QFD for Small Business

A Shortcut through the "Maze of Matrices"

Glenn H. Mazur
Japan Business Consultants, Ltd.

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Japan Business Consultants, Ltd. 1140 Morehead Ct. Ann Arbor, MI 48103
(313) 995-0847 Fax: (313) 995-3810

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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 [Mizuno and Akao 1994, Akao 1990]. Well-known Japanese users include Toyota, Nissan, Sharp, NEC, etc.

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 own small business, **Japan Business Consultants**, and saw revenues increase 285% the first year, 150% the second year, and 215% the third year.

QFD has been heralded for such benefits as promoting cross-functional teams, improving internal communications between departments, and translating the customer's needs into the language of the organization. Can small business be improved by these? Absolutely!

Small businesses often enjoy advantages that make QFD even more powerful.

1. The entrepreneurial spirit. A great deal of effort is spent in QFD identifying project goals, customers, and focusing development efforts. Small businesses that retain the original drive of the founder are clearer on these issues.
2. There are fewer layers between the planners and developers and the customer. In private comments, Dr. Akao laments: "Time was when a man could order a pair of shoes directly from the cobbler. By measuring the foot himself and personally handling all aspects of manufacturing, the cobbler could assure the customer would be satisfied" [Mazur 1991c]. Likewise, small business is closer to its customers.

Since 1990, the author has consulted with small and large organizations in manufactured goods and services. This paper describes one use of QFD in an automotive parts wholesale distributor planning weekend hours to support its customers' (jobbers) sales to weekend do-it-yourself mechanics.

Why QFD for Small Business?

Why should small business need QFD? 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 the support staff 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 problems? 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

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Traditional Quality Systems

Traditional approaches to assuring 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 organizations are finding out, however, consistency and absence of problems are not enough of a competitive advantage as only good players remain in business. 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, broken product). 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 convenience, enjoyment). 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 repeat business. QFD focuses on delivering value by seeking out both spoken and unspoken needs, translating these into actions and designs, 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 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 tune up parts for a 1988 Chevrolet are shipped, customers (called jobbers) barely notice it. If they are backordered, 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 parts were available 24 hours a day, that would be exciting. If hours were 8:00 to 5:00, customers 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 organization to explore customer problems and opportunities for these unspoken items.

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 check warehouse inventory for a specific part within one minute via computer. On the other hand, expected requirements can become exciting after a real or potential

failure. An example might be a common part that has suddenly failed due to poor OEM design and demand skyrockets beyond expected inventory levels. A buyer who regularly monitors dealer service bulletins anticipates the problem and purchases an extra 1000 pieces before the supply runs out. The jobbers therefore, have product while their competitors don't.

The Kano Model has an additional dimension regarding which customer segments the target market includes. For example, the instant access to inventory levels which might be exciting to a jobber who uses you as a backup supplier may be expected by a jobber who is tied in to your computer system as a member of a programmed distribution group. Knowing which customer segments you wish to serve is critical to understanding their requirements.

Thus, eliminating 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 small businesses are part of a chain of customers. For example, the auto parts warehouse distributor purchases a muffler from a manufacturer and redistributes it to a jobber who in turn sells it to a repair shop who then installs it on a car driven by the customer's wife. The jobber, 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 2) [Mazur 1993a]. Who ultimately determines the success or failure of our business? 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 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 Planning and Development

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 products and services, developing training programs, and finally implementing the new product or service. Traditional development lacks the structure to communicate what matters most to the customer and to align organizational departments and employees behind these critical requirements. Such a system is incoherent and inefficient. Thus, more time is spent correcting and adjust-

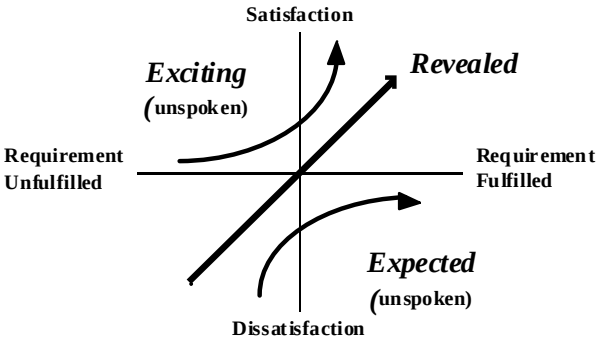

Figure 1. The Kano Model (adapted).
Small businesses must meet all three types of requirements - not just what the customer says.

