Six Sigma Requirement Development Tools Assure More Reliable Software

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Abstract

- Getting good product requirements and have them understood across the development team is the number 1 system challenge. These problems contribute to 90% of the today's critical system issues. Design for Six Sigma gives us a set of tools to better develop system requirements, promote their cross functional understanding and establish system requirements traceability. This presentation introduces 5 such development aids.

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 Orbitor (1998) *mix of metric and Imperial units*
- *FP&L 2008 power outage: "SW performed exactly as it was programmed to do"*

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

LOC Changed	Likelihood of error
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.

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

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)

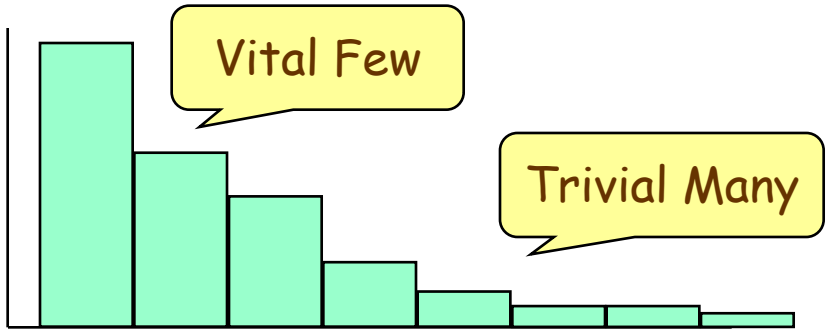
a. Emphasizing the importance of the whole and the interdependence of its parts.

