing to develop a definitive body of QFD knowledge (Mazur, 2000).

A survey was conducted through a collaboration of Tamagawa University and the University of Michigan, on recent trends in QFD applications (Ohfuji *et al.*, 1996). The Japanese side selected 400 Japanese companies for the survey which were involved with the QFD Research Committee of JUSE or attended introductory QFD seminars. The US side selected 400 US companies with a similar background. An identical survey form was sent to these companies. A total of 146 of the Japanese companies (37 per cent) and 147 US companies (37.6 per cent) responded. According to the survey results, 31.5 per cent of Japanese companies used QFD in their development process, while 68.5 per cent of US companies did the same. It was determined that QFD was most often used in the automotive industry and electronics industry. Interestingly, in the USA, QFD was used by the aerospace industry. Application of QFD was higher in the USA than in Japan. Companies cited that they used QFD in order to attain "better design" and "better customer satisfaction". USA companies put more emphasis on the latter purpose than their Japanese counterparts. "A tool for cross-functional communication/coordination" and "to shorten product cycle time" were also cited by US companies as their reason for using QFD. What caught my attention was the difference in the products to which QFD was applied. In Japan, QFD was used more often for product improvement based on an existing model. In the USA, QFD was more often used for a totally different product or the next generation product. The majority of QFD teams consisted of appointed members from several job functions. They reported that over 80 per cent of decision making was done in meetings. In both Japan and the USA, each team had ten or fewer members and met for two hours or less at a time. US companies reported more team meetings – at least once a week or more often was not uncommon.

For the information source for creating a quality chart, US companies used "personal interviews with customers", "customer surveys specifically designed for QFD implementation", and "focus group interviews". Japanese companies listed "experiences of the product design team" and "customer claims information". US companies in the survey reported that they had corporate support in QFD implementation in the form of "sufficient budget for QFD implementation", "sufficient resources", and "adequate time for QFD implementation". This attests that QFD is given an organizational importance in US companies.

In Brazil, QFD was first introduced in 1989 at ICQC-1989 in Rio de Janeiro (Akao and Ohfuji, 1989). After teaching efforts by Ohfuji of Tamagawa University and Mazur of the QFD Institute throughout the 1990s, the 5th International Symposium was hosted in 1999 by the Federal University of Minas Gerais and the newly established Instituto de QFD e GDP do Brasil.

Mexico has participated in QFD activities since the early 1990s. Recently, QFD Green Belt[sm] and QFD Black Belt[sm] courses have been conducted at the University of Monterrey and in Mexico City. Recently, the University of Monterrey and Monterrey Tech (ITESM) have joined with private enterprises in Mexico to form the Asociación Latino-americana de QFD. The Asociación looks to hold its first QFD Symposium in 2003 and host the 10th International QFD Symposium in 2004.

Cuba has also shown an increased interest in QFD, focusing on improving their burgeoning tourism industry. They have also been instrumental in translating the QFD Green Belt[sm] and QFD Black Belt[sm] course materials into Spanish, under an agreement with Mazur and the QFD Institute.

QFD has also found success in Argentina, Chile, Colombia, and other Latin-American countries.

Europe

In Europe, Akao was given opportunities to lecture on QFD at Galgano & Associati in Italy in 1987 and for several years thereafter. Italy was the first to implement QFD in Europe, hosting the 1st European QFD Symposium in 1993.

In the UK, QFD has been steadily promoted since the late 1980s with a branch office of the American Supplier Institute, the efforts of Ian Ferguson, the University of Limerick in Ireland, and other establishments. Two QFD Green Belt[sm] courses have been held there in both public and private forums.

Sweden has played a strong role in developing QFD and market research techniques such as conjoint analysis, through research at Linköping University and the University of Karlstad. Sweden hosted the 3rd International Symposium on QFD in 1997, after several successful domestic conferences in the preceding years.

Germany has emerged as a QFD center in Europe in the last four years, regularly conducting domestic conferences and publishing a quarterly newsletter. Spearheaded at the University of Cologne, Germany has focused a great deal of attention on software applications such as e-commerce, as well as traditional industries such as automobiles, electronics, and medical equipment.

Austria has also been at the forefront of QFD dissemination.

The Basque region of Spain has also supported QFD research and application, and held a QFD conference in the 1990s.

Turkey has been quick to pick up QFD for its emerging consumer products industry. Two public QFD Green Belt[sm] courses have been held there, and in 2002 they hosted their first QFD Symposium under the auspices of Dokuz Eylul University. They are eager to host a future International QFD Symposium.

Recently, interest has picked up in former Soviet-bloc countries as well, and the authors look forward to their progress. There are reports of activities from other European counties such as France, Denmark and The Netherlands.

