

Linking Customer Needs to Product Requirements and Robust Design

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- **Product or Process Excellence**
- **Project Management, PMO**
- **Lean Six Sigma, Design for Six Sigma**
- **Product Lifecycle Management**

Rob is an expert in product development, project management and lean six sigma tools and methodologies, dedicated to improvement of complex products and streamlined business processes. He is a collaborative problem solver with extensive experience and proven success across diverse industries, people, processes and products.

Areas of Expertise:

- Lean Six Sigma
- Project Management / Agile
- Operational Excellence
- Product Lifecycle Process
- Lean Product Development
- Robust Design / DFSS

Professional Experience:

- Synopsys (Director, Operations NPI PM)
- Siemens (Process Excellence Leader)
- Carl Zeiss Meditec (Sr. Consultant)
- Abbott Medical Optics (Sr. Consultant)
- TE Connectivity (LeanPD Leader)
- Honeywell (Lean Six Sigma Blackbelt)

Process Experience:

- End-to-End Value Stream Improvement
- Project Management & Governance
- Product Development
- Product Lifecycle (PLC) Management
- Shop Floor Lean Manufacturing
- Lean Transactional Processes
- Mergers & Acquisition Integration

Currently Available as a Trusted Advisor for:

- Consulting / contract assignments, business process assessments and tools & methodologies training



Rob's Articles can be found at Accendo Reliability:

<https://accendoreliability.com/articles/on-leadership-career/product-development-process-improvement/>



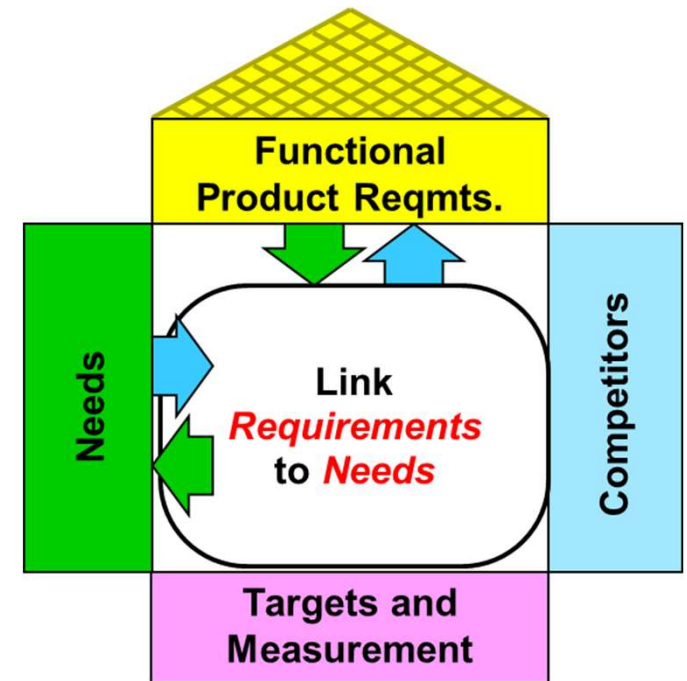
Objectives

- **Understand how to link customer needs product requirements**
- **Determine relative impact of product requirements on the customer**
- **Leverage our knowledge of valid requirements to help ensure robust design**

- **Quality Function Deployment (QFD) Tool**
 - Also known as “House of Quality”
 - Ensures Understanding of Customer Needs & Product Functional Priorities
 - Facilitates a Competitive Design Strategy and Design for Customer Value
- **Design Failure Modes and Effects Analysis (DFMEA)**
 - How can the design fail to meet requirements?

Quality Function Deployment

“QFD is a method for structured product planning and development that enables a development team to clearly specify the customer’s wants and needs, and then to evaluate each proposed product (or service) capability systematically in terms of its impact on meeting those needs.” – Lou Cohen

