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## THE HISTORY OF THE QFD METHOD

**Abstract.** The aim of the paper is to present historical review of the QFD method. The paper presents issues related to the history of the creation method, the origin of the name of the method, its use in the United States and the world, and the literature on methods in the world and in Poland.

**Keywords:** QFD, quality function deployment, design quality, quality methods

## HISTORIA METODY QFD

**Streszczenie.** Celem publikacji jest analiza historii zastosowania metody QFD na świecie. Artykuł przedstawia kwestie związane z historią powstania metody, pochodzeniem nazwy metody, jej zastosowanie w Stanach Zjednoczonych i na świecie oraz literatury na temat metody na świecie i w Polsce.

**Słowa kluczowe:** QFD, funkcja rozwinięcia jakości, projektowanie jakości, metody jakości

### 1. Introduction

QFD method is used to design new products and services and to modify existing ones such that they satisfy (to the extent possible) requirements specified by the customer. It belongs to the methods of design-oriented customer. This means that the design does not begin the work of planning the characteristics of the product, but the customer's requirements and then designed a product or service to meet these requirements.

The main element of the method is called. "House of Quality" (House of Quality). so named because of the specific shape of the diagram. "House of Quality" is defined as the first

array used in the method QFD (in the basic version of the method only), which is used to provide links between the needs of the customer and technical attributes of the product.

Quality function deployment is to translate the customer's requirements for appropriate action the company in all phases of development of the product quality. For this reason, sometimes also called Design-controlled by the Customer (Customer Driven Engineering) or an array of the Product Planning (Matrix Product Planning)<sup>1</sup>.

## 2. The emergence of the QFD method

Quality Function Deployment method was developed by Japanese engineers to ensure the quality of the product already in the design phase of the product. During the Second World War, the Japanese economy suffered huge losses. After the war, production was based mainly on the production of low-quality copies of American products. Then, influenced by the ideas presented by Deming and others who came to Japan specialists in quality management Japanese engineers realized that only innovative products of high quality can ensure their success.

At this time, the Japanese auto industry is in a rapid growth phase. Continually developed new models and introduced improvements to existing ones. To meet the situation Yoji Akao and Shigeru Mizuno have developed a method to improve the design of products. On the basis of their work in 1978 jointly they published the first book on the method QFD: Quality Function Deployment: A Company Wide Quality Approach.

The impetus for the development of methods of QFD was that a decisive factor in the financial condition of the company are manufactured by the buyer or its products indirectly – affect institutions to take customer decision about their purchase. Even if a product from an engineering point of view was made correctly, his production may be misguided, if this product does not accept the market. Quality function deployment to help resolve issues with the fact that mass production or large series will give the company a small possibility of direct contact with a potential client. This is particularly important at a time when the products become more and more advanced, and additionally usually one device meets the many different needs<sup>2</sup>.

Before arrays, the first Japanese engineers in the method QFD have used a tool called a graph of quality (Quality chart). This tool is referred to the tree functions used eg. In value analysis. This diagram presented in detail the functions of the test object, which then can be analyzed in terms of quality. Only link in the form of a matrix of the second tree quality has

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<sup>1</sup> Urbaniak M.: Zarządzanie jakością. Teoria i praktyka. Difin, Warszawa 2004.

<sup>2</sup> Hamrol A.: Zarządzanie jakością z przykładami. PWN, Warszawa 2005.

led to the emergence and development of the "House of Quality" and initiated the creation of the modern version of the method QFD<sup>3</sup>.

For the first time the method was used in the Kobe shipyard. Then it was applied in the Japanese auto industry. Research conducted in 1986 by the Union of Japanese Scientists and Engineers (JUSE) showed that 54 out of 148 surveyed companies used QFD method. Most often it was used in the following sectors: transport 86%, construction 82%, 66% precision mechanics, electronics industry 63%. The application of this method in service companies was smaller, but still significant, and stood at 32%. A German study, carried out in the early 90s, have shown that the method QFD is not yet in Europe as widely used as in the US and Japan (66% of enterprises did not use it, and only 4% used it regularly)<sup>4</sup>.

