

# QFD application for tackling Internal Customers Needs as a base for building a Lean Manufacturing System

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## Abstract

*In the fast-paced and lean economy that modern manufacturing nowadays has as its environment, we propose that the ability of applying QFD tools and principles along the whole manufacturing chain will turn critical, mainly because of 2 factors: (1) Lean Manufacturing allows no waste [1] and therefore, a complete match between resources and customer needs is required. (2) Rapid organizational redesign is needed to adapt to the ever-evolving customer needs and therefore company-wide understanding, alignment of purpose and common language (memes) are required. A successful application of an internal customer case will be presented as a reference for implementation..*

When QFD is referred as a system for focalizing the resources of companies to customer needs, the word “customer” usually refers to external users. Nevertheless, QFD can also be applied successfully to internal, next-process-in-line customers.

Alukal [1] defines Lean Manufacturing (LM) as a philosophy that shortens the lead time between customer orders and product shipments through the elimination of all forms of waste. The objective of LM approach is to respond rapidly to changing client tastes and to offer the most value possible at minimum costs [2]; due to the combined pressure of both economical and technological forces, LM is becoming the only solution to many manufacturing companies [3]. Since resources have to be aligned exactly with customer needs in order to maximize profitability, any resource that is allocated under or over customer needs can be also defined as waste.

Dr. Deming [4] always promoted that true quality occurs only when each stage of a process works with the next and preceding ones towards an optimum accommodation; this configuration demands an “internal customer - internal supplier” mindset, and QFD is a proven solution for developing successful customer-supplier relationships.

Nadler [5] points out that the principal function of managers is the design, development and operation of effective organizations, been organizational design the stage with best potential of generating significant impacts. LM implies a deep change in the organizational design, so the careful consideration of both internal and external customer needs provided by QFD appeals to be an effective approach.

As part of the QFD deployment, customer needs have been deployed through internal departments in many successful cases. QFD generates common language and common purpose, by deploying “customer memes”. Memes are significant pieces of data copied from individual to individual without too much alteration, and they guide action between organizations [6]; when “customer memes” are deployed, organization will act in order to satisfy this external customer understood needs.

We propose nevertheless for a true LM wasteless production system, profound knowledge of internal customer is also needed. This requires a more detailed communication between customer-supplier processes, including both external and internal customer needs . We believe that although common sense will be sufficient for initial LM improvement iterations, later iterations will require more formal, customer-oriented approaches such as QFD, in order to minimize waste within the production chain.

As part of the continuous improvement activities of an automotive company, QFD was successfully applied at a manufacturing process, considering next process (internal) as the customer. The process was selected because of its importance and possible payback of a successful improvement.

## **Methodology**

### ***1. Project definition and team***

The project objective was defined as significantly improve the performance of rotors line for windshield motors. A cross-functional team was integrated including process owners and specialists of the next process (internal customer), as well as quality, engineering and human resources personnel.

### ***2. Voice of the Customer***

A questionnaire was formulated in order to obtain customer needs, including questions regarding

- Basic requirements
- Expected requirements
- Exciting requirements
- Frequent complaints

Two levels of internal customers were addressed: Assembly and Preparation Line (direct level) and Production Management (indirect level)

### ***3. Identification of Customer Needs out of Voice of the Customer***

The team identified the Customer Needs out of the Voice of the Customer obtained from the questionnaires, by analyzing the verbalizations and translating them into customer needs.

### ***4. Organize and classify Customer Needs***

Using affinity diagrams customer needs were grouped into different categories, as shown in Figure 1.