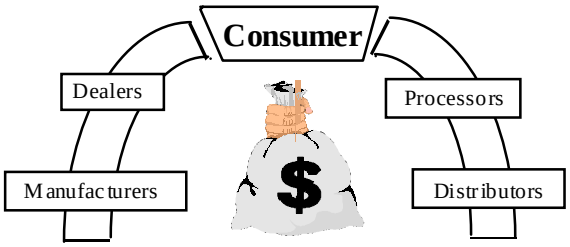

Figure 2. The Keystone Customer.
Who ultimately determines the success or failure of our business?

ing customer complaints than planning it right the first time (see Figure 3) [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 4) [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]. Add service to production and we might paraphrase this as "a system and procedures to aid the plan and development of products and services and assure that they will meet or exceed customer expectations" [Mazur 1993].

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

The Tools of 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. In a small business, we may only use a subset.

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.

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

Hierarchy Trees or systematic diagrams are found throughout all QFD deployments to check for missing data, to align levels of abstraction of the data, to dia-

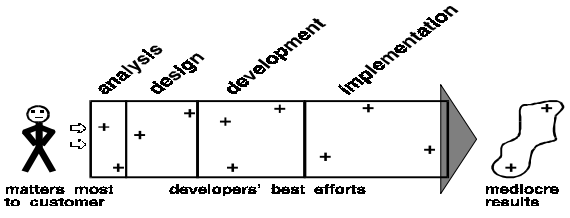

Figure 3. Incoherent Planning and Development. Traditional planning and development fails to focus best efforts. This is inherently inefficient, and dissatisfying.

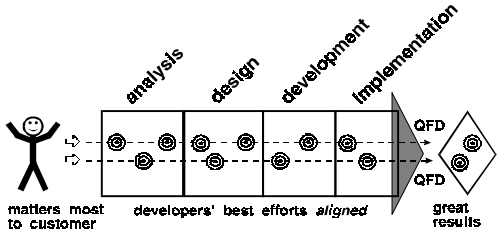

Figure 4. Coherent Planning and Development. QFD targets best efforts on value to the customer. For equivalent effort, more value is received.

gram 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 Small Business QFD

Small businesses are entrepreneurial and close to their customers. Thus, we will focus on those deployments of QFD that are most appropriate. The QFD model being introduced here is abbreviated to maximize the benefit for the time, money, and people resources used (see Figure 5).

If the business is engaged primarily in providing a service or if the support services of a producer are being examined, this QFD model will resemble a customer driven quality improvement story (called here a Customer Satisfaction Story or CSS). This differs from the traditional complaint driven quality improvement story which attempts to rectify something wrong in an existing product or service. If the small business is designing, the more traditional QFD approach should be used [Mazur 1992d].

Voice of Customer Deployment. This table is used to sort customer requirements into quality, performance, reliability, process, solution, cost, and other categories of requirements. **Tools:** Tables.

Quality Deployment. This is used to translate customer quality requirements and priorities into processes that the organization engages. **Tools:** Affinity Diagram, Hierarchy Tree, Prioritization Matrix, Tables, AHP.

Customer Satisfaction Story. This is a structured approach following the Plan-Do-Study-Act cycle popularized by the late Dr. W. E. Deming [JUSE 1991]. It uses the above mentioned QFD tools to uncover the real drivers of quality and customer satisfaction, propose and select alternative solutions, and to integrate them into a new business process. It takes into account prevention of failure, as well. **Tools:** Affinity Diagram, Hierarchy Tree, Relations diagram, PDPC, Blueprinting.

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, 1993a, 1993c]. **Tools:** Blueprinting, Table.

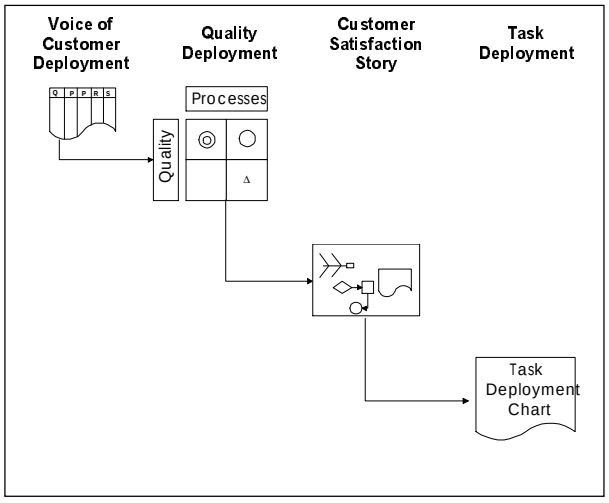

Figure 5. Small Business QFD Deployments.
This is a roadmap of the QFD study done by WSAP.