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

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

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%**

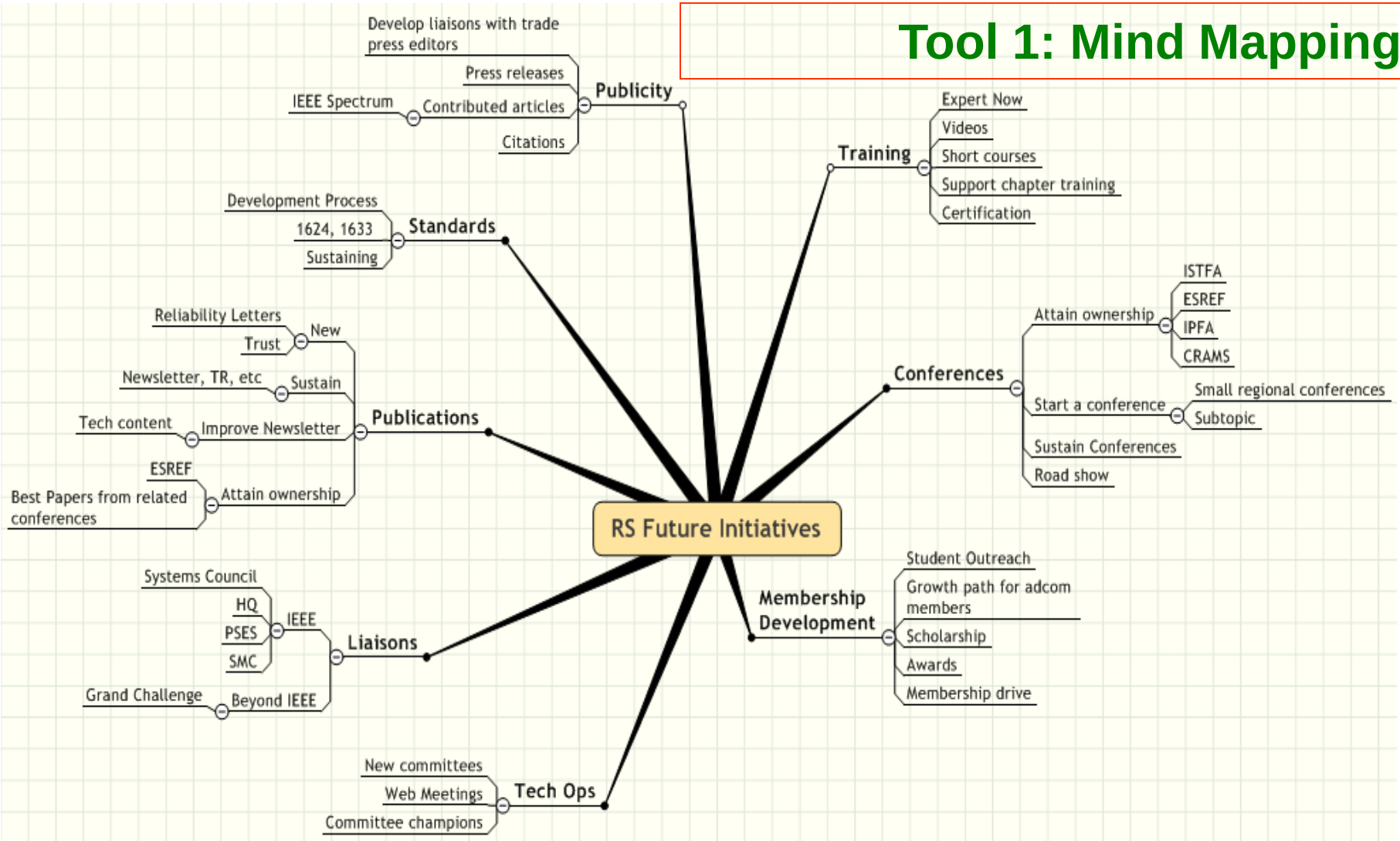


- **Focus on: Important, New, Critical, and Difficult**

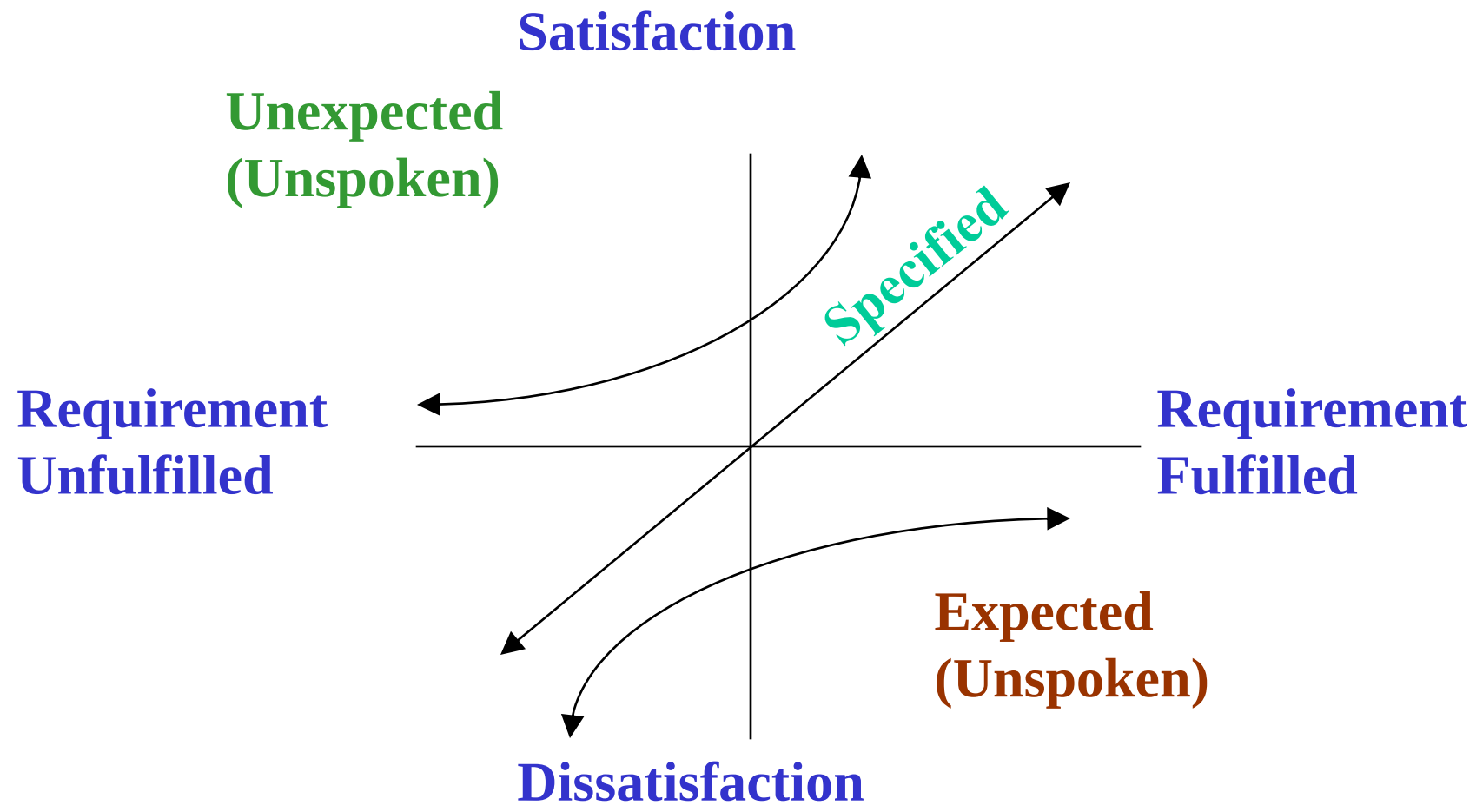
