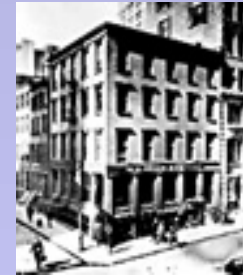


Six Sigma @ W.R. Grace

1854 William Russell Grace founds W. R. Grace & Co. in Peru.



1865 W. R. Grace & Co. relocates to New York City.



1964 Grace Davison introduces a breakthrough catalyst allowing refiners to produce more gasoline and other products per barrel of oil at lower cost.

.....

1999 Paul Norris becomes Chairman, relocates corporate HQ to Columbia, announces aggressive, focused growth initiatives and continuous process improvement driven by

Six Sigma



About Six Sigma

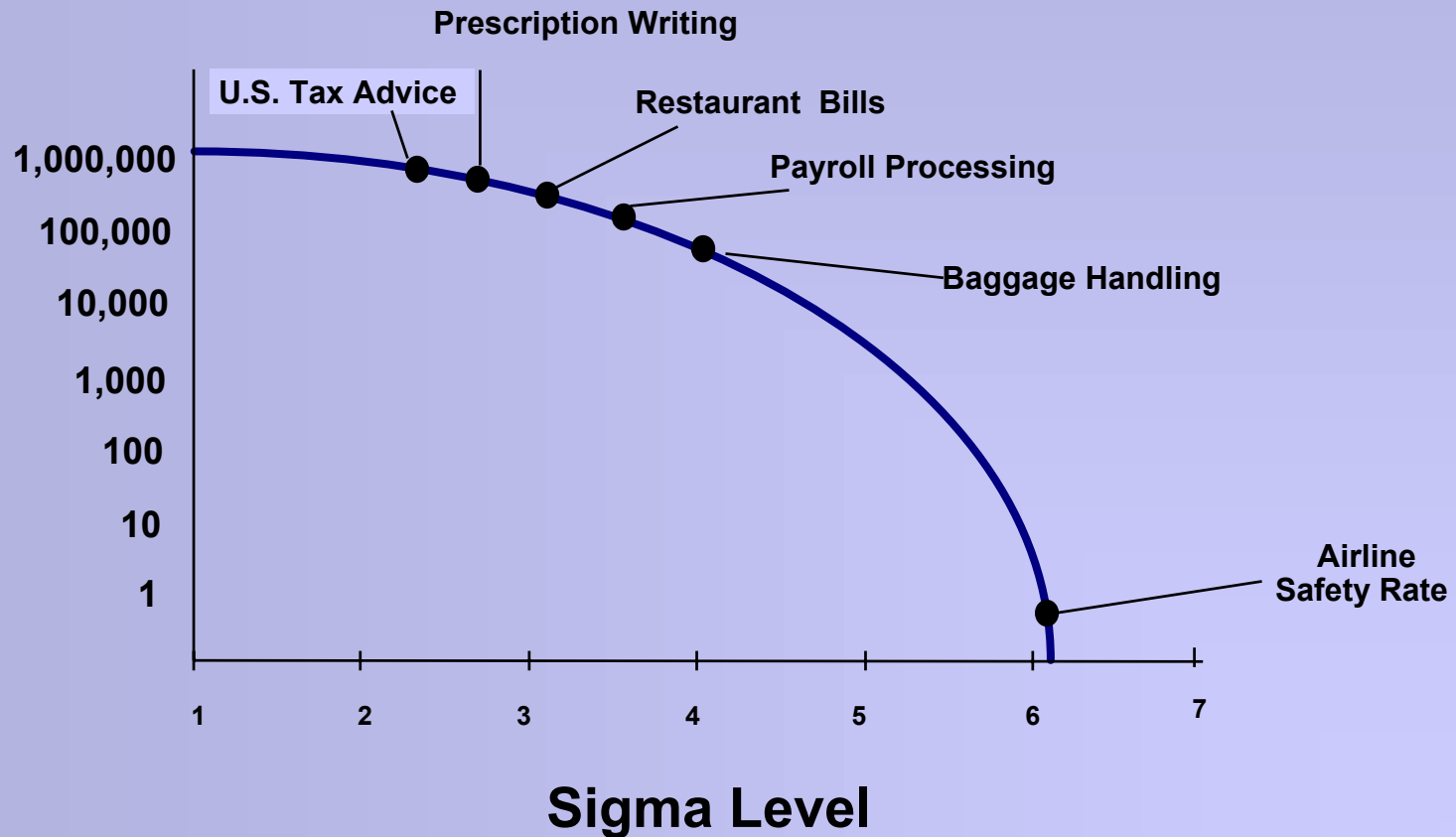
- **Business performance improvement...**
- **... through process performance improvement**
- **Strategic and Tactical**
- **Process focused** (eg. $Y=f(x)$, variation)
- **Systematic, information-driven** (eg. tools, statistics)
 - Define, Measure, Analyze, Improve, Control (DMAIC)
- **Motorola in the '80s... AlliedSignal (now Honeywell) and GE in the '90s... Dupont, Dow, 3M, Ford, American Express... W.R. Grace... and many others**
- **In the U.S. and world-wide**

