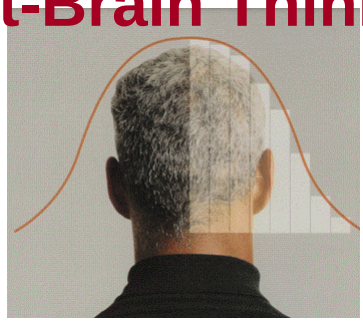
Roberts & Roberts Associates

Presentation on April 24, 2009
ASQ Fort Worth, Cowtown Quality Roundup

SPC for Right-Brain Thinkers™

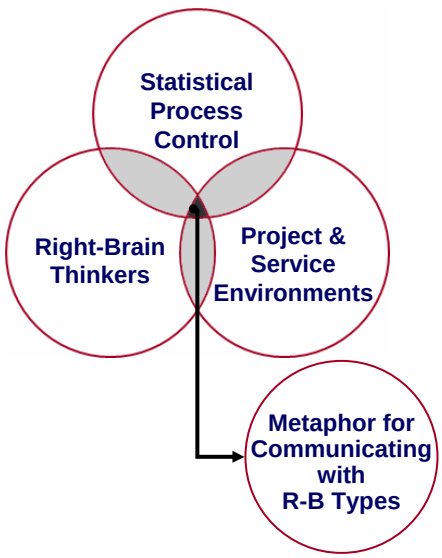


Presented by
Lon Roberts, Ph.D.
Roberts & Roberts Associates

Roberts & Roberts Associates

The Journey

For Right-Brain Thinkers



For Left-Brain Thinkers

How SPC can be applied to projects and service processes

- Special adaptations that are necessary in order to use SPC
- Critical distinctions between manufacturing & non-manufacturing
- The human factor in project and service environments

What analytical-types need to know about right-brain thinkers

- Understanding how right-brain thinkers think
- Communicating analytical concepts to right-brain thinkers

Roberts & Roberts Associates

The Left- and Right-Brain Aspects of SPC

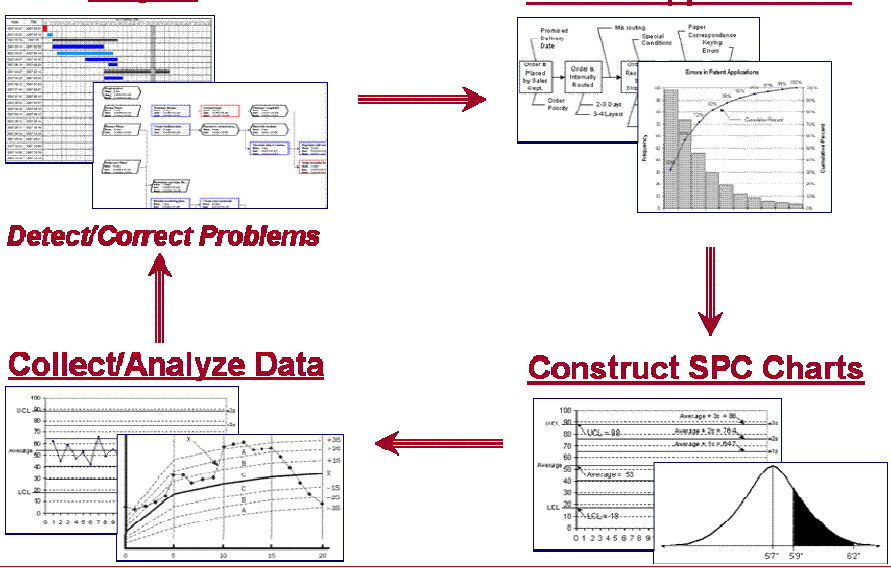
Left-Brain Focus …	*Right-Brain Focus …*
• Technique	• Application
• Ensuring baseline parameters are based on an "in-control" process	• Where and how can the tool be used on the job?
• Establishing control limits based on the "Law of Large Numbers"	• What are the charts telling me about the process or project?
• Ensuring the data are "normally distributed"	• What is the human impact from using the tool?
• Distinguishing "signals" from "noise"	• Do I trust what the charts are telling me?

