

Statistical Thinking (for Statisticians)

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Goal

To create a common understanding of
Statistical Thinking
within our own profession

Background

- JSM Roundtable Luncheon - Chicago
 - ST for Process Improvement
- JSM Roundtable Luncheons - Anaheim
 - ST for Statisticians
 - Hoerl and Hare (AMSTAT News Article)
- C. Mallows - 1997 Fisher Memorial Lecture, “The Zeroth Problem,” *The American Statistician*, Feb. ‘98.

Definition

Statistical Thinking is a philosophy of learning and action based on the following fundamental principles:

- All work occurs in a system of interconnected processes,
- Variation exists in all processes, and
- Understanding and reducing variation are keys to success.

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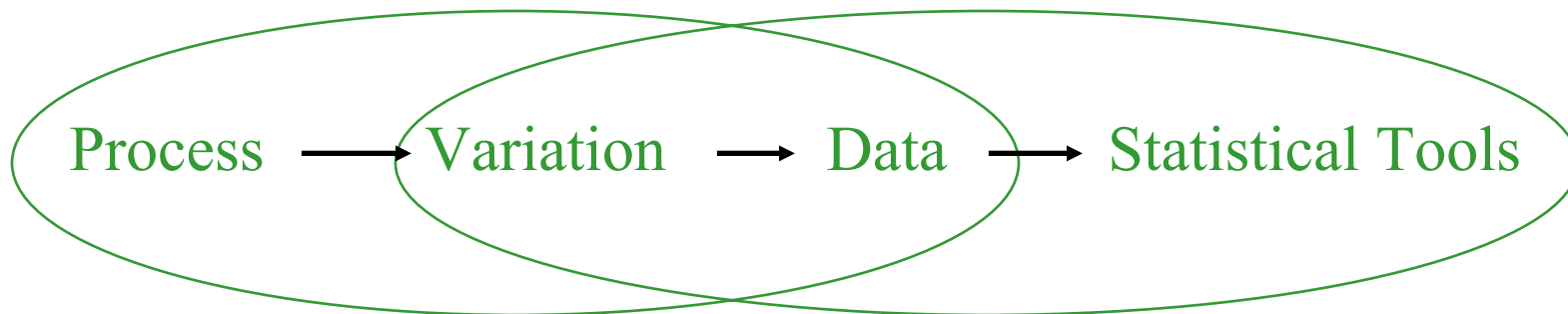
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Source: Glossary of Statistical Terms, ASQ Quality Press

Statistical Thinking and Methods



Statistical Thinking

Statistical Methods

Statistical Thinking

Key Concepts

- Process and systems thinking
- Variation
- Analysis increases knowledge
- Taking action
- Improvement

Role of Data

- Quantify variation
- Measure effects

Without a Process View

- People have problems understanding the problem and their role in its solution (turf).
- It is difficult to define the scope of the problem.
- It is difficult to get to root causes.
- People get blamed when the process is the problem (85/15 Rule).
- Process management is ineffective
- Improvement is slowed

*“You can’t improve a process
that you don’t understand”*

Without Understanding Variation

- Management by the last data point
- There's lots of fire fighting
 - Using special cause methods to solve common cause problems
- Tampering and micromanaging abound
- Goals and methods to attain them fail
- Understanding the process is handicapped
 - Learning is slowed
- Process management is ineffective
- Improvement is slowed

Without Data

- Everyone is an expert: discussions produce more heat than light
- Historical memory is poor
- Difficult to get agreement on:
 - What the problem is
 - What success looks like
 - Progress made
- Process management is ineffective
- Improvement is slowed