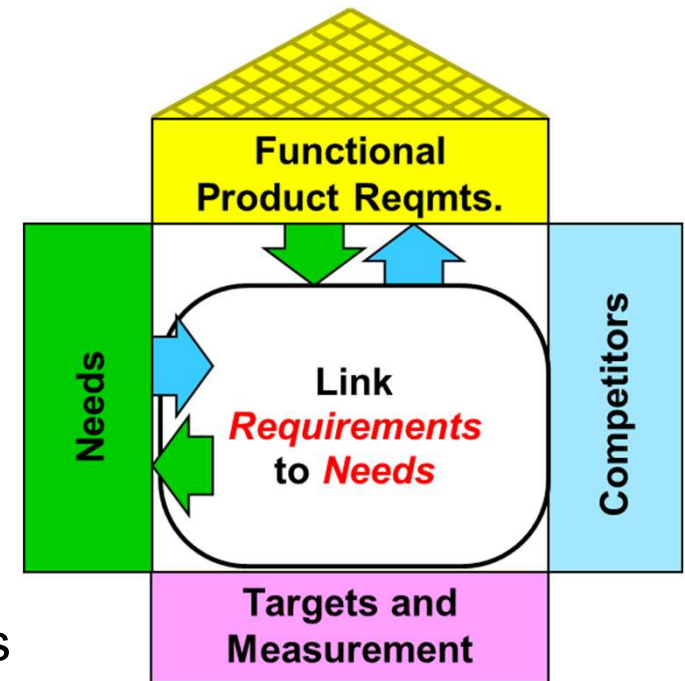


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Key Points:

- Structured, yet customizable methodology
- Produces data-driven understanding of the product to be developed
- Brings together all functions in the organization
- Sets priorities and measurable goals
- Provides critical information to guide the product development
- Focuses is on what the customer truly wants/needs



QFD Focuses the Product Development Team on Customer Value

QFD Example: High Speed Printer

Market/Customer Assessment

| | | Functional Product Requirements | | | | | | | | | Competitive Products | | | | |
|--------------------------------|-------------------|---------------------------------|--------------------------|--------------------|---------------------|-----------------------------|----------------------|----------------------|-------------|----------------|----------------------|-----------|-----------------|-----------------|------------|
| Maximize, minimize, or target | | MIN | MIN | MIN | MAX | MIN | MAX | MAX | MIN | MAX | | | | | |
| | Importance Rating | Misfeed rate / million | Multifeed Rate / million | Jam rate / million | Print rate / minute | Paper Damage rate / million | Maintenance Interval | Print Clarity Rating | Floor Space | Maier Test | Box 2.0 | Xerox 345 | BoxyButGood 200 | Print Majic 100 | Noble 5000 |
| Customer / Market Needs | | | | | | | | | | | | | | | |
| Always provides a print | 6 | 3 | 3 | 3 | | | | | | | 8 | 4 | 4 | 6 | 6 |
| No blank sheets | 2 | 3 | 9 | 3 | 1 | | | | | | 2 | 2 | 4 | 4 | 6 |
| No paper jams | 8 | 9 | 3 | 9 | 3 | 1 | | | | | 4 | 10 | 4 | 4 | 6 |
| Fast printing | 4 | 9 | 3 | 9 | 9 | | | | | | 2 | 2 | 6 | 8 | 2 |
| Easy to clear jams | 6 | 3 | 3 | 3 | | | | | | | 4 | 8 | 2 | 8 | 6 |
| No paper damage | 10 | 9 | 3 | 1 | 1 | 9 | | | | | 4 | 8 | 4 | 4 | 10 |
| Low ownership costs | 10 | | | | 3 | 1 | 9 | | | | 8 | 8 | 4 | 6 | 10 |
| Print appearance / clarity | 5 | | | | | | 1 | 9 | | | 6 | 4 | 2 | 4 | 6 |
| Compact size | 4 | | | | 1 | | 3 | | 9 | | 6 | 4 | 6 | 4 | 6 |
| Scratch Resistant | 6 | | | | | | 1 | | | 9 | 4 | 4 | 6 | 8 | 6 |
| | | | | | | | | | | | | | | | |
| Relative Importance | | 240 | 120 | 160 | 106 | 108 | 113 | 45 | 36 | 54 | 314 | 384 | 250 | 340 | 430 |
| Measurement Units | | Rate / million | Rate / million | Rate / million | Rate / min | Rate / million | Rate / 10 million | Scale 1 to 10 | Sq/Ft | Scale 1 to 100 | | | | | |
| Target value | | 90 | 30 | 100 | 70 | 100 | 1.5 | | 15 | 75 | | | | | |
| USL | | 100 | 50 | 120 | | 110 | | | 18 | | | | | | |
| LSL | | | | | 60 | | 1 | 7.9 | | 60 | | | | | |

