

## VOICE OF CUSTOMER ANALYSIS: A MODERN SYSTEM OF FRONT-END QFD TOOLS, WITH CASE STUDIES

### SUMMARY

Quality Function Deployment (QFD) has been used world-wide since 1966 (Mizuno and Akao 1994) by organizations to bring new products to market faster, better, and cheaper. The earliest QFD models focused on assuring quality in the factory so that production processes would deliver goods as designed. As early QFD adopters became proficient with the methodology, their improvement focus moved upstream in order to improve the quality of the designs themselves. In recent years, QFD has continued this upstream move towards improving the quality of understanding the customers' requirements that drive the design. The latest tools and techniques, called Voice of Customer analysis, are the subject of this paper. Here, they will be introduced, the steps explained, and case studies given to illustrate their power, in the hope that readers will be able to use these tools and techniques to enhance their own QFD and new product development processes.

### INTRODUCTION

What is Quality Function Deployment? Basically, QFD is designed to improve customer satisfaction with the quality of our products and services. What can QFD do that is not already being done by traditional quality systems? To understand QFD, it is helpful to contrast the differences between modern and traditional quality systems.

### TRADITIONAL QUALITY SYSTEMS

Traditional approaches to assuring quality often focus on work standards (Love 1986), automation to eliminate human error-prone processes, and in more enlightened organizations, Quality Improvement Teams to empower employees to resolve problems.

As organizations are finding out, however, consistency and absence of problems are not enough of a competitive advantage after the market shakes out suboptimal players. 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. Suboptimal makers have all but disappeared from the North American market, the fit and finish of today's North American built vehicles are better than ever, but still the Japanese makes of Toyota, Nissan, and Honda grab top honors.

**Nothing Wrong  $\neq$  Anything Right**

#### MODERN QUALITY SYSTEMS

QFD is quite different from traditional quality systems which aim at minimizing negative quality (such as poor service, broken product). With traditional systems, the best you can get is *nothing wrong* - which is no longer good enough. In addition to eliminating negative quality, we must also maximize positive quality (such as convenience, ease of use). This creates **value** which leads to customer satisfaction.

Quality Function Deployment 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 repeat business. QFD focuses on delivering value by seeking out both spoken and unspoken needs, translating these into actions and designs, and communicating these throughout the organization. Further, QFD allows customers to prioritize their requirements, benchmark us against our competitors, and then direct us to optimize those aspects of our product and organization that will bring the greatest competitive advantage. What business can afford to waste limited financial, time and human resources on things customers don't want or where we are already the clear leader?

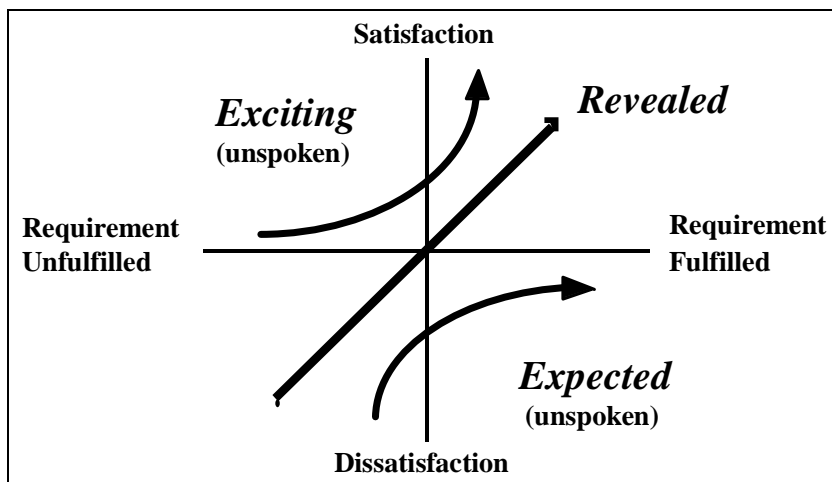
#### TYPES OF REQUIREMENTS

To satisfy customers, we must understand how meeting their requirements effects satisfaction. There are three types of customer requirements to consider (see Figure 1) (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 product or service. Fast delivery would be a good example. The faster (or slower) the delivery, the more they like (or dislike) it.