### 3. The name of the method

The method name is a translation of Japanese words hinshitsu cinema Tenkai. In dictionaries, English-Japanese word Tenkai means evolution or development. For the first time the method name was translated in 1978 as a quality function evolution, but then it was that the word development is more creatively and method received its present name Quality Function Deployment<sup>5</sup>.

Detail Japanese name can be broken down into three words of which it is composed<sup>6</sup>:

- 品質 – hinshitsu – signifying quality, characteristic, attribute,
- 機能 – kino – denotes a function, a mechanism of action,
- 配置 – tenkai – meaning the development, evolution.

In English, you can submit it as follows<sup>7</sup>:

- Q – quality – how well we meet the needs of the customer,
- F – a feature that defines all parameters related to the product, such as. size, shape, etc.,
- D – how is shaped function of the quality of what is being done to meet the needs of the customer.

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<sup>3</sup> Ćwiklicki M., Obora H.: Ewolucja i dyfuzja metody QFD. „Problemy Jakości”, nr 3, 2008, s. 4-7.

<sup>4</sup> Krzemień E., Wolniak R.: Zastosowanie komputerowego wspomaganie w metodzie QFD. „Problemy Jakości”, nr 7, 2001, s. 31.

<sup>5</sup> Akao Y.: QFD: Past, Present, and Future, International Symposium on QFD '97 – Linköping (dokument internetowy); Kogure M., Akao Y.: Quality Function Deployment and CWCQ in Japan. “Quality Progress”, No. 10, 1983.

<sup>6</sup> Zinkgraf S.A.: Quality Function Deployment and Six Sigma. A QFD Handbook. Pearson Education, Indiana 2010.

<sup>7</sup> Duffy G.L., Moran J.W., Riley W.: Quality Function Deployment and Lean-Six Sigma Application in Public health. ASQ Quality Press, Milwaukee 2006.

#### 4. Developing the use of the method in the world

Based on the experience of the Japanese method has been used in the USA. The first companies that have used it on a larger scale in the 80s was the "Big Three" car manufacturers (Ford, General Motors, Chrysler). Then, as in Japan, the method began to be widely used in other industries.

For the first time the method QFD is presented in the US in 1983 under the name develop (economic) function of quality<sup>8</sup>. This year, appeared in the United States first article Y. Akao on QFD. This year also saw the four-day training in its use<sup>9</sup>.

In 1986, he applied it in the US Ford and Xerox. Then began to use it, inter alia, the following organizations: Hewlett-Packard, Kodak Digital Equipment, Eaton Controls, Texas Instruments, the US Army, etc. It is now mainly used in the following industries: construction machinery and equipment, paper industry, construction, electrical industry, chemical industry, tourism industry, insurance, health care<sup>10</sup>.

The most important stages of the history of QFD method in the world have been summarized in Table 1. The table shows the history of the method in the share of Japan, the United States and the rest of the world.

In Europe, the UK, this method began to be used in the 80s of the twentieth century, while in Ireland in the late 80s led her I. Ferguson. In Germany in 1996, the Institute dealing with the application of the method QFD (QFD-Institut Deutschland). This Institute dealt with the promotion of methods in Germany and conducting training in the area. In Latin America and East Asia, the method began to be used at the turn of the 80s and 90s of the twentieth century, China and India took place in 1992-1995<sup>11</sup>.

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<sup>8</sup> Obora H., Potocki A.: Zastosowanie tabeli współzależności powiązań do ustalenia hierarchii oczekiwań klienta w metodzie QFD. „Problemy Jakości”, nr 3, 1999.

<sup>9</sup> Urbaniak M.: op.cit.

<sup>10</sup> QFD w służbie klienta. TÜV Rheinland/ZETOM Polska Sp. z o.o., s. 10.

