

Collaborative Engineering

Product Definition



- ◆ Voice of the Customer
- ◆ Problem Statement
- ◆ Requirements & Constraints
- ◆ Quality Function Deployment

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'Voice of the Customer'

Capture the needs of customers in their own words

- Expectations, preferences, aversions
- Preserve original phrases, anecdotes, concerns
- Include comparative examples

Example: Easy chair

- **Who:** Old people in low-income-group families
- **What:** Need a chair with adjustable back rest
- **Why:** For reading (straight back), watching TV (inclined)
- **When:** Mostly during daytime, some evenings
- **Where:** In living room or balcony
- **Wish:** Reading light at the back



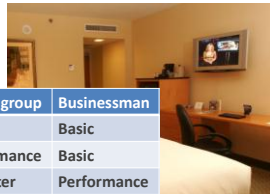
'Voice of the Customer'

Categorize the needs expressed by customers:

- **Basic features** (*must be*) – else Dissatisfiers
- **Performance features** (*optional, priced*) – Satisfiers
- **Unexpected features** (*bonus, free*) – Delighters

Example: Highway hotel

| Characteristic | Family group | Businessman |
|--------------------------|--------------|-------------|
| Comfortable bed | Basic | Basic |
| Internet (hourly charge) | Performance | Basic |
| Swimming pool (free) | Delighter | Performance |



Problem Statement

A well defined product is half-way to being designed

Clear statement of user need in minimum words:

- **Must not be vague** (difficult to evaluate alternatives)
- **Must not point to a solution** (new ideas get blocked)

Example:

1. Vehicle for rural needs – *too vague*.
2. Three-wheel cycle for carrying hay stacks in small village
– *points to a specific solution, limits application*
3. Manually powered vehicle for carrying farm produce
– *just right*

Problem Statement

- **Need:** Human flight
- **Statement:** "A machine that will fly like birds"
- 'Scientifically proven' to be impossible (1880s)
- Delayed the development of airplanes (till early 1900s)
- Until Wright brothers developed a 'heavier-than-air' plane



Problem Statement

- Ina Tile Factory, Japan
- **Need:** Uniform size of tiles after baking in furnace
- **Statement:** "Furnace with uniform internal temperature"

Final solution:

- Same baking furnace,
- Change tile composition:
- Less sensitive to furnace temperature variation



Customer Requirements

- **Functional Requirements** – Essential Features:
 - Function: mechanical, electrical, optical...
 - Usability: ambient conditions, safety, life
 - Efficiency: effort required, power consumption
- **Constraints** – Desirable Features or Limits:
 - Physical: size, weight, noise...
 - Cost: initial, service, disposal...
- **Swapping** – Depending on importance / essentiality



Functional Requirements

Design Axioms for FR's:

1. Maintain their independence - Decouple!
2. Minimise the number - Less information content!
3. Express them for ease of evaluation - Quantitative!

Example: Refrigerator

- FR: Provide storage and preservation of food in a cooled container to be placed in kitchen, with easy access by adults only.
- FR1: Provide 1 m³ storage of food items
- FR2: Preserve food items for at least one week
- FR3: Enable easy access by adults



Functional Requirements

Hierarchical Nature of FR's:

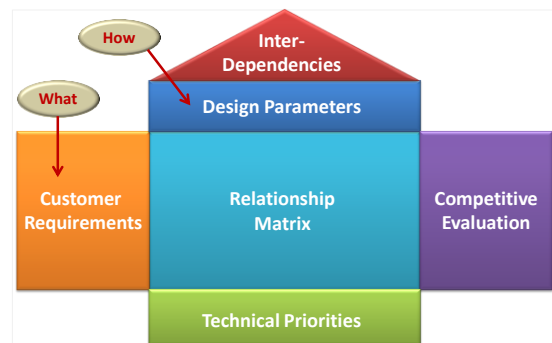
1. FRs can be satisfied by multiple sets of Design Parameters
2. FRs may be decomposed to obtain FRs for a lower level
3. DPs may become FR/constraints for lower level

Example: Refrigerator

- FR1: Preserve food items by cooling
 - FR2: Provide easy access to food
 - DP21: Horizontally hinge
 - DP22: Vertically hinge
 - DP23: Sliding door
- FR22: User height > 1.5m



Product Specifications – QFD



SUMMARY

- Capture the 'Voice of Customer' – original expressions
- Identify 'Basic Features', 'Satisfiers' and 'Delighters'
- Define the problem clearly
 - avoid ambiguity, don't point to a specific solution
- Specify functional requirements and constraints:
 - Minimum, independent, quantifiable
- Capture relation between FR's and DP's using QFD