



**Developing World Class Products
Building the Right Product &
Getting Requirements Right**

Boulder ASQ Meeting

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DFSS (Wikipedia base)

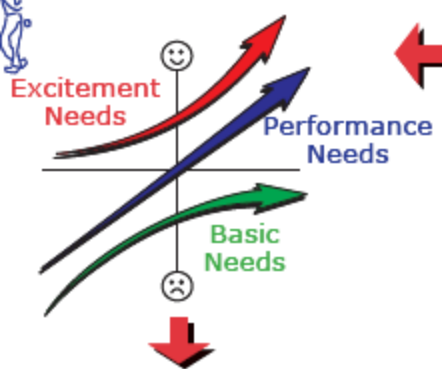
- Determining requirements
- process *generation* over process *improvement*
 - Tools map link

<http://www.c2c-solutions.com/pdfs/C2CRoadmapNP.pdf>

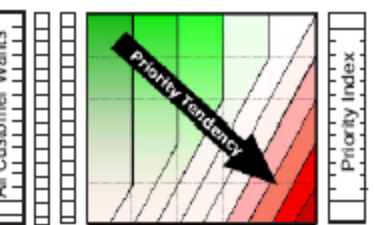


Understanding your customers better than they do! (VOC + MOC)

Video -> www.kanomodel.com



Document & Prioritize Customers' "Needs"

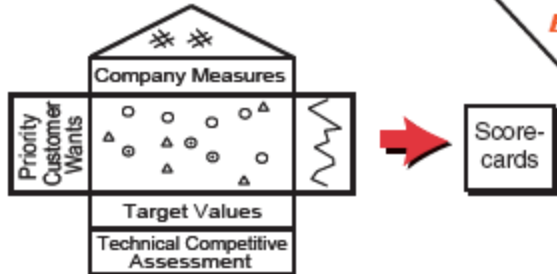


and optional e-QFD "Shortcut/Filter" A Prioritized Hierarchy of Customer Needs

(A) Business Case and Project Plan



(D) Develop Metrics and set Product Goals (HOQ Optional)



E-mail info@c2c-solutions.com for a printable electronic copy of the latest version of this Flowchart

"Concept to Customer"

(Integrating DFSS "best-practices" into a Product Development)

In the late 20th century leading companies realized that the Product Development Process is as important as the product itself. This process must involve Strategic Thinking, Customer Involvement, Discipline, Advanced Knowledge, Creativity, Speed, and Innovation to ensure a successful product for your Customers. This uniquely structured "C2C Flowchart" integrates leading Design For Six Sigma (DFSS) "tools" which accelerate product introduction and ensures profitable life cycles. Attached is a very brief explanation of the Integration steps. Each step represents a DFSS "proven" technique which additional detailed explanation is available. Detailed explanation for each step is available upon request.