Competitive Assessment

QFD Example: High Speed Printer

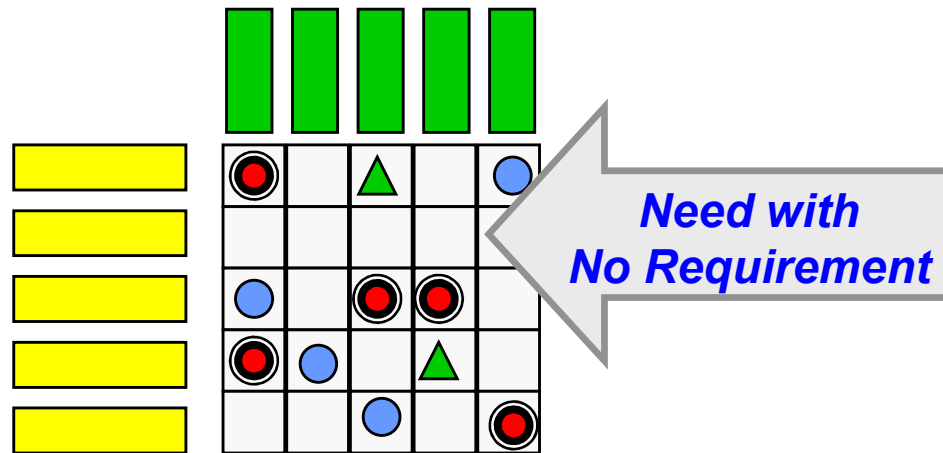
Market/Customer Assessment

(2) Critical to Quality Requirements

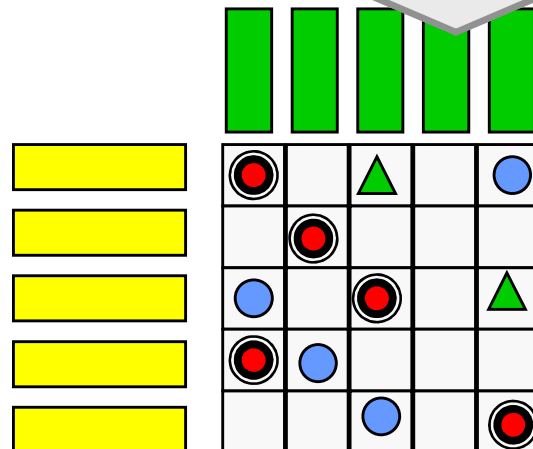
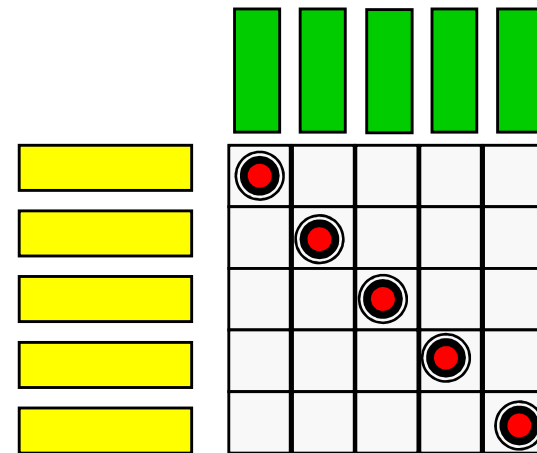
| | | Functional Product Requirements | | | | | | | | | | Competitive Products | | | | |
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| Measurement Units | | Rate / million | Rate / million | Rate / million | Rate / min | Rate / million | Rate / 10 million | Scale 1 to 10 | Sq/Ft | Scale 1 to 100 | | | | | | |
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| LSL | | | | | 60 | | 1 | 7.9 | | 60 | | | | | | |

Competitive Assessment

Reviewing the QFD relationship matrix



Have some relationships been overlooked?



- Each customer need should have at least one strong relationship
- Offering functional product requirements without at least one strong relationship should have a low rank
- Check whether any need or functional product requirement seems to have “too many” or “too few” relationships
- *Review the rankings... “Does it make sense?”*