Presentation Goals

- "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

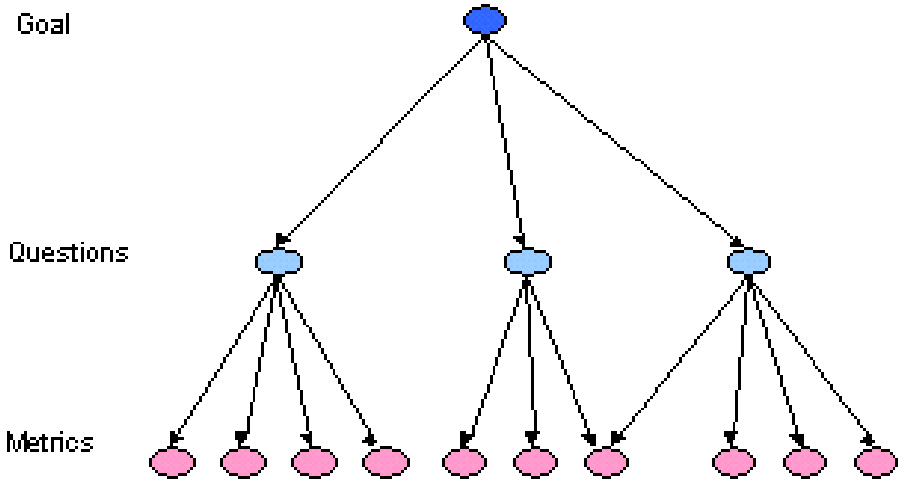
Tool 1: Mind Mapping



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

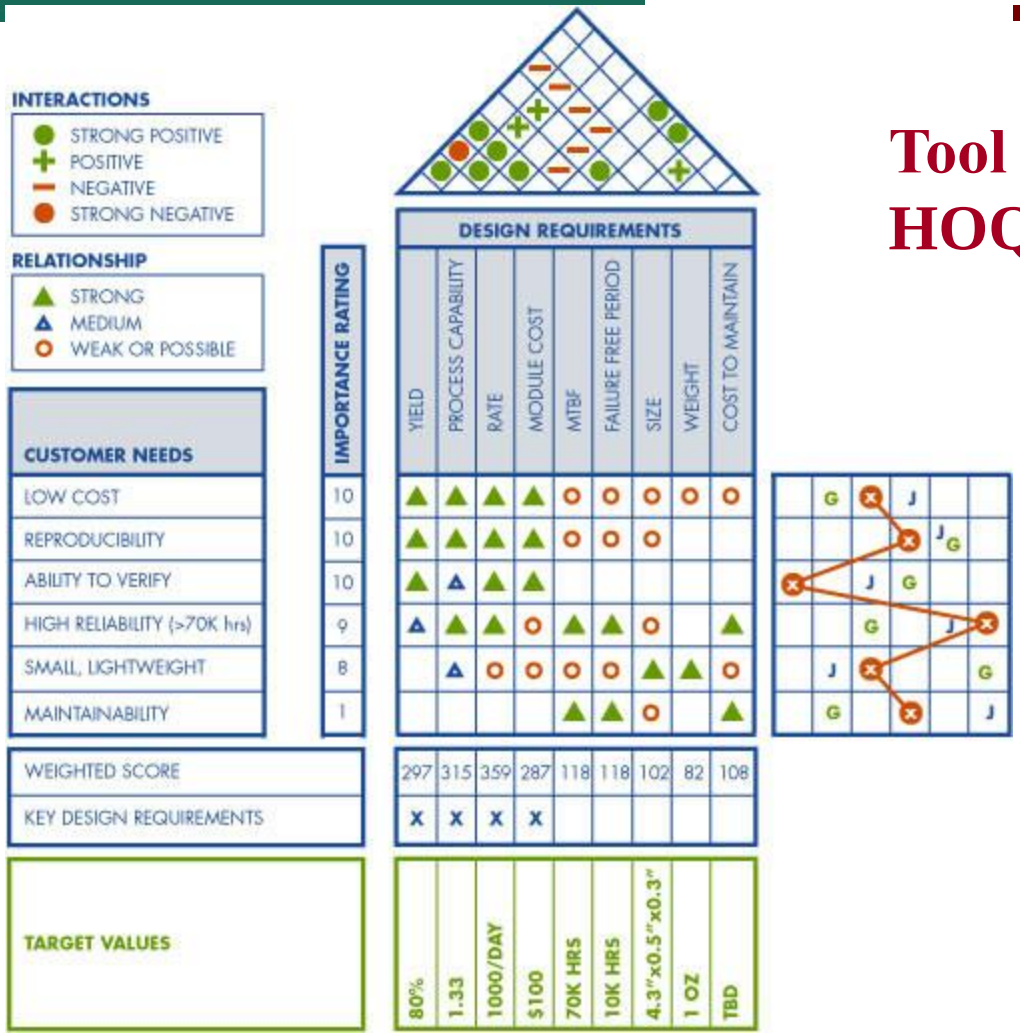
Ratio (variable) measures are the best metrics