Case Study: WSAP, Ltd.

WSAP opened its doors in 1926 as a supplier of used auto parts to southwest Detroit area repair shops. During the ensuing 60 years it grew to three warehousing locations and five retail (jobber) outlets, with 100 employees. By the 1980s, as a result of the decline in neighborhood gas stations doing repair, the number of do-it-yourself (DIY) backyard mechanics constituted a significant enough market segment that several retail chain parts stores sporting supermarket-like cleanliness and friendliness (never a hallmark of the parts business) posed a serious threat to the traditional retailer jobbers and the warehouses that supplied them.

Typical of these chains were a broad inventory of user replaceable components and consumables, late hours, and Saturday and Sunday access to their company owned warehouse's inventory. Thus, a DIY who discovered on a Saturday afternoon that he needed additional parts had a better chance of getting them at a chain than at a traditional jobber who also had devote shelf space to professional-replaced parts. In order to give its jobbers weekend access to its inventory, WSAP decided to open its doors on weekends. Since weekend hours devoted to small orders that had already been sold and promised was not familiar territory, QFD was used to assure the success of this new endeavor.

Voice of Customer Deployment

The QFD team consisted of Mr. R., manager of the company owned jobber stores, Mr. A, warehouse manger, and the author, a former employee, as facilitator. In a small business, a QFD team should include an inside person and an outside person. We met for five 2-hour sessions to get the framework laid out and the work started. At some meetings we were joined by the VPs of sales, purchasing, and administration.

Mr. R., as the manager of WSAP's own jobber operations developed customer requirements which the team categorized as **quality** (eg. easy to place order), **performance** (eg. time to check stock), **process** (eg. order entry), **reliability** (eg. said you had the part but when our driver got there, it was backordered), **solution** (eg. computer tie-in), etc. These were listed in a table, as shown in Figure 6 [Ohfuji, et. al. 1990, Nakui 1991]. It was necessary to do this because customers often try to tell us what we should do, not what they need. By categorizing their words, we can then look for the needs underlying their suggestions (shown in italics).

In Figure 6, the customer asked for a computer tie-in. Through voice of customer deployment, we see that he has offered a solution and we must then determine his problem. After some discussion, we determined this to be wanting to "know quickly if you have the part" and wanting to "place his orders easily." The customer also asked for a "stock check in less than one minute" which we determined was a performance requirement for which the underlying need was also a need to "know quickly if you have the part."

Quality Deployment

All the quality issues were then grouped using the Affinity Diagram (see Figure 7) and adjusted using the Hierarchy Tree (see Figure 8). For details of these techniques see Mazur 1992d and 1993a in the Reference section at the end of this paper. The tree is used as the input rows to a matrix that will identify those processes which will most strongly affect customer satisfaction (Figure 9). A Customer Satisfaction Story will then be done to optimize these critical processes.

Quality	Performance	Process	Reliability	Solutions	Misc.
Broad inventory coverage.					
I know quickly if you have the part.	Stock check in <1 minute			Computer tie-in	
Easy to place order.					
Convenient hours					

Figure 6. Voice of Customer Deployment. (Partial) Use this to categorize and uncover unspoken customer quality needs.

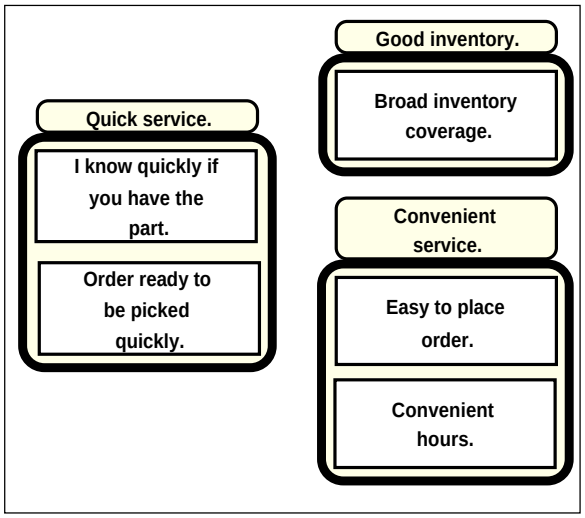

Figure 7. Affinity Diagram.

