QFD for Service Industries

From Voice of Customer to Task Deployment

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Introduction

Quality Function Deployment (QFD) began more than twenty years ago in Japan as a quality system focused on delivering products and services that satisfy customers. To efficiently deliver value to customers, it is necessary to listen to the "voice" of the customer throughout the product or service development process. The late Dr. Shigeru Mizuno, Dr. Yoji Akao, and other quality experts in Japan developed the tools and techniques of QFD and organized them into a comprehensive system to assure quality and customer satisfaction in new products and services (see Figure 1) [Mizuno and Akao 1993, Akao 1990].

Since 1983, a number of leading North American firms have discovered this powerful approach and are using it with cross-functional teams and concurrent engineering to improve their products and services, as well as the design and development process itself [Akao 1983, Sullivan 1986, King, 1987]. The author used QFD in 1985 to develop his Japanese translation business, **Japan Business Consultants**, and saw revenues increase 285% the first year, 150% the second year, and 215% the third year. An update of his study is included in this report. QFD was an integral part of **Florida Power & Light**'s successful bid to become the first non-Japanese Deming Prize recipient in 1990 ["Quality System Implementation..." 1988, Webb 1990]. It has been successfully applied in the U.S. healthcare industry since 1991 at the **University of Michigan Medical Center** [Gaucher 1991] and **Medical Center of Central Massachusetts** [presented but unpublished report at the Third Symposium on Quality Function Deployment (Novi, MI: 1991) by L. Kelly].

Early applications of QFD in service organizations in Japan by Ohfuji, Noda, and Ogino in 1981 were for a shopping mall, a sports complex, and a variety retail store [Akao, 1990]. More recently, Kaneko has been integrating QFD, reliability, and quality circle activities in hotels, shopping centers, and hospitals [Kaneko 1990a, 1990b, 1991, 1992].

Since 1990, the author has consulted with other service organizations in distribution, education, personnel, finance, healthcare, repair, and retail businesses. Quality Function Deployment has provided a structure for assuring quality and customer satisfaction in the otherwise fuzzy and intangible world of service.

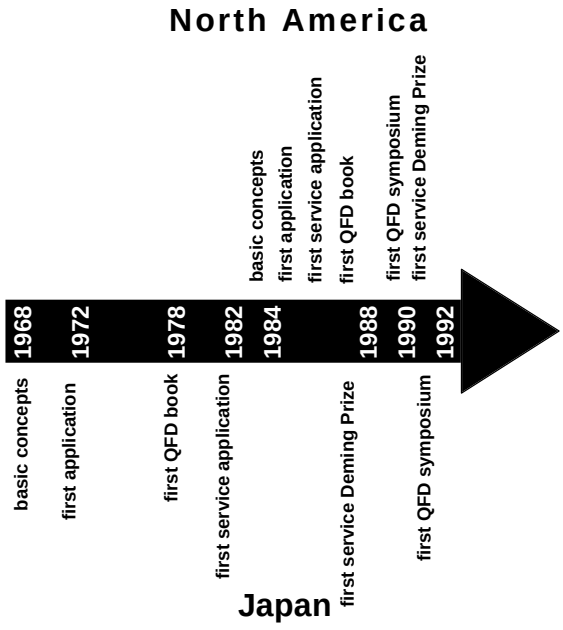

Figure 1. History of QFD.
Originating in Japan over two decades ago, QFD is the only comprehensive quality system for satisfying customers.

Why QFD for Services?

Increasing economic pressures from competition, government, and rapidly changing technology have forced companies to ask more of fewer employees. Internal company services such as personnel, accounting, information management, etc. are no longer ancillary activities, but have become critical processes in assuring end customer satisfaction and in achieving organizational objectives. How will they do this with ever diminishing financial, time, and human resources?

What about service oriented businesses? For example, there are mounting pressures for healthcare reform that will undoubtedly mean fewer people with fewer resources doing more for more customers. How will they assure that the quality of healthcare will not suffer?

What about small business? In *Liberation Management* [Peters 1992, p.142], Tom Peters describes his personal view of the consulting firm McKinsey & Company as an organization with consultants (professionals) and support staff (second-class citizens). As long as they remain at McKinsey, they will never rise to top positions (partnership). For these support staff to become first-class citizens, they must eventually join an organization that specializes in support activities (research, duplicating services, desktop publishing, transcription, etc.) where they can be "professionals" in their own right. Peters sees a North America proliferating with service firms electronically linked to their customers.

Why look to QFD to address the problems of services? What can QFD do that is not already being done by traditional quality systems? In understanding QFD, it is helpful to understand the differences between modern and traditional quality systems.

Nothing Wrong ≠ Anything Right

Traditional Quality Systems

Traditional approaches to assuring service quality often focus on work standards [Love 1986], automation to eliminate people, or in more enlightened organizations, Quality Improvement Teams (QuITs?!) to empower employees to solve problems.

As manufacturers are finding out, however, consistency and absence of problems is not a competitive advantage when only good players are left. For example, in the automobile industry, despite the celebrated narrowing of the "quality" (read that fit and finish) gap between U.S. and Japanese makers, Japanese cars still win the top honors in the J.D. Powers Survey of New Car Quality.

Modern Quality Systems

QFD is quite different from traditional quality systems which aim at minimizing negative quality (such as poor service, inconsistency). With those systems, the best you can get is *nothing wrong* - which we see is not enough when all the players are good. In addition to eliminating poor service, we must also maximize positive quality (such as fun, luxury). This creates **value**.

Quality Function Deployment (QFD) is the only comprehensive quality system aimed specifically at satisfying the customer. It concentrates on maximizing customer satisfaction (positive quality) - measured by metrics, such as return business and compliments. QFD focuses on delivering value by seeking out both spoken and unspoken needs, translating these into actionable services, and communicating this throughout the organization. Further, QFD allows customers to prioritize their requirements, tells us how we are doing compared to our competitors, and then directs us to optimize those aspects of our service that will bring the greatest competitive advantage. What business can afford to waste limited financial, time and human resources on services customers don't want or where we are already the clear leader?

Types of Requirements

To satisfy customers, we must understand how meeting their requirements effects satisfaction. There are three types of customer requirements to consider (see Figure 2) [Kano, *et. al.*, 1984].

Revealed Requirements are typically what we get by just asking customers what they want. These requirements satisfy (or dissatisfy) in proportion to their presence (or absence) in the delivered service. Fast service would be a good example. The faster (or slower) the service, the more they like (or dislike) it.

Expected Requirements are often so basic the customer may fail to mention them - until we fail to deliver them. They are basic expectations of the service, without which the service may cease to be of value; their

absence is *very* dissatisfying. Further, meeting these requirements often goes unnoticed by most customers. For example, if an airplane takes off safely, passengers barely notice it. If it fails to take off safely, dissatisfaction, though brief, is intense. Expected requirements *must* be fulfilled.

Exciting Requirements are difficult to discover. They are beyond the customer's expectations. Their absence doesn't dissatisfy; their presence excites. For example, if champagne and caviar were served in coach class on a flight from Detroit to Cleveland, passengers would be ecstatic. If the fare were more mundane, passengers would hardly complain. These are the things that wow the customers and bring them back. Since customers are not apt to be aware of these requirements, it is the responsibility of the service organization to explore customer problems and opportunities for new levels of service.

Kano's model is also dynamic in that what excites us today is expected tomorrow. That is, once introduced, an exciting service will soon be imitated by the competition and customers will come to expect it from everybody. An example would be special long distance telephone rates at certain hours. On the other hand, expected requirements can become exciting after a real or potential failure. An example might be the passengers applauding a pilot who has safely maneuvered a landing despite severe weather conditions.