Elsewhere

QFD continues to gain interest in other regions of the world, including South Africa and Iran.

The future

Yoshizawa (1997) listed the following two points as the significance of QFD in industry:

(1) QFD has redefined quality control in manufacturing by moving it upstream to quality control for development and design. It has shifted the focus of TQM from process-oriented QA to design-oriented QA and in the creation of a product development system.

(2) QFD has provided a communication tool for designers. Engineers, positioned midway between marketing and production, need to take a leadership role in new product development. QFD is a powerful tool for engineers to build a system for product development.

In this spirit, we can expect QFD to continue to grow in the following areas.

New product development and strategic management were the key areas for TQM in the future that the Japanese Union of Scientists and Engineers (JUSE) selected at their 61st QC Symposium in 1995. They looked to QFD in particular as a methodology to aid new product development based on strategic product planning and as a method for creating more attractive products. The key to attractive products was a linkage between QFD and marketing, and new methods to do so needed to be developed. The seven product planning tools were introduced in the late 1990s as a skill set necessary for this purpose. Refinement of these market research tools, including soft tools such as interview and focus group techniques and hard tools like conjoint analysis, continues to be a challenge.

The blending of QFD with strategic management and strategy formulation, including *hoshin kanri*, has been spearheaded outside Japan by Robert Hunt, Director, Centre for Management Innovation and Technology (CMIT) at the Macquarie Graduate School of Management in Australia (Hunt, 2000).

Other Japanese methods can be found in such as the New Lanchester Strategy for Sales and Marketing (Taoka, 1977).

Although using QFD is not new to the software industry, the quality that information systems provide will draw more attention as we move toward the advanced information era of the twenty-first century. Every social infrastructure, not just production systems, will be affected by this change and, to understand the requirements of the future, QFD will be positioned as the core methodology for building quality into these information systems (McDonald, 1995).

Future TQM will find more importance in how to align company-wide activities with customer focus. It is these authors' belief that the voice of the customer should be a common bedrock for creating a partnership of such activities. For companies to attain customer satisfaction, it is important that all

employees acquire customer-focused thinking through the value chain created by the awareness that "the next process is your customer". It is with QFD that companies will be able to accomplish this future challenge. QFD will serve as a tool for creating this alignment, where true partnership can sprout (Akao, 1995; Mazur, 1997).

Effective use of voice of customer data will improve with access to the data by all parts of the organization, now and for future products. Knowledge management is being investigated by Akao and others in various fields including health care (Akao, 2002).

New product development will also require price design along with quality design. Recently Mochimoto has proposed QDm, his new concept and method, in this attempt. In the future, cost design and deployment method need to be developed, in addition to price design (Mochimoto, 1997).

Among the most emerging critical customer needs is that of faster time to market. Richard Zultner of the Wesley J. Howe School of Technology Management, Stevens Institute of Technology, has successfully integrated QFD and advanced project management methods such as critical chain project management into schedule deployment (Zultner, 1998). For those companies without the resources to complete a comprehensive QFD study, Blitz QFD promises to identify and develop the requirements that are key to success (Zultner, 2000).

Non-functional requirements that relate to image and brand will become increasingly important. The *kansei* engineering models used by Mitsuo Nagamachi of Hiroshima University (retired) build a bridge between industrial design, marketing, and engineering (Nagamachi, 1999).

Development management engineering challenges the traditional view that new product development belongs in the arena of marketing and market research. New product development encompasses every process from marketing, planning, design, production preparation, inspection, through sales. QFD prevents problems from materializing, thus creating a smooth, end-to-end development process. Traditionally, engineering constituted control of the technical aspects of the finished product and production control, emphasizing operational quality and efficiency. Akao coined the term "development management" as early as 1994 to urge that concurrent engineering and similar methods be used to better align and control the management of product development.

In the USA, the QFD Institute has been integrating the QFD system with other best practices such as stage gates (Cooper, 1993), product and cycle time excellence (McGrath, 1996), and Six Sigma (Watson, 2001). *Total Quality Development*, a book by Clausing (1996), promotes a similar approach.

QFD and ISO 9000, as well as other quality standards, will continue to be an area of development. ISO defines quality system as the:

> . . . organizational structure, responsibility, procedure, process and resource for implementing quality control.

The origin point lies in the following definition that Feigenbaum, the proponent of TQM, set forth: A quality system is a:

> . . . network of the management/control and procedure that are required to produce and deliver a product with a specific quality standard (Feigenbaum. 1961).

Good quality is born from a good system. This is why a quality system is valued in the ISO. Juran called the quality function "job functions that create quality". In QFD we call these "quality functions". A good system is where quality functions are clearly identified. The network of this procedure is called "narrowly defined quality function deployment".

