



Accelerating the Six Sigma Learning Process using Statgraphics Centurion

ABI Associates, Inc.

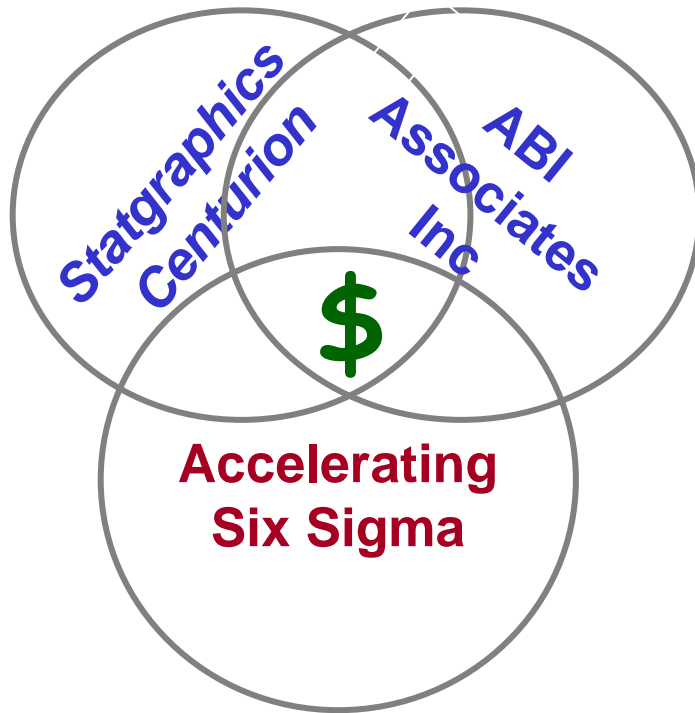
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Statgraphics Centurion™ and ABI Associates, Inc.

Can HELP Your Business **INCREASE PROFIT!**



- Statgraphics Centurion includes the framework for Six Sigma Implementation
- Statgraphics Centurion & ABI –the perfect link for Six Sigma Training & Application
- ABI applies Statgraphics Centurion with proven methods for your business
- ABI applies Over 50 years of combined Engineering / Management Expertise



ABI is Applied Business Improvement

- First and foremost, we listen to the **Voice of the Customer**..... to Customize our training for **you**
- Generally, we start with our traditional **Six Sigma Executive Overview**
- **Black Belt** or **Green Belt** Training is our main focus
- **Statgraphics** is the key ingredient.....
to Reinforce & Simplify our Training



Six Sigma is

....an Improvement System Focused on Driving Business Success

- **Customer focused business strategy**
- **A disciplined data-driven approach for eliminating defects**
- **A statistical measurement - 3.4 DPMO**
- **A dedication to meeting customer requirements**
- **A philosophy, culture change for greater customer satisfaction**



Why Six Sigma Works

- **Customer and Process Focus**
- **Senior Management Involved**
- **Disciplined Approach Used**
- **Short Project Completion Times (3 to 6 months)**
- **Clearly Defined Measures of Success**
- **Infrastructure of Trained Individuals (Black Belts, Green Belts)**
- **Sound Statistical Approach Used**
- **Bottom Line Results**



Six Sigma Business Successes

- **Cost Reduction**
- **Market Share Growth**
- **Defect Reduction**
- **Culture Change**
- **Productivity Improvement**
- **Customer Relations Improvement**
- **Product and Service Improvement**
- **Cycle - Time Reduction**

Six Sigma Goal is Business Improvement



Motorola's Early Experience With Six Sigma

- **Five-fold growth in sales**
- **Profits increased 20 percent per year**
- **\$14 billion in cumulative savings**
- **Stock price gains compounded at 21% annual rate**

Motorola set the original Six Sigma Benchmark



After Motorola.....

Many other Companies and Industries have Embraced Six Sigma achieving Greater Customer Satisfaction and Improved Profitability

- **Texas Instruments**
- **GE**
- **Allied Signal/Honeywell**
- **Black and Decker**
- **DuPont**
- **Caterpillar**
- **Polaroid**
- **Boeing**
- **Federal Express**
- **Sony**
- **Toshiba**
- **Nokia**
- **Healthcare**
- **Education**
- **Government**
- **Other Service - IT**

And the Journey Continues!

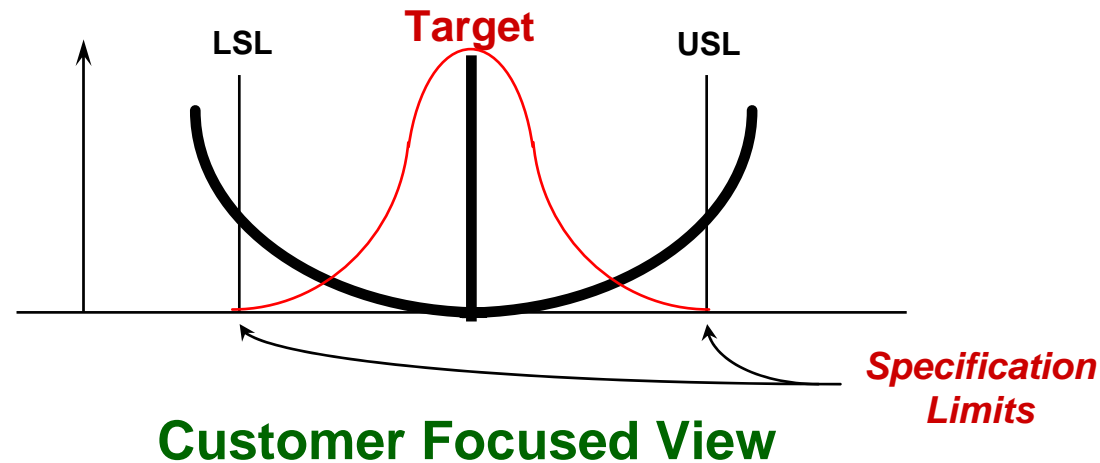


Six Sigma Success Stories

- **GE (Mid 1990's)**
 - Jack Welch: CEO – implemented 6s in 1996 to be aligned with GE's business needs
 - Creates knowledge leading to higher quality products in less time than the competition.
 - Significant bottom-line benefits to the company.
 - The GE 1997 annual report - Six Sigma delivered more than \$300 million to operating income
 - Medical – 10X increase in the life of CT scanner x-ray tubes
 - “Super Abrasives” (Industrial Diamond Business) – quadrupled their return on investment
 - Railcar Leasing – 62% reduction in turnaround time at repair shops. Additional 50% later.
 - Plastics – 300 million pounds of new capacity (“free plant”). Saved \$400 million in investment.
- **Other Six Sigma Success Stories**
 - **Raytheon** – 25% of sales spent fixing problems at 4sigma; 1% predicted at 6sigma level.
 - **Allied Signal** – \$85 million plant not needed; \$30–\$50 million savings per year.
 - **Lockheed Martin** – Could not solve problem by traditional methods; now saves \$14k per jet.
 - **Yale – New Haven Hospital** - Measurable success in improving service levels, cost productivity and customer satisfaction



Variability Drives Cost



- Any deviation from target will result in losses
- The further from target the greater the cost

Any Variation from Target will Increase Costs

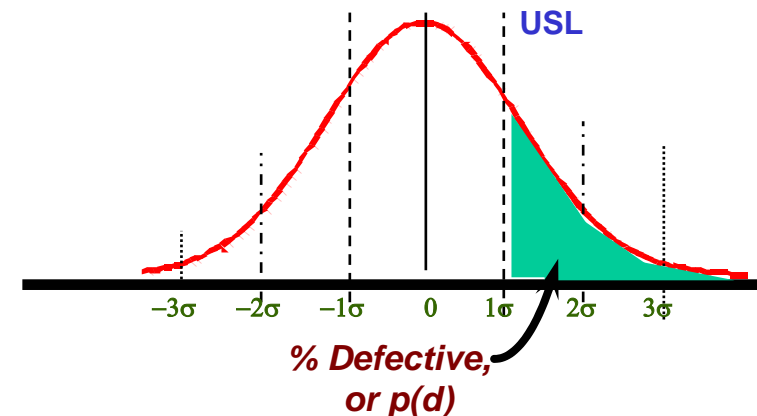


Statistically Speaking, What is Six Sigma?

- Plot Sample data as a Histogram
- Draw the Normal Distribution curve over the histogram, described by its **Mean** (location) and **Standard Deviation or Sigma** (spread).
- The “bell shaped curve” is used to identify the probably of a defect.
- A Six Sigma level process limits defects to 3.4 per million opportunities – virtual defect-free performance.



Calculate Mean,
& Sigma





Examples of Sigma Levels

<u>Sigma Level</u>	<u>Sports</u>	<u>Spelling</u>	<u>Time</u>
3	1 putt missed per round	1.5 misspelled words per page in a book	3.5 months per century
4	1 putt missed per 9 rounds	1 misspelled word per 30 pages	2.5 days per century
5	1 putt missed per 2.33 years	1 misspelled word in a set of encyclopedias	30 minutes per century
6	1 putt missed per 163 years	1 misspelled word in all the books in a small library	6 seconds per century