The Kano Model has an additional dimension regarding which customer segments the target market includes. For example, the champagne and caviar that might be exciting in the coach section might be expected on the New York to Paris Concord flight. Knowing which customer segments you wish to serve is critical to understanding their requirements.

Thus, eliminating service problems can be likened to expected requirements. There is little satisfaction or competitive advantage when nothing goes wrong. Conversely, great value can be gained by discovering and delivering on exciting requirements ahead of the competition. QFD helps assure that expected requirements don't fall through the cracks and points out opportunities to build in excitement.

The Keystone Customer

Many service organizations are part of a chain of customers. For example, an auto parts warehouse distributor purchases a muffler from a manufacturer and redistributes it to a retailer who in turn sells it to a repair facility who then installs it on a car driven by the customer's wife. The retailer, the installer, and the customer are all part of a customer chain; they have different needs and occasionally conflicting ones.

QFD can accommodate multiple customers. The first step, though, is to uncover what I call the "keystone" customer (see figure 3) [Mazur, 1993a]. Who ultimately determines the success or failure of our service? Like the keystone that holds a Roman arch in place, if we do not satisfy this customer's needs first, the whole customer chain can collapse. In our muffler example, I think the keystone is the wife. If she is unhappy with the sound or smell of her car after the new muffler is installed, she may ask that it be checked again (time for which the installer will not be paid), and if she is still

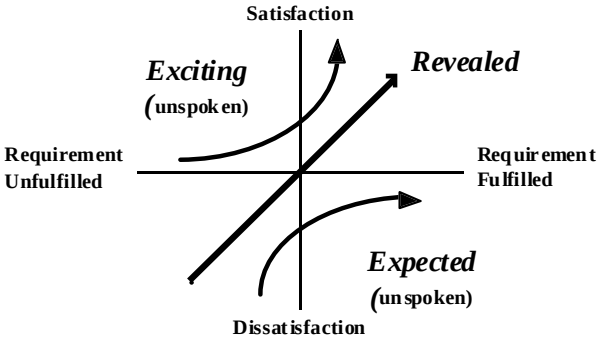

Figure 2. The Kano Model (adapted).
World-class services must meet all three types of requirements - not just what the customer says.

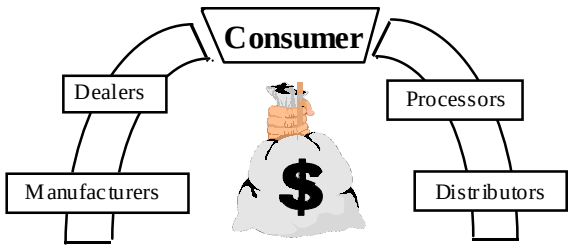

Figure 3. The Keystone Customer.
Who ultimately determines the success or failure of our service?

not satisfied, she may not want her car taken to that installer for other services. Conversely, if the keystone customer is satisfied, good will and word-of-mouth advertising may result. In QFD, it is important that the needs of the keystone customer be addressed first.

Coherent Service Planning

Once customer requirements are obtained, they must be translated into actionable plans and communicated throughout the service organization. This requires analyzing the customer needs for expected and exciting requirements, designing and planning new services and facilities, developing training programs, and finally implementing the new service. Traditional development lacks the structure to communicate what matters most to the customer and to align organizational components and employees behind these critical requirements. Such a system is incoherent and inefficient. Thus, more time is spent correcting and adjusting customer complaints than planning it right the first time (see Figure 4) [Zultner 1992].

QFD is Coherent

When constrained by financial, time, human, and other resources, when faced with regulatory, competitive, and other pressures, it is necessary to concentrate the best efforts of all members of the organization on what matters most to the customer. It is necessary for these best efforts to be aligned, or coherent. This way, each person builds on and reinforces the efforts of others to deliver what matters most to the customer (see Figure 5) [Mazur, 1983a]. The result is a superb service that exhibits features that have the greatest value to the customer.

To do this, customer needs must be analyzed for unspoken requirements and prioritized. Then both the needs and the priorities must be translated into responses by the organization. The activities of each individual are then developed accordingly so that they may concentrate on the vital few aspects of their job *without constraint.* In effect, we "pull out all the stops" to satisfy our customers [Porter 1985]. This analysis, prioritization, translation, and participation by everyone is called Quality Function Deployment.

What is QFD?

Yoji Akao, the man who developed Quality Function Deployment from 1965 to 1967 with Katsuyo Ishihara of Matsushita Electric, defines QFD as "a method for developing a design quality aimed at satisfying the consumer and then translating the consumer's demands into design targets and major quality assurance points to be used throughout the production stage" [Akao, 1990]. Change production to service and we might paraphrase this to "a system and procedures to aid the plan and development of services and assure that they will meet or exceed customer expectations" [Mazur 1993].

"QFD is a philosophy for quality assurance" [Mizuno and Akao, 1993], not merely a series of steps to follow. The reduction of QFD to four phases in the West and used by many practitioners has prompted Akao in the introduction of his latest book to regret this "misapplication or incomplete use of QFD ... that often elevates the mechanics of a product above customer satisfaction" [Mizuno and Akao 1993]. Rather, A comprehensive QFD system "must reflect technology, reliability, and cost considerations" (see Figure 6) [Akao 1990].

The name QFD expresses its true purpose, which is satisfying customers **(Quality)** by translating their needs into a design and assuring that all organizational units

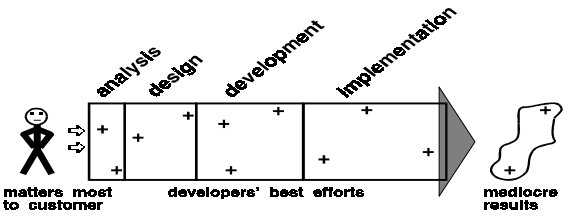

Figure 4. Incoherent Planning and Development. Traditional planning and development fails to focus best efforts. This is inherently inefficient, and dissatisfying.

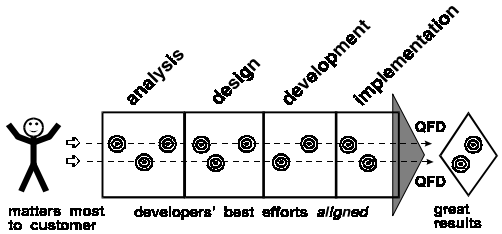

Figure 5. Coherent Planning and Development. QFD targets best efforts on value to the customer. For equivalent effort, more value is received.

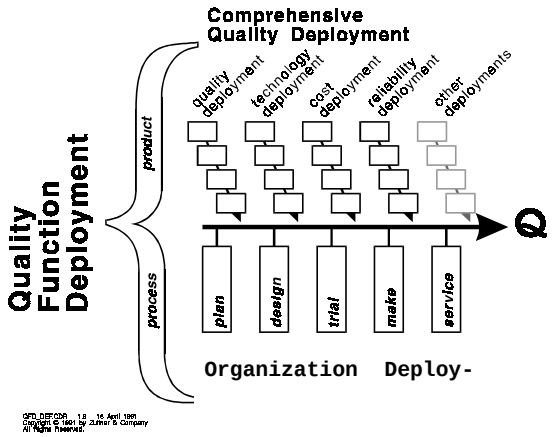

Figure 6. Comprehensive QFD is a System.
QFD systematizes the improvement of quality, technology, cost, and reliability of both the service itself and the process of planning and delivering it.

(Function) work together to systematically break down their activities into finer and finer detail that can be quantified and controlled **(Deployment)**.