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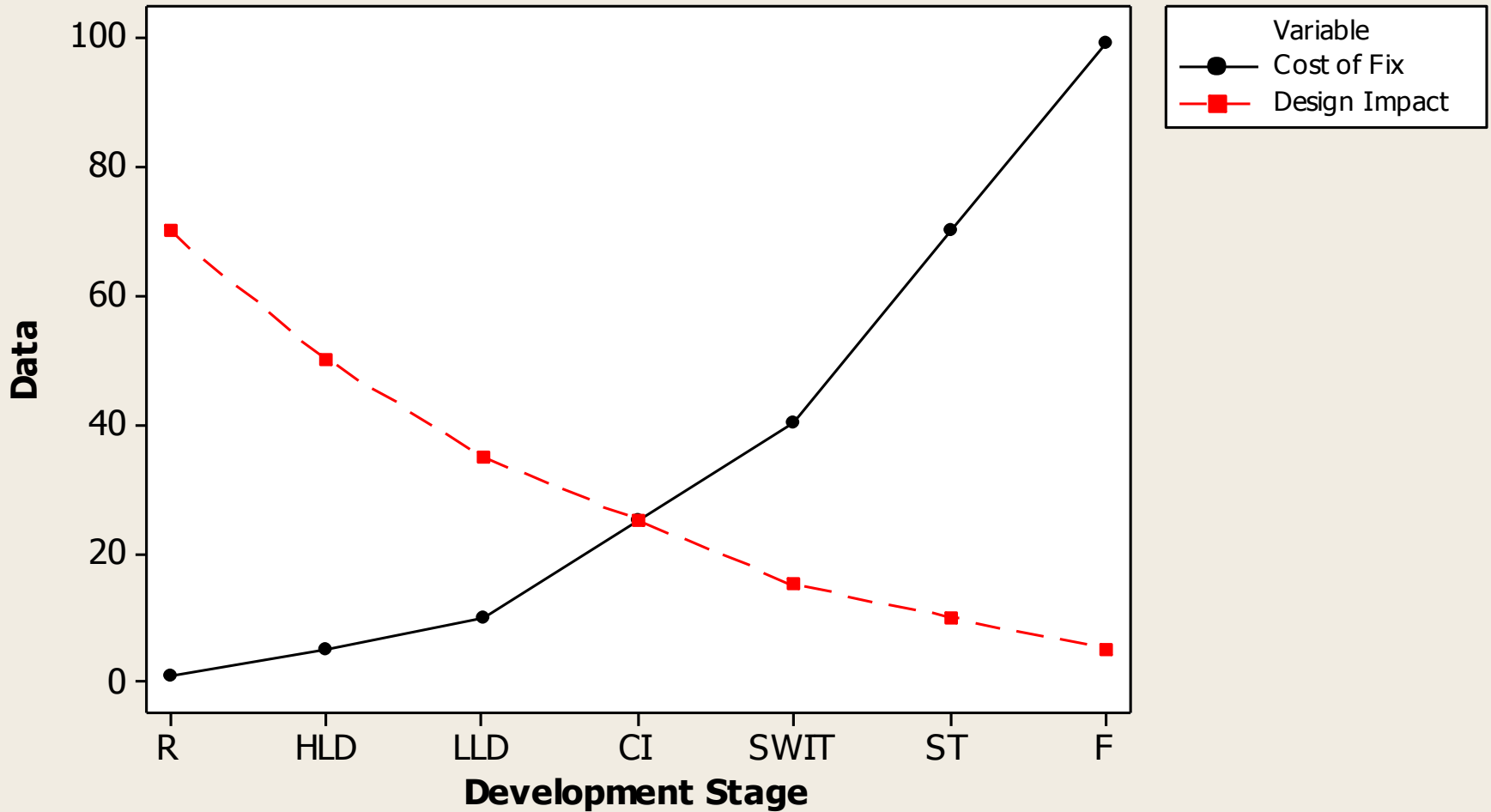
A. Business Case / Project Plan - Here the team explains why it is important to work on this "Project" and develops a plan which includes the Issues, ID Customers, Market, Scope, Goals, Constraints, Strategy, Team Members.

B. Understanding your Customer's Needs - The cornerstone of a successful project. The "Enhanced" Kano Model illustrates three customer needs that must be delivered to the customer: **1) Basic Needs** - unspoken needs, yet unspoken by the customers. **2) Performance Needs** - spoken and consciously evaluated needs that customers value. **3) Excitement Needs** - Are the Innovations, "WOWs", & r... Over 35 strategies exist to "uncover" the Voice of the Customer and truly understand the "Mind" of the Customer (MOC).

C. Document & Prioritize the Customers' Needs - A well documented and prioritized list of requirements...



Figure 6: Time Series Plot of Cost of Fix, Design Impact



1. Department of the Navy, NAVSO P-3679, Producibility Measurement Guidelines , August 1993



Six Sigma

- *Six Sigma is a process of asking questions that lead to tangible, quantifiable answers that ultimately produce profitable (trustworthy) results*

Mikel Harry

Question Requirements, **Question** Data, **Question** Process, **Question** Assumptions – Samuel Keene



Six Sigma focus systematically using:

1. Cognitive tools
 - Eg., Mind Map, Flow charts, Swim Lane
2. Analytical tools
 - Eg., FMEA, FTA, QFD
3. Statistical decision support tools
 - Special Cause vs Common Cause



Notorious Failures (assignable cause)

- Jupiter Fly by – Programmed to switch power supplies if communication not received within in 7 days (15 year mission)
- Mars Climate Orbiter (1998) *mix of metric and Imperial units*
- FP&L 2008 power outage: “SW performed exactly as it was programmed to do”