99.9 Percent Yield (Sigma Level ~4.5) May Not be Good Enough

20,000 Wrong Drug Prescriptions per Year

25,000 Newborn Babies Dropped per Year

2 Short / Long Landings at O'Hare Airport per Day

500 Incorrect Surgical Operations per Week

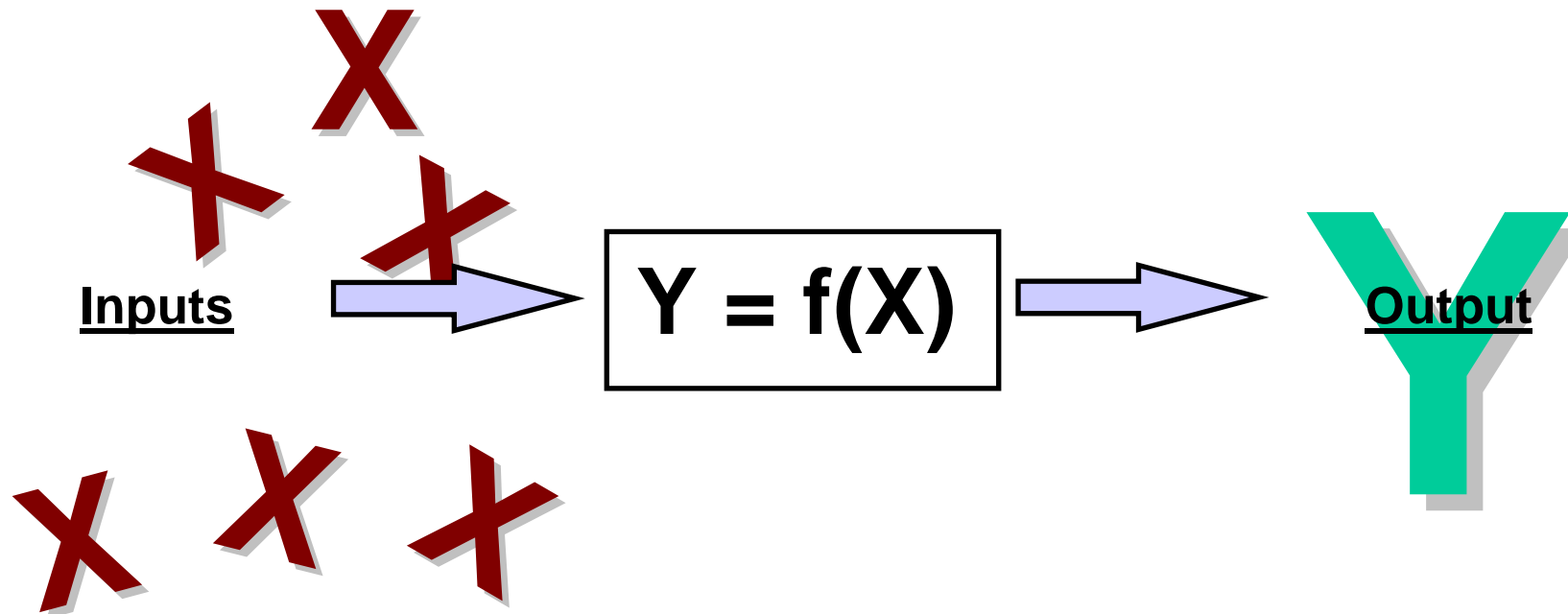


Six Sigma Savings and Cost Breakdown

- **Direct**
Revenue (Price, Growth, Capacity)
Material Cost (Price, Material Productivity, Services)
Conversion Cost (Productivity, Overhead)
Base Cost (Engineering, Warranty, Concessions)
Other Income (Taxes)
- **Indirect**
Conversion (Productivity reductions)
Base Cost (Engineering savings)
- **Avoidance** *(Direct, Balance Sheet Plant & Equipment, Tooling)*
- **Implementation Cost**



Cause and Effect *Inputs Determine the Output*



Key Six Sigma Concept

Process Output (Y) is Function (f) of its Inputs (Xs)



The Process for DMAIC Six Sigma Projects

Define -

Listening to the Voice of the Customer

- Prerequisites (Philosophy, Mgmt buy-in)
- Y=f(X) Concept & Strategy
- ID Team / Key Constituents
- Project Statement (4 Boxer.ppt)
- Process Mapping/ Risk Assessment
- Quality Function Deployment (QFD)
- Financial Analysis

Measure

Measuring Current Process Health

- Define Performance Standards
- The Y's (CTQ's) & the Z's
- 7 Basic Tools (Pareto Analysis, Run Chart, Scatter Diagrams etc.)
- Fishbone Diagrams
- Validate the Measurement System
- Establish SPC and Process Capability
- Establish Tolerance Limits

Analyze

Identifying important causes of the defects

- Multiple Box-Whisker
- Regression Analysis (y vs x)
- ANOVA / Components of Variance
- Hypothesis Testing
- Chi Square Testing
- Screening Designs

Improve

Removing the causes of the defects

- Fishbone Revisited
- Sequential Design of Experiments (DoE)
- Error Proofing
- Revisit Tolerance Limits

Control

Maintaining the improvements

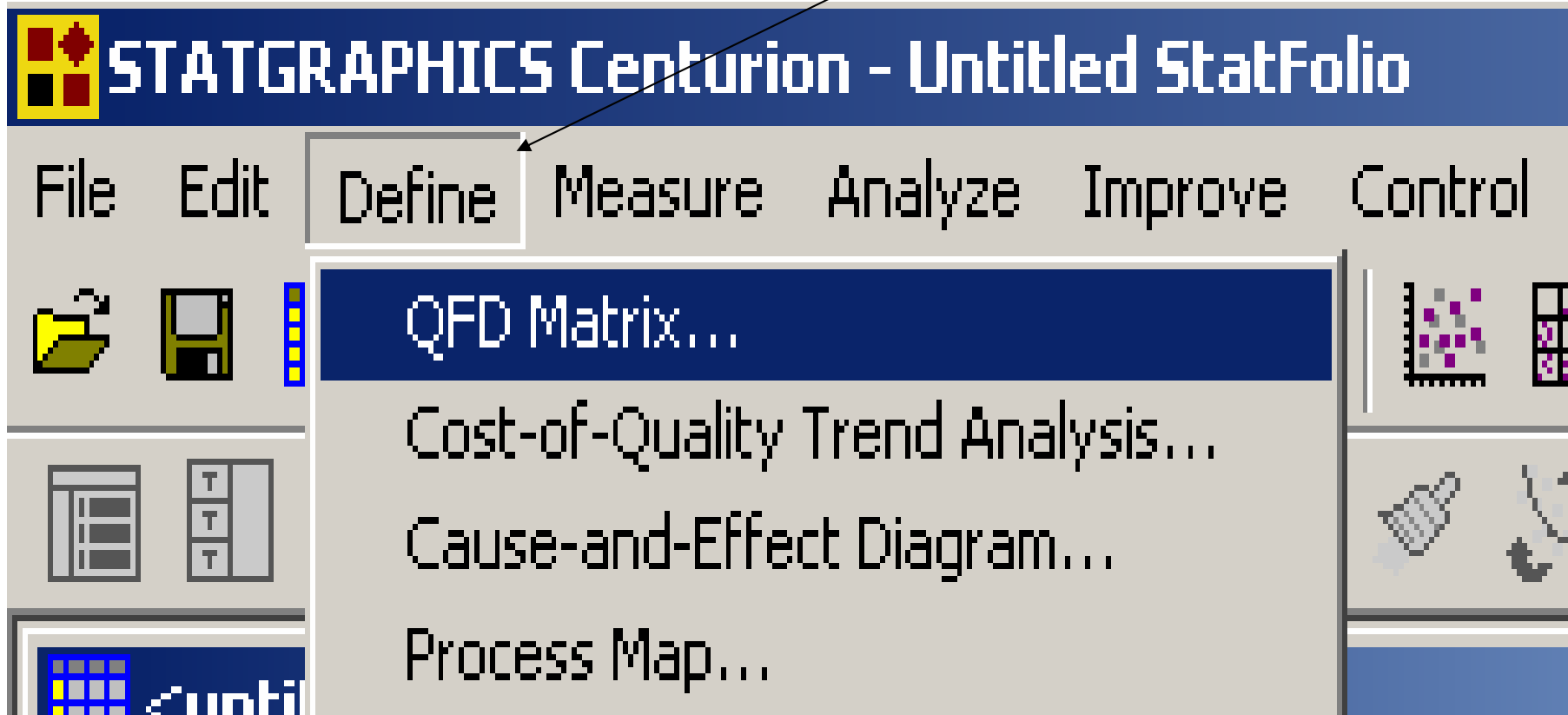
- Statistical Process Control (reduced inspection)
- Capability Monitoring
- Failure Mode Effects Analysis
- Action Plans



Using the Six Sigma (DMAIC) Model in Statgraphics Centurion



The new Statgraphics Centurion Six Sigma Menu Option - Define



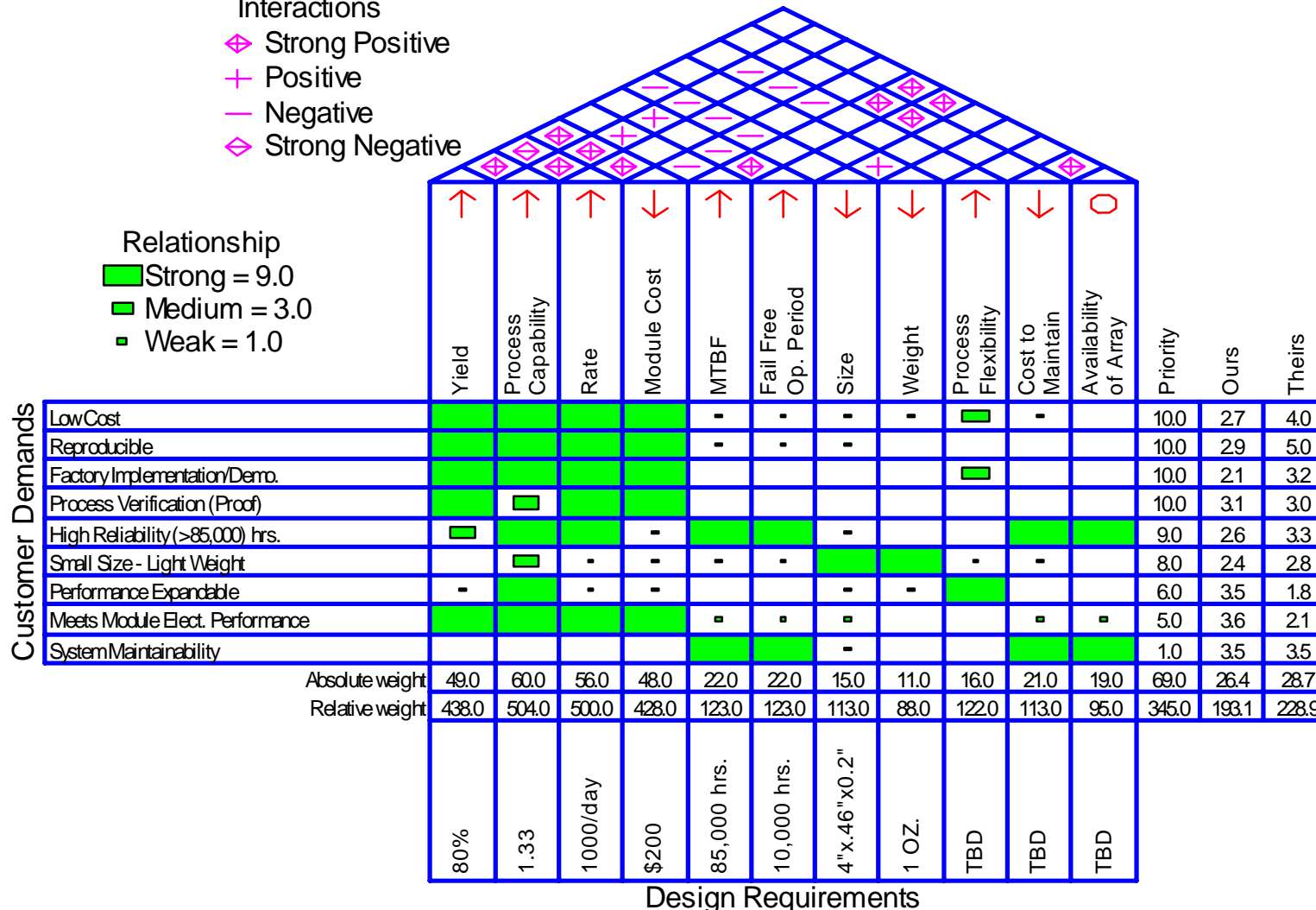


Quality Function Deployment - The House of Quality

Listening to the *Voice of the Customer*

- Interactions
- ◆ Strong Positive
 - + Positive
 - Negative
 - ◇ Strong Negative