The Tools of Service QFD

While traditional quality tools were developed to handle quantitative data, a new set of tools were created to handle the more qualitative language and relationships often associated with nonmanufacturing activities [Mizuno 1988, Brassard 1989, Ozeki and Asaka 1990, Mazur 1992b]. The tools aid process reengineering for improving existing services, as well.

Matrix Data Analysis Charts are used to present the results of multivariate analysis of data. Particularly for customer segmentation, techniques such as conjoint analysis, cluster analysis, factor analysis, multiple regression analysis, and other techniques are useful when substantial quantitative customer data exists. This is the most mathematically sophisticated quality tool.

Affinity Diagrams are used to surface the"deep structure" in voiced customer requirements. This right-brained tool is generally produced by the *KJ Method*™ developed by cultural anthropologist Jiro Kawakita [Kawakita 1986]. Team members can directly elicit customers natural organization of requirements. Also, makes a good first step for creating hierarchy diagrams.

Relations Diagrams also called interrelationship digraphs can be used to discover priorities, root causes of service process problems, and unvoiced customer requirements.

Hierarchy Diagrams also called tree diagrams or systematic diagrams are found throughout all QFD deployments to check for missing data, to align levels of abstraction of the data, to diagram the why/how nature of functions, and to diagram failures.

Matrices and Tables are used to examine two or more dimensions in a deployment. Common types include relationships matrix, prioritization matrices, and responsibility matrices.

Process Decision Program Diagrams (PDPC) are used to analyze potential failures of new processes and services.

The Analytic Hierarchy Process (AHP) is used to prioritize a set of requirements and to select from among many alternatives to meet those requirements. This method employs pairwise comparisons on hierarchically organized elements to produce a very accurate set of priorities [Saaty 1990, Tone and Manabe 1990].

Blueprinting is a tool used to depict and analyze all the processes involved in providing a service [George and Gibson 1991]. A variant of the diagrams used in time/motion studies.

The Deployments of Service QFD

Organization Deployment. This is used to map the QFD steps to the different organizational functions such as the President, Marketing and Planning, Development, Training, Customer Service, etc. It shows who is responsible for what activities and when during the service planning and development process. Often, it is used with a responsibility matrix to clarify organizational roles [Mizuno and Akao 1993, Nakui and Terninko 1992, Chalmers 1992]. This deployment is often ignored in the West, although ironically, in Japan it proceeded any of the matrix deployments. It is highly recommended that Organization Deployment be done before QFD is applied to a specific service, so that the necessary team players understand their respective roles, activities, and schedules. **Tools:** Flow Chart, Matrix. (See Figure 7.)

Customer Deployment. This is the deployment of organizational goals (profit, utilization rate, etc.) into core competencies (skills, location, etc.) into customer attrib-

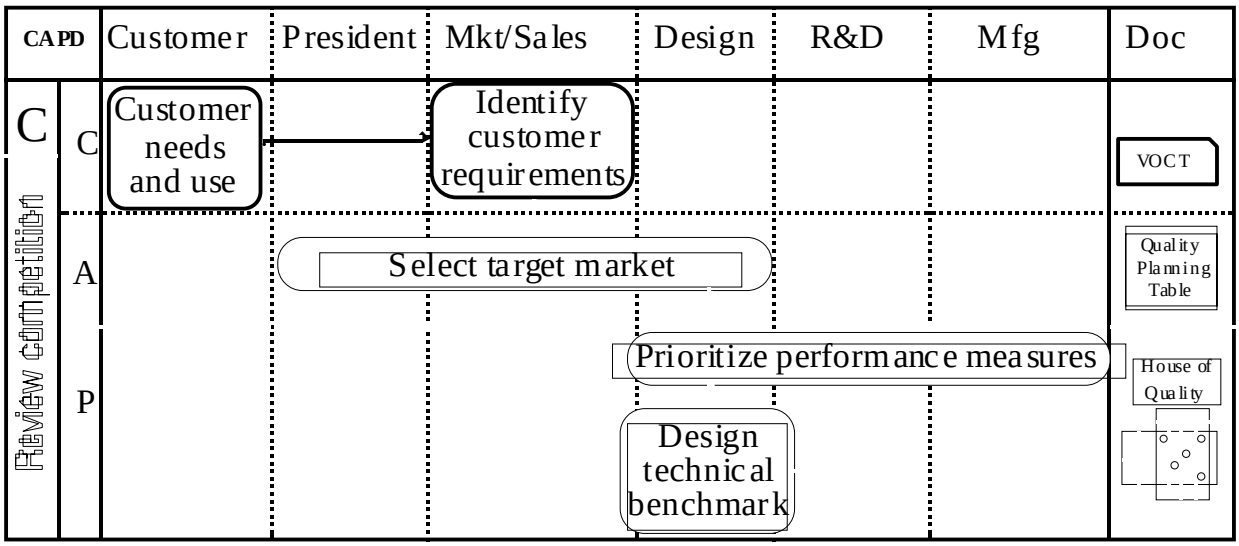

Figure 7. Organization Deployment. The Quality Design Process Chart defines organizational responsibilities as well as determining which matrices, tables, etc. get done by whom and when.

utes (high disposable income, impulse buyers, etc.) into target customer segments (Yuppies, Dinks, seniors, etc.). This helps tailor our service to the needs of those customers who can best help us achieve our goals. Unlike mass produced products, services often focus on niche markets. **Tools:** AHP, Matrix, Matrix Data Analysis Charts.

Voice of Customer Deployment. These tables are used to record raw customer data, use characteristics, and separate the different types of service attributes, such as demanded quality, consistency, reliability, safety, etc. These tables are also used to uncover unspoken customer needs such as expected and exciting requirements. **Tools:** Tables.

Quality Deployment. This is used to translate customer demanded quality and priorities into measurable service quality attributes such as accuracy, responsiveness, atmosphere, privacy, etc. Targets can then be set for these attributes so that customer satisfaction can be assured. **Tools:** Affinity Diagram, Hierarchy Tree, Prioritization Matrix, Tables, AHP.

Function Deployment. This is used to identify functional areas of the organization that are critical to performing tasks that must achieve the quality attribute targets. **Tools:** Affinity Diagram, Hierarchy Diagram (Function Tree), Relationships Matrix.

Reliability Deployment. This is used to identify and prevent failures of critical customer requirements. **Tools:** Hierarchy Diagram (Fault Tree), PDPC, Relationships Matrix.

Process Deployment. This is used to diagram the current and reengineered processes. **Tools:** Blueprinting.

New Concept Deployment. This is used in conjunction with Quality Improvement Stories (a structured problem solving approach), to select a new process which will best satisfy customer needs [King 1987, 1989, Imai 1986, Hosotani 1992, Ozeki et.al. 1990]. **Tools:** Blueprinting, Concept Selection Matrix. QI Story.

Task Deployment. This is used to break down critical jobs into tasks and steps. It identifies what the tasks and steps are, who does them, where they do them, when, how, how well (measurable standard), with what equipment, required training and skills, and personality and human relations. The task deployment table can be sorted to yield valuable information such as job descriptions, schedules, floor plans, standards, equipment and training requirements [Mizuno and Akao 1993, Mazur 1992a]. **Tools:** Blueprinting, Table.