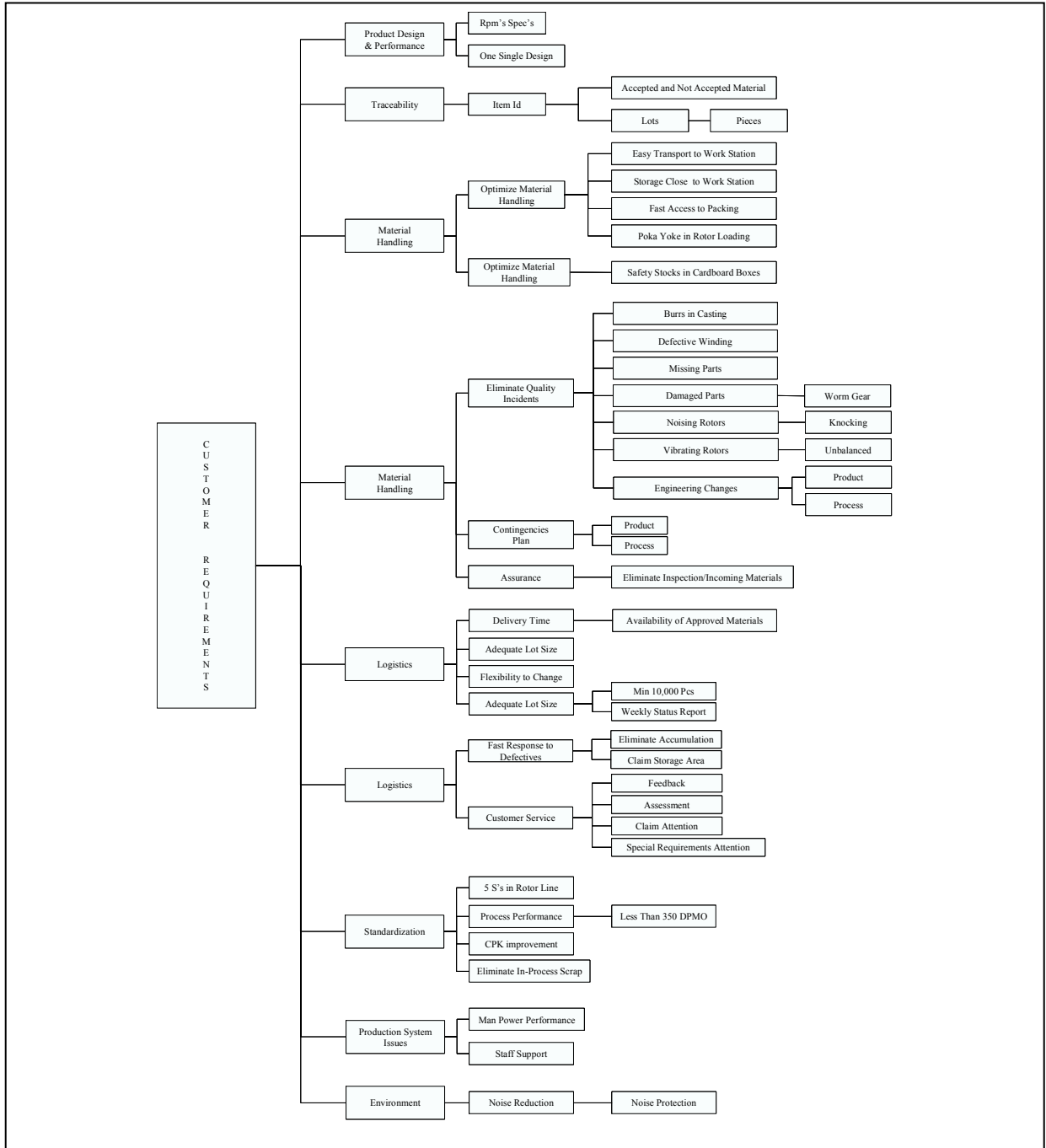


Figure 1. Affinity Diagram

### 5. Customer Importance Rating

Customer Importance Rating was obtained by asking Internal Customers (both direct and indirect) to evaluate and rate the importance of identified needs. An average was obtained for the needs within each group and then for the need of both groups. Customer Importance Ratings were used both as weighting factors and as multipliers for later on deploying relevance to process parameters through the House of Quality (HoQ, Figure 2). A scale of 5 to 1 was chosen for this rating, where the customers gave higher ratings to more important requirements.