Six Sigma is a Measurement of Quality

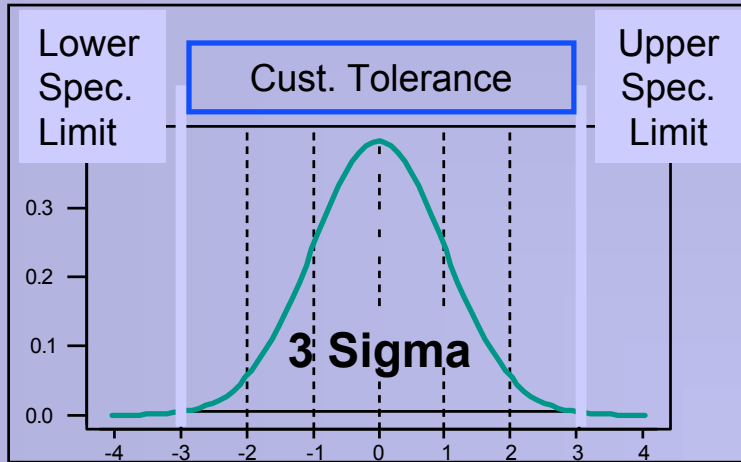
Sigma Level	% Good
2	69.1%
3	93.32%
4	99.379%
5	99.9767%
6	99.99966%

What Does Six Sigma Mean In Daily Life ?

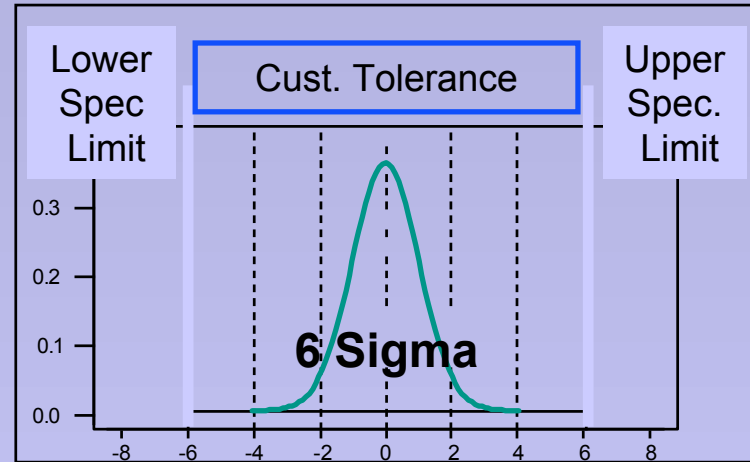
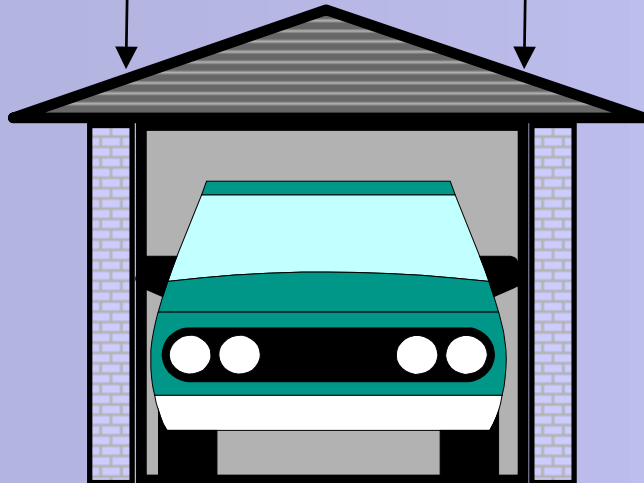
PPM