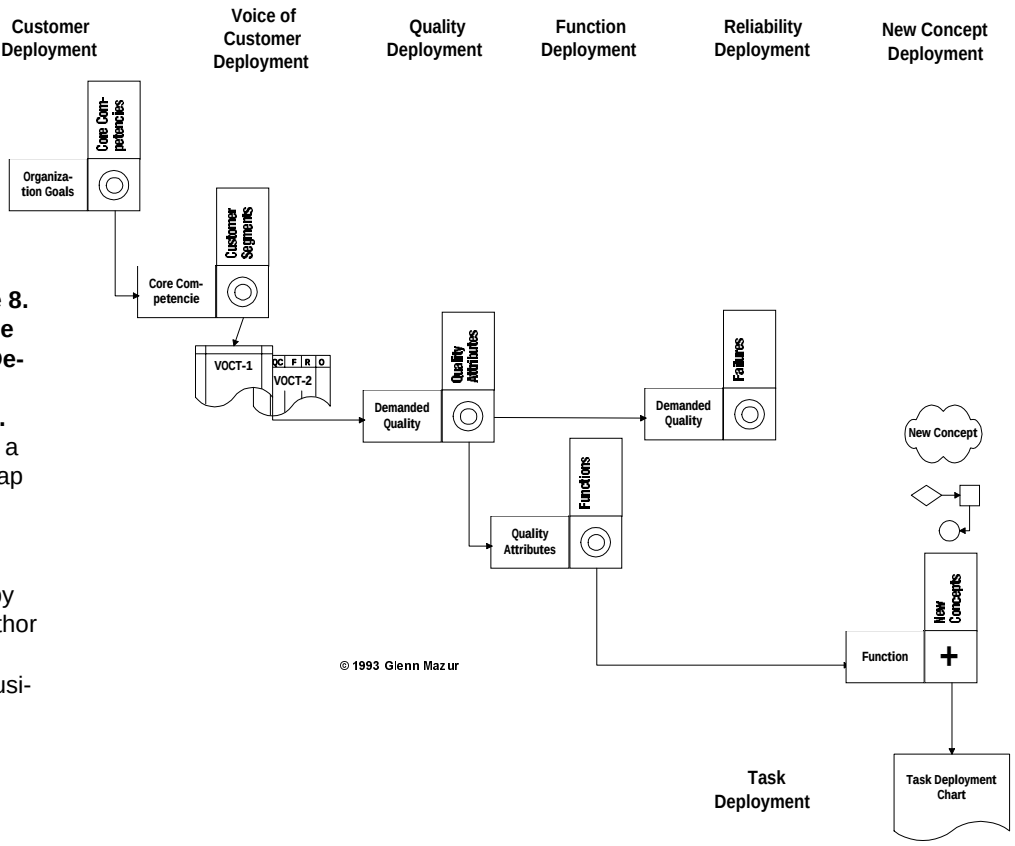

Figure 8. Service QFD Deployments. This is a roadmap of the QFD study done by the author for his own business.

Case Study: Japan Business Consultants, Ltd.

In 1982, while a part-time MBA student and a full time automotive warehouse manager, the University of Michigan asked me to participate in a Joint U.S.-Japan Automotive Studies Project as a translator and interpreter. I did this part time until my graduation in 1984. In 1985, I received an interpreting job from Ford's American Supplier Institute to work with a former Toyota quality specialist name Akira Fukuhara when he taught some obscure subject called QFD. Over the ensuing three years, I spent several weeks each year interpreting for Mr. Fukuhara as he taught this methodology to the Big Three and many of their key suppliers.

In 1986, I had the pleasure to finally meet the two men who created QFD, Drs. Mizuno and Akao. In 1987, Dr. Akao was invited by Bob King of GOAL to teach QFD in Massachusetts. Just *two weeks* before the start of a five-day seminar, after Bob asked me to translate some QFD material, Dr. Akao began faxing over a series of twelve QFD articles that contained some of the most complicated charts I had ever seen, covering a variety of industries from tractors, to construction, to software. Given the time constraints and a lack of technical knowledge of these varied industries, I knew my wife, Mayumi, and I could not do it alone. We needed more people who had the same language skills as us.

Fortunately, I had been applying QFD to my business and when this new opportunity arose, I had the tools to analyze the situation. By understanding Bob's needs, Dr. Akao's needs, and most importantly, the needs of GOAL's students, we were able to complete the translation of what eventually was republished as a 369 page book [Akao 1990]. What follows is an update of this, the first application of QFD to a service in the U.S.

Customer Deployment

In 1984, I knew the translation business was for me. But finding enough business for what was still a minor language was difficult. I needed to pursue customers that would bring success. The first step was to define success, which I will call organization goals. Since not all goals were of equal importance, it was necessary to prioritize them. Since I did not know the Analytic Hierar-

chy Process at that time, I had to guess. I will demonstrate it here (see Figure 9).

The next step was to determine which of my skills (core competencies) could be best exploited to achieve my goals. A relationships matrix was set up using my goals and their priorities as inputs in the rows and my core competencies as outputs in the columns. The ◎ ○ △ symbols indicate the strength of the relationship which is multiplied by the row weights. The resulting product is added for each column and normalized to a percentage at the bottom to yield which of my core competencies was most exploitable (see Figure 10).

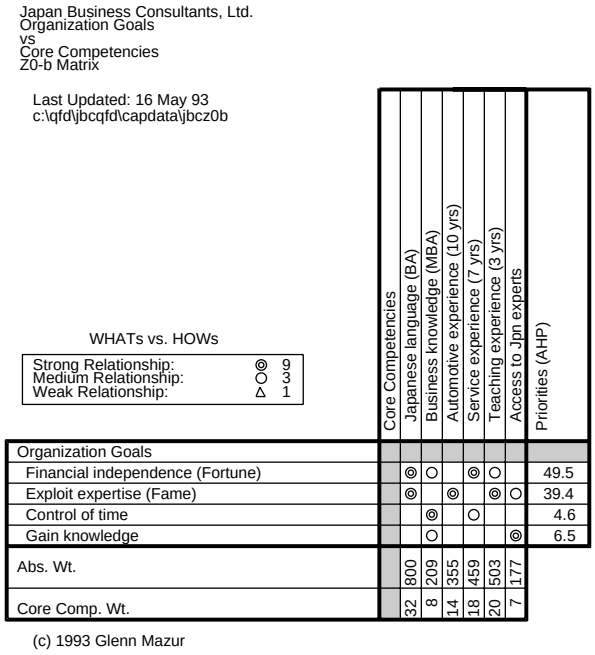

Figure 10. Organizational Goals / Core Competencies Matrix. This matrix indicates that my Japanese language and teaching skills could be the most helpful. Sounds like an interpreter's job.

Finally, I created a matrix between my now prioritized core competencies and the types of customers I could pursue (see Figure 11.) This lead me to look for business with Japanese sales people coming to the U.S. to sell to the Big Three and with experts coming to teach Japanese quality and management. In fact, this is still the mainstay of our translation business eight years later.

	FI	Ex	Tim	Ln	Normalize Columns				Sum	%
Gain financial independence (FI)	1	2	7	7	0.56	0.63	0.37	0.4	1.96	**0.49**
Exploit areas of expertise (Ex)	1/2	1	9	9	0.28	0.31	0.47	0.51	1.57	**0.39**
Control my time. (Tim)	1/7	1/9	1	1/2	0.08	0.03	0.05	0.03	0.19	**0.05**
Learn new knowledge. (Ln)	1/7	1/9	2	1	0.08	0.03	0.11	0.06	0.28	**0.07**
Totals	1.79	3.22	19	17.5	1	1	1	1	4	1

Figure 9. AHP of Organizational Goals. AHP uses pairwise comparisons and ratio scales to calculate priorities. [Saaty 1990].

