

APPLICATION OF QUALITY FUCTION DEPLOYMENT FOR PRODUCT QUALITY AND INDUSTRIAL EXCELLEACE

Chandrashekhar K. Patil¹, Dr.M.Husain², Dr. N.V. Halegowda³

¹ PhD Scholar ^{2,3} Professor S.S.B.T's College of Engineering, Jalgaon (India)

ABSTRACT

Quality Function Deployment (QFD) is a efficient process to integrate customer requirements into every phase of the design and delivery of products and services. Understanding the customers wants or needs from a product or service is crucial to the booming design and development of new products and services. QFD is a system that utilizes customer demands to congregate client missions by outlining what the customer wants in a service or product. QFD was used in this research to determine customer needs and thus to make certain that customer demands are met. The periodic theme in the literature is achieving quality effectiveness in a dynamic global market through development and research. Within this ample literature of QFD, the many frameworks seem deficient in studies that reflect the past, present and future trends of research in the field.. The paper may help to top management in organizations those have a urgent need to develop a product, created on systematically verified data, of the critical parameters and success factors for successful execution of QFD programs. The successful execution of QFD gives results in long-term enhancement in performance, value for money, and strength. QFD and its critical parameters and their interrelationships also need to understand.

Keywords: *QFD Implementation, Quality Improvement, Quality Of Service, House Of Quality*

I. INTRODUCTION

Quality Function Deployment, of the second edition of Gower Handbook of Quality Management edited by D. Lock, Hill (1994) wrote similarly,

“QFD evolved from a number of different initiatives between 1967 and 1972, but the two main drivers which led to its creation in Japan were those:

1. To improve the quality of design.
2. To provide manufacturing and field staff with the planned quality control chart (showing the points to be controlled within the production process) before the initial production run.”[1]

1. QFD (quality function deployment) is defined as a method for developing a design quality aiming at satisfying the consumer and then translating the consumer's demand into design targets and major quality assurance points to be used throughout the production phase. QFD is a way to assure the design quality while the product is still in the design stage (Akao, 1990) [2]. From this definition, QFD can be seen as a process where the consumer's voice is valued to carry through the whole process of production and services.

Quality Function Deployment (QFD) was conceived in Japan in the late 1960's, and introduced to America and Europe in 1983. During the period between the late 1960's and early 1980's, the concept of QFD was evolved from the belief that Total Quality Control must include not only checking of the control points during production, but an understanding of the requirements prior to the design phase. In the late 1960's, Japanese companies were breaking from their post-World War II mode of imitation and copying to a more original mode of product development, making design quality an important consideration. The need to understand the critical design issues prior to production was acknowledged and QC process charts were widely used to ensure that the design criteria were met during manufacturing, but there was no formal system to translate the customer's needs into the initial design and subsequent process control points. Thus, an opportunity was created for QFD to come to fruition as a method to check the design itself for adequacy in meeting customer requirements and to translate those requirements to production.

2. At this juncture, the quality chart as created by the Kobe Shipyards of Mitsubishi Heavy Industry (MHI) became known. The quality chart developed at MHI showed the relationship between customer needs and quality characteristics. Because the quality chart was first created at Kobe, it is often stated that QFD originated there. However, Akao states that "I first wrote about quality deployment, however, in an article published in April 1972, which described both the terminology and the procedure. This article was a compilation of what I 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 of 1978" 2. In 1983, Akao published an article on QFD in *Quality Progress*, the magazine by the American Society of Quality Control, and began giving lectures and seminars to American audiences. It was at this time that QFD was brought to the American automotive industry and the QFD Institute was founded. Since then, QFD has been extensively utilized in many diverse applications and industries. Examples of this diversity include the use of QFD in developing education products for Northern Australia beef producers 3, designing the animatronics for the Triceratops Encounter at Universal Studios in Florida exploring a new market for fresh pork sausage in southern Brazil 5, and improving the Ritz-Carlton's housekeeping system. There have also been numerous QFD projects in the automotive industry including Visteon's power train control systems division work on fuel system components 7 and Ford Motor Company's project on automotive painting.

1.1 QFD Past, Present

1.1.1 The Past

1. Quality Function Deployment (QFD) was conceived in Japan in the late 1960s, during an era when Japanese industries broke from their post-World War II mode of product development through imitation and copying and moved to product development based on originality. After World War II, 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* 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 I 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.