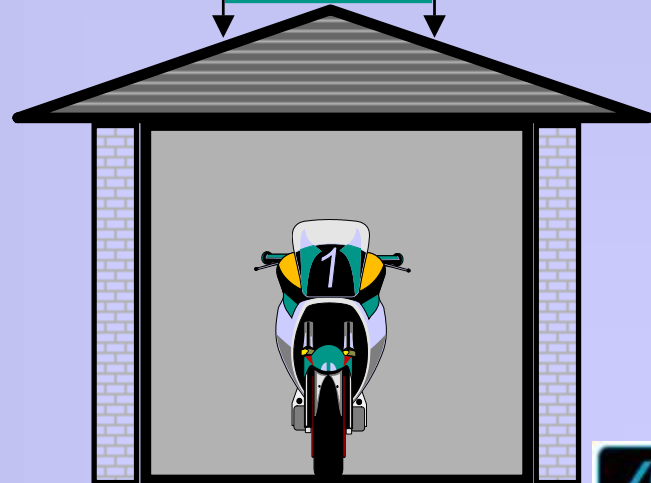
3-Sigma vs. 6-Sigma



Process Capability



Process Capability



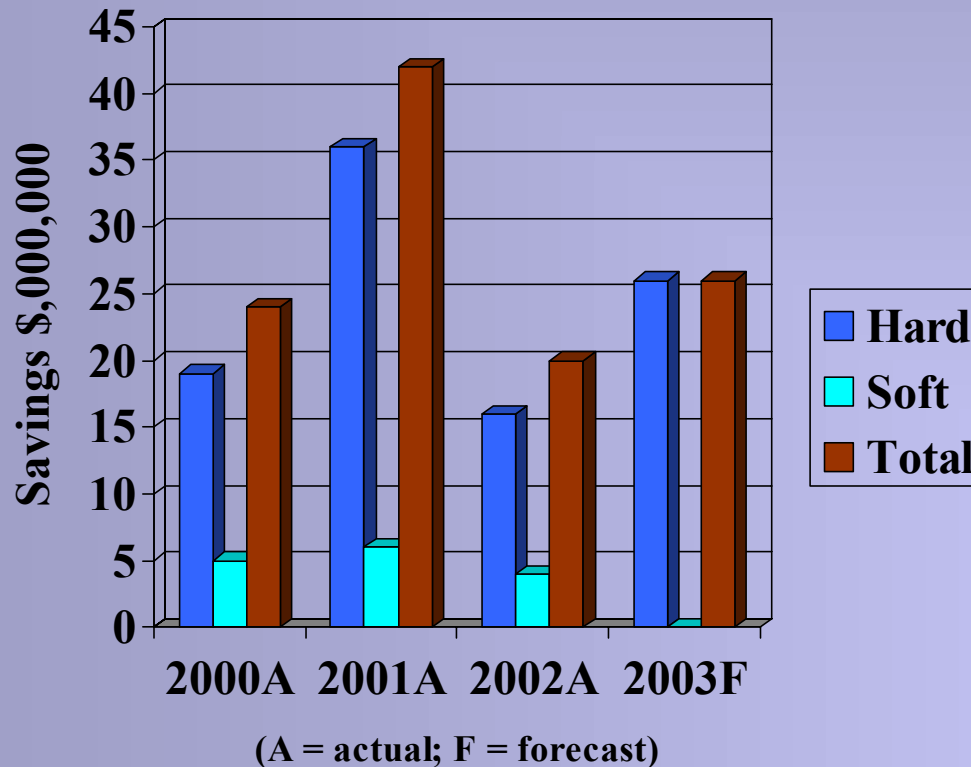
About W.R. Grace

- **\$1.8 Billion in sales for 2002**
- **\$275 Million operating earnings (EBITDA)**
- **6,000+ people in over 40 countries**
- **Davison – catalysts and silica products**
- **GPC – building and packaging product**

About Davison

- **about 1/2 of the Grace business**
- **\$945 Million in sales for 2002**
- **3,100 employees**
- **Catalysts:** oil refining, plastics, emissions control
- **Silicas:** in industrial and consumer products
- **In your life:** transportation and heating fuels, plastics, cleaner air, paint, toothpaste, cosmetics, other personal care products, ink-jet printer paper, edible oils, thermal-pane windows, pharmaceuticals...

Davison Six Sigma Savings



- **Hard or EBIT savings**
 - Revenues up
 - Costs down
- **Soft savings are**
 - Cash Flow
 - Cost and Capital Avoidance

EBIT: Earnings Before
Interest & Taxes

A project's savings are tracked
over a 12 months period.