Allegedly, The
first time the F-
15 Crossed the
equator

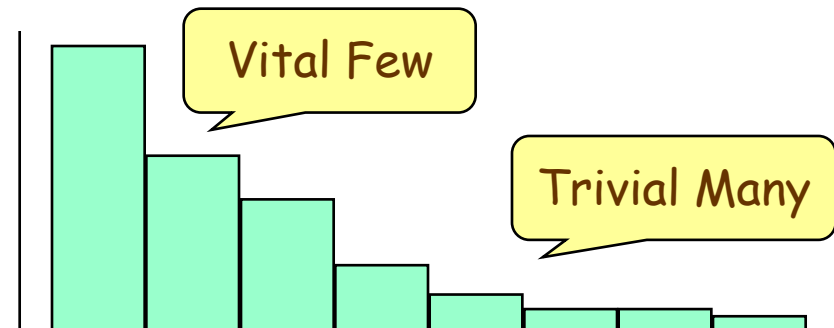




Pareto Principle

- **Vilfredo Pareto - Italian economist from the 1800's**
“Very few parts cause most of the system problems”
- **80% of the problems are linked to only 20% of the causes**

- **Sometimes 99%, 1%**



- **Focus on: Important, New, Critical, and Difficult**



Biggest System Challenge

Systems Management – Brendan Murphy

1. Requirements Challenge

- Needs Data
- Context Data

2. Interface Challenge

“Tell people not just so they understand, tell them so they cannot misunderstand” (Mark Twain)

3. Managing Changes (Keene)

Design Understandability

Situational awareness

Manage unintended consequences

Configuration control



Small Changes are Error Prone with unintended consequences

<u>LOC Changed</u>	<u>Likelihood of error</u>
1 line	50%
5 lines	75%
20 lines	35%

Classic Example: DSC Corp, Plano Texas,
3bits of a MSLOC program were changed
leading to municipal phone outages in major
metropolitan areas

Edwards, William, "Lessons Learned from 2 Years Inspection Data", Crosstalk Magazine, No. 39, Dec 1992, cite: Weinberg. G., "Kill That Code!", IEEE Tutorial on Software Restructuring, 1986, p. 131.



Accurately capturing requirements is the major factor in the failure of 90% of large software projects

- Davis, C. J., Fuller, R. M., Tremblay, M. C., & Berndt, D. J. (2006). Communication challenges in requirements elicitation and the use of the repertory grid technique. *Journal of Computer Information Systems*, 78.

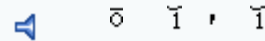


DFSS Tools Aid Requirements Development

- **Situational awareness** – (Environmental focus)
- **Navigability** - (internal consistency, interfaces)
- **Product understandability** to reduce interoperability problems and improve the robustness to design changes. This also helps in assessing the completeness of the design and identifying improvement opportunities.
- **Compact focus** to see the overall design in a single view or a more limited view (if more frames are required)
- **Differing System Views** to get “fresh” examinations of the system under development, looking for improvement opportunities and design completeness.



ho·lis·tic _ (h -l s t k)



- a. Emphasizing the importance of the whole and the interdependence of its parts.

- b. Concerned with wholes rather than analysis or separation into parts: holistic medicine; holistic ecology.