2. In 1966, a process assurance items table was presented by Mr. Kiyotaka Oshiumi [12] of Bridgestone Tire Corp... In 1972, I assembled this concept and the experiences in a publication [3] 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 startup, the important quality assurance points needed to ensure the design quality throughout the production process. Dr. Shigeru Mizuno and Dr. Yasushi Furukawa provided guidance to 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.” [4] Dr. 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.” [5] It is useful when creating a “quality assurance activity table,” a part of the QA system documentation.

3. In contrast, broadly defined QFD refers to the combination of the quality deployment (QD) described earlier and the narrowly defined QFD. What we call QFD today was molded and took shape through 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 myself 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. [6] [7] The companies surveyed listed the following as the purpose of using QFD: setting design quality and planned quality, bench-marking 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, reducing initial quality problems, reducing design changes, cutting development time, reducing development costs, and expanding market share. Please see figures 3 and 4 in reference [4] listed in the bibliography. They 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.

4. QFD received very little interest in the beginning until 1972 when the publications of the articles by Mitsubishi Heavy Industry and me paved the way for more QFD related articles to be published later. Following 1978 publication of “Quality Function Deployment,” [5] the first book on the topic, the number of QFD applications leaped. In recent years, International Symposium on QFD '97 – Linköping Ó 1997 Yoji Akao 3 about 50 to 60 application case studies in new product development are publicly reported and put in print each year in the specialty books and magazines. In 1987, the Japanese Standards Association published a book focused on QFD case studies. This book was later translated and published in the U.S. and Germany. [8] An introductory QFD book and work books were published in 1990 (by JUSE). [9-11] these are used by many companies today. The introduction of QFD to America and Europe began in 1983 when an article of mine was

published in Quality Progress [12] by the American Society of Quality Control. At the same time, I was invited to give a 4-day seminar in Chicago on “Corporate Wide Quality Control and Quality Deployment.” Later Mr. Bob King of GOAL/QPC invited me to give QFD lectures to American audiences for every year starting in 1986. Also in the U.S., Mr. Robert M. Adams spearheaded the North American QFD Symposium in 1989, contributing greatly to advancement of QFD in America by providing a place for QFD research and case study reports to be broadly viewed. In order to bring together all these activities, the QFD Institute was founded by Mr. Glenn H. Mazur in 1994 together with Mr. Richard Zultner and Dr. John

5. Terninko. The QFD Institute later instituted the Akao Prize in 1996. In its inaugural year, the Institute awarded the prize to Mr. King, Mr. Sullivan, and Professor Tadashi Yoshizawa. This year, Dr Clausing, Mr. Adams, and Professor Hisakazu Shindo will be honored with this Prize. Professors Yoshizawa and Shindo received the prize in recognition of their contribution toward building the framework of QFD methodology in the very early days when they were colleagues of mine at Yamanashi University in Japan.

5. In Europe, the author 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. Mr. Alberto Galgano, chairman of Galgano & Associati, will be another recipient of Akao Prize for his contribution toward education and dissemination of QFD in Europe. Regrettably, the first QFD book published in Japan in 1978 [5] did not get translated into English until much later. As a result, incorrect historical facts seem to be widely accepted. [18]