About Six Sigma at Grace

- **What is Six Sigma (at Grace, at Davison)**
 - Improving business performance by improving process performance
 - All kinds of processes -- from mfg to corporate
 - Leadership, alignment, support
 - Objectives, financial and otherwise
 - Organization, infrastructure
 - Staffing, training (6s staff and everyone else)
 - Projects, scoping, tools, review & follow-up
 - Results at departmental, product line... Grace levels
 - Individual mind-set, organizational culture

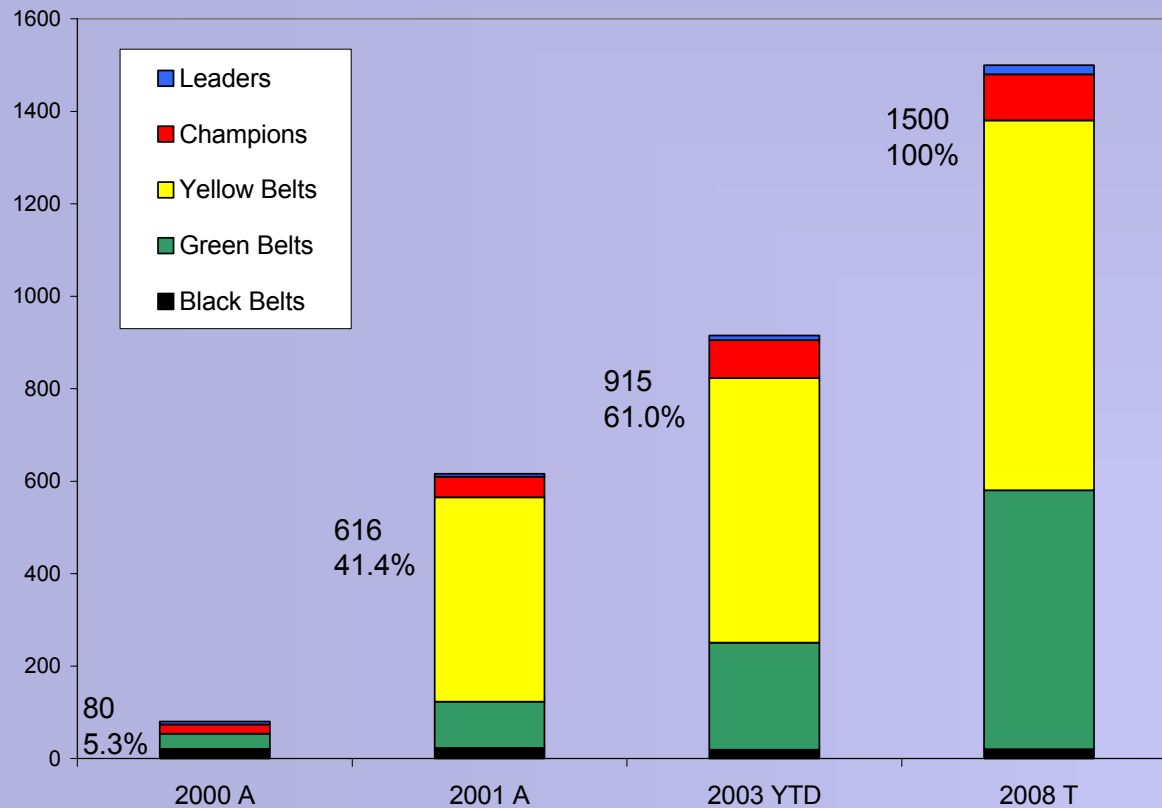
Implementing Six Sigma in a Manufacturing Environment

- Evolution
- Training
- Resources
- Projects
- Project selection & management
- Expansion
- Measurement Systems

Six Sigma - Evolution

- Sept - Oct. 1999 → Champion training in U.S. and Europe
- January 2000 → First Black Belt Wave Training Complete
- February 2000 → First Green Belt Training (Admin)
- June 2000 → Second Black Belt Wave Training Complete
- December 2000 → Second Ops Green Belt Wave Training Complete
- May 2001 → First Yellow Belt Training Complete
- June 2001 → Six Sigma Project Hopper - 100% Utilized
- December 2001 → First Catalyst DFSS Green Belt Class Complete
- January 2002 → First German “Regional” Ops GB Class Complete
- April 2002 → Sales/Tech Service Green Belt Training Complete
- September 2002 → Analytical Green Belt Training Complete
- September 2003 → Reliability Green Belt Training Scheduled

Trained Belts - Davison



Goal is for each salaried employee to hold an active, engaged Six Sigma role

	2000 A	2001 A	2003 YTD	2008 T
Black Belts	21	23	19	20
Green Belts	33	100	232	560
Yellow Belts	0	442	572	800
Champions	20	45	82	100
Leaders	6	6	10	20
Total	80	616	915	1500
<i>Entitlement</i>	5.3%	41.1%	61.0%	100%

Six Sigma Resource Definitions

•Black Belts

- Full Time Six Sigma Resource
- 4 Weeks Initial training, plus follow-up advanced statistical training
- Work 3-4 projects Simultaneously
- Mentor 5-10 Green Belt project
- Train all Yellow Belts and some Green Belts