<sup>11</sup> Abu-Assab S.: Integration of preference analysis methods into Quality Function Deployment. Technische Univeritat, Cottbus 2011.

Table 1

## The most important stages of the history of QFD method in the world

Year	Person	Characteristic
<b>Development of QFD in Japan (1966-1994)</b>		
1966	Oshiumi	Ensuring the quality of the company Bridgestone Tire
1972	Akao	The first publication on a new approach "hinshitsu tenkai"
1972	Nishimura, Suzuki	The use of quality charters based on an earlier version of QFD in the yard Mitsubishi Kobe
1972	Ishihara	The first version of QFD – business process function deployment
1975	JSQC	Application of the method in the computer industry
1975	Mizuno, Akao	The first book on the method QFD in Japan in 1994, translated into English
1987	Akao	The first study on the application of the method QFD in Japan
1987	JSA	The book of case studies on QFD in Japan translated into English and German
1990-1994	JUSE	Drafting a manual for carrying out the method QFD
<b>The introduction of QFD method in the United States (1983-1988)</b>		
1983	Akao	The introduction of QFD method in the United States. Akao publishes an article in the "Quality Progress"
1983	King	Akao leads a seminar on methods of QFD in Chicago
1984-1991	King, Clausing, Sullivan	Presentations, seminars and training on methods of QFD
1985	Sullivan, McHugh	Form running a project for the implementation of the method QFD
1986	Sullivan	Subsequent articles in the "Quality Progress"
1986-1990	GOAL/QPC	Akao conducts a series of lectures on the method QFD in the United States
1988	Hauser, Clausing	Numerous publications about the method QFD
<b>QFD in other regions of the world (1987 years and later)</b>		
1987	Germany	The first implementation of the method in Germany
1988	Sweden	Articles on methods published at the University of Linköping
1994	China	A series of lectures conducted by Akao

Source: Abu-Assab S.: Integration of preference analysis methods into Quality Function Deployment. Technische Univeritat, Cottbus 2011.

Currently, this method used by organizations as General Motors, AT&T, ICI Chemical and Polymers, Procter and Gamble, BASF, ITT, Rank Xerox, Jaguar and many others.

The most important and documented use of QFD methods are associated with its use<sup>12</sup>:

- in the preparation, construction and commissioning of new products in such diverse industries as shipbuilding, construction, mechanical engineering,
- preparation of new services in banks and health care,
- in the development of new computer systems hardware and programming,
- in the pharmaceutical industry to develop new substances,
- the development of new techniques of information transfer.

A complete overview of industries and areas where you can apply the method QFD introduced A. Samah<sup>13</sup>. The results of the analysis are shown in Table 2.

<sup>12</sup> Hamrol A.: op.cit.; Toruński J.: Metoda QFD w procesie zarządzania jakością w przedsiębiorstwie. Zeszyty Naukowe, s. Administracja i Zarządzanie, nr 23. Uniwersytet Przyrodniczo-Humanistyczny, Siedlce 2013, s. 9-17.

<sup>13</sup> Samah A.A.: Integration of preference analysis methods into Quality Function Deployment. Springer, Cottbus 2011.

Table 2

## Summary of documented examples of use of the method QFD

A key category	Subcategory	Selected examples
Transport and communications	Shipbuilding industry	Nishimura, Lyu i Gunasekaran
	Automotive industry	Ferguson, Gould
	Aerospace industry	Ghobadian i Terry
	Space industry	Jacobs
Electrical and electronic equipment	AT&T	Nolle
	Intel	Kerr
	Helwett-Packard	Thompson i Chai
	Philips	Gronveld
Software	Software	Herzwurm i Schockert; Sharma
	Expert systems	Buyukozkan i Feyzioglu
	Information systems	Moskowitz i Kim; Sarkis i Liles
Production	Production	Han
	Equipment	Barad i Gien
Services	Different services	Matzler i Hinterhuber; Maduri
	Banking	Patrovi
	Food distribution	Costa, Charteris
	Bookstores on-line	Barnes i Vidgen
	Health Service	Dijkstra i Bij; Gonzalez; Moores; Lim i Tang; Mohiuddin
Education and research	Schools and Universities	Duffuaa; Bier i Cornesky; Ho
	Educational institutions	Singh i Deshmukh; Singh
	Business school	Hwarng i Teo
Other	Clothing industry	Wies; Fischer; Stellmach
	Taking care of your appearance	Chan
	Agriculture	Milan
	Environmental Protection	Halog; Masui, Zhou i Schoenung