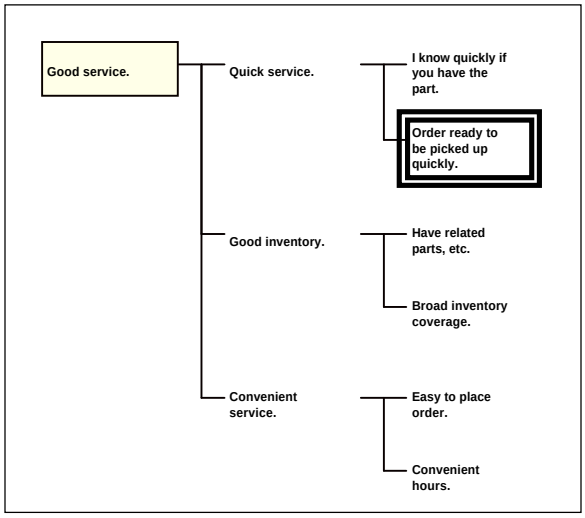

Figure 8. Hierarchy Tree. Look for missing requirements - shown in box.

The matrix shown in Figure 9 is used to determine which processes, when improved, will give the greatest increase in customer satisfaction. The input rows on the left side are the lowest level leaves of the hierarchy tree. The right side room 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 to Customer column is a scale of 1-5 with 5 being most important to the customer. A survey was sent to 20 jobbers within a 20 minute radius of WSAP, which was determined by the experience of Mr. R. to be the minimum time in which a customer could drive to a competing warehouse. The customers were asked to rate how important each of the quality requirements were and how well WSAP currently performed. The purpose was to determine where an important quality issue was currently being unmet. The modal values (most frequent response) were entered in the "Importance to Customer" and "Current Performance" columns. The line graph to the far right of the matrix shows the gap between these two.

An improvement ratio was calculated by setting our desired performance level equal to the importance to the customer, and then dividing desired level by the current level. The quality weight is the improvement ratio expressed as percents. It shows improvement priorities.

In the center columns of the matrix are the key processes for the weekend customer will call program. These processes exist because they have some relationship to customer quality requirements. These relationships are expressed quantitatively by the values of 9 for a strong relationship, 3 for a medium relationship, and 1 for a weak relationship.

These relationship values are multiplied by the quality weights and the results are summed for each column yielding the process criticality which is then expressed as a percentage or process weight. A bar graph is added to visually identify those processes which will have the strongest impact customer satisfaction. A Customer Satisfaction Story will be done on the highest weighted processes. "Check stock" will be examined in this report.

Customer Satisfaction Story

In order to improve the stock check process, the team asked two of the senior stock checkers to join a brainstorming session. Various issues were analyzed using a relations diagram (see Figure 10). This diagram is used to clarify the multiple causal relationships between issues and to pinpoint areas where the greatest improvement at the least cost and effort could be made. After analyzing the data, the team determined that finding the part on the shelf was often a barrier to quick stock checks. This was due to inventory that was had either just been delivered and was still in pallet boxes or was in bulk storage and the shelf stock had not been replenished yet.

WSAP
Quality Requirments
vs.
Weekend Will Call Processes

Date: 12 May 94
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	Open warehouse.	Pull orders.	Receive customers at will call counter.	Answer phones.	Check stock.	Enter orders.	Obtain signature on paperwork.	Importance to customer.	Current performance.	Improvement ratio.	Quality Weight.	Minimum value = 1.0 o— Importance to customer. ▫ ··· Current performance. Maximum value = 5.0
I know quickly if you have the part.				1	9			5	3	1.67	23.9	
Order ready to be picked up quickly.		9	9					2	2	1.00	14.4	
Have related parts, etc.		1			3	3		4	4	1.00	14.4	
Broad inventory coverage.						1		4	5	0.80	11.5	
Easy to place order.	1			3		9		3	3	1.00	14.4	
Convenient hours.	9		3	3				3	2	1.50	21.5	
Process Criticality.	208	144	194	132	258	184						
Process Weight.	18.6	12.8	17.3	11.8	23.1	16.4						
Maximum value = 25.0 Process Weight. Minimum value = 11.0												

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Figure 9. Quality Requirments and Process Matrix.
This matrix is used to translate customer priorities into the processes which when improved, will yield the greatest satisfaction.

To alleviate this problem several alternative solutions were proposed, evaluated, and eventually one was selected. The selected method was than standardized into a job description using the task deployment table.