•Green Belts

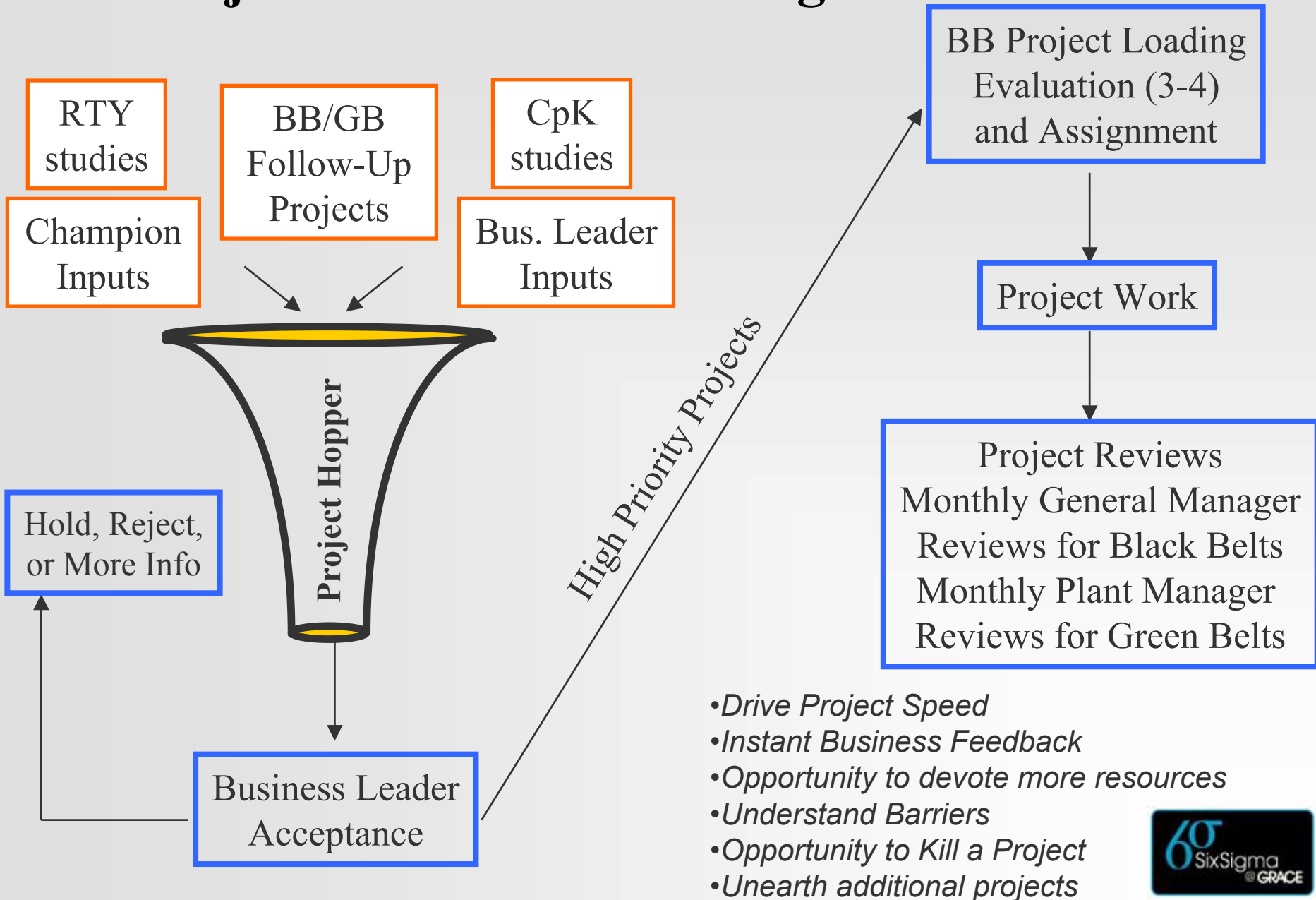
- Initially trained Manufacturing or Operations GBs
- 2 Week training -- equivalent Define and Measure skills
- Expectation is to complete at least 1 project per year, and then work on 2nd project
- Currently 25% of savings is from Green Belts
- Evolved to DFSS, Technical Service, Transactional, Analytical GBs

•Yellow Belts

- One day of training focusing on Define and Measure tools
- Target team members, then future project resources



Project Selection & Management Process



Measurement Systems Analysis

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- Six Sigma Black Belts and Green Belts Perform MSAs during Project Work
 - Lab Managers and Technicians are Part of Six Sigma Teams
 - Measurement Systems are Improved as Six Sigma Projects are Completed
-