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

Tool 5: QFD's HOQ

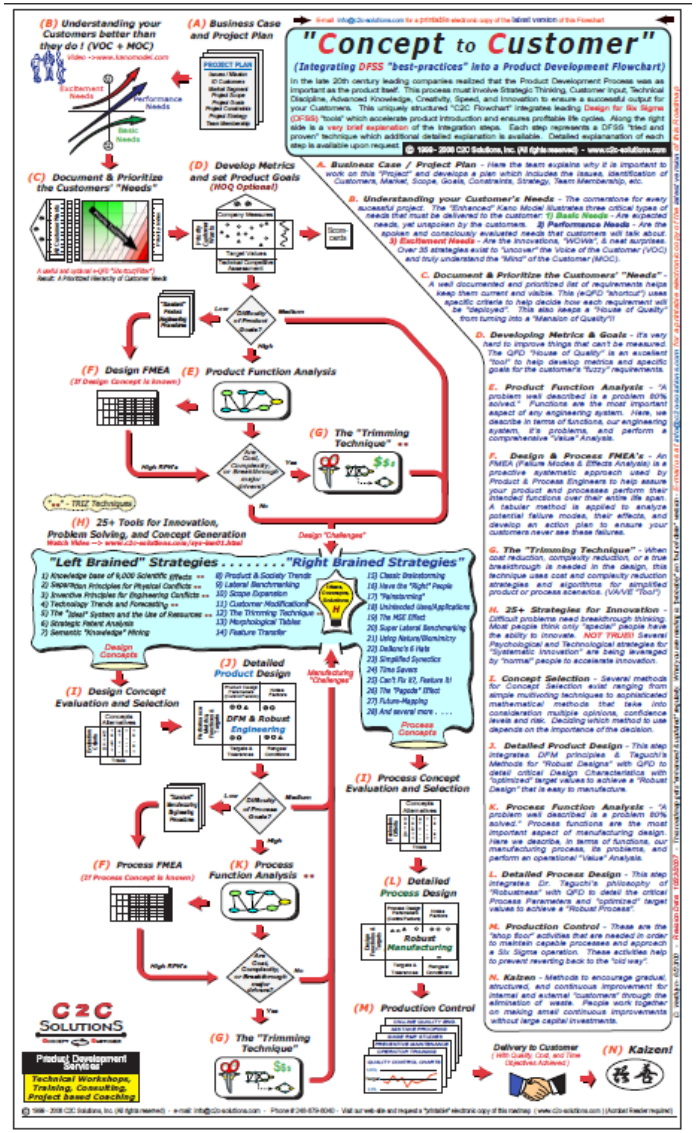


Source: American Society for Quality. *ASQ Six Sigma Black Belt online learning course, Release 2.3.* ASQ 2006

DFSS Focus

- Process *generation* over process *improvement*
- Requirements development focus
- Requirements allocation and flowdown
- Cross functional development and process/product visualization tools

- Tools map link
- **http://www.c2c-solutions.com/pdfs/C2CRoadmapNP.pdf**


"Concept to Customer"
(Integrating DFSS "best-practices" into a Product Development Flowchart)
(A) Business Case and Project Plan
(B) Understanding your Customers better than they do ! (VOC + MOC)
(C) Document & Prioritize the Customers' "Needs"
(D) Develop Metrics and set Product Goals (HOQ Optional!)
(E) Product Function Analysis
(F) Design FMEA
(G) The "Trimming Technique" **
(H) 25+ Tools for Innovation, Problem Solving, and Concept Generation
"Left Brained" Strategies . . . . . "Right Brained Strategies"
(I) Design Concept Evaluation and Selection
(J) Detailed Product Design
DFM & Robust Engineering
(K) Process Function Analysis **
(F) Process FMEA
(I) Process Concept Evaluation and Selection
(L) Detailed Process Design
Robust Manufacturing
(M) Production Control
(N) Kaizen!
Delivery to Customer
C2C SOLUTIONS
Product Development Services
Technical Workshops, Training, Consulting, Project based Coaching

Valuable Links

- *RISKS-FORUM Digest* _ Peter G. Neumann
- Standard for Software Reliability Prediction IEEE_P_1633
- iSixSigma.com
- Wikpedia (DFSS)
- Mindjet.com (Mindmap)
- Edward Tufte (the Leonardo Da Vinci of data)