- Relationship
- Strong = 9.0
 - Medium = 3.0
 - Weak = 1.0

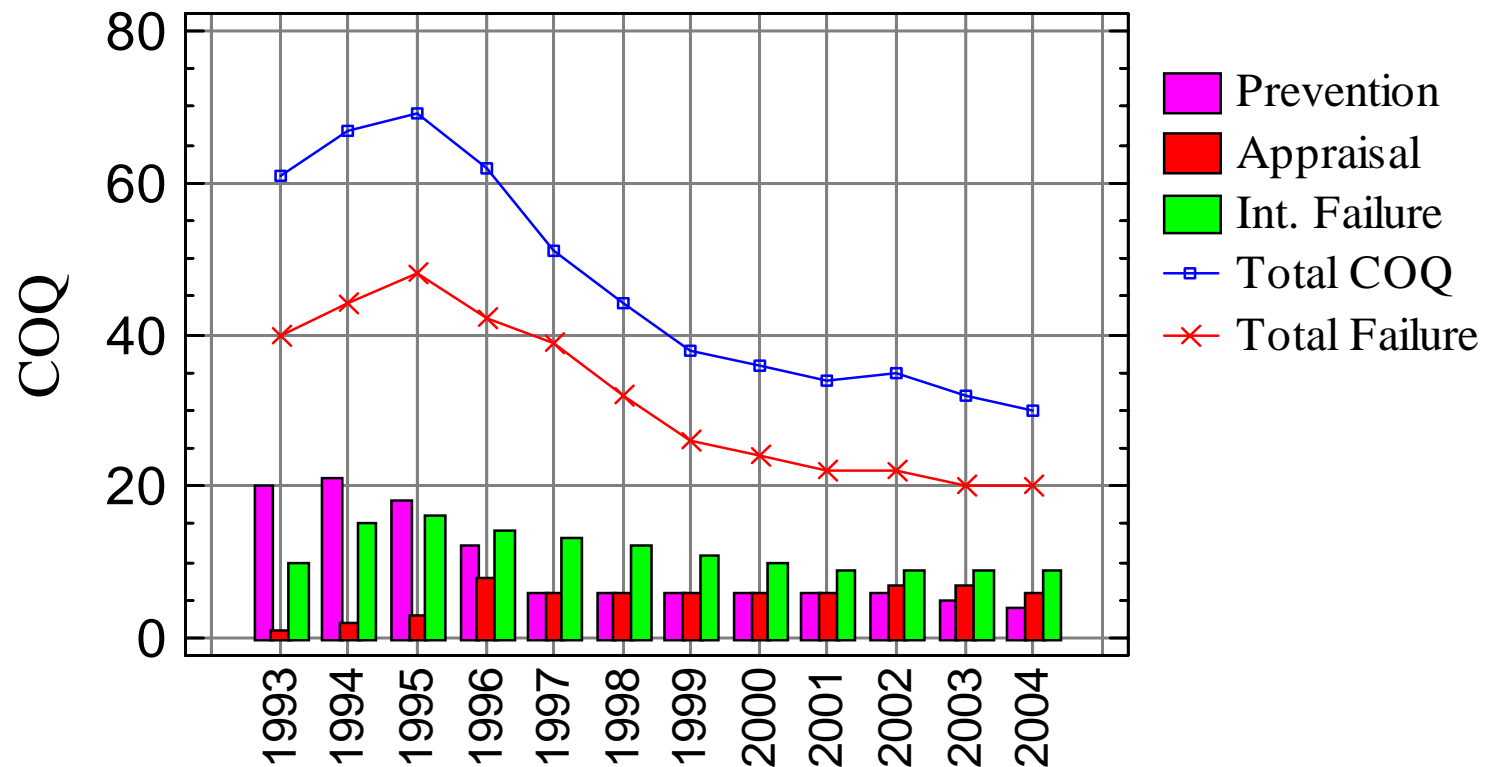


Design Requirements



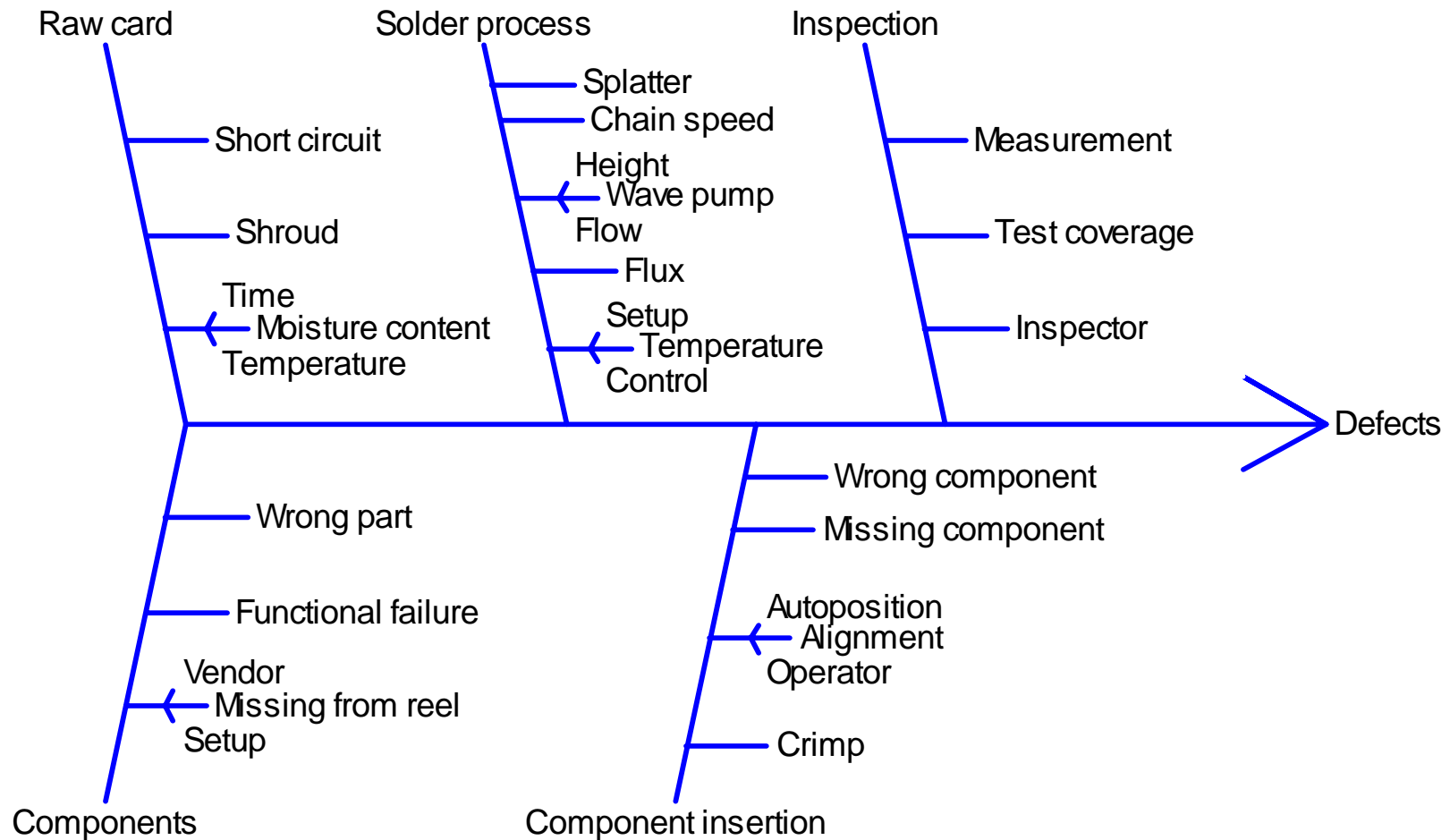
Cost of Quality for a Six Sigma Project

Cost of Quality History



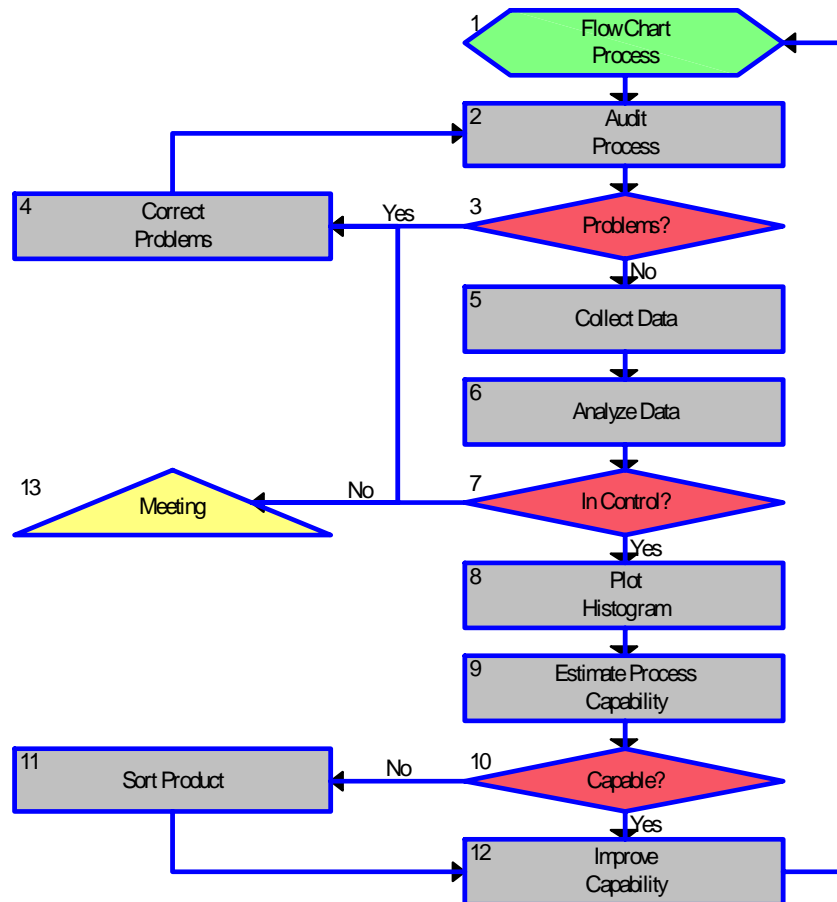


Brainstorming over a Fishbone Diagram



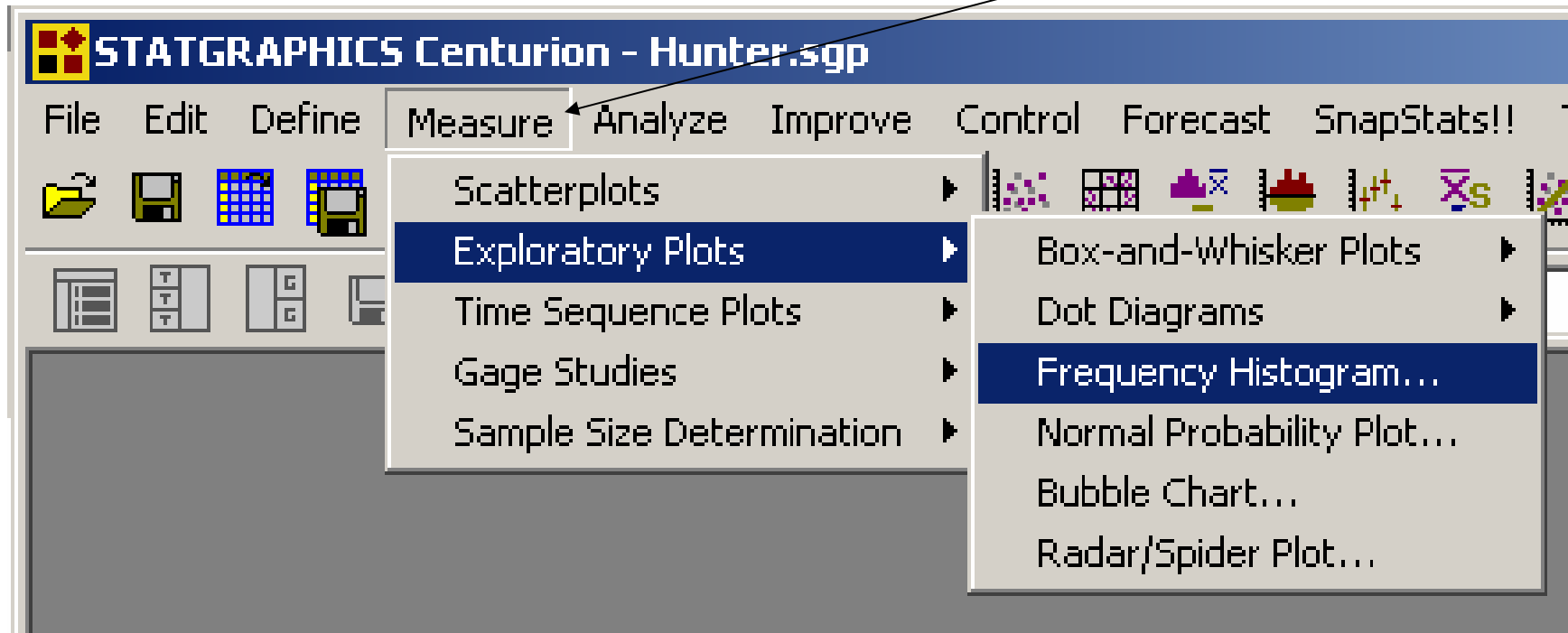


The Process Map to Understand your Process Early in Six Sigma