- Some Lab Personnel become Green Belts
 - Lab Efficiency and Machine Set-up Projects are Started
-

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- A Few Black Belts Selected to Join a Measurement Systems Task Force
- Black Belts Receive Specialty Training in Advanced Measurement Topics
- All Lab Personnel Receive Analytical GB training, with the Goal of Continuous Upgrading of MSA Through Evaluation of all Tests for GR&R and P/T ratio
- Highly Organized Nested and Crossed Laboratory Studies to Evaluate Factors Between and Within Laboratories -- Communication of Results
- A Repository of all GR&R studies are available throughout the globe

Some of the tools we use

- **Project Charter**
- **Process Map, Flowchart**
- **Cause & Effect Analysis (C&E)**
- **Failure Modes and Effects Analysis (FMEA)**
- **Statistics and Data Analysis**
 - **Graphs, plots, etc... Multi-Vari Studies**
 - **Control Charts**
 - **Measurement Systems Analysis (MSA)**
 - **Regression, ANOVA**
 - **DOE (improve, optimize)**
 - **Surface Response (improve, optimize)**
 - **Process Capability**
- **Control Plan**
 - **procedures, specifications, etc.**

Define

Measure

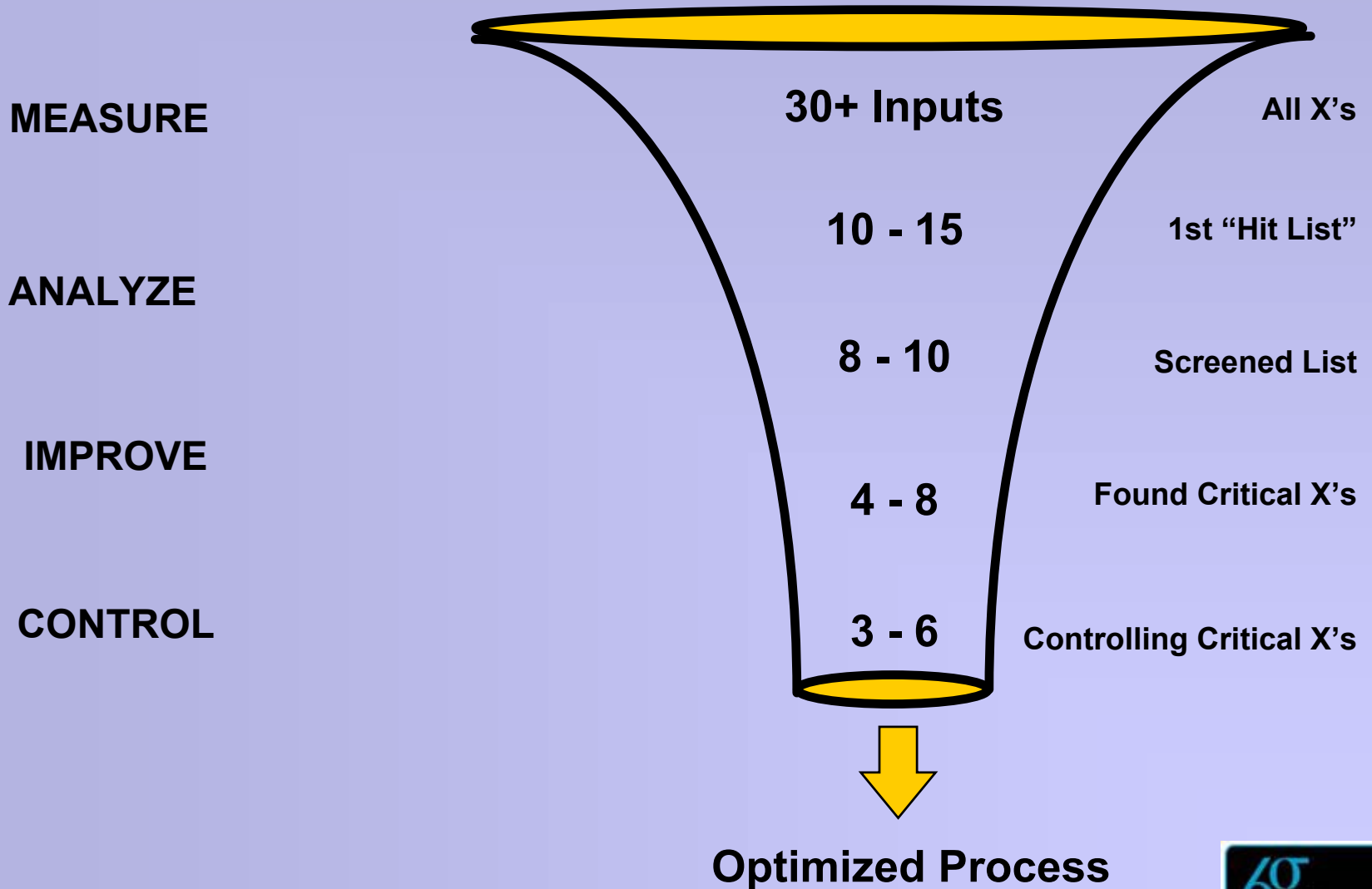
Analyze

Improve

Control

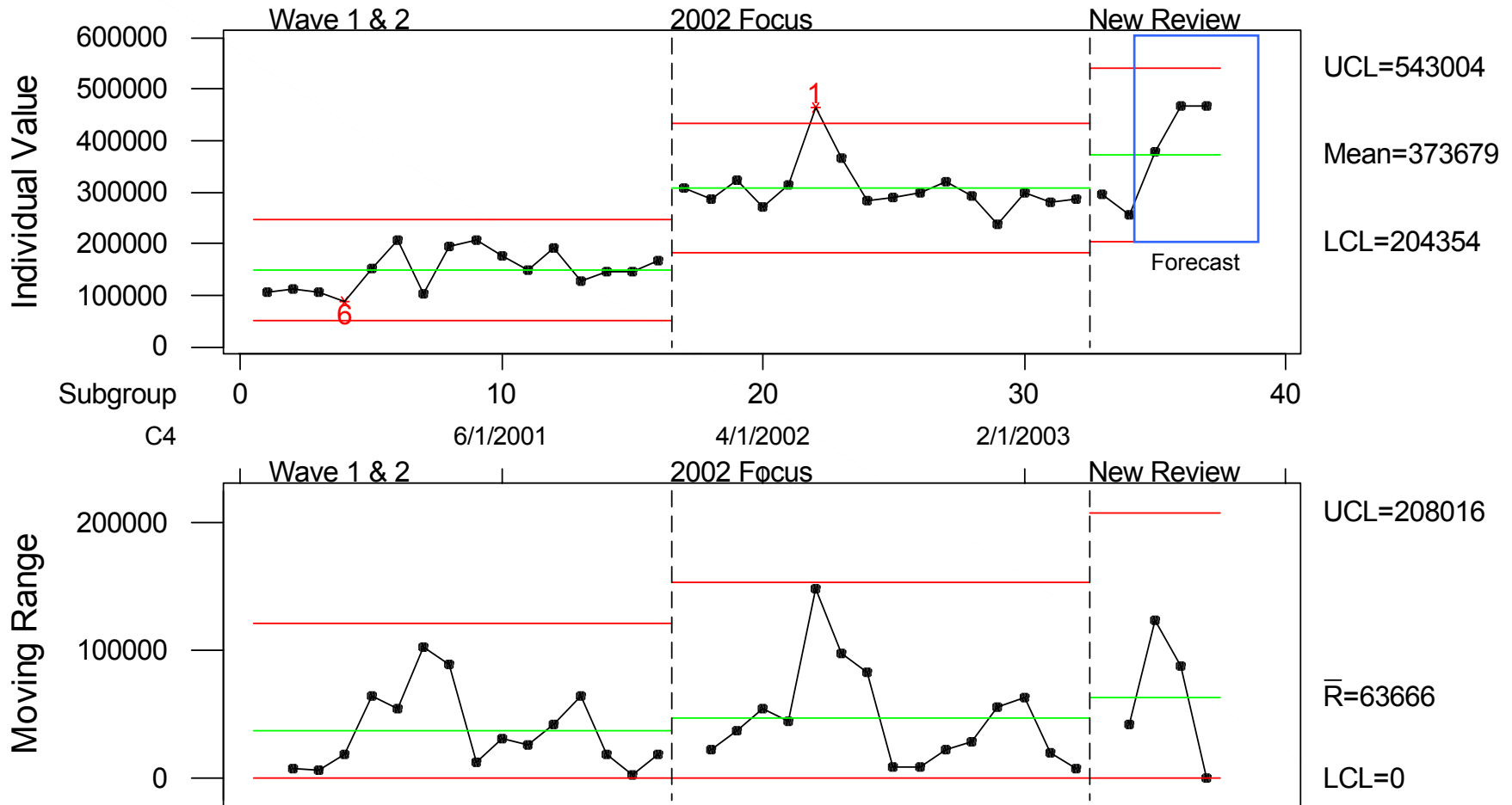


The Funnel Effect



Silicas/Adsorbents

Tracking Cost Reduction Performance using a Control Chart



- May, 2003 Started New Six Sigma Review Format
- Better Six Sigma Alignment to Drive Higher Performance