1.1.2 The Present

The first QFD seminar (a 2-day seminar) in Japan was organized in 1983 by Japan Productivity Center, and was followed by many others. Today QFD classes are available through the Japan Standards Association (a 2-day seminar), Central Japan Quality Control Organization (a 3-day seminar), and Union of Japanese Scientists and Engineers (a 4-day seminar). Over the past ten years, I have 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 I have chaired until Dr. Yoshizawa succeeded me in 1997. This committee, which celebrated its tenth anniversary this year, has held five meetings every year with research foci 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, QFD as development management engineering. These topics were discussed in a series of articles in Quality Control magazine for a period of one year beginning in 1996 [13]. Utilization of QFD by American companies is particularly noticeable in recent years. Its early days were reported by Mr. Bob King [14]. Further developments were presented by Mr. Glenn Mazur in 1994 at the 4th Japanese QFD Symposium sponsored by JUSE. Mr. Mazur also detailed the historical development of QFD since 1983 and the dissemination in America in his Japanese paper titled “QFD Inroads to North America and The First 10 Years.” [15] At the 1st ISQFD, a speech made by Mr. Harold M. Ross of General Motors, “The Status of Automotive QFD in the USA,” [16] revealed to International Symposium on QFD ’97 – Linköping Ó 1997 Yoji Akao 5 hat extent and in how many vehicle models QFD is actually used in the U.S., drawing a strong interest from the audience. 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 Brazil, QFD was first introduced in 1989 at ICQC-1989 in Rio de Janeiro [8]. Later dissemination efforts have been led by Mr. Ohfuji. 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. In Australia, the 1st Pacific Rim Symposium on Quality Deployment was organized in 1994 by Mr. Bob Hunt. Australia will host the 3rd International Symposium on QFD in Sydney next year. The 1st International Symposium on QFD was attended by 174 people, including 63 from overseas, notably 39 from Korea and 21 from Brazil. The 2nd ISQFD was held in Novi, Michigan, a suburb of Detroit, in the US. It 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 present. A survey was conducted through a collaboration of Tamagawa University and the University of Michigan, on recent trends in QFD applications. [17] The Japanese side selected 400 Japanese companies for the survey who were involved with the QFD Research Committee of JUSE or attended introductory QFD seminars. The U.S. side selected 400 U.S. companies with a similar background. An identical survey form was sent to these companies. 146 of the Japanese companies (37%) and 147 U.S. companies (37.6%) responded. According to the survey results, 31.5% of Japanese companies used QFD in their development process, while 68.5% of American companies did the same. It was determined that QFD was most often used in the automotive industry and electronics industry. Interestingly in the U.S., QFD was used by the aerospace industry. Application of QFD was higher in the U.S. than in Japan. Companies cited that they used QFD in order to attain 'better design' and 'better customer satisfaction.' American companies paid 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 American 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 U.S., 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% of decision making was done in meetings. In both Japan and the U.S., each team had ten or fewer members and met for two hours or less at a time. American companies reported more teams meetings, at least once a week or more often was not uncommon. [18]

1.2 Benefits of QFD

- The major advantages of the QFD process are that it encourages proactive product development instead of reactive product development.
- Proactive product development results in fewer and earlier design changes, decreased development time, fewer start-up problems, lower start-up costs, fewer field problems, and a more satisfied customer.
- A less obvious, though equally important, benefit of QFD is that it facilitates organizational knowledge transfer and establishes a proprietary knowledge base.

- The matrices that are generated during a QFD project make the logic flow obvious and act to preserve technical and customer knowledge.
- This affords others in the organization the opportunity to easily access and use the accumulated knowledge.

1.3 Functional fields of QFD

QFD was originally proposed, through collecting and analyzing the voice of the customer, to develop products with higher quality to meet or surpass customer's needs. Thus, the primary functions of QFD are product development, quality management, and customer needs analysis. Later, QFD_s functions had been expanded to wider fields such as design, planning, decision-making, engineering, management, teamwork, timing, and costing. Essentially, there is no definite boundary for QFD_s potential fields of applications.

- Product development One of QFD_s two popular application fields is product development
- Quality management Another popular field of QFD_s applications is quality management that is an important part of the QFD process and essential for successful product development, and many publications can be found in this field,
- Customer needs analysis Quality management and product development are achieved in QFD through customer needs analysis that, in fact, is always the very first step of a QFD process and is thus an important functional field of QFD. Publications in this field are quite rich, focusing mainly on the two key aspects of customer needs analysis: collecting/translating customer needs
- Product design QFD can be referred to as designed-in quality rather than traditional inspected-in quality in the sense that it helps a company shift from inspecting the products quality to designing quality into the product through customer needs analysis (Guinta and Praizler, 1993). Therefore, product design is also a functional field of QFD
- Planning QFD is a pro-active "customer-driven planning process" so that problems could be found and solved at the very beginning of the product development and fewer people have to deal with the problems at the later stages (Day, 1993). This idea of QFD is not only applicable to the usual product planning
- Engineering Apart from the above five popular functions, QFD is also related to and can thus be applied to other fields. One such field is concurrent engineering
- Decision-making QFD determines product design specifications (shows) based on customer needs (what's) and competitive analysis (whys), which represents a customer-driven and market-oriented process for decision-making. It is quite natural to use QFD in this field for such purposes as determining customer needs
- Management all of the above reviewed functions of QFD are related to management, more or less. It is thus not surprising that QFD can be directly used as a management tool
- Teamwork, timing, costing, and others QFD_s above-mentioned multi-functions demonstrate its usefulness, and its successful applications have produced noticeable benefits such as the promotion of teamwork, the provision of documentation, shorter design cycles, and lower start-up cost

III. CONCLUSION

QFD is a systematic method of developing a new product, by which the organization shall ensure that customer's requirements are translated correctly into its specifications. Therefore, achieving or exceeding customers an expectation means more than maintaining or improving customers' performances. It means the design and manufacture of new products that "delight and amaze" the customer, by meeting latent unspoken requirements but understood and translated correctly by the QFD team. Companies that understand this, that to be competitive you have to put an emphasis on innovation and creativity and meet the needs of their customers, will be able to grow in the global business environment of the 21st century.