The new Statgraphics Centurion Six Sigma Menu Option - Measure

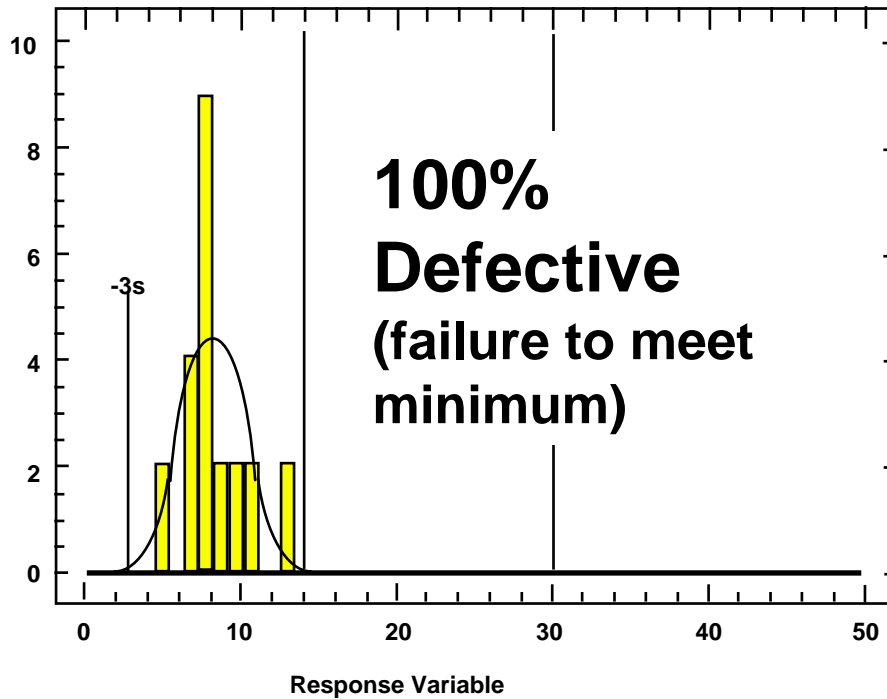




Statgraphics & Six Sigma can take “failure to meet minimum” to a 6 sigma process

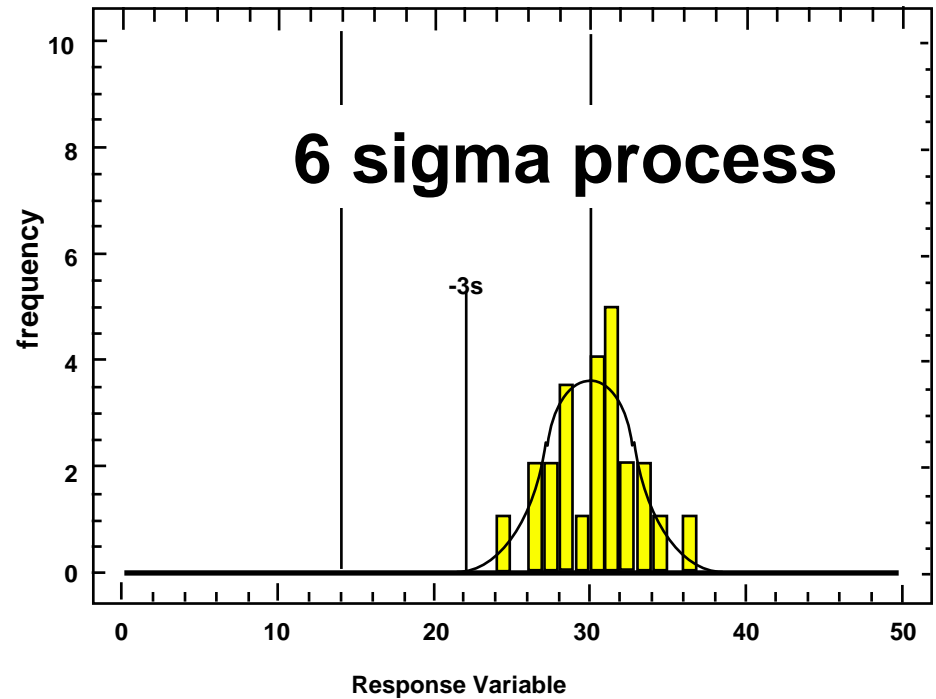
Bad Process

LSL Nominal



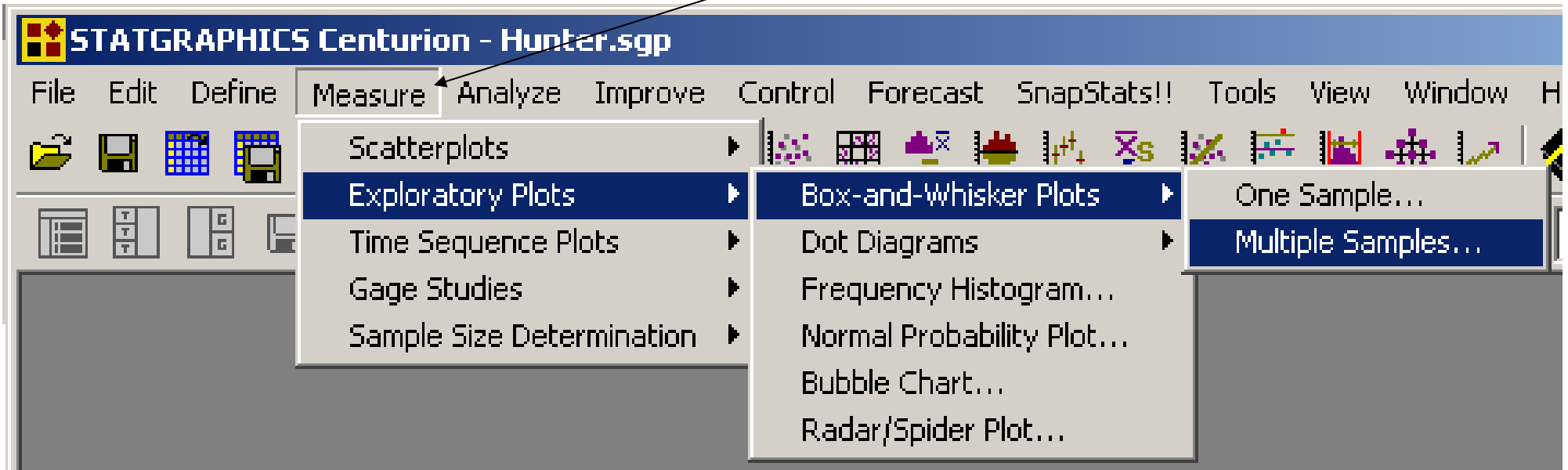
Good Process

LSL Nominal





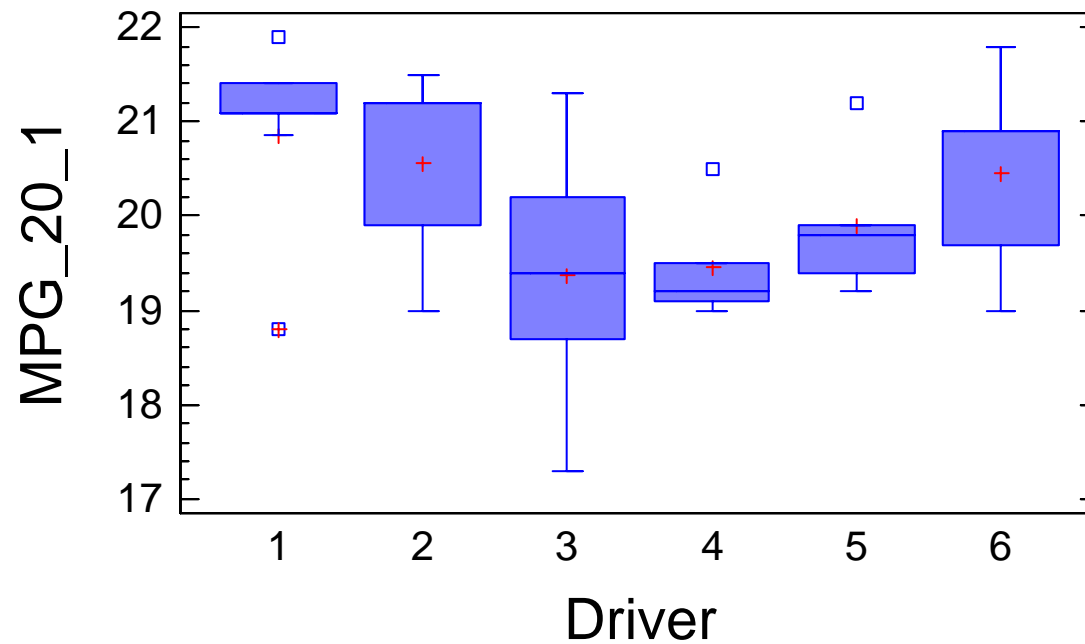
The new Statgraphics Centurion Six Sigma Menu Option - Measure