Source: Samah A. A.: Integration of preference analysis methods into Quality Function Deployment. Springer, Cottbus 2011.

## 5. Research on the prevalence of methods

The first study of the prevalence of QFD methods were conducted by the same creator of the method of Y. Akao in 1983. They relate to compare the number of articles on methods of QFD between 1967 and 1982, appearing in Japanese literature in the field of quality management and quality control. Based on the survey Akao said more than forty times increased interest in using QFD in Japan examined by him during the period. Akao test results are shown in Fig. 1<sup>14</sup>.

<sup>14</sup> Ćwiklicki M., Obora H.: op.cit.

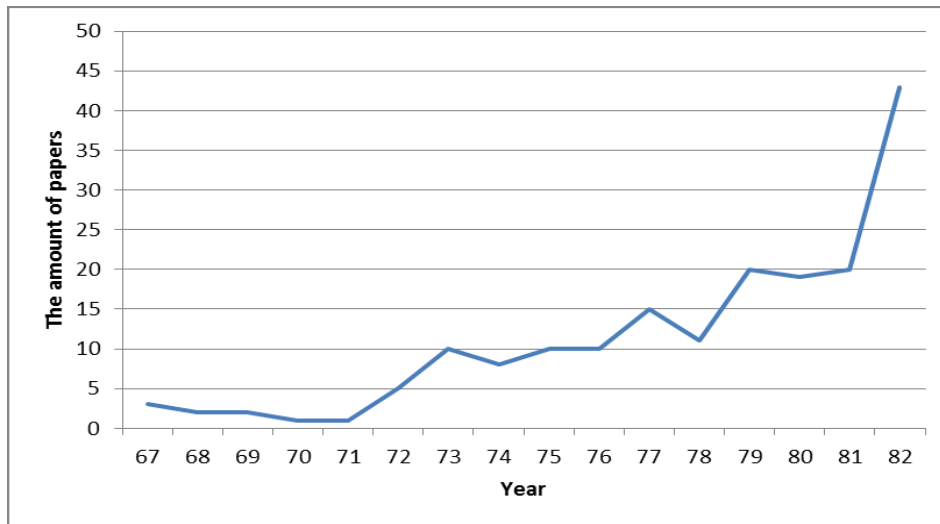


Fig. 1. The number of publications on QFD method in the Japanese professional press in the years 1967-1982

Source: Akao Y.: Quality Function Deployment. Integrating customers' requirements into product design. Productivity Press, Portland 1988, by: Ćwiklicki M., Obora H.: Ewolucja i dyfuzja metody QFD. „Problemy Jakości”, nr 3, 2008, s. 4-7.

In the same year he made the research on the frequency of use of the method QFD for various purposes related to the implementation of specific business functions: marketing, planning, development, research, design, procurement, production preparation, control and sales. Conducted in the years 1978-1982 survey (Fig. 2) showed that the most affected applications of broad-based design and research and development<sup>15</sup>.