By combining QFD with these standards, we are better able to prioritize the job functions for better implementation of the improvement plans (Akao, 1999; Akao and Hayazaki, 1999; Akao and Mazur, 1998).

Six Sigma and design for Six Sigma (DFSS) are growing in use around the world. To the tools and methods of TQM has been added financial accountability for better cost/benefit analyses of measurement and quality control. Stronger, also, is the systemization of the quality processes and tools into a more logical flow that is easier to teach, test, and certify. QFD will play a vital role in improving the understanding of the voice of the customer, capturing customer priorities, and translating them into Six Sigma directives (Mazur, 2002).

Conclusion

This paper has reflected on the early days of QFD, the current status, and future challenges. Much more progress is expected in the QFD world, as it provides a tangible method to manage new product development, an area that will be most important in future TQM. QFD will also be positioned as an effective tool for quality assurance of systems in the information age. For these goals, QFD methodology needs to be standardized. The QFD Institute under the auspices of Akao has been leading an effort to shape the body of QFD knowledge as well as the training and certification necessary to uphold these standards.

References

Akao, Y. (1972), "New product development and quality assurance – quality deployment system", (in Japanese), *Standardization and Quality Control*, Vol. 25 No. 4. pp. 7-14.

Akao, Y. (Ed.) (1988), *Practical Applications of Quality Deployment for New Product Development*, (in Japanese), Japan Standards Association, Tokyo.

Akao, Y. (Ed.) (1990a), *Quality Function Deployment: Integrating Customer Requirements into Product Design*, translated by Mazur, G.H., Productivity Press, Cambridge, MA.

Akao, Y. (1990b), "History of Quality Function Deployment in Japan", *The Best on Quality, IAQ Book Series*, Vol. 3, International Academy for Quality, pp. 183-96.

Akao, Y. (1990c), *Introduction to Quality Deployment (Application Manual of Quality Function Deployment (1)*, (in Japanese), JUSE Press, Tokyo.

Akao, Y. (1995), "Voice of customer – basis for partnerships – as a viewpoint from QFD", 3rd Quality Summit, 2-4 November, Bangalore.

Akao, Y. (1996), "Quality Function Deployment on total quality management and future subject. QFD and TQM Series No. 1", (in Japanese), *Quality Control*, Vol. 47 No. 8, pp. 55-64.

Akao, Y. (1999), "ISO 9000 and 14000 systems supported by QFD", Keynote Address from *Proceedings of the 4th International Conference on ISO 9000 & TQM '99*, 7-8 April, Hong Kong, pp. 325-31.

Akao, Y. (2002), "QFD and knowledge management on health-care service", *Proceedings of the 8th International Symposium on Quality Function Deployment*, Munich.

Akao, Y. and Hayazaki, T. (1998), "Environmental management system on ISO 14000 combined with QFD", *Transactions of the 10th Symposium on QFD*, QFD Institute, Novi, MI.

Akao, Y. and Mazur, G.H. (1998), "Using QFD to assure QS-9000 compliance", Keynote Address from *Proceedings of the World Innovation and Strategy Conference and 4th International Symposium on Quality Function Deployment*, 2-5 August, Sydney.

Akao, Y. and Ohfuji, T. (1989), "Recent aspects of Quality Function Deployment in service industries in Japan", *Proceedings of the International Conference on Quality Control – 1989*, Rio de Janeiro, pp. 17-26.

Akao, Y., Kogure, M. and Furukawa, Y. (1983), Company-wide Quality Control and Quality Deployment Seminar, Arlington Park Hilton, Chicago, IL, 31 October-3 November, sponsored by the Cambridge Corporation and co-sponsored by ASQC.

Akao, Y., Naoi, T. and Ohfuji, T. (1989), "Survey of the status of quality deployment – report from the quality deployment research committee", (in Japanese), *Quality Control*, Vol. 19 No. 1, pp. 35-44.

Akao, Y., Ohfuji, T. and Naoi, T. (1987), "Survey and reviews on Quality Function Deployment in Japan", *Proceedings of the International Conference for Quality Control – 1987*, JUSE and IAQ, Tokyo, pp. 171-6.

Clausing, D. (1996), *Total Quality Development*, ASIN 0791800350.

Cooper, R.G. (1993), *Winning at New Products*, 2nd ed., Addison-Wesley, Reading, MA.

Feigenbaum, A.V. (1961), *Total Quality Control: Engineering and Management*, McGraw-Hill, New York, NY.

Hunt, R. (2000), "*Hoshin* and strategic QFD organizations: where are they now?", *Transactions of the 12th Symposium on QFD*, QFD Institute, Novi, MI.

King, R. (1987), "Listening to the voice of the customer: using the Quality Function Deployment system", *National Productivity Review*, Summer.