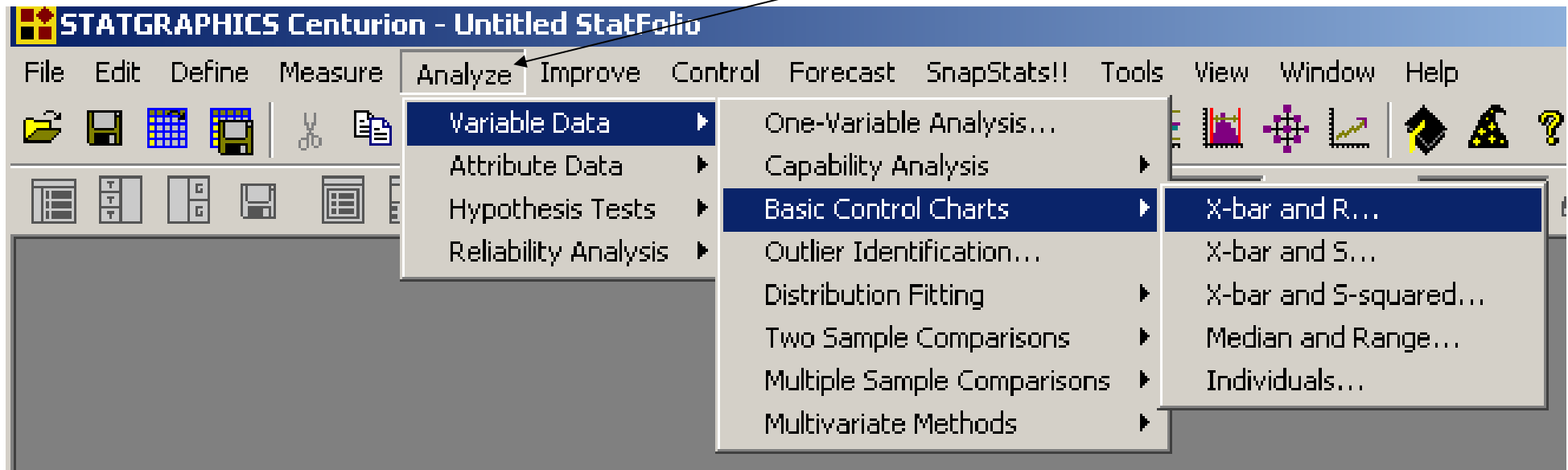
Which Driver has the best mileage?

Box-and-Whisker Plot





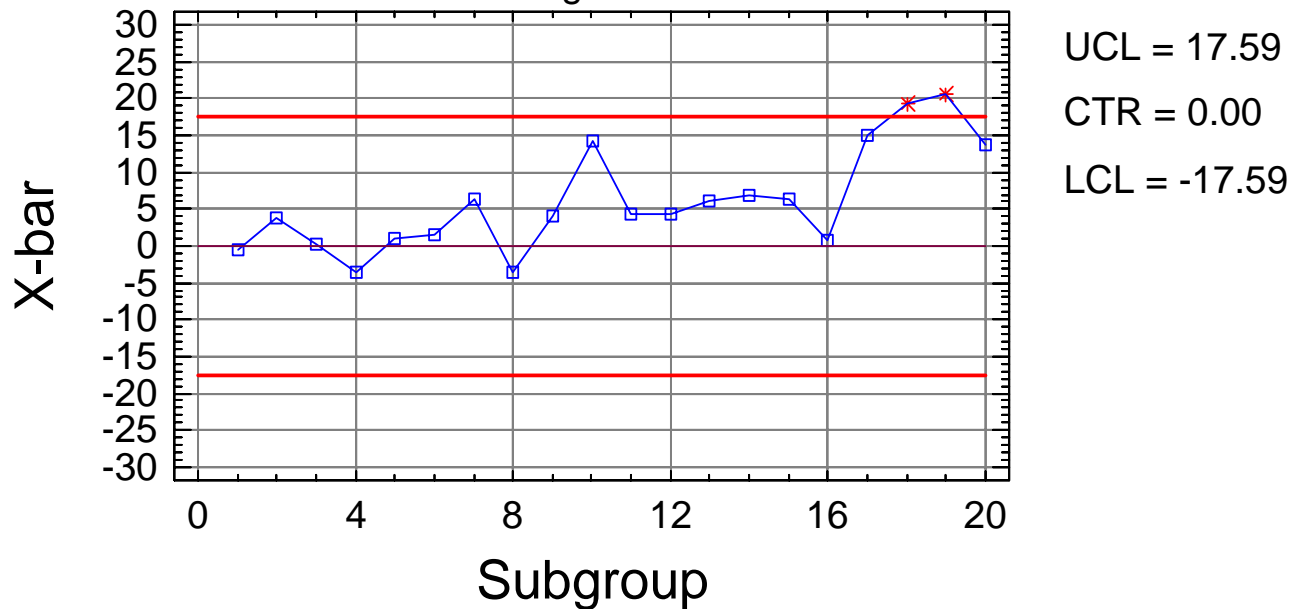
The new Statgraphics Centurion Six Sigma Menu Option - Analyze





X-Bar Variables Control Chart

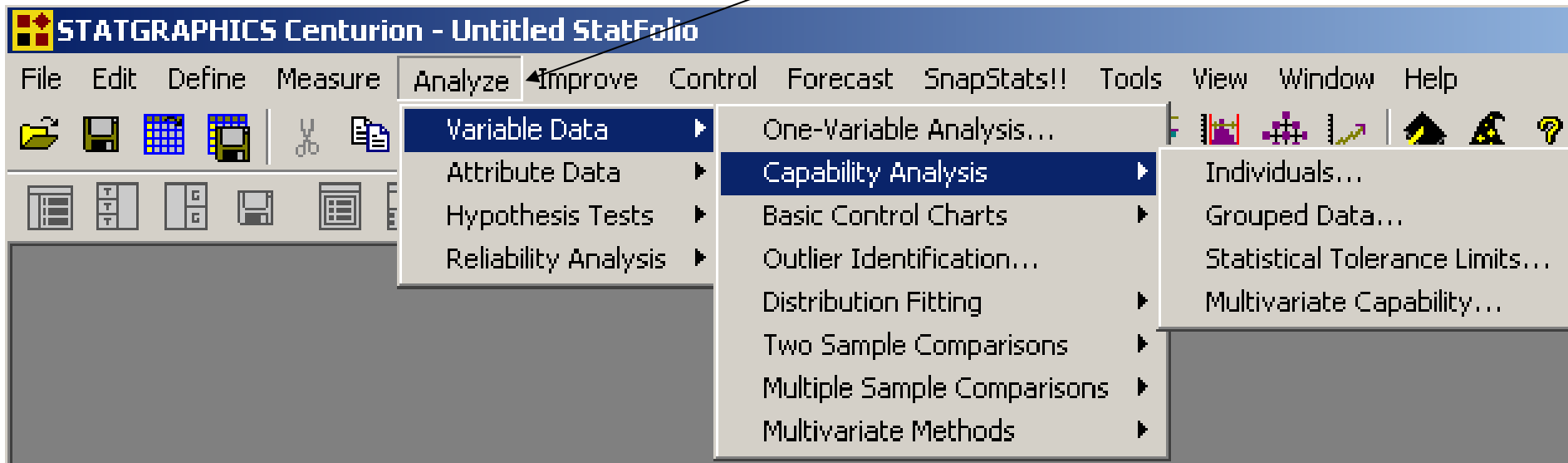
X-bar Chart for Dia DevFromTarget
Target = 0



You Can't Predict the Future if your Process is Out of Control!

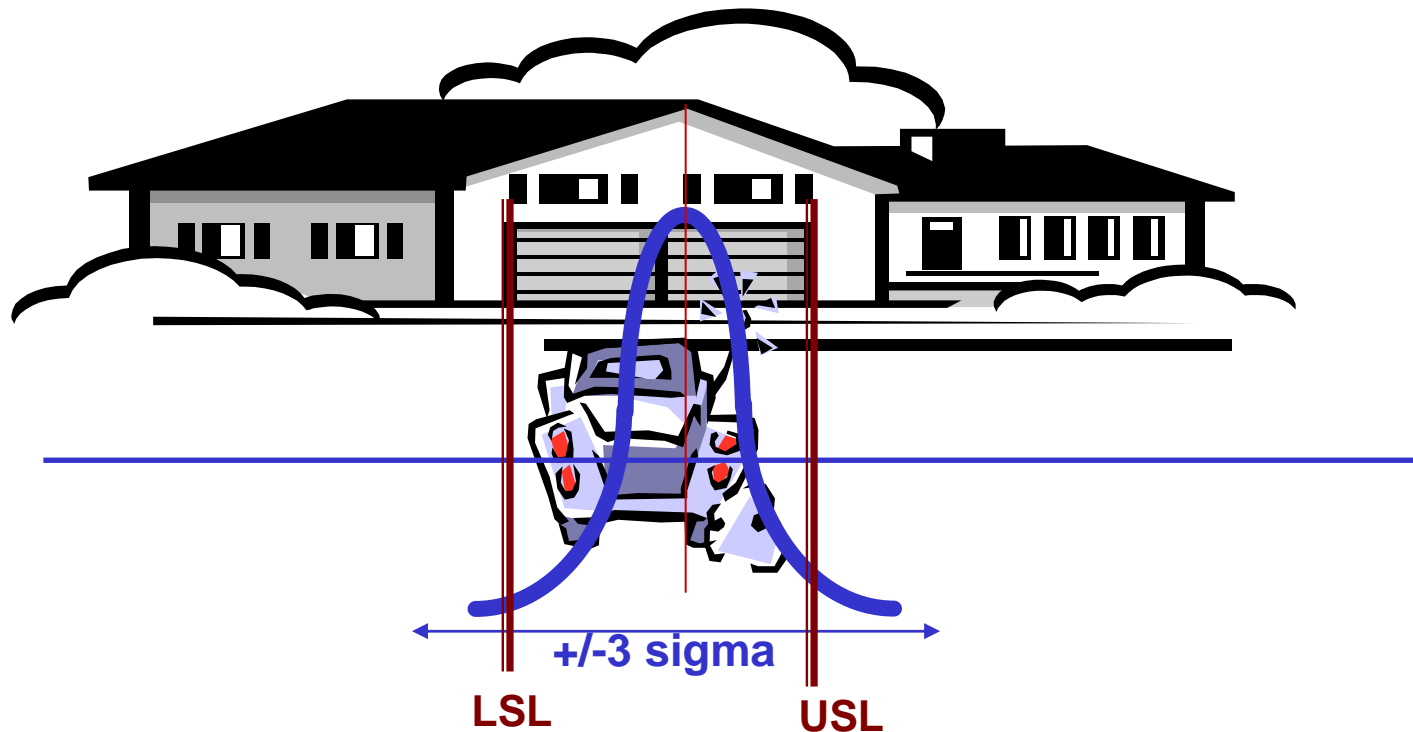


The new Statgraphics Centurion Six Sigma Menu Option - Analyze





Defining Process Capability





Snapstats: A Special Feature in Statgraphics Centurion for Quick Process Capability