*Expected Requirements* are often so basic the customer may fail to mention them - until we fail to perform them. They are basic expectations without which the product or 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 coffee is served hot, customers barely notice it. If it's cold or too hot, dissatisfaction occurs. 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 caviar and champagne were served on a flight from Detroit to Chicago, that would be exciting. If not, customers would hardly complain. These are the things that wow the customers and bring them back. Since customers are not apt to voice these requirements, it is the responsibility of the organization to explore customer problems and opportunities to uncover such unspoken items.



**Figure 1. Kano Model (adapted).** Products and services must meet all three types of requirements - not just what the customer says.

Kano's model is also dynamic in that what excites us today is expected tomorrow. That is, once introduced, the exciting feature will soon be imitated by the competition and customers will come to expect it from everybody. An example would be the ability to have pizza delivered in thirty minutes. On the other hand, expected

requirements can become exciting after a real or potential failure. An example might be when the passengers applaud after a pilot safely lands the airplane in rough and stormy weather.

The Kano Model has an additional dimension regarding which customer segments the target market includes. For example, the caviar and champagne that's exciting on the domestic flight might be expected on the Concorde from New York to London. Knowing which customer segments you want to serve is critical to understanding their requirements.

Thus, eliminating problems is similar to meeting 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.

In summary, Kano found that the exciting needs, which are most tied to adding value, are unspoken and thus invisible to both the customer and the producer. Further, they change over time, technology, market segment, etc. The Voice of Customer analysis tools and techniques were created to break through this dilemma.

#### GEMBA: THE SOURCE OF VOICE OF CUSTOMER DATA

The Japanese have coined a word to describe the *true* source of information - the call it the *gemba*. The *gemba* is where the product or service becomes of value to the customer, that is, where the product actually gets used. It is in the *gemba* that we actually see who our customers are, what their problems are, how the product will be used by them, etc. We go the *gemba* in QFD to see our customer's problems and opportunities as they happen. Unlike other customer information gathering techniques, such as focus groups, we do not ask questions about our problems with technology or marketing, we are not removed to an artificial site such as a meeting room (unless our product is tables and chairs), and we are not relying on customers' memories to report problems to us. Rather, we can employ all of our senses to work for us by using contextual inquiry, video taping, audio taping, direct observation, direct interviewing with customer's employees, etc. for the larger purpose of trying to understand how we can help our customers better conduct their business with *their* customers.



Going to the *gemba* requires planning. While paying customer visits is not

new, books (McQuarrie 1993) on the subject are often long on advice and short on tools and techniques to maximize the value of such visits. QFD, as a quality based methodology, brings several tools together from the Seven Quality Control Tools (Brassard and Ritter 1994, JUSE 1991), the Seven Management and Planning Tools (Brassard and Ritter 1994, Mizuno 1988, Nayatani et al 1994), the Seven Product Planning Tools (Gustafsson 1996, Kanda 1994, Kanda 1995), and several specialized tools as will be described herein. A customer visit planning guide for using these tools developed by Mazur (1995) to assist those going to the gemba. Issues that should be dealt with in advance are summarized in Table 1 below.

**Table 1. Planning to go to Gemba.**

<b>Which</b>	<b>Who</b>	<b>When</b>	<b>Where</b>	<b>What</b>	<b>How</b>
customers to visit?	from your company should go?	is the customer using your product?	is the customer using your product?	information do you need?	will data be captured?
employees at the customer?	has what roles?			problems/opportunities are customers facing?	will data be analyzed?

The tools and techniques will be presented here with examples from real products and services, although in some cases, products still under development with which the author has non-disclosable knowledge will be disguised. The tools will be presented in the most common order of use, although customization for specific projects is encouraged. They are organized into a table that describes the task at hand, the tool, what the tool does, step-by-step instructions for using the tool, and a case study. Since these tools are meant to be used by the reader, this quick look-up chart format seemed eminently more logical than pages of prose describing the same thing.

