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TenStep Supplemental Paper

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Quality Function Deployment – Case Study

For today's manufacturers, meeting customer expectations is no longer sufficient. Companies need to exceed these expectations. Because of this, listening to customers has taken on a new importance. Everyone in the organization, from the CEO to the person who directly interacts with the customer, must be aware of the customer's needs.

Quality Function Deployment (QFD) is a technique used to optimize the process of developing and producing new products on the basis of customer need. It is a team-based methodology used to identify and translate customer requirements into technical specifications for product planning, design, process, and production. In simple terms, it is used to transform customer requirements into company requirements.

The following is a comprehensive case study featuring a company that developed a Quick Release Top Nozzle (QRTN) to replace the Removable Top Nozzle (RTN) that was currently in use. The RTN is an expensive piece of equipment used in the manufacture process to repair products. Failing to quickly make repairs when they are needed can lead to a steep escalation in costs.

When the RTN worked correctly, it was capable of getting the repair done within an acceptable time frame. However, problems with the RTN often caused delays. Sometimes the product would fail to detach from the nozzle, and a special tool would have to be used to lift it. Another problem with the RTN involved the locking tube, an independent part of the machine. This tube had to be detached from the RTN during the removal process. It would often fall during this process, and time would be wasted in retrieving it. The RTN experienced many other problems as well. The general feeling was that it could not be counted on to behave predictably during critical times.

The company decided to develop a new Quick Release Top Nozzle (QRTN) to minimize the repair time. This project had been undertaken once before, but abandoned due to high development and production costs. However, with pressure from its customers, the company decided to use the principles of Quality Function Deployment, among others, to renew its efforts. Employees were selected and trained in QFD techniques. These employees, along with a QFD expert, formed the development team. The development team started off by first getting insights from the previously conducted QRTN development process. Then the team attempted to identify the needs of the customers.

Voice of the Customers

A crucial part of QFD involves listening to customers' requirements. The team identified three important customers who would be affected by the QRTN and made efforts to find out what they expected in the product. The first group identified was the end user. Team members attempted to get to know this group by handing out questionnaires, scheduling meetings with various groups within the end user organization, and visiting their work sites. These activities enabled the team to gain valuable customer input. In the end, it was clear that the end user required a QRTN that would consistently deliver the shortest repair

time possible. The team then studied QRTN alternatives being provided by the competitors and the alternatives developed by the customers themselves. Engineers within the customer organization were constantly updated about the development process.

Personnel from the servicing division comprised the second group of customers. The servicing division was often involved in the process of installation, adjustment, repair, and replacement of the RTN. Because they were so familiar with the RTN, they were able to make some valuable suggestions regarding the QRTN. Apart from gathering verbal information from the service division personnel, the development team watched the personnel complete service and repair work and videotaped the process so that they could study it further. The team noted the time spent by the service personnel to do the various servicing tasks and compared it with the values that had been set for the new QRTN.

The third customer voice was that of the design engineer. The design engineer was able to provide guidelines for developing the QRTN in compliance with regulatory and other standard requirements.

After they had gotten their customer input, the development team analyzed the requirements and placed them in the appropriate categories. This helped to prevent repetition of the same requirement from different customers. It also helped members better understand the interrelationships between the various requirements. Then, the requirements were summarized with short phrases, and a glossary was created to aid in the understanding of these phrases. This glossary became invaluable as the development process progressed. The analysis and categorization enabled the development team to reduce the 33 identified customer needs into twelve broad requirements. Some of them are shown below.

Original Customer Needs	Consolidated Customer Need	Comment
• Thimble rotation resistance • Precludes skeleton damage • No loose parts during joint operation	Joint reliability during repair	Asking "why" helped consolidate customer needs back to the basic need.
• Simplified tooling • Low cost tooling • Minimize tool start-up time • Minimal removal force	Simple tooling	Consolidated requirements because simple tooling generally leads to lower cost. Concluded that simple tooling would minimize start-up time. Minimal removal force also related back to simple tooling.
• Fast nozzle removal/install • Repair on critical path • No loose parts during joint operation • Minimum number of joints	Fast repair	Asking "why" helped consolidate customer needs back to the basic need. Many of these lower-level needs then became technical characteristics.

• Maintain alignment during repair		

After condensing the 33 customer identified needs into 12 broad requirements, the requirements were placed on the **left side** of the House of Quality diagram.

The development team then created a product-planning matrix. Here, they allotted points to each customer requirement, based on the priorities of the customer, on scale from 1 to 5. The team also compared their allotted points with those of their competitors' designs and performed a critical evaluation. Comparisons were made to four other designs, including a customer-built design and the current RTN design. The team then collected customer feedback on the product matrix and incorporated the suggested modifications. This information was place on the **right side** of the House of Quality diagram.

Once the product-planning matrix was created, the next step was to translate customer requirements into key product definitions. The key product definitions can be challenging to develop, since they should neither be constricting nor unrealistic. These product definitions were added to the **top** of the House of Quality.

Once the key product definitions were made, the development team created a point system to measure how closely the product definitions matched the stated customer requirements. The points were assigned on a 1 to 5 scale, with 5 meaning a close match and 1 a poor one. These points were placed in the **center** of the matrix between customer requirements (rows) and product definitions (columns).

The development team had set numeric goals for each of the key product definitions that, if met, would mean that the requirement had been met. The goals were placed on the **bottom** of the House of Quality, along with the actual value from adding up the rows for each column. However, as the process progressed, these values were modified to be more realistic. Then, the development team studied the effects that the definitions had on each other. Slightly positive influence between the various product definitions was ignored, while any significant negative influences were noted. These relationships were noted on the **roof** of the House of Quality.

Based on all of these factors, the development team determined the optimum numerical specifications for each of the product definitions. After the optimum numerical specifications were set for the key product definitions, the next step was product design. This required detailed discussions among the various development team members about how to turn the product definitions into a design reality.

The design team had an extensive brainstorming session, both as one big group and in smaller sub-groups. Many ideas for incorporating the product specifications into design were generated and recorded, and then the best ideas were developed further. Finally, the many ideas were narrowed down to one. Having developed this *'best possible design solution',* the preliminary design phase of the QRTN was launched.

The results have so far been quite satisfactory. The previous effort to develop a QRTN was scrapped because it exceeded existing RTN costs by 85%. However, the QRTN

developed by the team using QFD concepts managed to keep it at just 15% more than the RTN costs. Customers will certainly be willing to pay for this as it provides a better solution.

QFD is a very powerful concept as far as new product development and meeting customer requirements are concerned. However, it requires the complete backing of management. It also requires the involvement of several key people across various functional areas and expertise. The QFD process is time consuming, especially with regard to recording and analyzing customer input and using these inputs in actual engineering design.

Summary

Industry experiences reveal that short-term benefits of QFD include reduction in cross-functional barriers associated with product development teams and increased inter-departmental interactions. Long-term tangible benefits include reduction in cycle times and development costs along with increased productivity. The most important benefit of QFD has been its effectiveness in capturing, prioritizing and stabilizing customer requirements into the appropriate technical requirements for every stage of product/service development and production. These include marketing strategies, planning, product design and engineering, prototype evaluation, production process development, production and sales.