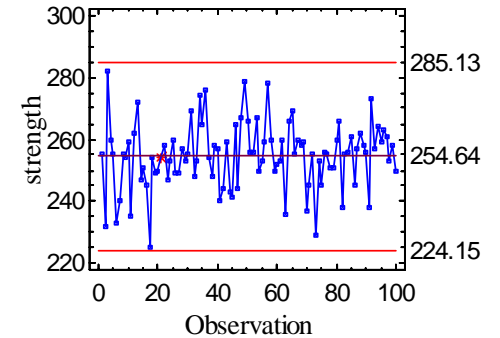
SnapStat: Capability Assessment (Individuals)

Data variable: strength
Sample size = 100 Mean = 254.64

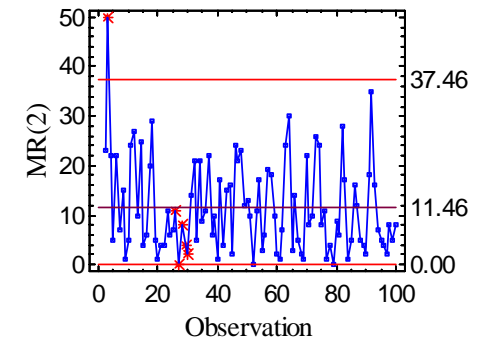
Specifications	Beyond Spec.	Z-Score
USL = 300	0.000000%	4.25
Nom = 250		
LSL = 200	0.000000%	-5.12

Long-Term Capability	Short-Term Capability
Sigma = 10.6823	Sigma = 10.1637
Pp = 1.56	Cp = 1.64
Ppk = 1.42	Cpk = 1.49
DPM = 11.03	DPM = 4.08