Lon Roberts • Roberts & Roberts Associates
www.R2assoc.com • (972) 596-2956

Roberts & Roberts Associates

Panorama of SPC Applied to PM

Project → **ID SPC Opportunities** → **Construct SPC Charts** → **Collect/Analyze Data** → **Detect/Correct Problems**



Lon Roberts • Roberts & Roberts Associates
www.R2assoc.com • (972) 596-2956

Roberts & Roberts Associates

SPC Charting Tools Useful in a Project Environment

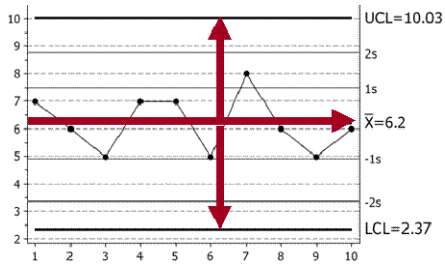
XmR Charts
Monitor variance of individual values in relation to their means and control limits

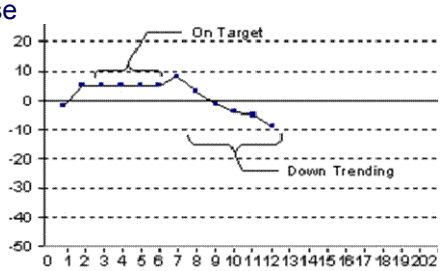
Run Charts
When control limits can't be established

Pre-Control Charts
Monitor metrics WRT spec limits rather than control limits—effective, easy to use

CuSum Charts
To detect/track gradual shifts in metrics

Scatter Diagrams
To observe correlation, if any, between variables





Roberts & Roberts Associates

Traditional PM Metrics vis-à-vis SPC

Point-indicators (such as BCWP, ACWP, BCWS) are beneficial in answering such questions as . . .

- Where are we at this point in the project relative to the plan?
- What are the ETCs based on where we are now?

Statistical Process Control can expand the value of point-indicators to help answer such questions as . . .

- Is the gap between the plan and the actuals cause for concern?
- How do we detect and interpret trends and patterns in the point indicators?
- What metrics besides $ and time should we pay attention to?

Roberts & Roberts Associates

Processes versus Projects

Process Issue	Project Issue
Processes are repeatable, thus variation in parameters can be predicted from history	Since no two projects are identical, there's limited information that history can reveal about anticipated variation
Seek to distinguish between chance and assignable causes of variation	The distinction is harder to draw since projects aren't repeatable processes
Performance is measured by collecting samples (n ≥ 1)	Performance is often evaluated by observing point values (n = 1)
Process cycle times are consistent over time	No two projects have the same schedule
Measurements vary around a constant value—typically the mean	Some metrics increase or decrease over time, such as ACWP or ETC

Roberts & Roberts Associates

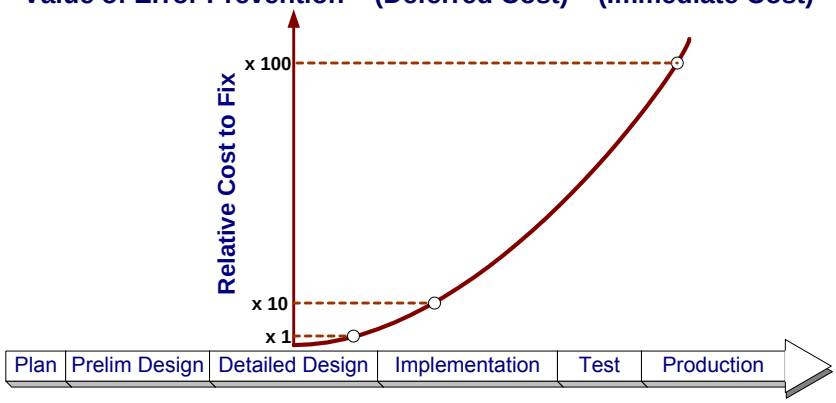
Adaptations for Applying SPC to Projects

Project Issue	Adaptations
Since no two projects are identical, there's limited info that history can reveal about anticipated variation	• Gather data from similar projects to establish control limits … or, • Use engineering specs and C_{PK} = 3
Difficult to distinguish chance variation from assignable causes	• Modify the "action rules" to account for dynamic nature of project parameters
Performance is often evaluated by observing point values (n = 1)	• Use XmR charts if data are ≅ "normal" • Use Pre-Control charts if not normal
No two projects have the same schedule	• Normalize time scales into an equal # of intervals to establish control limits
Some metrics increase or decrease over time, such as ACWP or ETC	• In such cases allow for ascending or descending control limits and zones

Compelling Reasons for Using SPC in Projects

Schedule and budget are only 2 of many project success factors

Value of Error Prevention = (Deferred Cost) – (Immediate Cost)



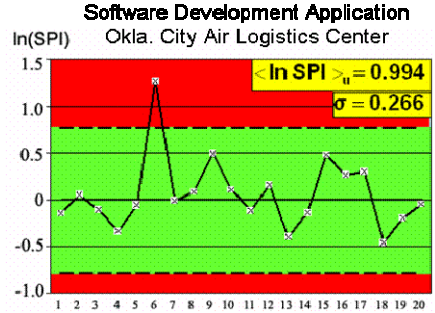
Point-indicators offer little help in pinpointing process problems