#### HOW MANY GEMBAS

In a study reported by Pouliot (1992), about 70% of customer requirements were captured in as few as ten to twelve gemba visits. Additional visits yielded little more than repetitious data. Since the purpose of the gemba visit is to get an understanding of customer voices, not a statistically valid sample from which to determine

preferences and choice (this is done later in the QFD process in the Quality Planning Table), it takes much less effort than other quantitative research methods. It has been the author's experience that fifteen gemba visits are sufficient to elicit nearly all revealed requirements (the 70%) and that the other 30% which represent the unspoken expected and exciting requirements can be analyzed with the Voice of Customer tools and techniques explained in this paper.

Since the number of customers visits is small, it is best to optimize them by focusing on customers who are significant to the success of the project. The Chart of Tools begins at this point with Task No. 1.

Task		Tool		Purpose		Step-by-step Instructions		Case Study	
<p><b>1. Define and prioritize project success criteria.</b></p> <ul style="list-style-type: none"> <li>This aligns to same goals, team members who work for different functional bosses.</li> <li>Develop selection criteria for determining to which gemba to go.</li> </ul>	<p><b>Brainstorming</b> (Brassard and Ritter 1994)</p>	<p>Quickly generate ideas in a process that promotes discussion without criticism.</p>	<ol style="list-style-type: none"> <li>Define goal (not action) statements with clear measurable targets, measurement method, and deadline.</li> <li>Common goals are profit, ROI, market share, utilization of capacity, time to market, etc.</li> </ol>	<p>Increase customer satisfaction as measured by J.D. Powers and Associates from 13<sup>th</sup> place to 5<sup>th</sup> place by 2000.</p>					
	<p><b>Affinity Diagram</b> (Brassard and Ritter 1994, Mizuno 1988, Nayatani et al 1994)</p>	<p>Reveal underlying structure of ideas. Rather than pre-determine categories and slot ideas into them, this allows ideas themselves to form natural groupings.</p>	<ol style="list-style-type: none"> <li>Write each criterion on a Post-It<sup>TM</sup> Note.</li> <li>Arrange silently into clusters based on a shared affinity</li> <li>Discuss header cards to represent each cluster. Grouping groups is permitted.</li> </ol>	<p>(Lampa and Mazur 1996)</p>	<p>Host Phoenix QFD Bakery Project</p>				
	<p><b>Hierarchy Diagram (Tree)</b> (Brassard and Ritter 1994, Mizuno 1988, Nayatani et al 1994)</p>	<p>To refine Affinity Diagram groupings in terms of overlap between levels of abstraction, and to identify missing ideas.</p>	<ol style="list-style-type: none"> <li>Lay Affinity Diagram out left to right with most abstract level to the left.</li> <li>Adjust hierarchy nodes so that they represent same degree of abstraction at each level. Nodes at each level should be mutually exclusive.</li> <li>For each node, review leaves and add any missing items. For each node, leaves should represent collectively exhaustive set.</li> </ol>	<p>(Lampa and Mazur 1996)</p>	<p>Host Phoenix QFD Bakery Project</p>				





Task		Tool	Purpose	Step-by-step Instructions					Case Study													
<p>2. Define and apply selection criteria to key market segments.</p> <ul style="list-style-type: none"> <li>QFD team can define both current and unknown potential markets.</li> <li>Team can identify most promising customer segments.</li> <li>Team can apply limited resources</li> </ul>		<p>Customer Segmentation Table. (Daetz et al 1995 Ch. 9, Mazur and Zultner 1996)</p>	<p>QFD team can quickly identify both use and demographic data about potential customer segments, and then quickly identify most important segments.</p>	<p>1. Create a table with 5W1H column headers of who will use product/service, what will they use it for, when will they use it, where will they use it, why will they use it, how will they use it. Other categories can be added as needed to define the customer segments.</p> <p>2. In each column, list as many items as possible, including any market research data on market size, sales, % etc. for each item.</p> <p>3. Circle promising characteristics of each customer and link together in a chain to profile a customer segment. Try to identify 10-15 promising customer segments this way.</p>	<p><b>Who</b> Business travelers 60% of airport traffic</p>	<p><b>What</b> Breakfast 75%</p>	<p><b>When</b> am weekdays 60%</p>	<p><b>Where</b> eat at kiosk 10%</p>	<p><b>Why</b> in a hurry no time to stop on way to airport 30%</p>	<p><b>How</b> eat plain 15%</p>	<p><b>Who</b> Leisure travelers 20% of airport traffic</p>	<p><b>What</b> Lunch 5%</p>	<p><b>When</b> pm weekdays 15%</p>	<p><b>Where</b> eat in departure lounge 65%</p>	<p><b>Why</b> transferring flights during a meal time 25%</p>	<p><b>How</b> eat with toppings 85%</p>	<p><b>Who</b> Greeters and meeters 15% of airport traffic</p>	<p><b>What</b> Snack 20%</p>	<p><b>When</b> weekends 20%</p>	<p><b>Where</b> carry on board 25%</p>	<p><b>Why</b> no food on airplane 45%</p>	<p>(Zultner and Mazur 1996.)</p>