Note: Safety, security, reliability, and survivability are system attributes



Presentation Goals

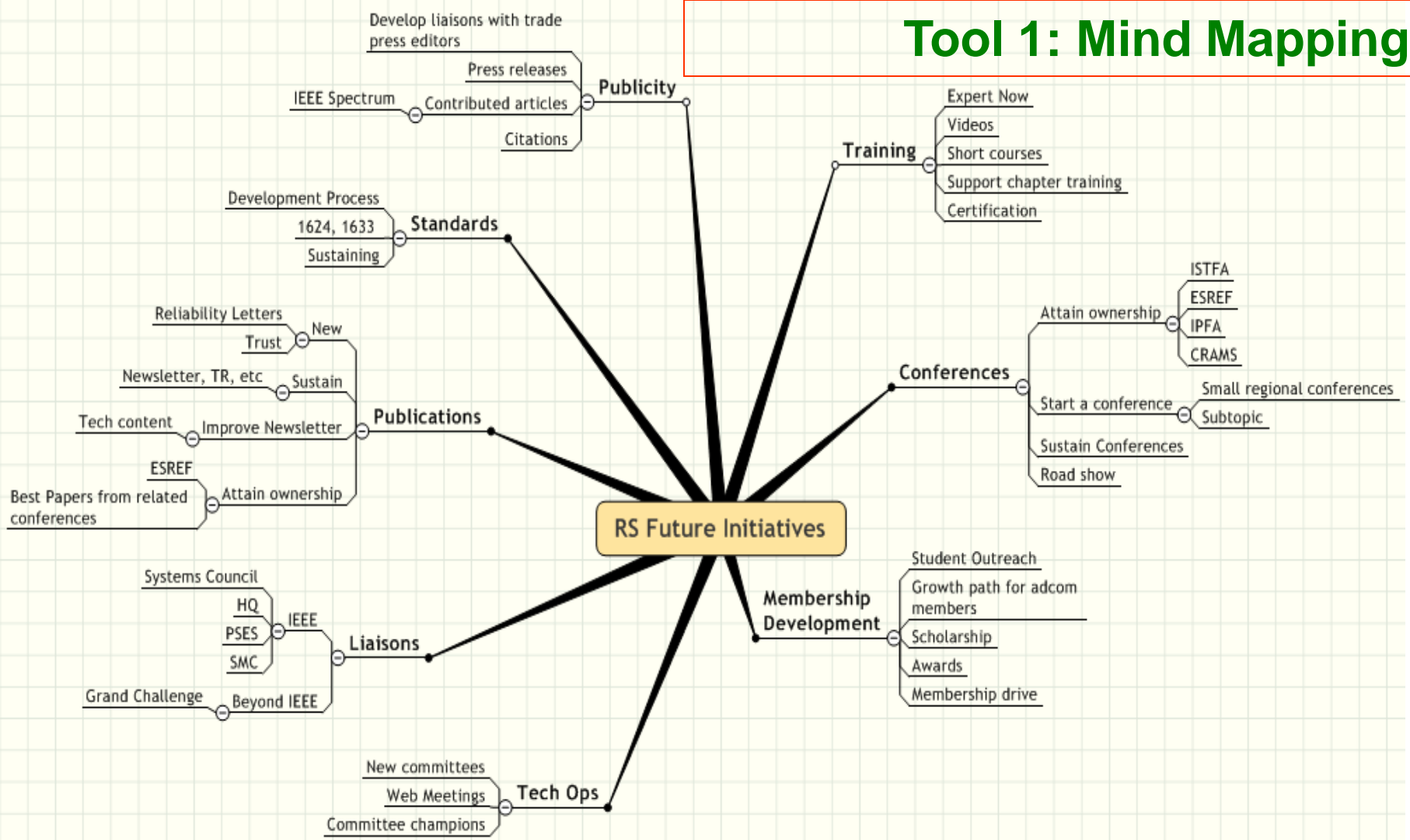
- “DFSS tools” focus for requirements development, team building, product understandability, and robustness
 1. Mind map
 2. Kano
 3. GQM
 4. Defect Prevention Process
 5. QFD
 6. Pair Programming