Voice of Customer Deployment

Once my target customers were selected, the next step was to find out what they wanted. Having worked already with Fukuhara and Akao, it was evident they liked the US. With the GOAL seminar, it was getting the translations done on time that was most critical. These and other customer requirements needed to be ana-

lyzed for additional requirements using the Voice of Customer Tables (see Figures 12 a and b) [Ohfuji, et. al. 1990, Nakui 1991]. In VOCT Part 1, the voice "People want to hear what I have to say" is examined in terms of the use the client will have of my service. I discovered underlying requirements, "My message is accepted." and "I am asked to return often." In VOCT Part 2, the reworded data or requirements are sorted by categories that will later be used to position them in the appropriate matrix deployment. If this were not done, then our matrices would be a jumble of different data and the resulting priorities would misleading. The Voice of Customer Tables were devised to avoid this problem, which Dr. Akao lamented about earlier.

Voice of Customer	Use	Reworded Data
People want to hear what I have to say.	Salesmen, teachers coming to do business.	My message is accepted. I am asked to return often.
Work done in 2 weeks.	Teaching class.	Work done in 2 weeks.

Figure 12a. Voice of Customer Table - Part 1 (partial).

Demanded Quality	Quality Attributes	Function / Task
My message is accepted.		
I build ongoing relationships. ←	Return often.	
My deadlines are met. ←	Done in 2 weeks. ←	Do work.

Figure 12b. Voice of Customer Table - Part 2 (partial).

Japan Business Consultants, Ltd.
Core Competencies
vs
Customer Segments

Date: 16 May 93
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WHATs vs. HOWs

Strong Relationship: ◎ 9
Medium Relationship: ○ 3
Weak Relationship: △ 1

Core Competencies	Customer Segments	Automotive industry	Exporters	Management consultants	Translation agencies	Government	Japanese in U.S.	Core Comp. Wt.
Japanese language (BA)		○	○		◎		◎	32
Business knowledge (MBA)			○	◎			○	8
Automotive experience (10 yrs)		◎	△		○		○	14
Service experience (7 yrs)					○	○	△	18
Teaching experience (3 yrs)				◎			○	20
Access to Jpn experts		◎		◎				7
Abs. Wt.		287	135	320	385	55	434	
Cust. Seg. Wt.		18	8	20	24	3	27	

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Figure 11. Core Competencies / Customer Segments. Pursue Japanese coming to the U.S.

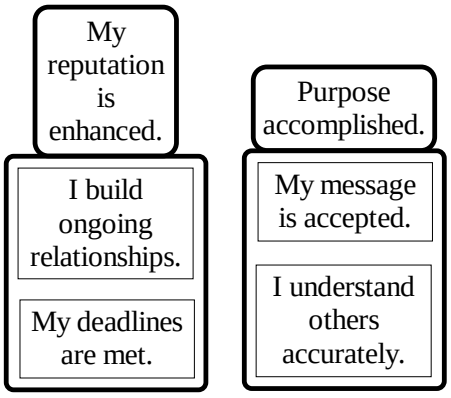

Figure 13. Affinity Diagram for Demanded Quality.

When using Part 2, we should look for additional demanded quality items for use in our next deployment. Demanded quality items are the imprecise words that describe what it takes to satisfy the customer. Quality attributes are the measurable aspects of a service like frequency, turnaround time, etc. When we encounter these, we should ask "Why is this important to the customer?" Here, I found that my clients wanted to build ongoing relationships (in italics) and that deadlines were met (in italics).

All the demanded qualities were then grouped using the Affinity Diagram (see Figure 13). The hierarchy tree is not shown. The demanded qualities became the input

Translation Service
Demanded Quality
vs
Quality Attributes
(House of Quality)

Date: 02 Jun 93
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WHATs vs. HOWs

Strong Relationship:	◎	9
Medium Relationship:	○	3
Weak Relationship:	△	1

	Time	Turnaround time	Availability	On-time rate	Return visit rate	Repetition of message	Expertise	Subject matter expertise	Social expertise	Language expertise	Importance Rating	Current Service	Competitor S	Competitor U	Target	Improvement Ratio	Sales Point	Absolute Wt.	Demanded Quality Wt.
My reputation is enhanced.																			
I build ongoing relationships.			○	○	◎				◎	△	3	3	2	4	4	1.33	1.2	4.8	26
My deadlines are met.		◎	◎	◎							5	3	2	3	5	1.67	1.2	10.0	53
Purpose accomplished.																			
My message is accepted.					○	◎		○	△	◎	2	4	2	3	4	1.00	1.0	2.0	11
I understand others accurately.			○			○		◎	△	◎	2	3	2	3	3	1.00	1.0	2.0	11
Absolute Weight		479	587	555	262	128		128	251	217									
Quality Attribute Wt.		18	23	21	10	5		5	10	8									
Our Current Performance		10	10	90	2	3		3	75	10									
Competitor S		6	8	75	1	1		0	33	8									
Competitor U		9	8	90	5	2		3	50	10									
Target		20	24	100	7	3		3	75	11									
Unit of Measurement		Pg/day	Hrs/day	%	# Visits	#Repeats		#Courses	%Customs	FleschGr									

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Figure 14. The House of Quality.
The House of Quality consists of the Demanded Qualities, the Quality Planning Table, the Service Quality Attributes, the relationships matrix that transfers the Demanded Quality Weights into Service Quality Attribute Weights. At the bottom is a quantitative comparison of these attributes for my company and two of my competitors. Targets are set to exceed my competitors for the most highly weighted attributes (most critical).

rows to what is called the "House of Quality" matrix, so named by Mr. Sawada of Toyota Auto Body for its many rooms and occasional roof (see Figure 14).

The rightmost room of the House of Quality is called the Quality Planning Table. It is here that customer priorities, competitive assessments, and company objectives are factored in to produce an overall weight. The Importance rating column is a scale of 1-5 with 5 being most important to the customer. Based on my discussions with clients, meeting deadlines was far and away the most important quality requirement for a translation service. Conventional wisdom might suggest that accuracy, no mistakes, would be the most important. Sure enough, it is. In QFD, however, no mistakes is one of those expected requirements; we call this reliability, and as Figure 8 shows, it will have a deployment all to itself. Were we to include reliability and other expected requirements in the House of Quality, they would overpower all the satisfying and exciting requirements during the prioritization process. The result would be a service that had nothing wrong but not necessarily anything right.

The next three columns in the Quality Planning Table compare my existing service with my competitors. For "deadlines," given the GOAL project I was facing, no one would be good enough. Still, since this was the most critical demanded quality, I chose to set a target of 5, the best, on the same scale as before. Dividing where I want to be (5) by where I was (3), I calculated an Improvement ratio of 1.67. The Sales Point is another weighting factor that reflects the direction that the organization wants to head. I chose a medium value of 1.2. The absolute weight was calculated by multiplying the Importance Rating x the Improvement Ratio x the Sales Point (5x1.67x1.2 = 10.0) The absolute weights for all the Demanded Qualities were summed and each one divided into the sum and multiplied by 100 to yield a percentage, which is called the Demanded Quality Weight.

This number represents the priority of each Demanded Quality based on **C**ustomer need, **C**ompetitive performance, and the objectives of the **C**ompany. I call these the 3 Cs. These weights tell us not to concentrate on things that don't matter much to customers or where we are already ahead of the competition. They focus us on areas where we are not meeting customer needs and where our competition is better. This is one of the efficiencies of QFD - put your efforts where they will have the greatest impact on the customer.

The next step is to translate the Demanded Quality items into measurable Service quality Attributes. In QFD, assuring quality is a main objective and unless something is measurable, it cannot be assured. Demanded Quality items cannot be measured directly. For example, how would you measure "My message is accepted?" We have no gauge for acceptability. We must find a substitute that is measurable, "Return Visit Rate," for example. We call these substitutes Service Quality Attributes. Common ones are volume, convenience, responsiveness, efficiency, privacy, etc. [Brown 1991].