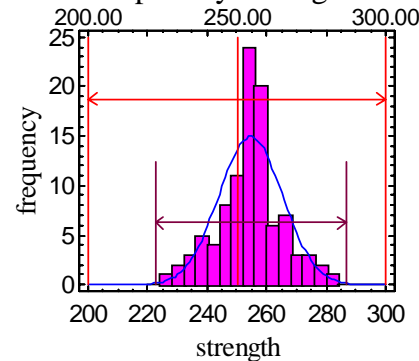
X Chart



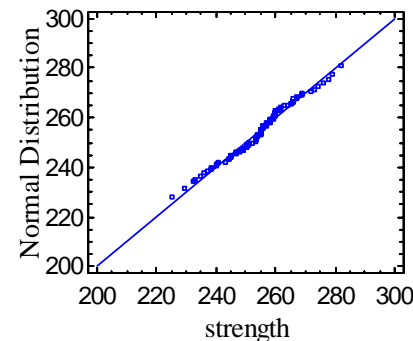
Range Chart



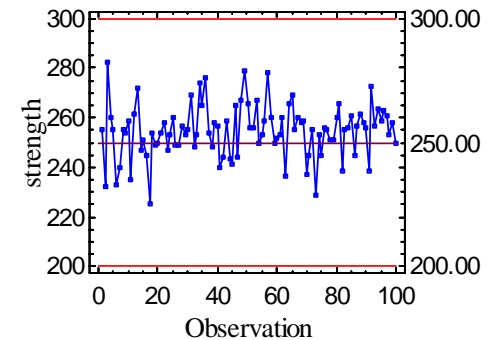
Capability Histogram



Probability Plot

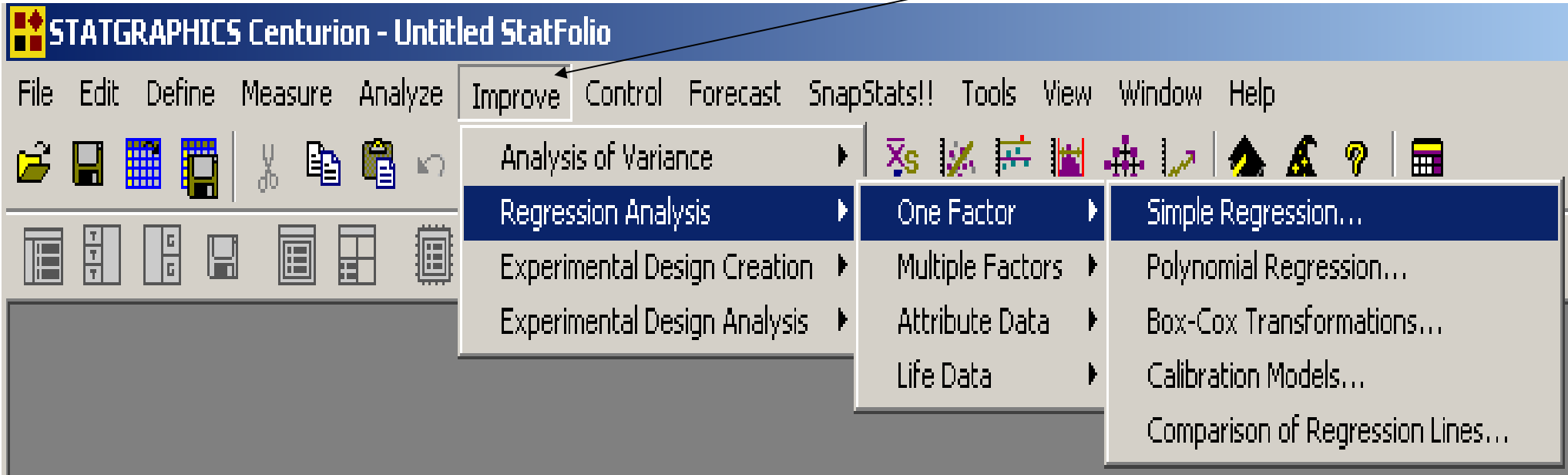


Tolerance Chart



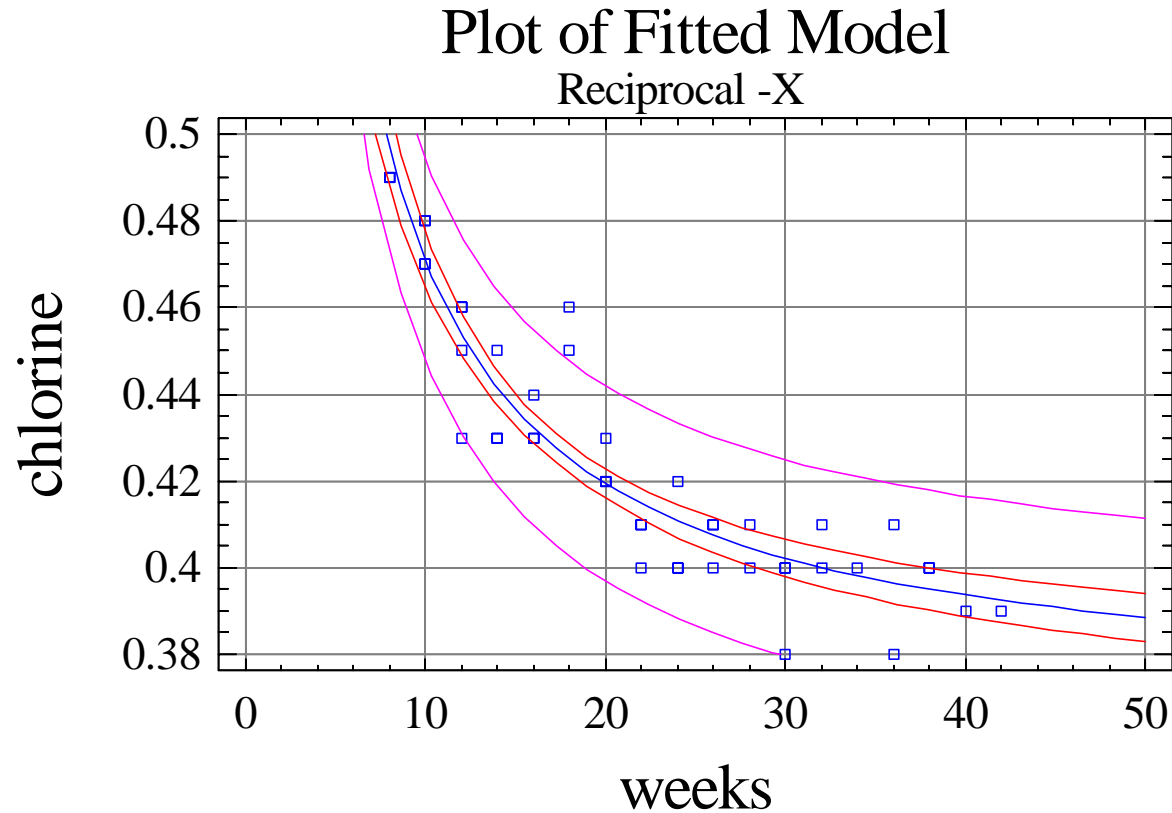


The new Statgraphics Centurion Six Sigma Menu Option - Improve



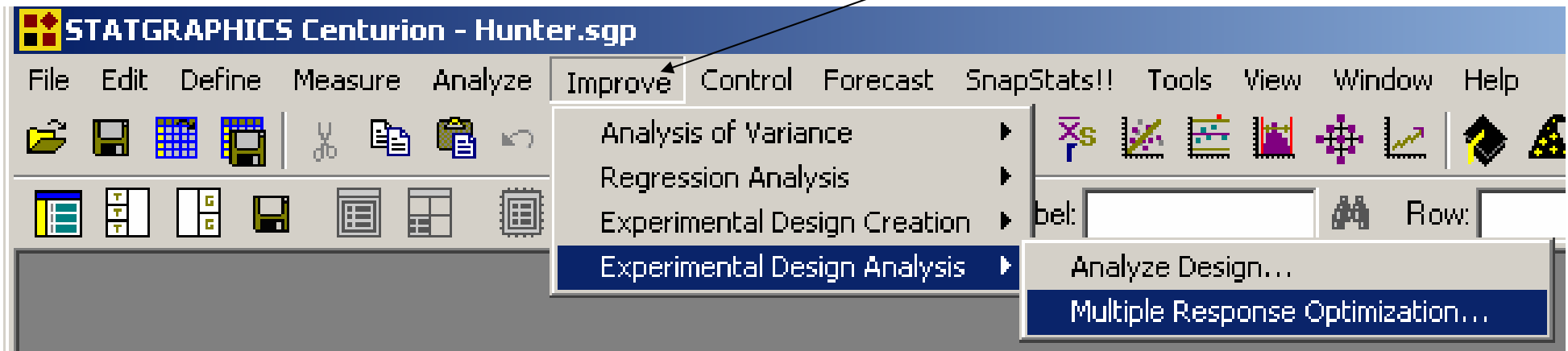


Best Fit Model Selected from 27 Transformations





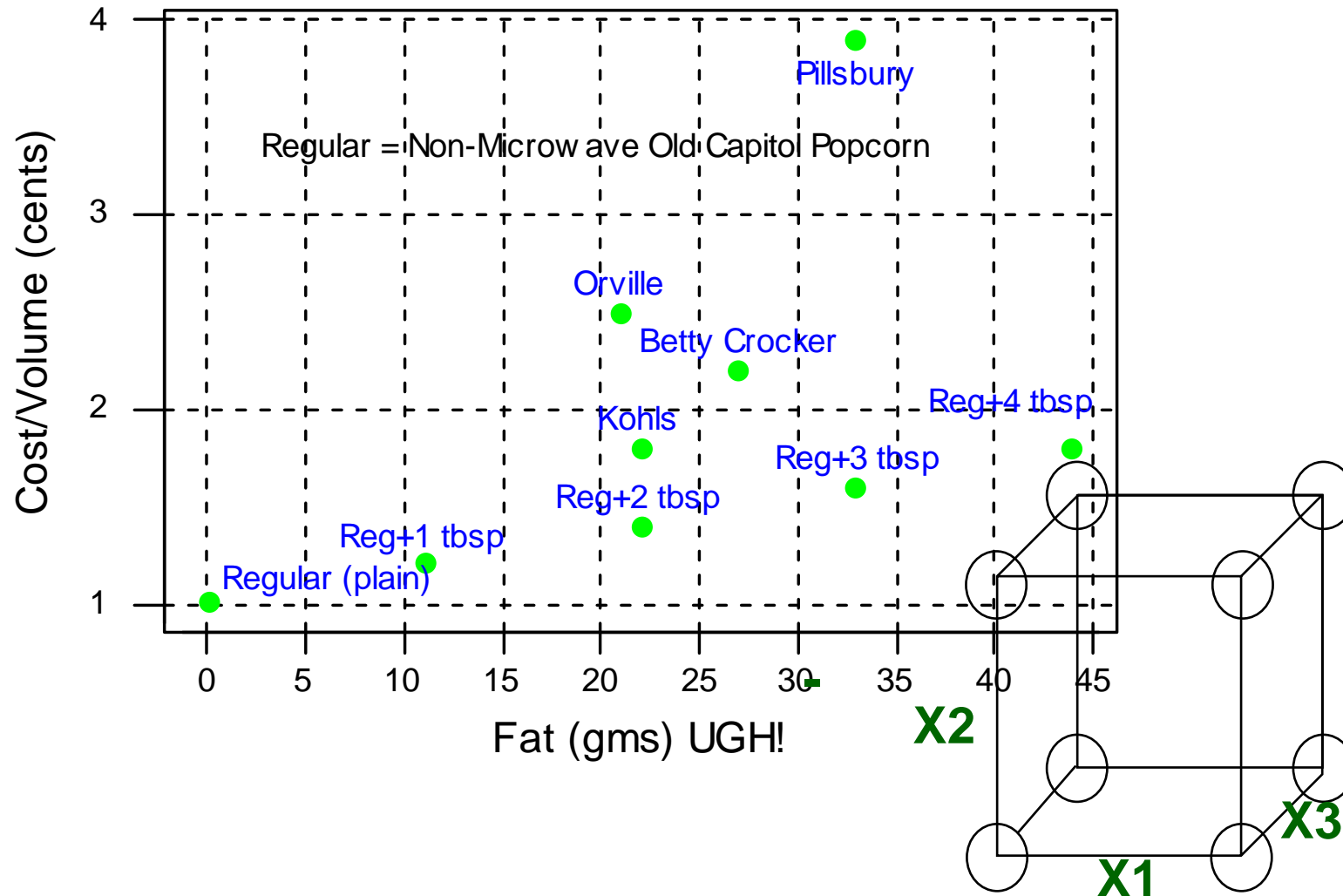
The new Statgraphics Centurion Six Sigma Menu Option - Improve





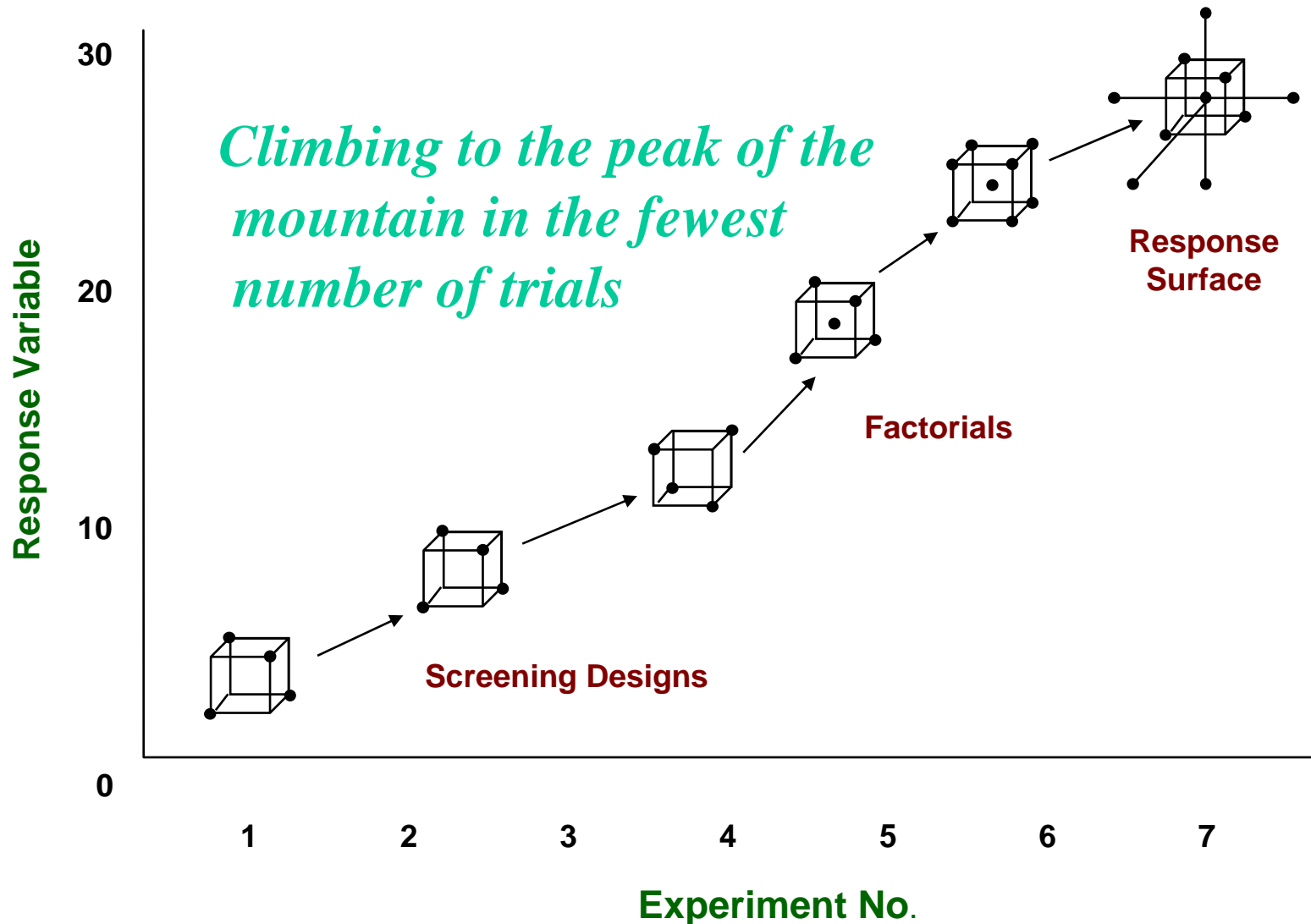
Six Sigma Enters the World of a Science Project

“Maybe Microwave Popcorn ain’t so Hot !”