Kogure, M. and Akao, Y. (1983), "Quality Function Deployment and company-wide quality control in Japan: a strategy for assuring that quality is built into products", *Quality Progress*, Vol. 16 No. 10, October, pp. 25-9.

McDonald, M. (1995), "Quality Function Deployment: introducing product development into the systems development process", *Transactions of the 7th Symposium on QFD*, QFD Institute, Novi, MI.

McGrath, M.E. (1996), *Setting the PACE in Product Development*, Butterworth-Heinemann, Oxford.

Mazur, G.H. (1994), "Current status of QFD in North America", (in Japanese), *Standardization and Quality Control*, Japan Standards Association, March, pp. 17-23.

Mazur, G.H. (1997), "Voice of customer analysis: a modern system of front-end QFD tools", *Proceedings of the 50th ASQ Congress*.

Mazur, G.H. (2000), "QFD 2000: integrating supporting methodologies into Quality Function Deployment", *Transactions of the 12th Symposium on QFD*, QFD Institute, Novi, MI.

Mazur, G.H. (2002), "QFD and design for Six Sigma: a quality product development system", *Proceedings of the 8th International Symposium on Quality Function Deployment*, Munich.

Mazur, G.H. and Morishima, M. (1994), "Report on QFD in America", (in Japanese), *Proceedings of the 4th QFD Symposium*, JUSE, Tokyo, March, pp. 17-26.

Mizuno, S. and Akao, Y. (Eds) (1978), *Quality Function Deployment: A Company-wide Quality Approach*, (in Japanese), JUSE Press, Tokyo.

Mizuno, S. and Akao, Y. (Eds) (1994), *QFD: The Customer-Driven Approach to Quality Planning and Deployment*, translated by Mazur, G.H., Asian Productivity Organization, Tokyo.

Mochimoto, T. (1997), "Product, quality, and price: a new viewpoint for TQM", *Proceedings of the International Symposium on Quality Function Deployment '97*, Linköping.

Nagamachi, M. (1999), "*Kansei* engineering", *Special Lecture of the 11th Symposium on Quality Function Deployment*, QFD Institute, Novi, MI.

Nishimura, K. (1972), "Ship design and quality chart", (in Japanese), *Quality Control*, Vol. 23, Special Issue, May, pp. 71-4.

Ohfuji, T. and Ono, M. (1990), "Quality deployment (1) – creation and practice of quality charts", (in Japanese), Vol. 2, *Application Manual of Quality Function Deployment*, JUSE Press, Tokyo.

Ohfuji, T. and Ono, M. (1994), "Quality deployment (2) – comprehensive deployment including technology, reliability, and cost", (in Japanese), Vol. 3, *Application Manual of Quality Function Deployment*, JUSE Press, Tokyo.

Oshiumi, K. (1966), "Perfecting quality assurance system in plants," (in Japanese), *Quality Control*, Vol. 17, May, pp. 62-7 (supp.).

Ross, H. and Paryani, K. (1995), "QFD status in the US automotive industry", *Proceedings of the International Symposium on Quality Function Deployment '95*, Tokyo, pp. 19-28.

Sawada, T. (1979), "Quality deployment and product planning", *Proceedings of the 9th Annual Convention of the Japanese Society for Quality Control*, (in Japanese), pp. 27-30.

Suzuki, Y. (1972), "Endeavor of design improvement for large diesel engine for ships", (in Japanese), *Quality Control*, Vol. 23, May, special issue, pp. 16-20.

Takayanagi, A. (1972). "Quality control in production-to-order at our company (1): quality control activities for made-to-order products – re: concept of a quality chart", (in Japanese), *Quality Control*, Vol. 23, special issue, May, pp. 63-7.

Taoka, N. (1977), *Lanchester Strategy: An Introduction*, Vol. 1, Lanchester Press, Sunnyvale, CA.

Watson, G.H. (2001), "Six Sigma and TQM: aiming to achieve quality management in the 21st century", presented at the Special Japan-US Seminar at the JUSE, August.

Yoshizawa, T. (1997). "Origins and development of internationalization of QFD", (in Japanese), *Proceedings of the 6th Symposium on QFD*, Tokyo.

Zultner, R.E. (1998), "Blitz QFD", *Tutorials of the 10th Symposium on QFD*, QFD Institute, Novi, MI.

Zultner, R.E. (2000), "Project schedule reduction with QFD", *Tutorials of the 12th Symposium on QFD*, QFD Institute, Novi, MI.

Further reading

Akao, Y. and Ono, M. (1993), "Recent developments in cost deployment and QFD in Japan", *Proceedings of the EOQ '93 World Quality Congress*, Helsinki, Vol. 2, 6 June, pp. 252-6.