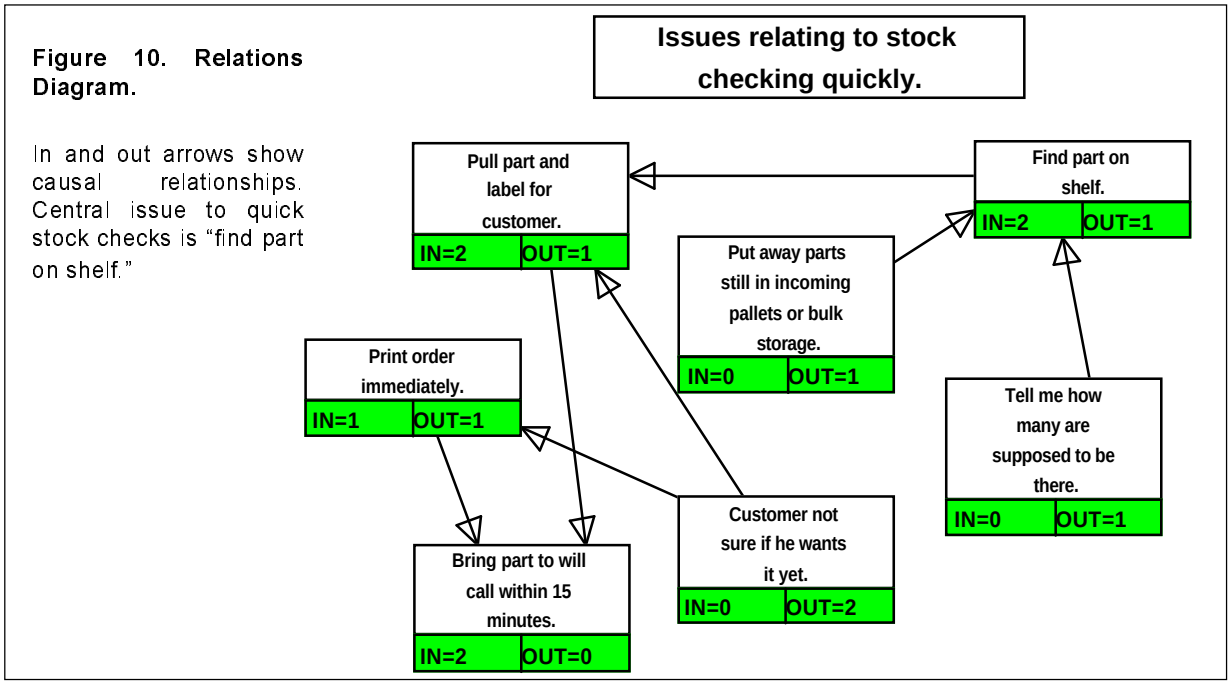

Figure 10. Relations Diagram.

In and out arrows show causal relationships. Central issue to quick stock checks is "find part on shelf."

Task Deployment

To assure that the changes are followed by all warehouse employees on both Fridays and Saturdays, the task deployment table was used to identify required actions, who was responsible, and some measurable performance level. The key issue became a change in the way Friday's incoming shipments were checked in and shelved. If a shipment could not be completely put away, the pallet boxes were to slit opened exposing the part numbers of the individual part boxes. Pallets were to be positioned so that the contents would follow numerical order. Finally, the manufacturer's packing slip would be copied and attached to each pallet box so that the contents could be ascertained quickly and removed parts could be indicated as sold to prevent a shortage from being mistakenly reported.

Conclusion

QFD allowed the warehouse team to better understand the needs of the jobber customer, particularly in their

What	Who	When	How	How Much	Why
Receive shipment	Assistant warehouse manager	Special handling for Fridays	Approve # pallets. Copy packing slip and submit to purchasing for input.	Within 15 minutes of truck arriving.	To assure that shipment is complete and to get inventory figures into computer before weekend.
Unload truck	Forklift driver	After pallet # confirmed.	Forklift.	5 min./pallet or 1.5 hours/trailer.	To position pallets for proper placement in shelf areas.
Stage pallets.	Warehouse workers.	As truck unloaded.	Pallet jacks.	Within one aisle of shelf indicated in computer.	To asssure pallet can be checked quickly after shelf is checked.
Slit pallet boxes.	Warehouse workers.	As pallets staged.	Special box cutters that can be calibrated to cut only outer carton.	All must be slit by end of workday Friday.	To assist weekend workers in finding parts that are not yet shelved.
ETC.	*ETC.*	*ETC.*	*ETC.*	*ETC.*	*ETC.*

Figure 11. Task Deployment Chart.

need to compete with the new retail chains. The warehouse, known for its inventory breadth and depth, was able to assure its resources give jobbers a competitive edge even on weekends.

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About the author

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.

Mazur holds a Master's Degree in Business Administration and a Bachelor's Degree in Japanese Language and Literature, both from the University of Michigan.