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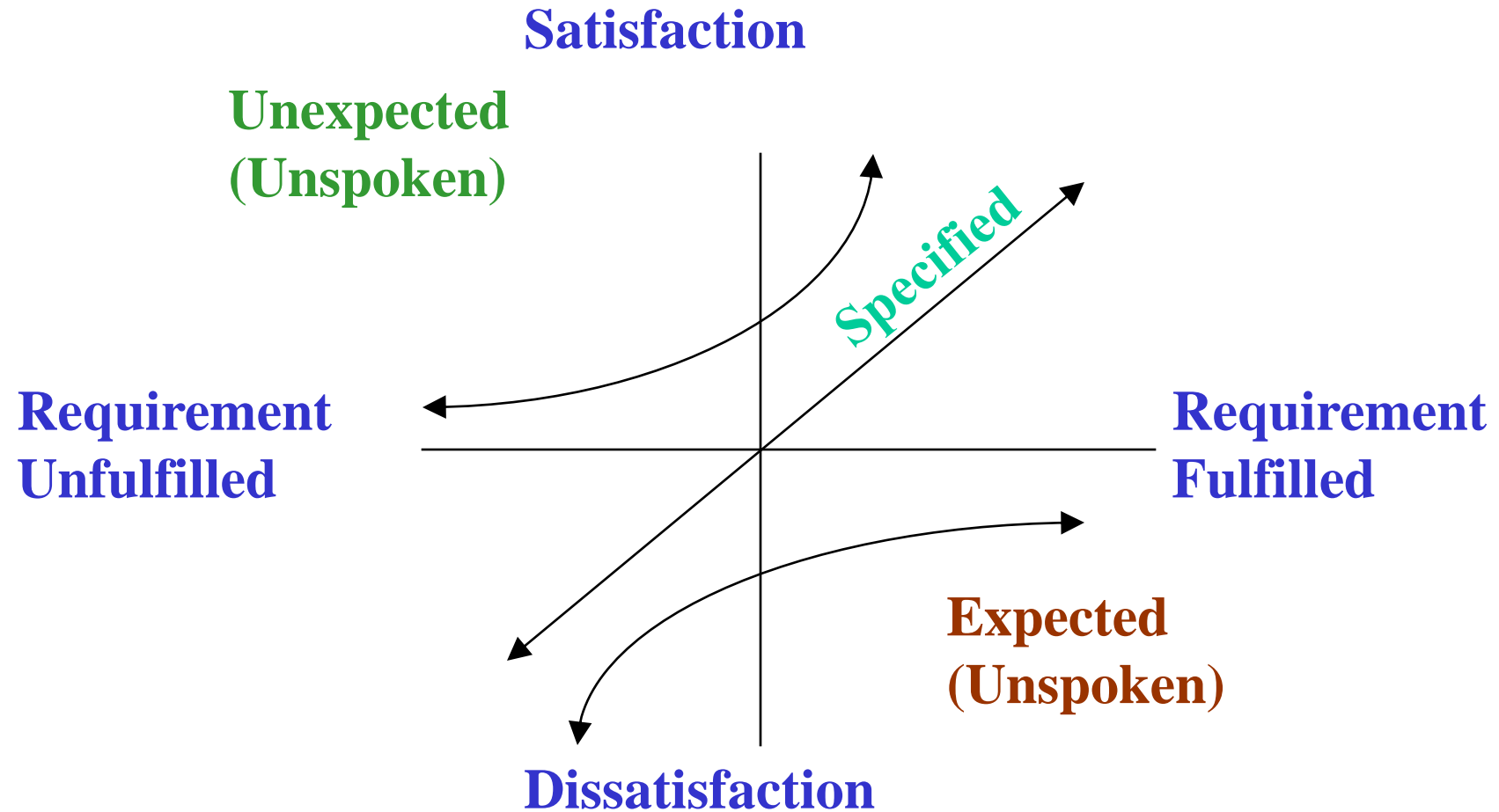
Keene & Associates

Tool 1: Mind Mapping



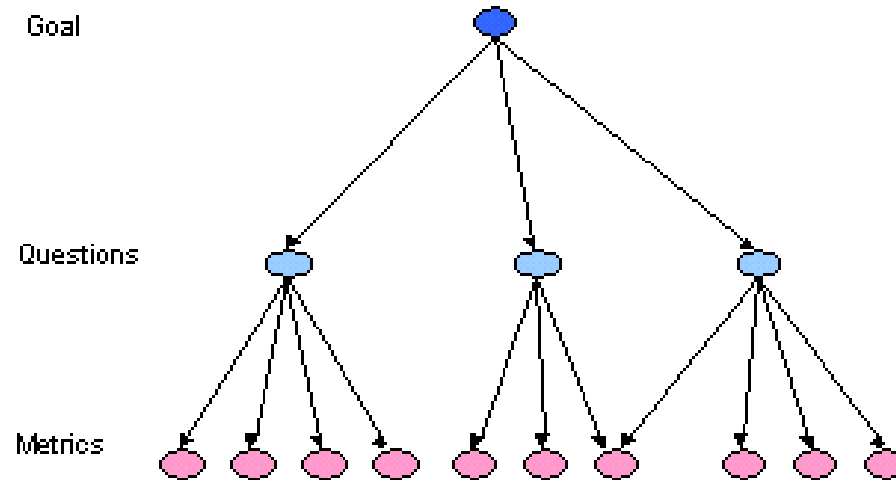


Tool 2: Customer Fulfillment: Kano Diagram





Tool 3: Goal – Question – Metrics (GQM)