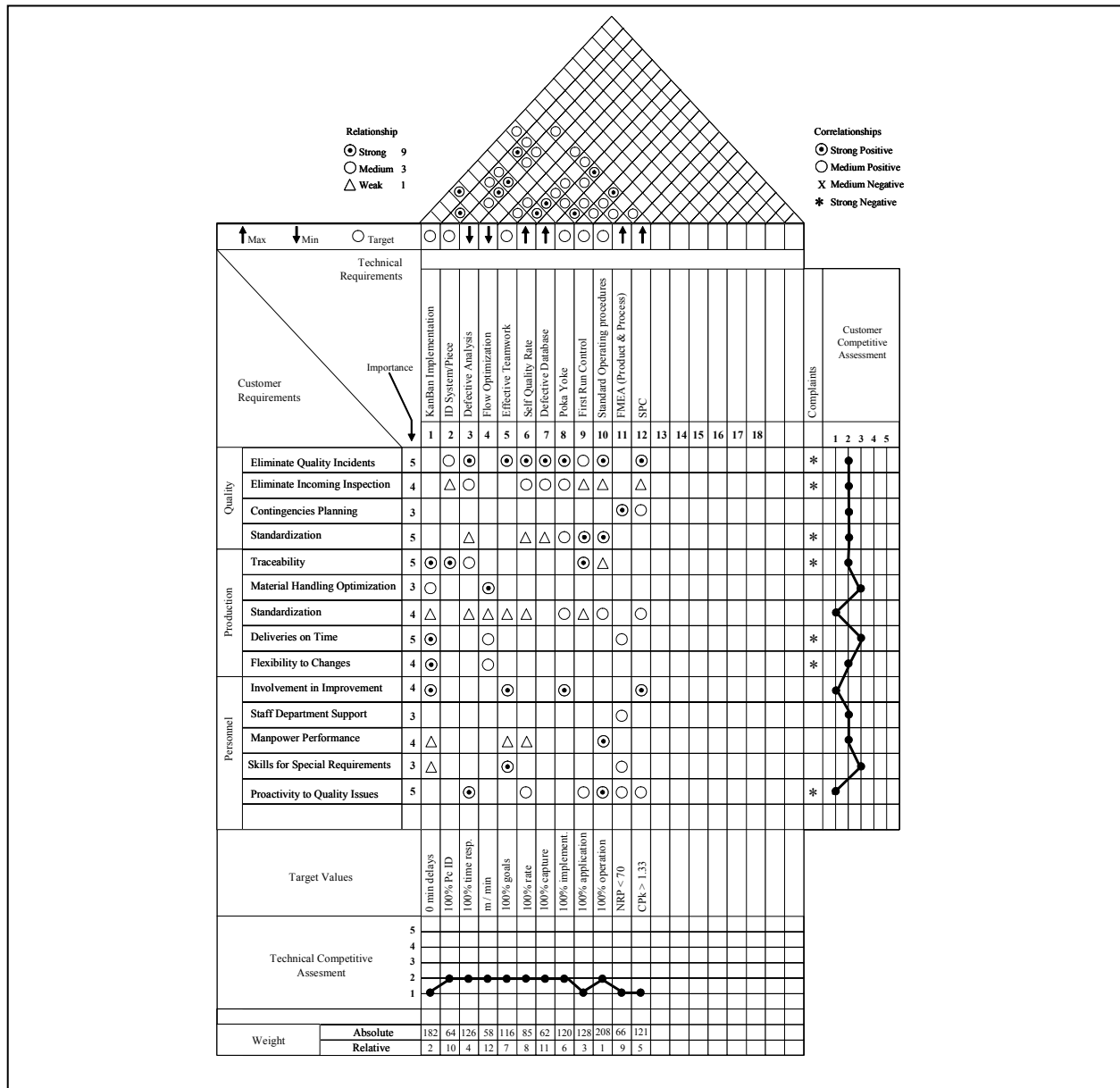


Figure 2. House of Quality (HoQ)

### ***6. Customer Competitive Assessment***

The Customer Competitive Assessment is an evaluation made by internal customers of how much was the current system satisfying each of the Customer Requirements; a chart was plotted in the right side of the HoQ. The numbers 1 to 5 indicate the level of performance: 5 for excellent satisfaction of this requirement, 1 for poor or unsatisfied requirement. This evaluation provided an assessment of the strengths and weaknesses of the process, and it also highlighted areas where *muda* (waste) was possibly been generated so they were good candidates for LM projects.