Task	Tool	Purpose	Step-by-step Instructions	Case Study
<p>Understand how he does business, what his customers need, and what problems he has satisfying their needs.</p>			<p>business, home, etc. you need to visit, and arrange time appropriately.</p> <ol style="list-style-type: none"> <li>Determine what equipment will be needed to capture voice of customer, and become familiar with using it.</li> <li>Make plans for debriefing other teams.</li> <li>Rehearse with safe "customers" such as employees.</li> </ol>	<ol style="list-style-type: none"> <li>non-conflicting</li> <li>limited number</li> <li>not a sales call</li> </ol> <p><b>B. Prioritize visit objectives</b></p> <ol style="list-style-type: none"> <li>Analytic Hierarchy Process (AHP)</li> </ol> <p>From Customer Visits Implementation Guide (Mazur 1995a)</p>
<p><b>Flow Charts, Fault Tree Analysis, Customer Process Table.</b> (Nelson 1992)</p>	<p>Diagram your customer's issues and processes.</p>		<ol style="list-style-type: none"> <li>Visit customer's gamba and discuss/observe customer's work and processes.</li> <li>Map customer's processes.</li> <li>Look for deviations, potential failures in customer's processes.</li> <li>Uncover implied customer needs.</li> <li>Clarify customer's functions and subsystems that perform those functions.</li> </ol> <p>Propose new concepts to perform those functions better than customer's current methods.</p>	
	<p><b>Customer Process Table for Unit Installation</b></p>		<p>business, home, etc. you need to visit, and arrange time appropriately.</p> <ol style="list-style-type: none"> <li>Determine what equipment will be needed to capture voice of customer, and become familiar with using it.</li> <li>Make plans for debriefing other teams.</li> <li>Rehearse with safe "customers" such as employees.</li> </ol>	<p>From Customer Visits Implementation Guide (Mazur 1995a)</p>
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	<p>(Nelson 1992, 322)</p>	<p>(Nelson 1992, 322)</p>	<p>(Nelson 1992, 325)</p>	<p>(Nelson 1992, 325)</p>

Task	Tool	Purpose	Step-by-step Instructions
	<p><b>State Transition Diagram (STD).</b> (Gane and Sarson 1977, Mazur 1995b)</p>	<p>Captures the customer's logic as states he passes through in the use of a product or service. Identifies events that can trigger customer needs.</p>	<p><b>Case Study</b></p> <p>Part of STD for cafeteria (Mazur 1995b)</p>
	<p><b>Data Flow Diagram (DFD).</b> (Gane and Sarson 1977, Mazur 1995b)</p>	<p>The data flow diagram allows a process to be displayed at a logical level (everything a customer sees) without committing to a constraining physical implementation. Since customers will make decisions based on some knowledge (data), the DFD can help us understand influencing factors.</p>	<p>DFD for selecting a restaurant (Mazur 1995b).</p> <p>"I think we'll go to ...."</p>