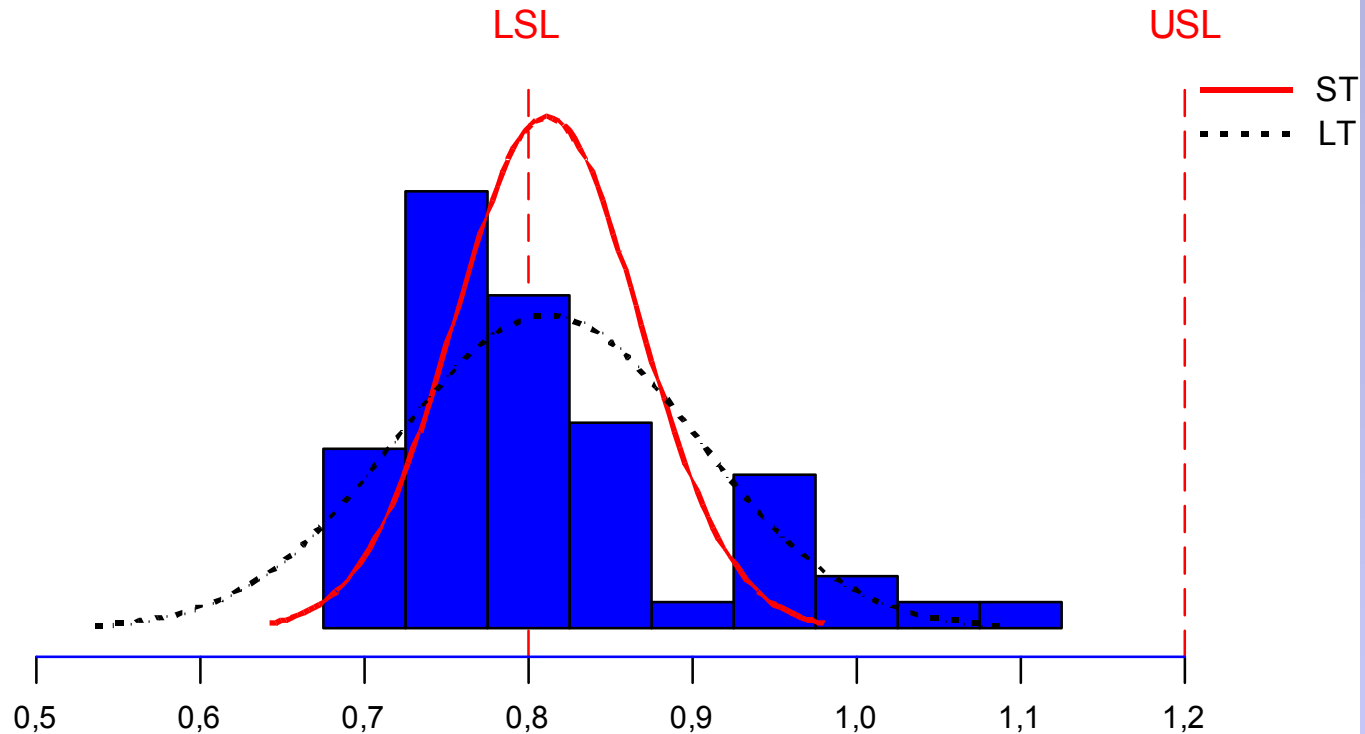
Process Capability

Process Data

USL	1,20000
Target	*
LSL	0,80000
Mean	0,81143
Sample N	56
StDev (ST)	0,0562540
StDev (LT)	0,0918981

Potential (ST) Capability

Cp	1,19
CPU	2,30
CPL	0,07
Cpk	0,07
Cpm	*



Overall (LT) Capability

Pp	0,73
PPU	1,41
PPL	0,04
Ppk	0,04

Observed Performance

PPM < LSL	589285,71
PPM > USL	0,00
PPM Total	589285,71

Expected ST Performance

PPM < LSL	0,00
PPM > USL	0,00
PPM Total	0,00

Expected LT Performance

PPM < LSL	0,00
PPM > USL	0,00
PPM Total	0,00

Where We're going with Six Sigma

- **Beyond manufacturing...**
- **Administrative,
Transactional,
Corporate,
Business processes**
- **Sales and Technical Service**
- **Maintenance, Reliability**
- **Lean Manufacturing**
 - Value Chain

Summary

- **Six Sigma**
- **Grace, and Davison**
- **Six Sigma at Grace**
 - Evolution
 - Strategic, infrastructure
 - Tactical, execution
 - Results
- **Questions...**
- **Drawing...**