### ***7. Historical Complaints***

Since statistical data was not available in order to provide a numerical metric, an asterisk was written at the HoQ on Customer Requirements with significant complaints observed by internal customers.

### ***8. System Parameters: “Voice of Internal Supplier”***

In this step, technical requirements were determined to respond to customer needs and consisted of manufacturing strategies and tools (Manufacturing Practices). This was carried out through a brainstorming session involving a multidisciplinary team of different departments dealing with different Manufacturing Practices.

### ***9. Target Values***

This part of the HoQ was filled with target goals for each of the manufacturing practices in measurable terms.

### ***10. Technical Competitive Assessment***

Technical Competitive Assessment was done in order to evaluate the level of implementation of each of the Manufacturing Practices that were listed. A similar scale from 5 to 1 was used to plot the level of performance in the HoQ.

### ***11. Relationship Matrix***

This matrix was used to express the strength of the relationship between Customer Needs and the Manufacturing Practices, using the traditional degrees of a HoQ (1 3 9). Two steps were followed: (1) Finding if there was a relationship between the Manufacturing Practices and the Customer Requirements, and if there was a relationship (2) assessing how strong it was.

### ***12. Correlation Matrix***

This matrix shows positive and negative relationships among the Manufacturing Practices determining which Manufacturing Practices support or hinder each another; the matrix also helped to identify which resources could be used for multiple purposes and where additional research and development efforts may be needed.

### ***13. Development of prioritized Manufacturing Practices***

Absolute weight was calculated by multiplying the Customer Importance Rating and the values of Manufacturing Practices at each column in the relationship matrix. Relative weight is the ordinal number representing the ranking order of importance of each of the Manufacturing Practices.

#### 14. Analysis of the House of Quality

During the construction of the HoQ, several conclusions were obtained in order to improve the existing process. The following questions were answered at this stage:

Manufacturing Practices that were not strongly related to any customer requirement: *None*

Customer Requirements that were not strongly related to any Manufacturing Practices: *Staff departments support.*

Opportunities to improve Customer Competitive Assessment: *Standardization*

Opportunities to improve Manufacturing Practices Competitive Assessment: *Kanban, First Run Control, FMEA's and SPC*

Manufacturing Practices that must be further deployed: *Standard Operating Procedures, Kanban, First Run Control and Defective Analysis.*

Situations requiring attention were translated into Action Plans with planned follow-up to assure successful results.

#### 15. Build a Lean Manufacturing System

In order to link QFD application to Lean Manufacturing System, the following matrix was proposed to guide efforts to the elimination of *muda* (waste). Taiichi Ohno [7] enumerates seven kinds of *muda* commonly found in manufacturing: overproduction, waiting, transport, overprocessing, inventories, movement and defective parts.

##### Matrix of Manufacturing Practices to LM 7 Waste (partial)

Technical Requirement	Over Produce	Waiting	Transport	Over Process	Inventory	Movement	Defective
Std Op Procedure		X	X	X		X	X
Kanban	X	X	X	X	X	X	
First Run Control				X			X
Defective Analysis				X	X	X	X

From this part of the table, it is evident that with these Manufacturing Practices implementation, overprocessing was the type of waste that would be more affected, while overproduction was only been attacked using kanban. Since the balance appeared to be convenient to both the internal customer and the team, the chosen Manufacturing Practices were kept, using LM metrics to validate effectiveness of implementation. In case a waste has required more attention, a revision of both the QFD and the selected Manufacturing Practices will be considered.

## Conclusions

Due to its characteristics, QFD can provide a solid base for LM implementation. QFD provides to the organization the adequate “customer memes” and helpful information such as prioritized actions and weighted customer opinion, which is critical for the design and operation of completely customer-aligned, waste-free processes.

Besides, QFD can generate profound and detailed knowledge of internal processes, requirements of next processes and requirements of external customer. We believe that knowledge is the key word in order to achieve LM objectives of dramatic reductions of the waste chain, more robust and defect-free production systems, development of optimal material delivery systems and improvement of layouts for increased flexibility.

Dr. Deming [4] believed that knowledge is a national resource (the most valuable, he used to say); therefore QFD can enhance LM toward more effective, knowledge intensive implementations, allowing a faster exploitation of this national resource at manufacturing countries and communities.

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