Metrics drive behavior: right metrics drive the right behavior

Metrics should answer questions of interest

Ratio (variable) measures are the best metrics

Plan tool usage and action plans



Tool 4: Defect Prevention Process (DPP)

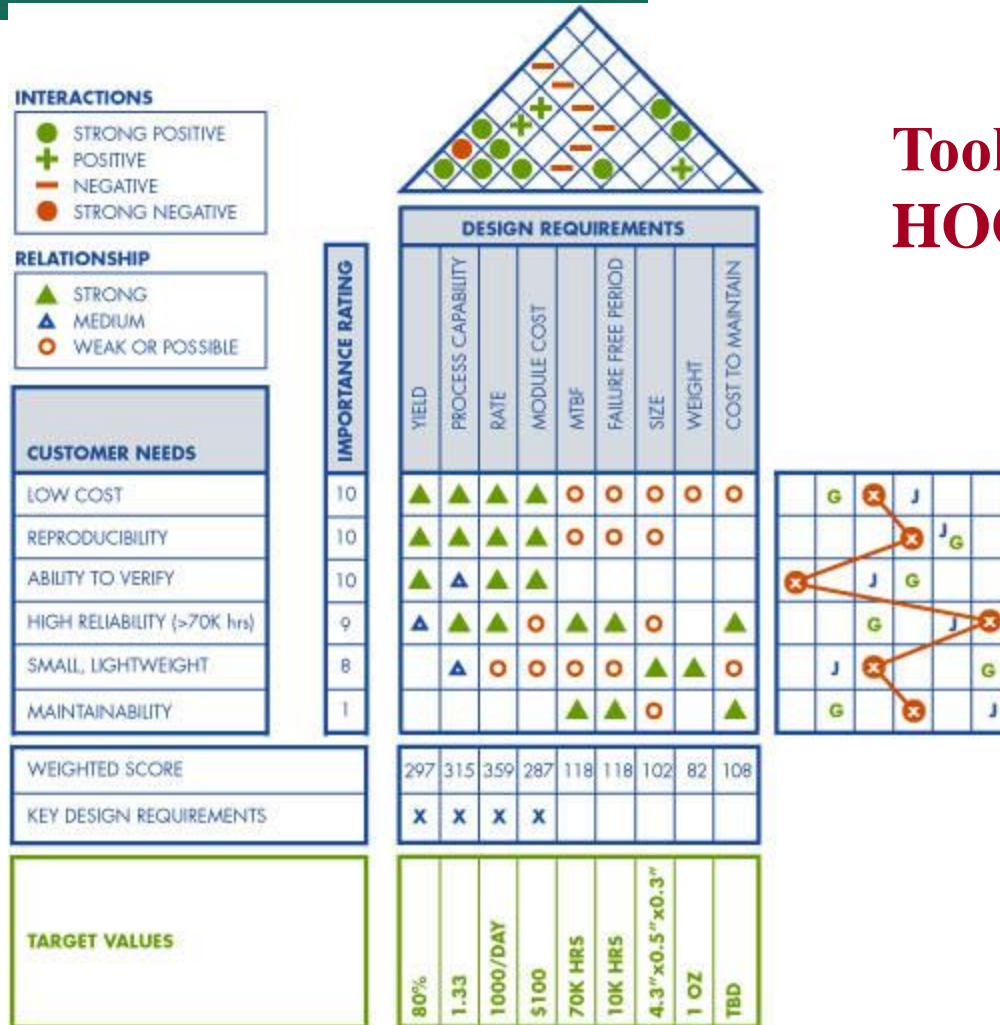
- Diagnose Pareto significant failures
 - Frequency
 - Severity
- Understand underlying fault
 - Parse similar faults
 - How to preclude or mitigate
 - How to detect sooner
- Teach JIT fault avoidance by phase
- Stop/Start problems
- **Six Sigma fixes product and the process**



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Tool 5: QFD's HOQ





Valuable Links

- *RISKS-FORUM Digest* _ Peter G. Neumann
- Standard for Software Reliability Prediction
IEEE_P_1633
- [IEEE 90] Institute of Electrical and Electronics Engineers. *IEEE Standard Computer Dictionary: A Compilation of IEEE Standard Computer Glossaries*
- iSixSigma.com
- Edward Tufte (the Leonardo Da Vinci of data)