The Service Quality Attributes are also grouped with an Affinity Diagram and Hierarchy Tree (not shown) and are entered in the columns of the House of Quality. I then examined each Demanded Quality to see which Quality Attributes could help me measure it. If a relationship existed, I noted the strength of the relationship

with a symbol, ◎ for strong, ○ for medium, and △ for weak. As in Figure 10, the Demanded Quality Weights were multiplied by a value for the symbols (9, 3, 1) and the products (not shown due to software representation) were summed to give the absolute weight at the bottom of the House of Quality. These were then normalized to give the Quality Attribute Weights.

I then compared my measurable performance level for the most critical attributes with my competitors, as best as I could measure based on what clients told me. The most critical areas dealt with the time I could be available to translate this mammoth project. Since the maximize time was two weeks, I set a daily target of working 24 hours a day. Right away, my wife pointed out a problem! I encountered what is called a technical bottleneck. To solve this bottleneck required further deployment and analysis.

Function Deployment

I looked at the functions that I currently performed and that I would need to perform to satisfy my clients. I used a fishbone diagram (no sub-bones) with the Demanded Quality as the head and functions as the bones. For "My deadlines are met" functions such as "Manage Communications" and "Output data" were determined. These were organized into a function tree. A second matrix was created with the Quality Attributes, their priorities and targets from the House of Quality as the input rows and the function tree as the output columns

(see Figure 15). Relationships were analyzed and the priorities transferred as in the House of Quality.

The most critical function was “Translate written information” and the Quality Attribute Target of 24 hours per day was translated into a function target of *n* words per hour per person. I examined our current translating process of each person working on a project by themselves and realized that it was not possible to reach our target of *n* with this method. Before changing the process, I wanted to clarify possible failures so I could avoid them in the process reengineering. I created a matrix with Demanded Quality items as input rows and potential failures as output columns (see Figure 16). This revealed that lateness and mistakes were critical failures. This caused me to consider an extra edit step in any new process I might try.

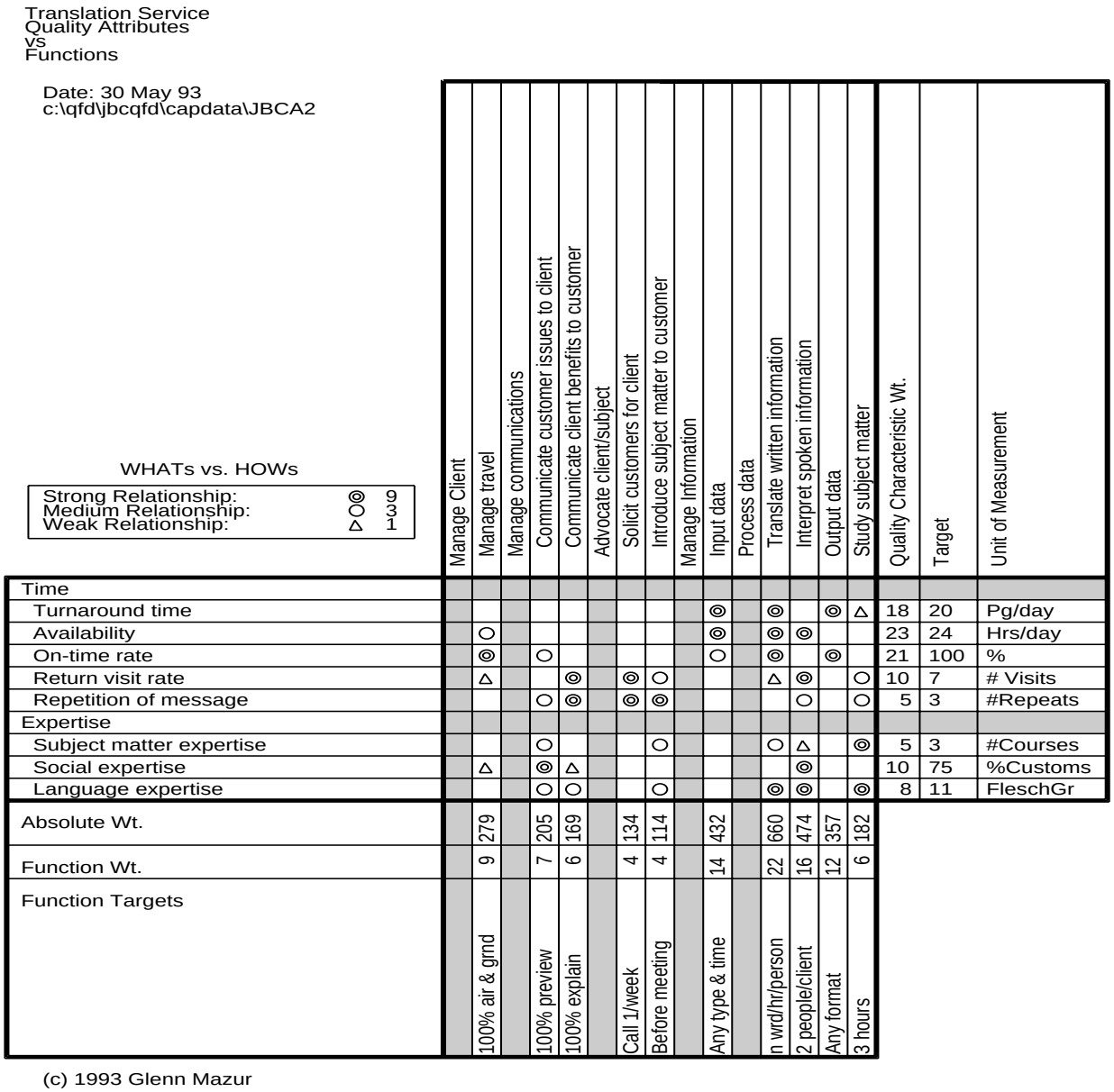

Figure 15. Service Quality Attributes / Function Matrix.
This matrix transfers Quality Attribute priorities and targets into Function priorities and targets.

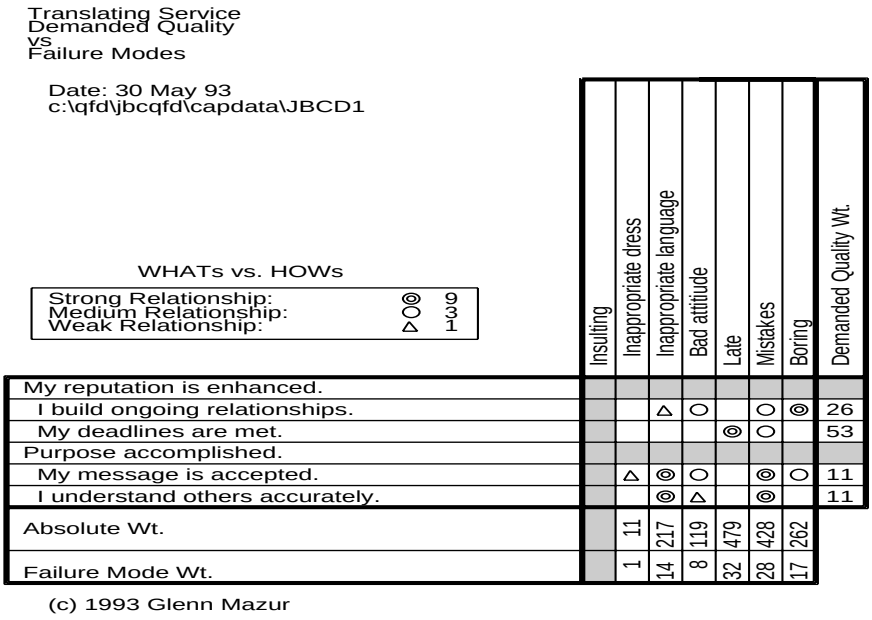

Figure 16. Demanded Quality / Failure Modes Matrix.