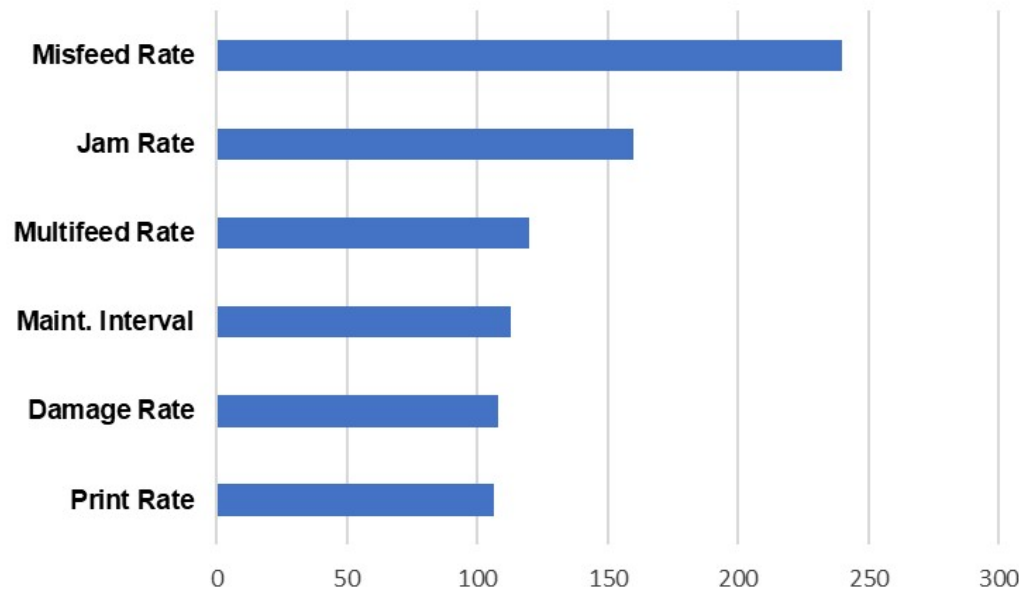


A Word About Validation

- **Validation is the completeness and correctness of product requirements**
- **Build the right product (validation), build the product right (verification)**
- **What is a requirement?**
 - **A statement of what the design shall provide (output) @ input conditions**
 - **Example: Misfeed rate shall be less than 100 per million copies**
 - **Our QFD matrix helped ensure this requirement is tied to customer needs (ie. the requirement is correct, although perhaps not entirely complete)**
 - **What would make this a valid requirement...?**

QFD Example: Copy Machine

• Critical to Quality Requirements Relative Importance:



DFMEA Severity Criteria

- 10 - Misfeed Paper Jam (more difficult to clear, damaged paper)
- 6 - Paper Jam ("clearable", no damaged paper)
- 6 - Issue Requiring More Frequent Maintenance
- 4 - Blank Pages (need to be removed from stack of copies)
- 4 - Paper Damaged (print rerun may)
- 3 - Slow Copy Rate

QFD Knowledge Helps Establish Severity Criteria and Weighting



DFMEA

| Product Requirement | Potential Failure Mode | Potential Failure Effects | S E V | Potential Causes | O C C | Current Controls | D E T | R P N | Actions Recommended |
|--|--|--|---|--|--------------------------------------|---|--------------------------------------|-------------|---|
| What is the product requirement under investigation? | In what ways could the product requirement fail to be fully met? | What would be the impact of the Failure Mode on the customer (internal or external)? | How Severe is the effect on the customer? | What are the potential causes of the failure mode? | How likely is the cause or FM occur? | What existing control(s) either (1) detects the cause (allowing for corrective action), or (2) detects the failure mode before the effect occurs? | How well can you detect cause or FM? | | What are the actions for reducing the occurrence of the Cause, or improving detection? Emphasize actions only on high RPN's. |
| Misfeed rate | Excessive misfeed rate | Paper jam requiring removal of damaged paper, | 10 | Excessive retard friction | 7 | | 4 | 280 | |
| Misfeed rate | Excessive misfeed rate | Paper jam requiring removal of damaged paper, | 10 | Excessive retard brake torque | 5 | | 4 | 200 | |
| Misfeed rate | Excessive misfeed rate | Paper jam requiring removal of damaged paper, | 10 | Indadequate retard brake torque | 10 | Torque sensor accuracy and reliability | 4 | 400 | Redundant torque sensors, fault detection, maintainance, reliability requirement and test |
| Misfeed rate | Excessive misfeed rate | Paper jam requiring removal of damaged paper, | 10 | Premature trigger timing | 7 | | 4 | 280 | |
| Jam rate | Excessuve jam rate | Paper Jam "Clearable", no damaged paper | 6 | Indadequate retard brake torque | 10 | | 4 | 240 | |
| Jam rate | Excessuve jam rate | Paper Jam "Clearable", no damaged paper | 6 | Premature trigger timing | 1 | | 7 | 42 | |
| Jam rate | Excessuve jam rate | Paper Jam "Clearable", no damaged paper | 6 | Indadequate retard brake torque | 7 | | 7 | 294 | |



Summary / Key Deliverables

- **Assess the market for your product, emphasize customer needs & competitive advantage before product requirements (Market Assessment Document)**
- **QFD and Product Requirements Document (PRD)**
- **DFMEA (and design enhancements or actions to ensure robust design)**