Akao, Y. (1995), "QFD toward development management", *Proceedings of the International Symposium on Quality Function Deployment '95*, Tokyo, pp. 1-8.

Ohfuji, T., Cristiano, J.J. and White, C.C. (1996), "Comparison of QFD status in Japan and the USA", (in Japanese), *Proceedings of the JSQC 25th Anniversary 52nd Research Presentations*, 1 June, pp. 1-4.

Sullivan, L.P. (1986), "Quality Function Deployment – a system to assure that customer needs drive the product design and production process", *Quality Progress*, June, pp. 39-50.

Yoshizawa, T., Akao, Y., Ono, M. and Shindo, H. (1993), "Recent aspects of QFD in the Japanese software industry", *Quality Engineering*, Vol. 5 No. 3, pp. 495-504.

This article has been cited by:

1. Sara De Pelsmaeker, Xavier Gellynck, Claudia Delbaere, Nathalie Declercq, Koen Dewettinck. 2015. Consumer-driven product development and improvement combined with sensory analysis: A case-study for European filled chocolates. *Food Quality and Preference* **41**, 20-29. [CrossRef]
2. Ling-Zhong Lin, Huery-Ren Yeh, Ming-Chao Wang. 2015. Integration of Kano's model into FQFD for Taiwanese Ban-Doh banquet culture. *Tourism Management* **46**, 245-262. [CrossRef]
3. Colm Heavey, Ann Ledwith, Eamonn Murphy. 2014. Introducing a new continuous improvement framework for increased organisational return on investment. *The TQM Journal* **26**:6, 594-609. [Abstract] [Full Text] [PDF]
4. Zhonghua Zhang, Anjali Awasthi. 2014. Modelling customer and technical requirements for sustainable supply chain planning. *International Journal of Production Research* **52**, 5131-5154. [CrossRef]
5. Vinayak Kalluri, Rambabu Kodali. 2014. Analysis of new product development research: 1998-2009. *Benchmarking: An International Journal* **21**:4, 527-618. [Abstract] [Full Text] [PDF]
6. Selim Zaim, Mehmet Sevkli, Hatice Camgöz-Akdağ, Omer F. Demirel, A. Yesim Yayla, Dursun Delen. 2014. Use of ANP weighted crisp and fuzzy QFD for product development. *Expert Systems with Applications* **41**, 4464-4474. [CrossRef]
7. Eli Kolberg, Yoram Reich, Ilya Levin. 2014. Designing winning robots by careful design of their development process. *Research in Engineering Design* **25**, 157-183. [CrossRef]
8. Endris Kerga, Marco Taisch, Sergio Terzi, Walter Bessega, Alberto Rosso. 2014. Set-Based Concurrent Engineering Innovation Roadmap (SBCE IR): a case on Adiabatic Humidification System. *International Journal of Design Creativity and Innovation* 1-32. [CrossRef]
9. Shuki Dror. 2014. House of Reliability Costs: Developing Reliability Program Activities. *Quality and Reliability Engineering International* **30**:10.1002/qre.v30.3, 375-380. [CrossRef]
10. Liviu Moldovan. 2014. QFD Employment for a New Product Design in a Mineral Water Company. *Procedia Technology* **12**, 462-468. [CrossRef]
11. Ilya Kuselman, Elena Kardash, Emil Bashkansky, Francesca Pennecchi, Stephen L. R. Ellison, Karen Ginsbury, Malka Epstein, Aleš Fajgelj, Yury Karpov. 2013. House-of-security approach to measurement in analytical chemistry: quantification of human error using expert judgments. *Accreditation and Quality Assurance* **18**, 459-467. [CrossRef]
12. Kalluri Vinayak, Rambabu Kodali. 2013. Benchmarking the quality function deployment models. *Benchmarking: An International Journal* **20**:6, 825-854. [Abstract] [Full Text] [PDF]
13. Natalia Zaitsev, Shuki Dror. 2013. Water Quality Function Deployment. *Quality Engineering* **25**, 356-369. [CrossRef]
14. Arijit Bhattacharya, John Geraghty, Paul Young, P.J. Byrne. 2013. Design of a resilient shock absorber for disrupted supply chain networks: a shock-dampening fortification framework for mitigating excursion events. *Production Planning & Control* **24**, 721-742. [CrossRef]
15. Ali Masoudi, Elizabeth Cudney, Kioumars Paryani. 2013. Customer-driven hotel landscaping design: a case study. *International Journal of Quality & Reliability Management* **30**:8, 832-852. [Abstract] [Full Text] [PDF]
16. Madhav Sinha, Hatice Camgöz-Akdağ, Mehveş Tarım, Subash Lonial, Alim Yatkın. 2013. QFD application using SERVQUAL for private hospitals: a case study. *Leadership in Health Services* **26**:3, 175-183. [Abstract] [Full Text] [PDF]

