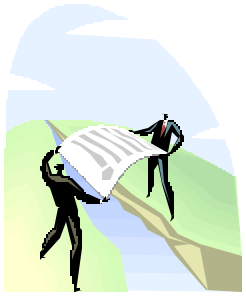
6σ Six Sigma in Research & Development

May, 17th 2003

Operations Management, Sydney Graduate School of Management, MBA
Mr. Haxa Does Blogs, http://haxa.blogs.com

Contents

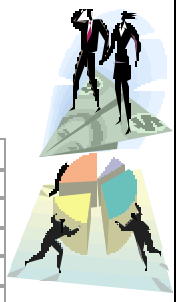
- Elimination of Defects
- 30 Seconds Elevator Speech
- From Shop Floor to Boardroom
- Six Sigma (SS) DMAIC Process
- Design for Six Sigma (DFSS) DMADV & DCCDI Processes
- SS & DFSS Tools
- Shift in SS & DFSS effort for R&D
- SS & DFSS 'Fit' for R&D
- R&D Customers
- Research Quality: Potential Implementation Areas
- Six Sigma R&D Org. Architecture
- Success Factors of SS & DFSS for R&D
- SS & DFFS Challenges for R&D
- Best Practices
- Further Studies



May, 17th 2003

Operations Management, Sydney Graduate School of Management, MBA
Mr. Haxa Does Blogs, http://haxa.blogs.com

Elimination of Defects



Sigma Level	Defects Per Million Opportunities (DPMO)
1	690.000
2	308.537
3	66.807
4	6.210
5	233
6	3.4

Situation/Example	In 1 Sigma World	In 3 Sigma World	In 6 Sigma World
Pieces of your mail lost per year [1,600 per year]	1,106	107	<1
Number of telephone disconnections [7,000 talk minutes]	4,839	467	0.02
Erroneous business orders [250,000 per year]	172,924	16,694	0.9

From Shop Floor to Boardroom

S CRITICAL TO QUALITY
Attributes most important to the customer

S DEFECT
Anything outside of customer specifications

S PROCESS CAPABILITY
What can your process deliver

S VARIATION
What the customer sees and feels

S STABLE OPERATIONS
Ensuring consistent, and predictable processes

S DESIGN FOR 6 SIGMA
Designing to meet customer needs & process capability

30 Seconds Elevator Speech

- A sweeping **'culture change'** effort to position a company for greater **customer satisfaction**, **profitability**, and **competitiveness**
- Six Sigma is uniquely **driven** by the close understanding of **customer needs**, disciplined use of **facts**, **data**, and **statistical analysis**, and **diligent attention** to managing, improving, and **reinventing business process**

Six Sigma (SS)
DMAIC Processes

- **Finding** and **fixing** problems in **existing processes**
- DMAIC/**Existing Product** or **Service**

Define opportunity
Measure performance
Analyze opportunity
Improve opportunity
Control performance

Design for Six Sigma (DFSS)
DMADV & DCCDI Processes

Define
Measure
Analyze
Design
Verify

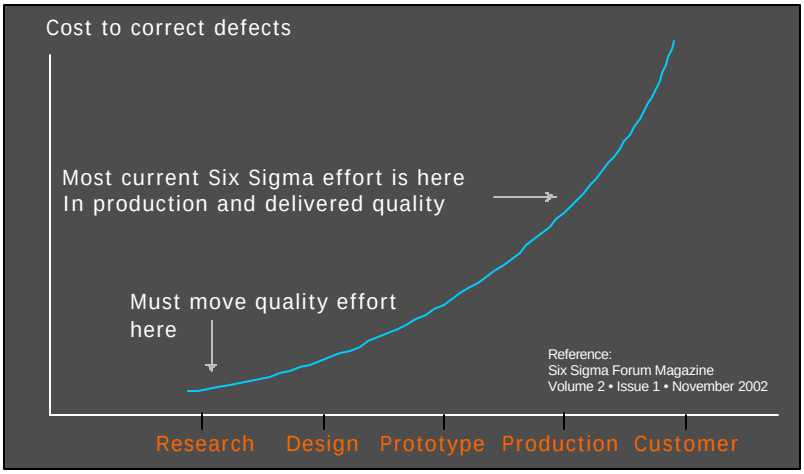
Define
Customer
Concept
Design
Implementation

- Designing **error-free** processes **after fixing** existing processes would **not resolve performance** concerns
- DMADV/**New Product** & **Service** Information

SS and DFSS Tools

- Balanced Scorecard
- Benchmarking
- Supplier, Inputs, Process, Output, and Customer (SIPOC) diagram
- Design for Experiment (DOE)
- Quality Function Deployment (QFD)
- Management (change management, leadership, motivation)
- Metrics (Specific, Measurable, Actionable, Relevant, & Timely)
- Plan, Do, Check, Act (PDCA)
- Process Performance (Cp, CpK)
- Failure Modes and Effect Analysis (FMEA)
- Critical to Quality (CTQs)