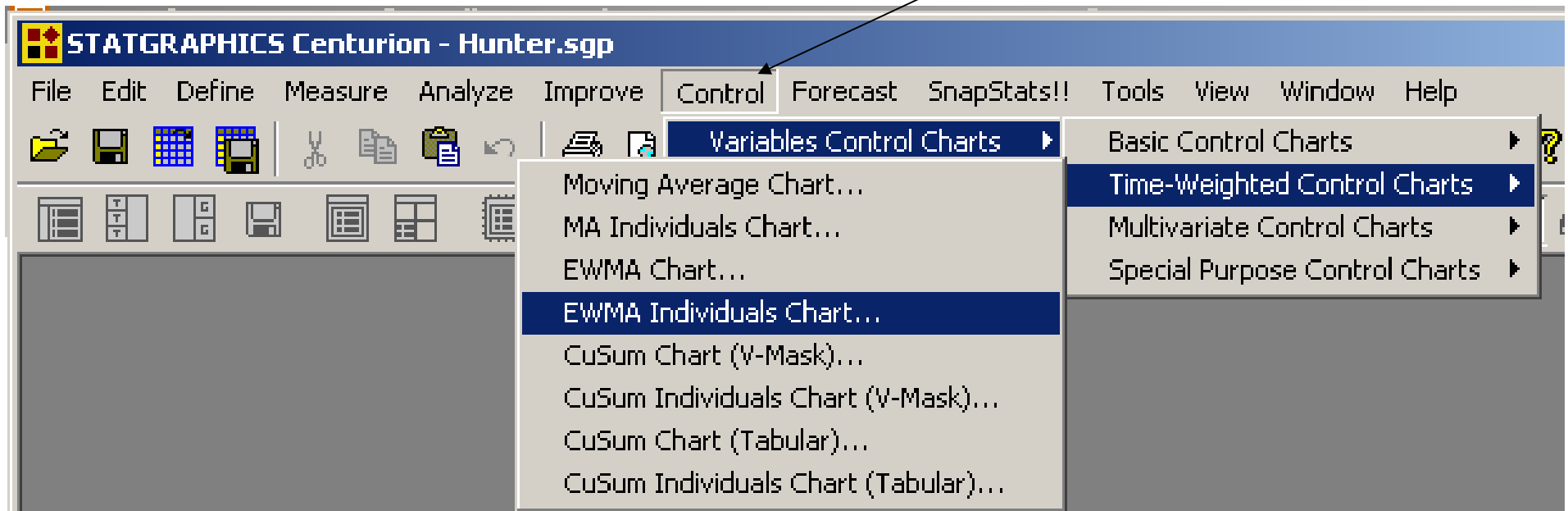


Process Development Using Sequential Experimentation





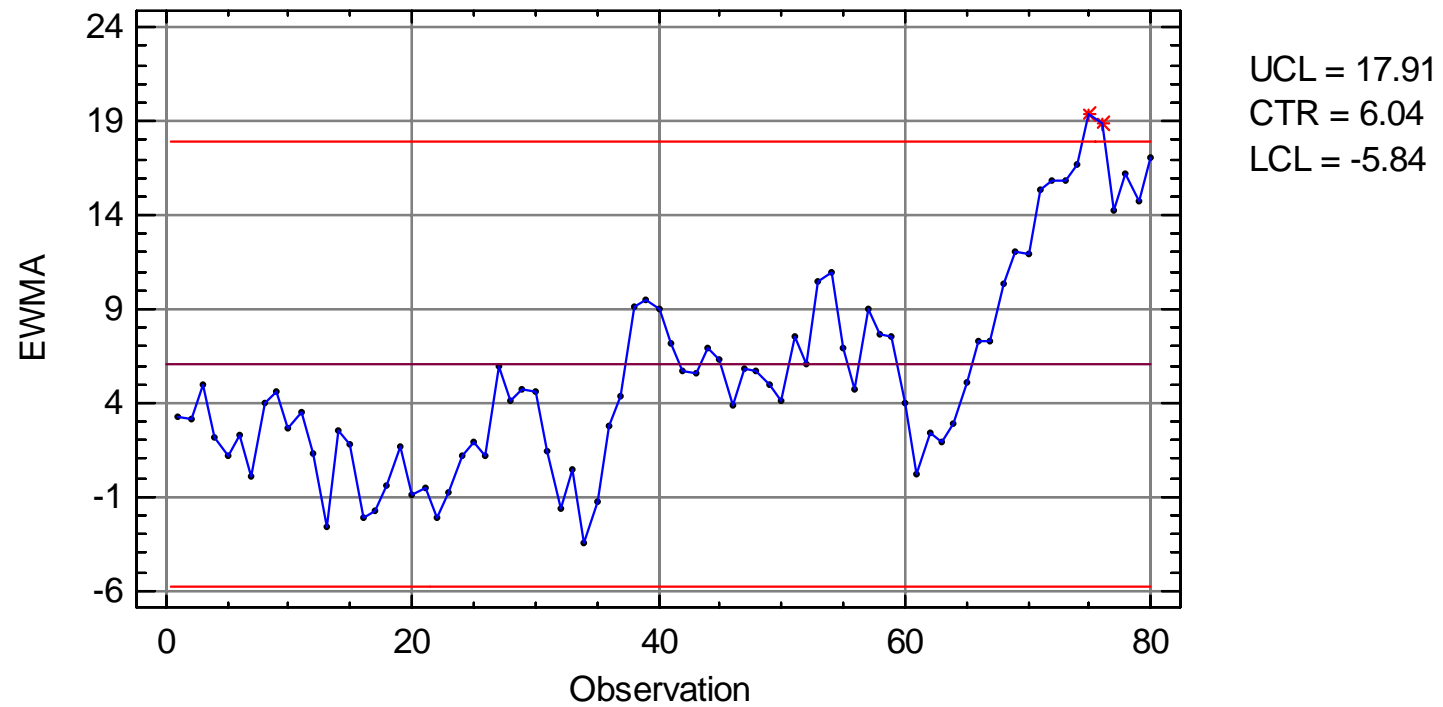
The new Statgraphics Centurion Six Sigma Menu Option - Control





Detecting Small Sigma Shifts

EWMA Chart for DATA





ABI Six Sigma Course Offerings

(using Statgraphics Version 5 or Centurion™)

- **Six Sigma Executive Overview (1/ 2 Day)** **\$ 2,500**
- **Six Sigma Overview (2 Day)** **\$ 5,000**
- **Six Sigma Green Belt (10 Days Total)** **\$ 25,000**
(Four x 2 Day sessions + 2 Day Project Mentoring)
- **Six Sigma Black Belt (14 Day)** **\$ 35,000**
(three x 2 + two x 3 Day sessions +2 Day Project Mentoring)
- **Process Understanding and Improvement (1/2 Day)** **\$ 2,500**
(1 Day also available)
- **Design of Experiment – Executive Overview (1/2 Day)** **\$ 2,500**
(1 Day also available)
- **Design of Experiments – Introduction (1 Day)** **\$ 2,500**
- **Design for Six Sigma (DFSS) (Under Development)**



Six Sigma Overview

Define / Measure / Analyze (Day 1)

- What is Six Sigma?
- DMAIC Model
- Project Selection
- Project Charter
- Team Roles and Responsibilities
- Voice of the Customer
- Concept Engineering
- Quality Function Deployment
- Using SIPOC for Process Identification
- Process Mapping
- Measurement System Analysis
- Data Collection Methods
- Understanding Variation
- Fundamentals of Statistical Process Control (SPC)
- Defining Process Capability
- Calculating Sigma Levels /DPMO



Six Sigma Overview

Analyze / Improve / Control (Day 2)

- **Seven Basic Quality Tools for Analyzing Data**
- **Basic Regression**
- **Design of Experiments (DoE)**
- **Analysis of Variance (ANOVA)**
- **Failure Mode & Effects Analysis (FMEA)**
- **Error Proofing**
- **SPC for Process Control**
- **Piloting and Implementing a Process Control Plan**
- **Lean Enterprise / Lean Six Sigma**
- **Reporting Project Benefits / Financial Impact**
- **Leveraging “Best Practices”**
- **Summary and Lessons Learned**



Six Sigma

Black Belt Training

Session 1

Define

2 Days

- Six Sigma Overview
- What's In It for Me?
- DMAIC Model
- Project Selection
- Project Charter
- Team Roles and Responsibilities
- Voice of the Customer
- Quality Function Deployment (QFD)
- Process Mapping
- Using SIPOC for Process Identification
- Pareto Diagram
- Cause and Effect Diagram
- Define Phase Summary
- Statgraphics Tutorial



Session 2

Measure

3 Days

- **Leadership Team Project Reviews**
- **Measurement System Analysis**
- **Data Collection Methods**
- **Understanding Variation**
- **Using Statistical Process Control (SPC)**
- **Defining Process Capability**
- **Calculating Sigma Levels/ DPMO/ Cycle Time**
- **Measure Phase Review**
- **Statgraphics Training**



Session 3

Analyze

3 Days

- **Leadership Team Project Reviews**
- **Seven Basic Quality Tools for Analyzing Data**
- **Linear and Multiple Regression**
- **Design of Experiments (DoE)**
- **Six Sigma DoE Exercise**
- **Analysis of Variance (ANOVA)**
- **Use of e-Tools/ Wizards**
- **Analyze Phase Review**
- **Statgraphics Training**



Session 4

Improve

3 Days

- Leadership Team Project Reviews
- Failure Modes and Effects Analysis (FMEA)
- Error Proofing
- Design for Six Sigma (DFSS)
- Piloting Process Improvement
- Process Improvement Assessment
- Implementing Process Improvement
- Improve Phase Review
- Statgraphics Training



Session 5

Control
2 Days

- **Leadership Team Project Reviews**
- **SPC for Process Control**
- **Process Control Plan**
- **Process Documentation**
- **Reporting Project Benefits/Financial Impact**
- **Leveraging “Best Practices”**
- **Summary and Lessons Learned**
- **Control Phase Review**
- **Lean Enterprise/ Lean Six Sigma**
- **Black Belt Certification Assessment**

George Dyson and Terry Russell have been actively involved in both teaching and mentoring Six Sigma and Design for Six Sigma directly with domestic and International businesses. Recently Terry and George were invited to participate in teaching Six Sigma and Design for Six Sigma for General Electric.

George H. Dyson III

George Dyson is Director of Engineering Statistics for ABI Associates, Inc., a business improvement consulting practice devoted to optimizing Six Sigma training/Implementation to improve business performance.

George is also the area Six Sigma representative for StatPoint, Inc., the developer of the **STATGRAPHICS Centurion™** software package. Prior to his current position, George accumulated 33 years of professional experience with United Technologies and General Electric Aircraft Engines. During his career at GE, he provided statistical support, managed teams, and developed new courses and patent applications to solve a wide variety of engineering and manufacturing problems, including new process development, Reliability/Quality and Six Sigma training and project support. His individual Six Sigma and Design for Six Sigma projects saved GE \$1.5 Million.

George holds an Associate in Applied Science, a Bachelor's Degree in Mechanical Engineering and a MS Degree in Engineering Management. He has taught undergraduate courses in Engineering Statistics and holds instructor certifications from GE and Motorola (Six Sigma). He has an Honorable Discharge from the U.S. Air Force Reserves 440th Troop Carrier Wing, Staff Sergeant.

Terry Russell

Terry Russell is Director of Management Systems for ABI Associates, Inc., a business improvement consulting practice working with domestic and international companies to improve business performance through management system and process improvement and through Six Sigma training and implementation. Clients have included companies in both product manufacturing and service sectors.

Prior to his current position, Terry accumulated 36 years of professional experience with the National Aeronautical and Space Administration and General Electric Aircraft Engines. With GE, Terry was recognized for his leadership in the development and implementation of international TQM based business improvement programs.

Terry holds a Bachelor's Degree in Mechanical Engineering and Master's Degrees in Mechanical Engineering and Business Administration. He holds instructor certifications from GE, Motorola (Six Sigma) and Ford (TOPS8D), and has been Leader of the Day for several Center for Quality of Management courses. He is a registered Professional Engineer in the State of Ohio and serves as Chair of the Industrial Advisory Board for the Ohio University Department of Mechanical Engineering. He has an Honorable Discharge from the U.S. Army Ordnance Corps, First Lieutenant.