

# Statistical Engineering: A Glimpse into the Future

Geoff Vining

Virginia Tech

USA

# Introductory Comment

- This session is really one talk divided into three sections.
- Goals:
  - Introduce Statistical Engineering
  - Its Origins
  - Some Current Examples
  - Future

# Outline of this Section

- The “Missing Link”
- Scientific Method
- Systems Approach
- Core Processes
- Overarching Competencies
- The Journey

# “Missing Link”

- Many Problem Solving – Quality Improvement Strategies
  - Deming
  - CPI
  - TQM
  - Six Sigma
  - Lean Six Sigma
- Flavor of the Month

# “Missing Link”

- Lessons Learned from the Past
  - Interdisciplinary Teams
  - Statistical Tools
  - Organizational Psychology – Team Dynamics
  - Project Management Skills
  - Strong Leadership
    - Senior Leaders
    - Team Leaders
    - Technical Leaders

# “Missing Link”

- Historical Focus: Too Much on Tools
  - Deming: Control Charts
  - CPI, TQM: Teams and the “Magnificent Seven”
  - Six Sigma: Bureaucratic Implementation of DMAIC
- Trouble Seeing the Forest!
- Missing: How to Generalize Solution Strategies
- Starting Point: Scientific Method
  - Shewhart – Deming PDCA
  - DMAIC

# Scientific Method

- Fundamental Approach for Discovery and Problem Solving
- Inductive/Deductive Problem Solving Process
  1. Define the problem (deductive)
  2. Propose an educated theory, idea or model (deductive)
  3. Collect data to test the theory (inductive)
  4. Analyze the results (inductive)
  5. Interpret the data and draw conclusions (inductive)
- Continues until a reasonable solution emerges.

# Scientific Method

- Sequential Learning Strategy!
  - Understand the Real Problem at Hand
  - Define the Problem
  - Discover Solutions
  - Abstract from the concrete to the abstract
  - Develop a theory
  - Test the theory using data
  - Modify the theory as necessary
- Strong Need for Interdisciplinary Collaboration



# Scientific Method

- Data Are the Keys to Successful Application
  - Data collection
  - Data analysis
  - Data Interpretation
- Quality Engineering/Industrial Statistics Are “Handmaiden”
- Very Important in Solving Complex Problems.

# Systems Approach

- A Start: Statistical Thinking
  - All Work Occurs within a Process
  - Note: Systems Thinking
- Missing Element: Systems Approach to the Solution!
- Model: Chemical Engineering
  - Origins of the Chemical Industry: Germany
  - Origins of Chemical Engineering: United States!
- Solution Strategies Must Use a Systems Approach

# Systems Approach

- Strategy for Success:
  - Right Tool
  - Right Job
  - Right Time
  - Correctly Applied
- Tools Are Not Solutions!
- If Your Only Tool Is a Hammer ...

# Systems Approach

- Chemical Engineering
  - Unit Operations
    - Mass Transfer
    - Heat Transfer
    - Chemical Kinetics
  - “Overarching” Methodologies
    - Optimization
    - Process Economics
- Statistical Engineering
  - Core Processes
  - Overarching Competencies

# General Systems Approach

- Identify Problem
- Provide Structure
- Understand Context
- Develop the Solution Strategy
- Develop and Execute Tactics
- Deploy Final Solution

# Systems Approach: Spectrum of Problems

- US DoD F-35, NASA SLS
  - Multiple Years
  - Multiple Projects
  - Strategic, Co-Ordinated Approach
- Roger's Financial Example
  - One Year, Basically Single Project
  - Larger than Six Sigma Project
- Complex Six Sigma Projects
- Solving Basic System Problems

# Core Processes

- Data Acquisition
- Data Exploration
- Modeling
  - Traditional Statistical Methodologies
  - Modern Analytics (Big Data)
- Inference to the Process/Problem
- Deployment of Tentative Solution
  - Does It Work?
  - Is It Sustainable?

# Overarching Competencies

- Data Visualization
- Project Management
- Teamwork
- Organizational Culture



# The Journey

- Solutions Involve a Journey
  - There Is a Well-Defined Road Map
  - However, Each Journey Is Unique
- Success Requires:
  - Teamwork/Collaboration
  - Proper Blend of Skills
  - Proper Understanding of the Tools and Their Roles
  - Proper Understanding How to Deploy the Tools Strategically
  - Strong Leadership!

# The Journey: ISEA

- New Professional Society
- Focus: The Emerging Discipline of Statistical Engineering
- Business Model Based on ENBIS
  - Web Based
  - Free Individual Memberships
  - Paid Organizational Memberships
- First Major Meeting in October
- Website: [isea-change.org](http://isea-change.org)

# The Future

- Success Requires Providing Value to Organizations
- Solving Complex Problems Provides Great Value
- Current State: Focus on Limited Number of Tools
- Future State: How Do We Use the Tools Most Effectively
  - Most Understand the Full Range of Tools Required
  - Most Understand Best Practices for Using the Tools
  - Must Understand How to Deploy the Tools Strategically
  - Must Understand Leadership in the Broad Sense
- The Future Is a Journey!