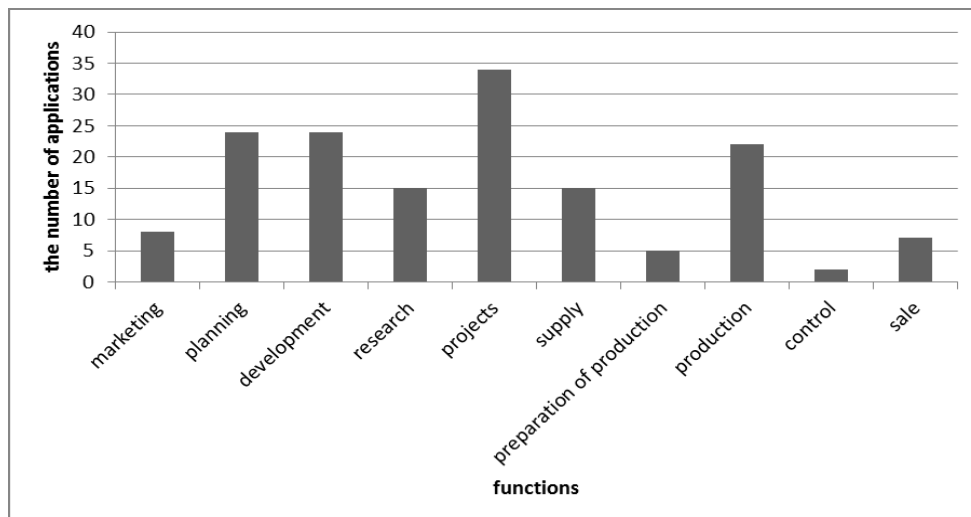


Fig. 2. The number of publications on QFD method in the Japanese professional press in the years 1967-1982

Source: Akao Y.: Quality Function Deployment. Integrating customers' requirements into product design. Productivity Press, Portland 1988, by: Ćwiklicki M., Obora H.: Ewolucja i dyfuzja metody QFD. „Problemy Jakości”, nr 3, 2008, s. 4-7.

<sup>15</sup> Ibidem.

The first research on the application of the method QFD in the United States were conducted by A. Griffin in 1992. They were subsequently repeated in 1995 and their results presented J.J. Christiano in 2000. In the studied Christiano it was attended by 417 companies that were typed for this purpose on the basis of information obtained from the American Supplier Institute – ASI. The selection criterion is the share of the company in training on QFD, as well as participation in one of the six national symposia concerning the method. The study sample did not include academic institutions and consulting firms<sup>16</sup>.

Further studies were conducted by Y. Akao and S. Mizuno and had to compare the Japanese applications of the US. In the Japanese study involved 400 enterprises – members of the Association of Japanese Scientists and Engineers (JUSE), invited previously organized by JUSE series of training courses and annual Japanese symposium on QFD. With qualified to study Japanese companies, six in which the implementation of QFD held under ozobistym supervision Akao (were: Tokyo Electric Power Company – TEPCO, Fuji Univance, Nec, Toyoda Gosei and Aishin Seiki), and among American organizations were selected for analysis four that extensive use of the method (General Motors, Chrysler, Richard Allen, Hayworth).

The survey showed that US companies usually apply the version of the method popularized in the US by ASI, which differs from the details of the original version, developed by Y. Akao. Another difference between American and Japanese applications QFD approach was applied to the rules for implementing the multidisciplinary team of professionals. 83% of US cases of application of the method used multidisciplinary teams of professionals and 55% of the participants of these teams came from more than five functional areas of activity of the company. Similar indicators in enterprises Japanese at the level of 53% and 30%<sup>17</sup>. From research it appears that the level of interdisciplinary teams implementing projects QFD was greater in the US than in Japan.

Swedish research suggests that the method QFD reached Sweden relatively late and is used most often by large industrial enterprises to implement a variety of purposes. For example, the company Whirlpool and Molnlycke use QFD to improve the technical characteristics of the products offered, while Volvo is focused on how to best meet the requirements and expectations of customers<sup>18</sup>.