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		<p><b>Customer Context Table (CCT).</b></p> <p><b>Verbatim Translation Table (VTT)</b> (Ohfuji et al 1990, Marsh et al 1991), Mazur 1995a, Mazur and Zultner 1996)</p>		<p>CCT records the context of use of the product or service. Useful for understanding environment and other issues related to reliability and robust design, and setting performance targets in the House of Quality. Sometimes combined with VTT to translate words and observations to reveal unspoken customer needs.</p>		<ol style="list-style-type: none"> <li>1. Enter information about each customer and gamba on a separate sheet. Record context of use such as who uses it, what for, when, where, why, how, etc.</li> <li>2. Capture spoken and observed “verbatim” as accurately as possible.</li> <li>3. Translate each verbatim into unique expressions of customer requirements. Feel free to extrapolate as we are not concerned at this point with preference, importance, or likelihood, which will be measured later in the Quality Planning Table in the House of Quality.</li> </ol>		<table border="1"> <thead> <tr> <th>Verbatim</th> <th>Who</th> <th>What</th> <th>When</th> <th>Where</th> <th>Why</th> <th>How</th> <th>Translated Data</th> </tr> </thead> <tbody> <tr> <td>Hi performance, but car sounds quiet.</td> <td>40 year old mail office worker</td> <td>commute</td> <td>morning, evening</td> <td>highway</td> <td>go to work</td> <td>car pool</td> <td>Accelerates quickly. Good gas mileage. Car is quiet. Engine is quiet. Absorbs Muffler</td> </tr> <tr> <td>Muffler doesn't rust out.</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>doesn't rust out. Pipes</td> </tr> <tr> <td>Starts easily when cold.</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Starts easily when cold. Starts easily when wet. Can drive off immediately</td> </tr> </tbody> </table>							Verbatim	Who	What	When	Where	Why	How	Translated Data	Hi performance, but car sounds quiet.	40 year old mail office worker	commute	morning, evening	highway	go to work	car pool	Accelerates quickly. Good gas mileage. Car is quiet. Engine is quiet. Absorbs Muffler	Muffler doesn't rust out.							doesn't rust out. Pipes	Starts easily when cold.							Starts easily when cold. Starts easily when wet. Can drive off immediately
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<p><b>4. Analyze Gamba Data.</b></p> <ul style="list-style-type: none"> <li>• The data gathered with the above tools is then analyzed for missing data, structured for later deployments, prioritized, and benchmarked.</li> </ul>		<p><b>Customer Voice Table (CVT).</b> (Ohfuji et al 1990, Marsh et al 1991), Mazur 1995a, Mazur and Zultner 1996)</p>		<p>“Customers buy benefits, producers make features,” goes the old marketing saw. The CVT is used to determine if the gamba data represents the <b>true</b> need or benefit the customer, or an engineering description of performance, functionality, technology, solution, price, etc.</p>		<ol style="list-style-type: none"> <li>1. Review each piece of gamba data from the above tools. They should be unique, not compound expressions of requirements.</li> <li>2. If the data is a qualitative expression of customer benefit, it is called “demanded quality” and is placed in the appropriate column on the CVT.</li> <li>3. If the data describes a measurable level of performance, a function, a failure, a solution or methodology, price or cost, etc. put it in the appropriate feature column for later deployment in Comprehensive QFD.</li> <li>4. For each feature, look for missing demanded quality items that un-</li> </ol>		<table border="1"> <thead> <tr> <th>Demanded Quality</th> <th>Performer</th> <th>Function</th> <th>Reliability</th> <th>Misc.</th> </tr> </thead> <tbody> <tr> <td>Car accelerates quickly <i>Music sounds good</i> Good gas mileage Car operates quietly Engine operates quietly Starts easily when cold Starts easily when wet Can drive away immediately</td> <td><b>DQ added</b></td> <td>Absorbs vibration</td> <td>Muffler doesn't rust out Pipes don't rust out Muffler is attached securely</td> <td></td> </tr> <tr> <td>Starts easily anytime Muffler emits no odor</td> <td>Distance from windows</td> <td>Carry exhaust</td> <td>Muffler doesn't rust out Muffler doesn't leak fumes</td> <td></td> </tr> </tbody> </table>							Demanded Quality	Performer	Function	Reliability	Misc.	Car accelerates quickly <i>Music sounds good</i> Good gas mileage Car operates quietly Engine operates quietly Starts easily when cold Starts easily when wet Can drive away immediately	<b>DQ added</b>	Absorbs vibration	Muffler doesn't rust out Pipes don't rust out Muffler is attached securely		Starts easily anytime Muffler emits no odor	Distance from windows	Carry exhaust	Muffler doesn't rust out Muffler doesn't leak fumes																		
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				<p>The Affinity Diagram is used to uncover the underlying structure of the Demanded Quality from the customers' point of view. The Tree is used to correct the structure and look for more missing data.</p>		<p>See detailed instructions above.</p>																																									
<p><b>Demanded Quality Affinity Diagram and Hierarchy Diagram (Tree).</b></p>																																															
<p><b>Quality Planning Table.</b> (Mazur 1995a)</p>		<p>This is the right hand room of the House of Quality where the Demanded Qualities are prioritized.</p>		<ol style="list-style-type: none"> <li>1. Use modal survey data or AHP to determine rate of importance.</li> <li>2. Enter survey data on customer view of competitive alternatives.</li> <li>3. Set improvement targets, sales points, calculate % priorities.</li> </ol>		<table border="1"> <thead> <tr> <th>Quality Planning</th> <th>Company Now</th> <th>Competitor X</th> <th>Competitor Y</th> <th>Plan</th> <th>Rate of Improvement</th> <th>Sales Point</th> <th>Demanded Weight (%)</th> </tr> </thead> <tbody> <tr> <td>Operates quietly easily</td> <td>4</td> <td>5</td> <td>4</td> <td>5</td> <td>1.25</td> <td>1.0</td> <td>4</td> </tr> <tr> <td>Car accelerates quickly</td> <td>3</td> <td>4</td> <td>5</td> <td>4</td> <td>1.0</td> <td>1.0</td> <td>4</td> </tr> <tr> <td>Engine operates quietly</td> <td>4</td> <td>3</td> <td>4</td> <td>5</td> <td>1.67</td> <td>1.2</td> <td>8</td> </tr> <tr> <td>Responds quickly</td> <td>4</td> <td>3</td> <td>4</td> <td>5</td> <td>1.67</td> <td>1.2</td> <td>8</td> </tr> </tbody> </table>		Quality Planning	Company Now	Competitor X	Competitor Y	Plan	Rate of Improvement	Sales Point	Demanded Weight (%)	Operates quietly easily	4	5	4	5	1.25	1.0	4	Car accelerates quickly	3	4	5	4	1.0	1.0	4	Engine operates quietly	4	3	4	5	1.67	1.2	8	Responds quickly	4	3	4	5	1.67	1.2	8
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## CONCLUSION