17. Paulo Augusto Cauchick Miguel. 2013. Benchmarking QFD application for developing packaging products. *Benchmarking: An International Journal* **20**:3, 419-433. [Abstract] [Full Text] [PDF]
18. Wen-Chang Ko. 2013. Exploiting 2-tuple linguistic representational model for constructing HOQ-based failure modes and effects analysis. *Computers & Industrial Engineering* **64**, 858-865. [CrossRef]
19. Ida Gremyr, Hendry Raharjo. 2013. Quality function deployment in healthcare: a literature review and case study. *International Journal of Health Care Quality Assurance* **26**:2, 135-146. [Abstract] [Full Text] [PDF]
20. Aida Azadegan, Gwendolyn Kolfschoten. 2012. An Assessment Framework for Practicing Facilitator. *Group Decision and Negotiation* . [CrossRef]
21. Chang-Hsi Yu, Chi-Kuang Chen, Wan-Hong Chen, Hsiu-Chen Chang. 2012. Developing a revised QFD technique to meet the needs of multiple-customer groups: a case of public policy analysis. *Total Quality Management & Business Excellence* **23**, 1413-1431. [CrossRef]
22. Freeman K.H. Chan, Alfred Lee. 2012. Designing a new service in a university language centre. *Asian Journal on Quality* **13**:3, 234-249. [Abstract] [Full Text] [PDF]
23. Michele Germani, Maura Mengoni, Margherita Peruzzini. 2012. An approach to assessing virtual environments for synchronous and remote collaborative design. *Advanced Engineering Informatics* **26**, 793-813. [CrossRef]
24. Yan-Lai Li, Jia-Fu Tang, Kwai-Sang Chin, Xing-Gang Luo, Yun Pu, Yu-Shi Jiang. 2012. On integrating multiple type preferences into competitive analyses of customer requirements in product planning. *International Journal of Production Economics* **139**, 168-179. [CrossRef]
25. Kenneth D. Strang, Cliff E.L. Chan. 2012. Simulating E-business Innovation Process Improvement with Virtual Teams Across Europe and Asia. *International Journal of E-Entrepreneurship and Innovation* **1**:10.4018/ijeei.20100101, 22-41. [CrossRef]
26. Yan-Lai Li, Jia-Fu Tang, Kwai-Sang Chin, Xing-Gang Luo, Yi Han. 2012. Rough set-based approach for modeling relationship measures in product planning. *Information Sciences* **193**, 199-217. [CrossRef]
27. S. Vinodh, J. Srikrishna. 2012. Application of fuzzy logic-based Eco-QFD for a disconnecting switch. *International Journal of Sustainable Engineering* **5**, 109-119. [CrossRef]
28. Ching-Wen Chen. 2012. Modeling and initiating knowledge management program using FQFD: a case study involving a healthcare institute. *Quality & Quantity* **46**, 889-915. [CrossRef]
29. Yan-Lai Li, Jia-Fu Tang, Kwai-Sang Chin, Yi Han, Xing-Gang Luo. 2012. A rough set approach for estimating correlation measures in quality function deployment. *Information Sciences* **189**, 126-142. [CrossRef]
30. Wafaa NadimModern Methods of Construction 209-233. [CrossRef]
31. Yan-Lai Li, Kwai-Sang Chin, Xing-Gang Luo. 2012. Determining the final priority ratings of customer requirements in product planning by MDBM and BSC. *Expert Systems with Applications* **39**, 1243-1255. [CrossRef]
32. Ling Wang, Yi-Kai Juan, Jie Wang, Kai-Meng Li, Colin Ong. 2012. Fuzzy-QFD approach based decision support model for licensor selection. *Expert Systems with Applications* **39**, 1484-1491. [CrossRef]
33. Markus Hartono. 2012. Incorporating Service Quality Tools into Kansei Engineering in Services: A Case Study of Indonesian Tourists. *Procedia Economics and Finance* **4**, 201-212. [CrossRef]
34. Kuang OuYang, Calvin S. Weng. 2011. A New Comprehensive Patent Analysis Approach for New Product Design in Mechanical Engineering. *Technological Forecasting and Social Change* **78**, 1183-1199. [CrossRef]