Although the method QFD is known to the world for several years, in our country it is still not very widely used. The study showed that the application of QFD in the study population stood at 7%. Wherein the application of substantially depend on the size and type of business. For example, organizations medium it settled at 14% and small reached is 2%. The highest percentage of companies using the method occurs in a group of organizations that

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<sup>16</sup> Christiano J.J., Liker J.K., White C.C.: Customer driven product development through Quality Function Deployment in the USA and Japan. "Journal of Product Innovation Management", Vol. 17, 2000, p. 286-308.

<sup>17</sup> Ibidem.

<sup>18</sup> Ekdahl F., Gustafsson A.: QFD: The Swedish experience. "Transactions from the 9th Symposium on Quality Function Deployment", QFD Institute, 1997, p. 15-18.



have certified ISO 9000, large or average size, while operating in an industry where a segment of the use of the method was 18%<sup>19</sup>.

## 6. Quality function deployment in international and Polish publications

Quality function deployment is present in the national and international literature. For magazines, which frequently appeared in these publications include:

- “International Journal of Quality & Reliability Management”,
- “International Journal of Production Economics”,
- “CE-Concurrent Engineering: Research and Application”,
- “European Journal of Operational Research”,
- “Computer & Industrial Engineering”,
- “Benchmarking: An International Journal”,
- “Industrial Management & Data Systems”,
- “Journal of Intelligent Manufacturing”,
- “Managerial Auditing Journal”<sup>20</sup>.

In the case of Polish articles on methods of QFD appeared especially in "Problems of Quality". In this magazine since the 90s of the twentieth century it was published fifteen articles directly concerning the method QFD and its multiple applications (Table 3). The breakthrough year was 1995, which published four publications directly devoted to the method QFD. In subsequent years, the future further development. Initially, these publications have focused on the use of conventional methods and it is rendered later evolved into the present application atypical examples of its use, first in the industry, and the 2005 service. Among the authors who publish frequently in the pages of the Quality Problems about the QFD are (listed authors who in this topic published at least 2 publications): H. Obora (4 publications), M. Ćwiklicki (3), M. Wiśniewska (3) R. Wolniak (3).

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<sup>19</sup> Wolniak R.: Komputerowe wspomaganie metod zarządzania jakością w przedsiębiorstwach. Praca doktorska napisana pod kierunkiem naukowym dr hab. inż. E. Krzemienia, prof. Pol. Radomskiej, obroniona na Wydziale Zarządzania i Komunikacji Społecznej Uniwersytetu Jagiellońskiego, listopad 2002.

<sup>20</sup> For example, in 2000-2006, it was published in these journals in total 79 papers on methods QFD, by: Carnevalli J.A., Miguel P.C.: Review, analysis and classification of the literature on QFD – Types of research, difficulties and benefits. “Journal Production Engineering”, No. 114, 2008, p. 737-754.

Table 3

The number of publications on methods of QFD,  
which appeared on the pages of "quality problems" in the years 1995-2015

Year	Number of publications	Authors
1995	4	A. Kleniewski; D. Kowalska; M. Wiśniewska; M. Piotrowski
1997	1	K. Lisiecka, S. Pater
1999	1	H. Obora, A. Potocki
2001	1	E. Krzemień, R. Wolniak
2003	1	R. Wolniak
2004	1	M. Ćwiklicki; H. Obora
2006	1	M. Wiśniewska
2007	1	Z. Zymonik; A. Wąsińska
2008	2	M. Ćwiklicki; H. Obora
2009	1	M. Wiśniewska
2012	1	R. Wolniak

Source: Authors own work.

## 7. Conclusion

Discussed in this publication method originated in Japan I had to help in ensuring a better quality product at the planning stage of the product. Its first application outside of Japan dates back to the years of the 80th century, initially in the United States and later in the countries of the European Union. In Poland the method was discussed in the literature since the early 90s of the twentieth century, for example, in the journal "Problems of Quality" was published in the years 1995 to 2012 on it 15 publications. However, the publication does not go its application, which so far on the Polish territory is not too wide, and only a few companies use the method in practice.

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