REFERENCES

- [1]. Lai-Kow Chan, Ming-Lu Wu 1 Quality function deployment: A literature review Department of Management Sciences, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon, Hong Kong European Journal of Operational Research 143 (2002) 463–497
- [2]. Akao, Y., ed. (1990). Quality Function Deployment, Productivity Press, Cambridge MA.
- [3]. Akao Yoji. 1972. "New Product Development and Quality Assurance – Quality Deployment System." (Japanese) Standardization and Quality Control. Vol. 25, No. 4. pp. 7-14.
- [4]. Akao Yoji. 1990. "History of Quality Function Deployment in Japan." The Best on Quality, IAQ Book Series Vol. 3. pp. 183-196. International Academy for Quality.
- [5]. Mizuno, Shigeru and Yoji Akao ed. 1978. Quality Function Deployment: A Company Wide Quality Approach. (in Japanese) JUSE Press. Mizuno, Shigeru and Yoji Akao ed. 1994. QFD: The Customer-Driven Approach to Quality Planning and Deployment. (Translated by Glenn H. Mazur) Asian Productivity Organization. ISBN 92-833-1122-1
- [6]. Akao Yoji, Ohfuji Tadashi, Naoi Tomoyoshi. 1987. "Survey and Reviews on Quality Function Deployment in Japan." Proceedings of the International Conference for Quality Control – 1987. Tokyo: JUSE and IAQ. pp. 171-176.
- [7]. Akao Yoji, Naoi Tomoyoshi, and Ohfuji Tadashi. 1989. "Survey of the Status of Quality Deployment – Report from the Quality Deployment Research Committee." (Japanese) Quality Control. Vol. 19. No. 1. pp. 35-44.
- [8]. Akao Yoji ed. 1988. Practical Applications of Quality Deployment for New Product Development.(in Japanese) Japan Standards Association. Akao Yoji ed. 1990. Quality Function Deployment: Integrating Customer Requirements into Product Design. (Translated by Glenn H. Mazur) Productivity Press. ISBN 0-915299-41-0
- [9]. Akao Yoji. 1990. Introduction to Quality Deployment (Application Manual of Quality Function Deployment (Japanese) JUSE Press.
- [10]. Ohfuji Tadashi and Ono Michiteru. 1990. Quality Deployment (1) – Creation and Practice of Quality Charts. (Japanese) Volume 2 of above series. JUSE Press.
- [11]. Ohfuji Tadashi and Ono Michiteru. 1994. Quality Deployment (2) Comprehensive Deployment including Technology, Reliability, and Cost. (Japanese) Volume 3 of above series. JUSE Press.

- [12]. Akao Yoji, Kogure Masao, and Yasushi Furukawa. 1983. Seminar on Company-Wide Quality Control and Quality Deployment. Oct. 31-Nov. 3, 1983. The Arlington Park Hilton. Chicago. Sponsored by the Cambridge Corporation and co-sponsored by ASQC.
- [13]. Akao Yoji. 1996. "Quality Function Deployment on Total Quality Management and Future Subject. (QFD and TQM Series No. 1)" (Japanese) Quality Control. Vol. 47, No. 8. pp. 55-64. International Symposium on QFD '97 – Linköping Ó 1997 Yoji Akao
- [14]. King, Robert. 1987. "Listening to the Voice of the Customer: Using the Quality Function Deployment System." National Productivity Review. Summer 1987.
- [15]. Mazur, Glenn H. 1994. "Current Status of QFD in North America," (Japanese) Standardization and Quality Control. Japan Standards Association. March, 1994. pp. 17-23.
- [16]. Ross, Harold and Paryani, Kioumars. 1995. "QFD Status in the U.S. Automotive Industry." Proceedings of the International Symposium on Quality Function Deployment '95 – Tokyo. pp. 19-28.
- [17]. Ohfuji Tadashi, Cristiano John J., and White, Chelsea C. 1996. "Comparison of QFD Status in Japan and the U.S." (Japanese) Proceedings of the JSQC 25th Anniversary 52nd Research Presentations. June 1, 1996. pp. 1-4.
- [18]. Yoji Akao QFD: Past, Present, and Future International Symposium on QFD '97 – Linköping Ó 1997 Yoji Akao Asahi University