35. Yan-Lai Li, Jia-Fu Tang, Kwai-Sang Chin, Yu-Shi Jiang, Yi Han, Yun Pu. 2011. Estimating the final priority ratings of engineering characteristics in mature-period product improvement by MDBA and AHP. *International Journal of Production Economics* **131**, 575-586. [CrossRef]
36. Marvin E. Gonzalez, Gioconda Quesada, James Mueller, Rene D. Mueller. 2011. International business curriculum design: identifying the voice of the customer using QFD. *Journal of International Education in Business* **4**:1, 6-29. [Abstract] [Full Text] [PDF]
37. Joaquin Sitte, Petra Winzer. 2011. Demand-Compliant Design. *IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans* **41**, 434-448. [CrossRef]
38. S. Vinodh, Suresh Kumar Chintha. 2011. Application of fuzzy QFD for enabling agility in a manufacturing organization. *The TQM Journal* **23**:3, 343-357. [Abstract] [Full Text] [PDF]
39. S. Vinodh, Gopinath Rathod. 2011. Application of ECQFD for enabling environmentally conscious design and sustainable development in an electric vehicle. *Clean Technologies and Environmental Policy* **13**, 381-396. [CrossRef]
40. Yan-Lai Li, Min Huang, Kwai-Sang Chin, Xing-Gang Luo, Yi Han. 2011. Integrating preference analysis and balanced scorecard to product planning house of quality. *Computers & Industrial Engineering* **60**, 256-268. [CrossRef]
41. Jong-Ho Shin, Hong-Bae Jun, Dimitris Kiritsis, Paul Xirouchakis. 2011. A decision support method for product conceptual design considering product lifecycle factors and resource constraints. *The International Journal of Advanced Manufacturing Technology* **52**, 865-886. [CrossRef]
42. PAVEL FOMIN, SHAHRAM SARKANI, THOMAS A. MAZZUCHI. 2010. GROWING THE HOUSE OF QUALITY. *Systems Research Forum* **04**, 137-149. [CrossRef]
43. Yan-Lai Li, Jia-Fu Tang, Xing-Gang Luo. 2010. An ECI-based methodology for determining the final importance ratings of customer requirements in MP product improvement. *Expert Systems with Applications* **37**, 6240-6250. [CrossRef]
44. Hilmi Yüksel. 2010. Design of automobile engines for remanufacture with quality function deployment. *International Journal of Sustainable Engineering* **3**, 170-180. [CrossRef]
45. Arijit Bhattacharya, John Geraghty, Paul Young. 2010. Supplier selection paradigm: An integrated hierarchical QFD methodology under multiple-criteria environment. *Applied Soft Computing* **10**, 1013-1027. [CrossRef]
46. C.G. Sorensen, L. Pesonen, S. Fountas, P. Suomi, D. Bochtis, P. Bildsøe, S.M. Pedersen. 2010. A user-centric approach for information modelling in arable farming. *Computers and Electronics in Agriculture* **73**, 44-55. [CrossRef]
47. S. Vinodh, Gopinath Rathod. 2010. Integration of ECQFD and LCA for sustainable product design. *Journal of Cleaner Production* **18**, 833-842. [CrossRef]
48. Murat Tanık. 2010. Improving "order handling" process by using QFD and FMEA methodologies: a case study. *International Journal of Quality & Reliability Management* **27**:4, 404-423. [Abstract] [Full Text] [PDF]
49. Siamak Aghlmand, Aboulfath Lameei, Rhonda Small. 2010. A hands-on experience of the voice of customer analysis in maternity care from Iran. *International Journal of Health Care Quality Assurance* **23**:2, 153-170. [Abstract] [Full Text] [PDF]
50. C.G. Sørensen, R.N. Jørgensen, J. Maagaard, K.K. Bertelsen, L. Dalgaard, M. Nørremark. 2010. Conceptual and user-centric design guidelines for a plant nursing robot. *Biosystems Engineering* **105**, 119-129. [CrossRef]