New Concept Deployment

Keeping in mind my potential failure modes, I began experimenting with using multiple people on a team, new technology like transcribers, machine translation, remote translators linked by fax and modem, etc. I created a New Concept Matrix with the key functions, priorities and targets as the row inputs and the new concepts as the column outputs, based on work done by Bob King and modeled after Stuart Pugh. (see Figure 17) [King 1987, 1989]. The + mean better than the current method, - means worse, and S means the same. I then selected the best process that would perform the functions at their targets, was least costly, and least prone to errors. This was Concept 2 which used "new" technology: a transcriber so I could dictate the editing for a more natural sounding English.

Key Function	Wt	Target	Current	Concept 1	Concept 2
Translate	22	*n* w/h/p		S	+
Interpret	16	2/p/c		S	S
Input Data	14	Any		S	+
Sum Wt. +				**S**	**36**

Figure 17. Key Function / New Concept Matrix.

Task Deployment

The final step was to outline the necessary tasks, who would do what, when, where, how much, etc. Figure 18 is a portion of that. Though not required here, the Task Deployment Chart can be sorted by its categories as follows to create other useful documents.

What	Process Flow
Who	Job Description
When	Schedule
Where	Floor Plan
How	Equipment List Training/Skill Requirements Personality Requirements

Conclusion

The job was done in two weeks. Dr. Akao was impressed because we actually completed the English work before the final Japanese monthly issue was out. Japan Business Consultants has continued to grow in both revenues and the number of quality materials it handles. In fact, most of the source documents for Hoshin Kanri, TQM, Daily Management, QFD, Kansei Engineering and others have been translated by us via this process.

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My greatest appreciation goes to my teachers Dr.Yoji Akao and the late Dr. Shigeru Mizuno. Special thanks to Professors Tadashi Ohfuji and Michiteru Ono for their constant work in updating QFD. Thanks to Mr. Akira Fukuhara, Bob King, and Larry Sullivan for their work in bringing QFD to America. And thanks to my associates Stan Marsh, Michael Brassard, and Cha Nakui of GOAL/QPC and John Terninko and Richard Zultner for their help and encouragement. Mr. Zultner has been most gracious in allowing me to adapt several passages from his works in this paper

References

Akao, Yoji. 1983. *Company-Wide QC and Quality Deployment.* Chicago, IL: The Cambridge Corporation.

Akao, Yoji, ed. 1990. *Quality Function Deployment: Integrating Customer Requirements into Product*

What	Who	When	How	How Much	Why
Divide work	Glenn	At start of project		per # translators	to assure even flow and work given where translator competent with subject matter
Translate	Translators (incl. Glenn & Mayumi)	14 hours/day	computer or by hand	*n* word/hour	to assure completion in 2 weeks
Type	Typist	as material available	computer	150 wpm	to type handwritten work
Edit	Glenn	as typed	using transcriber	4 hours/day	to assure natural sounding English
Retype	Typist	as transcribed	using transcriber	2 hours/day	to create final version
Send out	Mayumi	daily	fax	as available	so GOAL could do artwork

Figure 18. Task Deployment Chart.

Design. Translated by Glenn Mazur. Cambridge, MA: Productivity Press. ISBN 0-915299-41-0

Akao, Yoji, ed. 1990. *Introduction to Quality Deployment.* (In Japanese) Tokyo, Japan: JUSE. ISBN 4-8171-0257-8

Akao, Yoji, ed. 1991. *Hoshin Kanri: Policy Deployment for Successful TQM.* Translated by Glenn Mazur. Cambridge, MA: Productivity Press. ISBN 0-915299-57-7

Akao, Yoji and Michiteru Ono. 1993. "Recent Developments in Cost Deployment and QFD in Japan," EOQ '93, Helsinki Finland.

Brassard, Michael. 1989. *The Memory Jogger Plus.* Methuen, MA: GOAL/QPC. ISBN 1-879364-02-6

Brown, S.W., E. Gummesson, B. Edvardsson, and B. Gustavsson. 1991. *Service Quality: Multidisciplinary and Multinational Perspectives.* Lexington, MA: Lexington Books. ISBN 0-669-21152-4

Chalmers, Stuart. 1992. "Integration of Quality Assurance into Business Functions." *Transactions from the Fourth Symposium on Quality Function Deployment.* Novi, MI.

Gaucher, Ellen, T. Daly, J. Walker, and V. Walter. 1991. "Quality Function Deployment Process: Experiences in an Ambulatory Care Service." *Proceedings from the GOAL/QPC Eighth Annual Confere*nce. Boston, MA: GOAL/QPC.

George, William R. and Barbara E. Gibson. 1991. "Blueprinting: A Tool for Managing Quality in Service." Brown, S.W., E. Gummesson, B. Edvardsson, and B. Gustavsson. 1991. *Service Quality: Multidisciplinary and Multinational Perspectives.* Lexington, MA: Lexington Books. pp. 73-91. ISBN 0-669-21152-4

GOAL/QPC. 1992. *Comprehensive Quality Function Deployment.* Methuen, MA: GOAL/QPC.

GOAL/QPC. 1991. *Basic Quality Function Deployment.* Methuen, MA: GOAL/QPC.

Hauser, John R. and Don Clausing. 1988. "The House of Quality." *Harvard Business Review* 66, no. 3 (May-June): 63-73.

Hoffmeister, Kurt and Bill Slabey. 1992. "QFD Primer - Excerpts from the QFD Course Manual." *Transactions from the Fourth Symposium on Quality Function Deployment.* Novi, MI.

Hosotani, Katsuya. 1992. *Japanese Quality Concepts: An Overview.* Translated by Glenn Mazur. White Plains, NY: Quality Resources. ISBN 0-527-91651-X

Imai, Masaaki. 1986. *Kaizen.* New York: McGraw-Hill. ISBN 0-07-554332-X

Kaneko, Noriharu. 1992. "QFD Applied in a Restaurant and Hotel Chain." *Transactions of the 1st European Conference on Quality Function Deployment.* Milan, Italy.

Kaneko, Noriharu. 1991. (In Japanese) "Using QFD in a Service Industry." *Transactions of the First (Japanese) Symposium on Quality Function Deployment.* Tokyo, Japan: JUSE.

Kaneko, Noriharu. 1990a "Quality Assurance in Service Industries." *ASQC Congress Transactions.* San Francisco, CA: American Society for Quality Control.

Kaneko, Noriharu. 1990b. "QFD at a Supermarket." *Case Studies.* Austin, TX: Kaizen Institute of America 3-day Public Seminar.

Kano, Noriaki, Nobuhiko Seraku, Fumio Takahashi, and Shinichi Tsuji. 1984. "Attractive Quality and Must-Be Quality." Translated by Glenn Mazur. *Hinshitsu* 14, no. 2. (February): 39-48. Tokyo: Japan Society for Quality Control.

Kawakita, Jiro. 1986. (In Japanese) *The KJ Method: Seeking Order Out of Chaos.* Tokyo: Chuokoronsha. ISBN 4-12-001517-3

King, Bob. 1987, 1989. *Better Designs in Half the Time: Implementing QFD Quality Function Deployment in America.* Methuen, MA: GOAL/QPC.