Complying with Levels 4 & 5 of the SEI Capability Maturity Model

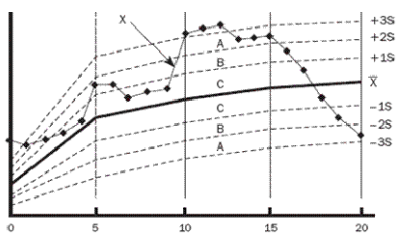
PM Applications of SPC

- Monitoring changes in EV indices, such as SPI and CPI
- Monitoring consumption of project buffers and management reserves
- Monitoring critical success factors, in addition to time and costs
- Monitoring within-process variables, i.e., leading indicators of problems

Software Development Application
Okla. City Air Logistics Center



Tracking Cumulatives, e.g., % complete



Roberts & Roberts Associates

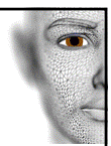
Challenges of Applying SPC in a Project Environment

- Measuring things that matter most … i.e., benefits > costs
- Slow-moving data streams → not able to collect samples in which n > 1 → not able to apply the Central Limit Theorem
- Obtaining data that's "normally distributed" → caveats related to interpretation of out-of-control conditions
- Establishing control limits & centerlines for critical parameters
- Interpreting chart results and patterns → using the results
- Gaming the numbers; Unintended consequences; Heisenberg's Uncertainty Principle
- Getting started → training PMs and educating stakeholders → making the tool useful and understandable to non-statisticians

Roberts & Roberts Associates

Human Dimension of the Project Environment

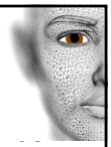
... Some Relevant Observations & Generalizations



- Experienced project managers know that "people problems" commonly outnumber technical problems by a factor of 2 or 3 to one
- Projects fail more often due to people problems than technical problems … with "communications problems" topping the list
- Executives and high-level customers often base their decisions on a few key facts … rather than mounds of statistical data
- The (normative) rules of formal logic are seldom followed when it comes to making decisions in the "real world" … *e.g., even highly educated people play the Lottery* (descriptive vs. normative rules)
- Right-brain people often gravitate to projects and service jobs … especially those that can benefit from their natural attributes
- Also, right-brain people are often attracted to management positions because of their comfort in dealing with complex human issues

Roberts & Roberts Associates

The Human Side of Projects & Service Processes



Even in high-tech companies, many stakeholders are apt to be "right-brain thinkers" – i.e., right-hemisphere dominant

- **External:** Executives, customers, financial backers
- **Internal:** Designers, programmers, sales and marketing types

Brain Hemispheric-Dominance Distinctions:

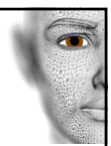
Left-Dominant	Right-Dominant
Verbal	Visual
Linear, logical reasoning	Non-linear, lateral reasoning
Analytical and deductive	Intuitive and inductive
Process symbols, numbers, equations	Process images, patterns, stories
Believe *their* way is superior	Believe *their* way is superior

Debunking the Math Myth:

Right-brain people aren't hard-wired to avoid math … but they may approach it from a different perspective than their left-brain peers.

Roberts & Roberts Associates

Brain-Hemisphere Dominance and the Project Environment



Risk Analysis

- **Left Dominant:** Comprehensive analysis of risk factors and weights
- **Right Dominant:** Fast and Frugal Heuristics (bounded rationality)

Risk Taking

- **Left Dominant:** Influenced by probabilities
- **Right Dominant:** Influenced by consequences

Source Data to Inform Decisions

- **Left Dominant:** Quantitative; data samples; probability over a range
- **Right Dominant:** Qualitative; anecdotal; point-value probabilities

Problem Solving

- **Left Dominant:** Identify and eliminate root causes – i.e. decompose
- **Right Dominant:** Devise and deploy work-arounds – i.e. synthesize

A Tool Well-Suited for Right-Brain Thinkers

As a tool SPC …

- Is helpful in visualizing patterns and trends
- Doesn't require end-users to be knowledge of its theoretical underpinnings
- Is useful in monitoring attributes as well as variables
- Doesn't impose itself on the user…nor is data collection (necessarily) an onerous task
- Can be adapted to projects and service processes…with certain restrictions and caveats