51. Kenneth David Strang. 2010. Portfolio selection methodology for a nuclear project. *Project Management Journal* n/a-n/a. [CrossRef]
52. Liang-Hsuan Chen, Wen-Chang Ko. 2009. Fuzzy approaches to quality function deployment for new product design. *Fuzzy Sets and Systems* **160**, 2620-2639. [CrossRef]
53. Sharlene A. Wolchik, Irwin N. Sandler, Sarah Jones, Nancy Gonzales, Kathryn Doyle, Emily Winslow, Qing Zhou, Sanford L. Braver. 2009. THE NEW BEGINNINGS PROGRAM FOR DIVORCING AND SEPARATING FAMILIES: MOVING FROM EFFICACY TO EFFECTIVENESS. *Family Court Review* **47**:10.1111/fcre.2009.47.issue-3, 416-435. [CrossRef]
54. Jacques Martin, Claudio Baccarani, Andreas Andronikidis, Andreas C. Georgiou, Katerina Gotzamani, Konstantina Kamvysi. 2009. The application of quality function deployment in service quality management. *The TQM Journal* **21**:4, 319-333. [Abstract] [Full Text] [PDF]
55. Min Wang, Yong Zeng. 2009. Asking the right questions to elicit product requirements. *International Journal of Computer Integrated Manufacturing* **22**, 283-298. [CrossRef]
56. R. B. Kazemzadeh, Majid Behzadian, Mohammad Aghdasi, Amir Albadvi. 2009. Integration of marketing research techniques into house of quality and product family design. *The International Journal of Advanced Manufacturing Technology* **41**, 1019-1033. [CrossRef]
57. S. Abdollahi-Negar, B. Yaqoobi. 2008. Applying Quality Function Deployment Approach to Design an English as a Foreign Language Writing Course for Engineering Students. *Journal of Applied Sciences* **8**, 3513-3517. [CrossRef]
58. S. Vinodh, G. Sundararaj, S.R. Devadasan, S. Rajanayagam, Immanuel Edinbarough. 2008. Agile ITQFD and its financial viability: a pilot project approach. *The TQM Journal* **20**:5, 520-534. [Abstract] [Full Text] [PDF]
59. Jose A. Carnevalli, Paulo Cauchick Miguel. 2008. Review, analysis and classification of the literature on QFD—Types of research, difficulties and benefits. *International Journal of Production Economics* **114**, 737-754. [CrossRef]
60. TIM MAZZAROL, SOPHIE REBOUD. 2008. THE ROLE OF COMPLEMENTARY ACTORS IN THE DEVELOPMENT OF INNOVATION IN SMALL FIRMS. *International Journal of Innovation Management* **12**, 223-253. [CrossRef]
61. Vicki-Smith Daniels, Irwin Sandler. 2008. Use of Quality Management Methods in the Transition from Efficacious Prevention Programs to Effective Prevention Services. *American Journal of Community Psychology* **41**, 250-261. [CrossRef]
62. Marvin E. Gonzalez, Gioconda Quesada, Kent Gourdin, Mark Hartley. 2008. Designing a supply chain management academic curriculum using QFD and benchmarking. *Quality Assurance in Education* **16**:1, 36-60. [Abstract] [Full Text] [PDF]
63. N. Kathiravan, S.R. Devadasan, T. Bijumon Michael, S.K. Goyal. 2008. Total quality function deployment in a rubber processing company: a sample application study. *Production Planning & Control* **19**, 53-66. [CrossRef]
64. Paulo Augusto Cauchick Miguel. 2007. Innovative new product development: a study of selected QFD case studies. *The TQM Magazine* **19**:6, 617-625. [Abstract] [Full Text] [PDF]
65. Ming-Li Shiu, Jui-Chin Jiang, Mao-Hsiung Tu. 2007. Reconstruct QFD for integrated product and process development management. *The TQM Magazine* **19**:5, 403-418. [Abstract] [Full Text] [PDF]
66. Jui-Chin Jiang, Ming-Li Shiu, Mao-Hsiung Tu. 2007. Quality function deployment (QFD) technology designed for contract manufacturing. *The TQM Magazine* **19**:4, 291-307. [Abstract] [Full Text] [PDF]

67. Issam S. Jalham, Wafa T. Abdelkader. 2006. Improvement of organizational efficiency and effectiveness by developing a manufacturing strategy decision support system. *Business Process Management Journal* **12**:5, 588-607. [Abstract] [Full Text] [PDF]

68. Tim Mazzarol, Sophie Reboud. 2006. The strategic decision making of entrepreneurs within small high innovator firms. *International Entrepreneurship and Management Journal* **2**, 261-280. [CrossRef]

69. V.R. Pramod, S.R. Devadasan, S. Muthu, V.P. Jagathyraj, G. Dhakshina Moorthy. 2006. Integrating TPM and QFD for improving quality in maintenance engineering. *Journal of Quality in Maintenance Engineering* **12**:2, 150-171. [Abstract] [Full Text] [PDF]

70. S.R. Devadasan, N. Kathiravan, V. Thirunavukkarasu. 2006. Theory and practice of total quality function deployment. *The TQM Magazine* **18**:2, 143-161. [Abstract] [Full Text] [PDF]

71. Associate, Professor Robert A. Hunt, Ms Catherine P. Killen, Verónica González Bosch, Francisco Tamayo Enríquez. 2005. TQM and QFD: exploiting a customer complaint management system. *International Journal of Quality & Reliability Management* **22**:1, 30-37. [Abstract] [Full Text] [PDF]

72. Robert M. Gerst. 2004. QFD in large-scale social system redesign. *International Journal of Quality & Reliability Management* **21**:9, 959-972. [Abstract] [Full Text] [PDF]

73. Kenneth D. Strang, Cliff E.L. ChanSimulating E-business Innovation Process Improvement with Virtual Teams Across Europe and Asia 1023-1043. [CrossRef]