Understanding the **true** needs of customers requires work on the part of designers and planners. It has never been an easy task, just ask anyone who has designed a product for what the customer thought he wanted, only to find out that the product was still not acceptable. Going to the gemba and analyzing the voice of the customer has come to be a tried and true way of getting a complete and accurate set of both the spoken and unspoken requirements of the customer, for later deployment with QFD into an assured design and delivery of the product, service, software, and even business processes. Following are some gemba stories that the author hopes will inspire readers to try even a few of the tools and techniques listed above.

- Isuzu sent tractor engine designers to farm rice paddies for two years to farm rice in order to develop an engine specifically for rice cultivation. Sales easily outpaced others which were retuned automobile engines.
- An American appliance manufacturer discovers in the gemba that customers cannot open theirs and competitive units on a kitchen counter under the cupboards. This led to redesigning the product to open to the front. An added benefit was that it became more accessible to wheel chair bound users as well.
- The University of Michigan Medical Center learned so much in the patients' and referring doctors' gembas that they spent two years just correcting problems.
- Host Marriott's Phoenix Sky Harbor Airport's units went to gemba and found that customers could not hold food and open the beverage coolers at the same time. They installed air curtains, took off the doors, and sales shot up within a week. In their bagel offerings, gemba research led to doubling sales within a month. (Lampa and Mazur 1996).

And so the list of successful users in all industries, all markets, goes on. On a cautionary note, be sure to schedule ample time in your QFD project for VOC analysis. What your customers aren't telling you can be overwhelming.

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