SPC charts are to Point Measurements as EKGs are to Pulse Rates

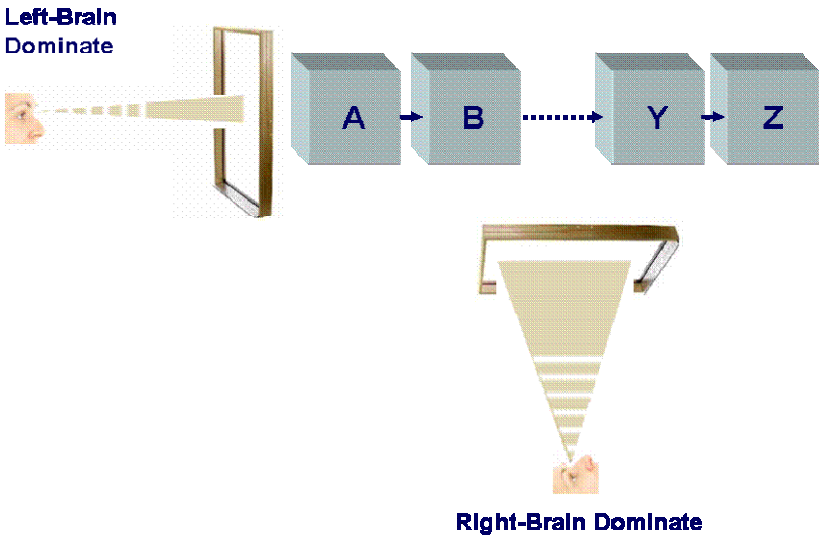
SPC for Right-Brain Thinkers as a Metaphor for Communicating with Non-Statisticians

Pays heed to 4 key premises…

1. There are fundamental differences between production and non-production processes that have bearing on the manner in which *measurements tools that apply to both* are deployed and utilized.
2. In contrast to *operators* in production processes, *professionals* who support non-production processes are an integral part of the processes itself…and can influence how the process is exercised.
3. Many of the professionals who support projects and service processes are "right-brain thinkers" who need quantitative data to support fact-based decisions.
4. It is incumbent on the purveyors of statistical data to use *frames of reference* and *representations* for their "product" that end-users can relate to…and consequently, will *embrace.*

Roberts & Roberts Associates

Process Perspectives: Front Door vs. Side Door



Roberts & Roberts Associates

Choice of Representation

$$[\text{Sin}^2\phi + \text{Cos}^2\phi] + \{[((\varepsilon^{j\phi} - \varepsilon^{-j\phi})/2j)^2] + [((\varepsilon^{j\phi} - \varepsilon^{-j\phi})/2)^2]\} = ?$$

Other Examples:

- Bayesian probabilities vs. natural frequencies
- Vectors depicted in rectangular vs. polar notation
- Correlation coefficients vs. scatter plots
- Displaying data in tables vs. graphs
- Change represented as relative vs. absolute percentages
- Narrative descriptions vs. formulas and symbols

Roberts & Roberts Associates

References

SPC for Right-Brain Thinkers: Process Control for Non-Statisticians, Lon Roberts, Quality Press, 2005 Link

Gut Feelings: The Intelligence of the Unconscious, Gerd Gigerenzer, Viking, 2007 Link

Simple Heuristics That Make Us Smart, Gerd Gigerenzer and Peter Todd, Oxford University Press, 1999 Link

The Psychology of Judgment and Decision Making, Scott Plous, McGraw-Hill, 1993 Link

A Whole New Brain, Daniel H. Pink, Riverhead Books, 2006 Link

Statistical Process Control of Project Performance, Walt Lipke, Crosstalk: The Journal of Defense Software Engineering, March 2002 Link

A Statistical Project Control Tool for Engineering Managers, Garland T.Bauch and Christopher A. Chung, Project Management Journal, June 2001 Link

Improving Traditional Earned Value Management by Incorporating Statistical Process Charts, Sou-Sen Len, et. al., ISARC 2006 Conference Proceedings Link

Statistical Process Control for Right-Brain Thinkers, Lon Roberts, Six Sigma IQ, Feb. 2009 Link

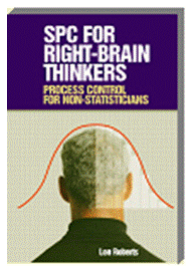
SPC Resources Website
http://www.r2assoc.com/SPC.HTM Link

Roberts & Roberts Associates

Roberts & Roberts Associates
Ph: (972) 596-2956
E-mail: Lon@R2assoc.com
http://www.R2assoc.com

Lon Roberts, Ph.D.

Author of . . .



Ratchet Up Your Skills With These Workshops!

See descriptions at www.R2assoc.com

Statistical Process Control for Service Providers™

Gleaning Facts From Figures™