Shift in SS & DFSS Effort for R&D

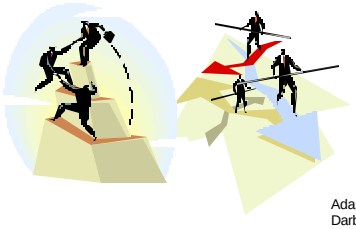


SS & DFSS 'Fit' for R&D

- **Knowledge** is the **main output** of R&D and **scientist** is like **process engine**
- To **value add** the **knowledge production**
- **Sales**, **product feature**, and **productivity** metrics are the most useful and relevant to SS in R&D
- Scientists resisted the use of SS in R&D until the **similarity** between **scientific** method and a key **SS method**, DMAIC (Define, Measure, Analyze, Improve, Control) was **demonstrated**
- **Quantitative nature** of R&D operations makes the application easier to implement

R&D Customers

- **Internal**
  - Manufacturing
  - Marketing
  - Business Unit
  - Corporation
- **External**
  - Direct customer
  - Customer's customer



Adapted from:
Darby (1990) as cited in Improving R&D Performance the Juran Way; Endres, 1997

Research Quality: Potential Implementation Areas

- **Technical Quality**
  - Conformance to good research practices
- **Impact**
  - "Game changer" vs. incremental
- **Business Relevance**
- **Timeliness**
  - Early or late relative to targeted market release

SS & DFFS Challenges for R&D

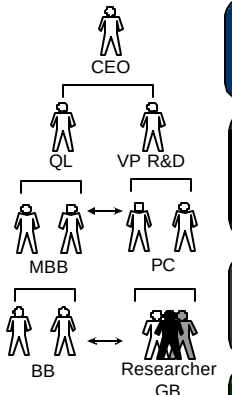
SS & DFSS

- Qualitative applications e.g. legal functions, was found hard to be implemented (GE)
- Not a simple process – many requirements and implementation protocols
- No formal six sigma standards or certifying institutes
- Implementation might be long
- Cost concern on training

R&D

- Slow – long cycle time
- Poorly defined, opaque
- Extend across organizations creating unclear roles
- Inquiry, analysis, and synthesis activities defy systematic improvements
- Little process data collected
- Control not maintained
- Improvements slow and sporadic

Six Sigma R&D Org. Architecture



Quality Leader
-represent customer needs
-improve operational effectiveness
-quality function is separated from manufacturing

Master Black Belt (MBB)
-assigned to specific business function
-work with the Project Champion
-ensure quality objectives are set, education is provided, progress is tracked

Black Belt (BB)
-critical in Six Sigma
-lead quality project full time until complete
-coach Green Belts

Green Belt (GB)
-employees trained in Six Sigma
-can spend 10%-50% of time on project
-progressively include SS methodology in work

Project Champion (PC)
-accountable for project undertaken

Success Factors of SS & DFSS for R&D

- **Commitment** and **leadership** from top of the organization
- **Repeatable** project **selection** and management processes
- Understand **customer's value proposition** very **early** in the **process**
- **Metrics** to prove and track **performance**
- Learning and using **common language** for improvement
- **Adequate funding for** improvement efforts

Best Practices

- **Motorola**
  - SS is registered trademark of Motorola
  - Transformed SS from a quality management tool to business philosophy
  - Documented $16 billion in savings
- **Allied Signal (now Honeywell)**
  - Elevated SS from shop floor to boardroom
- **General Electric**
  - Produces annual benefits of over $2.5 billion from SS
  - Roles for deployment of MBB, BB, and GB

Conclusions

- Six Sigma is **fairly new** to the R&D and early results worth considerations
- Despite its lack of standardization, SS and DFSS proves to be **highly flexible** for tweaking
- Major challenge is that R&D activities **defy the systematic improvement** efforts
- To date, Six Sigma in R&D **prevails for** gigantic firm with **fat R&D budget**
- **Cost of correcting defects increased exponentially** from research to customer stage
- Six Sigma **holistic approach** (from technical to business philosophies) explains why TQM is losing it momentum
- **Cost benefit** analysis of **implementing Six Sigma** should be considered thoroughly prior implementation, as it is **costly** and **timely**

For Further Study

1. Project and participant **selection**
2. **Financial tracking** for Six Sigma
3. Finding the right **business opportunities**
4. Increasing and improving **linkage** to and with **customers**
5. Outlining ways to ensure that the "**voice of the customer**" has **impact** in Design for Six Sigma projects
6. How to build "**multigenerational product thinking**" into SS processes
7. Key **SS metrics** for **R&D**
8. **Delineating** where **SS** does **not apply**
9. **Matching** SS/DFSS **tools to projects**

References

1. Al Endres, *Improving R&D Performance The Juran Way*, John Wiley & Sons, Inc, 1997
2. Tim Studt, *Implementing Six Sigma in R&D*, R&D Research & Development, Reed Business Information, 2002 (Online)
3. Dick Smith, Jerry Blakeslee, *The New Strategic Six Sigma*, TD, September 2002
4. *What is Six Sigma: The Roadmap to Customer Impact*, GE (Online)
5. Albert Johnson, *Six Sigma in R&D*, Industrial Research Institute, Inc, 2002
6. Charles Waxer et al, *What is Six Sigma*, etc,, (Online)
7. Maurice L. Berryman, *DFSS and Big Payoffs*, American Society for Quality, Volume 1, Issue 1, November 2002