Love, John F. 1986. *McDonald's: Behind the Arches.* Toronto: Bantam Books. ISBN 0-553-05127-X

Marsh, S., J.W. Moran, S. Nakui, and G. Hoffherr. 1991. *Facilitating and Training in Quality function Deployment.* Methuen, MA: GOAL/QPC. ISBN 1-879364-18-2

Mazur, Glenn. 1993a. *Basics of Service Quality Function Deployment.* Ann Arbor, MI: Japan Business Consultants, Ltd.

Mazur, Glenn. 1993b. "Using QFD for a Medical Device," *Proceedings of the Sixth Annual IEEE Computer-Based Medical Systems Symposium,* Ann Arbor, MI.

Mazur, Glenn. 1992a. "Task Deployment for Service QFD and the Americans With Disabilities Act," *Proceedings from the GOAL/QPC Ninth Annual Conference*, Boston, MA.

Mazur, Glenn. 1992b. "The Seven Management and Planning Tools and QFD," *Annual Review of Communications,* National Engineering Consortium, Vol. 46, 1992-93, pp. 804-811.

Mazur, Glenn. 1992c. "Voice of the Customer Table," *Transactions from the Fourth Symposium on Quality Function Deployment*, Novi, MI.

Mazur, Glenn. 1992d. *Basics of Quality Function Deployment.* Ann Arbor, MI: Japan Business Consultants, Ltd.

Mazur, Glenn. 1991a. "Voice of Customer Analysis," *Proceedings from the GOAL/QPC Eighth Annual Conference*, Boston.

Mazur, Glenn. 1991b. "Sensory QFD: Matching Product Image to Customer Image Using *Kansei* Engineering," *Proceedings from the GOAL/QPC Eight Annual Conference*, Boston, MA.

Mazur, Glenn. 1991c. "Quality Function Deployment: Should You Really Function Without It?" *The Quality Management Forum,* ASQC, Vol. 17, no. 3.

Mazur, Glenn. 1991d. "QFD - The House of Quality: Practicing What We Preach," *OMNEX News,* Ann Arbor, MI, Fall, 1991.

Mazur, Glenn. 1991d. "Getting Started with Quality Function Deployment," *OMNEX News,* Ann Arbor, MI, Summer, 1991.

Mazur, Glenn. 1991e. "Voice of the Customer Analysis and Other Recent QFD Technology," *Transactions from the Third Symposium on Quality Function Deployment*, Novi, MI, June, 1991.

Mizuno, Shigeru and Yoji Akao, ed. 1993. *Quality Function Deployment, Rev. Edition.* Translated by Glenn Mazur. Quality Resources.

Mizuno, Shigeru, ed. 1988. *Management for Quality Improvement: The 7 New QC Tools.* Cambridge, MA: Productivity Press. ISBN 0-915299-29-1

Nagasawa, Shinya. 1993. "Analysis and Evaluation of *Kansei:* Fuzzy Integrals." (In Japanese) *Hinshitsu Kanri*. Tokyo: JUSE, Vol. 44 No. 3. March, 1993.

Nakui, Satoshi and John Terninko. 1992. "A Road Map to a Better Product Design Process: Structuring a Quality Design Process Chart (QDPC)." *Proceedings from the GOAL/QPC Ninth Annual Conference.* Methuen, MA: GOAL/QPC.

Nakui, Satoshi. 1992. "Gaining a Strategic Advantage: Implementing Proactive Quality Function Deployment." *Transactions from the Fourth Symposium on Quality Function Deployment.* Novi, MI.

Nakui, Satoshi. 1991. "Comprehensive QFD System." *Transactions from the Third Symposium on Quality Function Deployment.* Novi, MI.

Nakui, Satoshi and Yoji Akao. 1990a. "Determining Demanded Quality Through Questionnaires." Tone, K. and R. Manabe, ed. (In Japanese) *Case Studies in AHP*. Tokyo: JUSE Press. pp. 136-145. ISBN 4-8171-5016-5

Nakui, Satoshi and Yoji Akao. 1990b. "Function Deployment Applied to Manufactured Housing." Tone, K. and R. Manabe, ed. (In Japanese) *Case Studies in AHP*. Tokyo: JUSE Press. pp. 145-159. ISBN 4-8171-5016-5

Nishihara, Ryoji, Chiyokatsu Yokogura, Kageo Yamaguchi. 1991. "Research on Image Deployment in QFD for New Product Development." (in Japanese). *Transactions from the First Japan QFD Symposium.* Tokyo: JUSE.

Ohfuji, Tadashi. 1993. "Analysis and Evaluation of *Kansei:* AHP - Subjective Evaluation Method for Verbal Data," *Hinshitsu Kanri.* Tokyo: JUSE. Vol. 44. No. 2. Feb. 1993.

Ohfuji, Tadashi, Michiteru Ono, and Yoji Akao. 1990. (in Japanese) *Quality Deployment Methods: Procedures and Practices for Making Quality Charts.* Tokyo: Union of Japanese Scientists and Engineers. ISBN 4-8171-0258-6

Ozeki, Kazuo, and Tetsuichi Asaka. 1990. *Handbook of Quality Tools: The Japanese Approach.* Cambridge, MA: Productivity Press. ISBN 0-915299-45-3

Porter, Michael E. 1985. *Competitive Advantage: Creating and Sustaining Superior Performance.* New York: The Free Press. ISBN 0-02-925090-0

Peters, Tom. 1992. *Liberation Management: Necessary Disorganization for the Nanosecond Nineties.* New York: Alfred A. Knopf. ISBN 0-394-55999-1

"Quality System Implementation at Florida Power & Light Company." Presented to Professor Yoji Akao, March 28, 1988.

Saaty, Thomas L. 1990. *Decision Making for Leaders: The Analytic Hierarchy Process for Decisions in a Complex World.* rev. 2nd ed. Pittsburg:RWS Publications. ISBN 0-9620317-0-4

Shiino, Jun et al. 1992. "Research on Image QFD for New Product Development." (in Japanese) *Transactions from the Second Japan QFD Symposium.* 4th Annual QFD JUSE Research Committee.

Tone, K. and R. Manabe, ed. (In Japanese) *Case Studies in AHP*. Tokyo: JUSE Press. ISBN 4-8171-5016-5

Webb, Joseph L. and W. C. Hayes. 1990. "Quality Function Deployment at FPL." *Transactions from the Second Symposium on Quality Function Deployment, Novi, MI.*

Zemke, Ron and Dick Schaaf. 1989. *The Service Edge: 101 Companies That Profit from Customer Care.* New York: Plume Books. ISBN 0-452-26493-6

Zultner, Richard E., 1992. "Quality Function Deployment (QFD) for Software: Satisfying Customers." *American Programmer*. Feb. 1992.

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Glenn H. Mazur has been active in QFD since its inception in North America, and has worked extensively with the founders of QFD on their teaching and consulting visits from Japan. His primary focus is in the service industry, as a manager for over 15 years in automobile repair and parts warehousing, as a teacher, and as an owner of a translating and consulting business he started in 1982. He is one of North America's leaders in the application of QFD to service industries, sits on several advanced QFD research committees, and sits on the steering committee of the Symposium on Quality Function Deployment held annually in Detroit. He is also Executive Director of the non-profit QFD Institute and an Adjunct Lecturer of Total Quality Management at the University of Michigan College of Engineering. He lectures and trains in QFD around the world.

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Japan Business Consultants, Ltd. provides consulting and training in Service TQM and Service QFD to organizations in distribution, education, personnel, finance, healthcare, repair, retail and other industries. They also specialize in locating and translating publications on leading edge Japanese quality and management systems.