Without Statistical Thinking

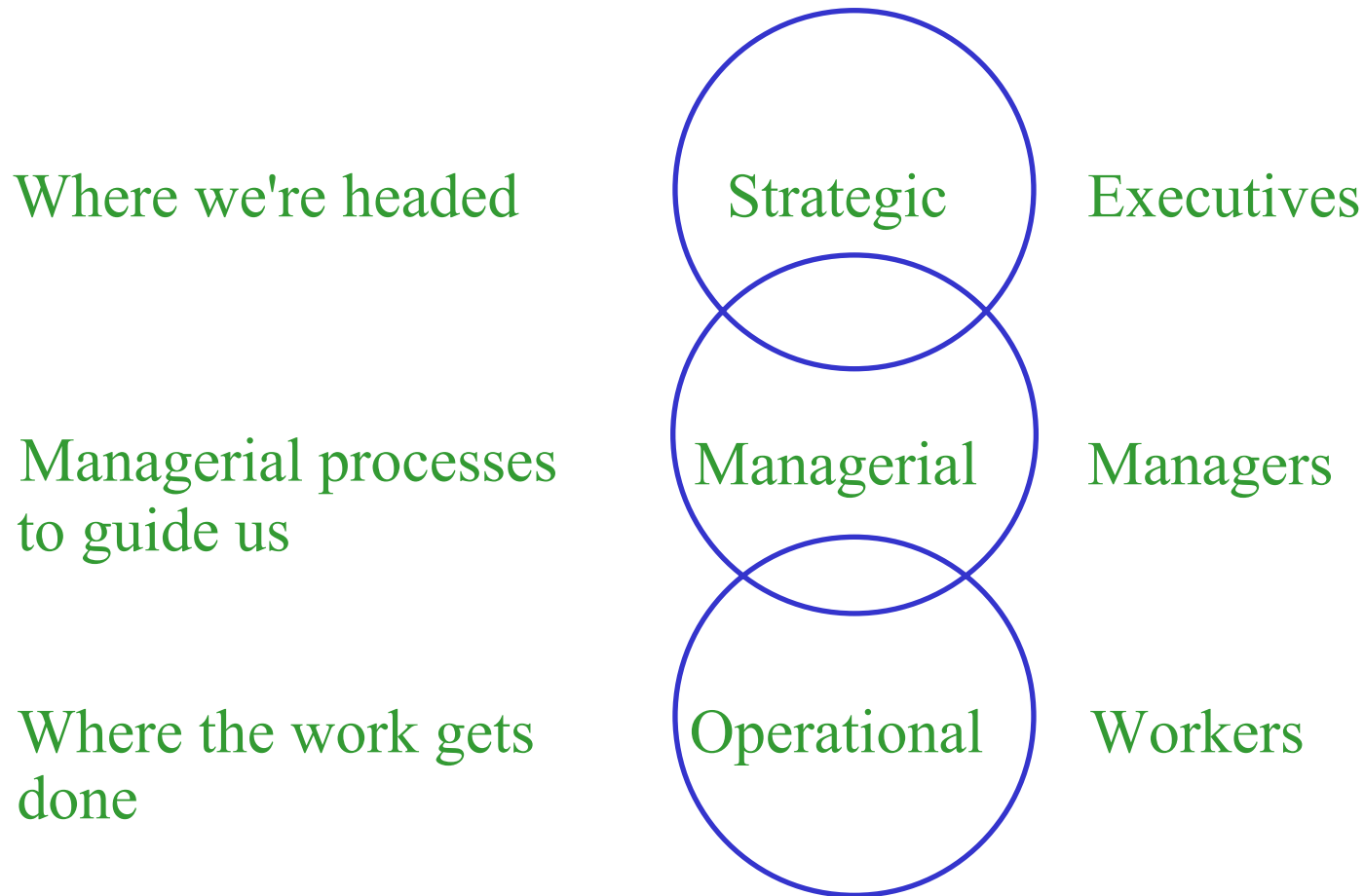
- Your management and improvement processes are handicapped
- It's like
 - Football without a passing attack
 - Growing a lawn without fertilizer
 - Doing research without measurements
 - Playing golf without your irons

“Early on, we failed to focus adequately on core work processes and statistics.”

David Kearns and David Nelder, Xerox Corporation

Use of Statistical Thinking

Depends on levels of activity and job responsibility.



Examples of Statistical Thinking at the Strategic Level

- Executives use systems approach.
- Core processes have been flow charted
- Strategic direction defined and deployed.
- Measurement systems in place.
- Employee, customer, and benchmarking studies are used to drive improvement.
- Experimentation is encouraged.

Examples of Statistical Thinking at the Managerial Level

- Managers use meeting management techniques
- Standardized project management systems are in place.
- Both project process and results are reviewed.
- Process variation is considered when setting goals.
- Measurement is viewed as a process.
- The number of suppliers is reduced
- A variety of communication media are used.

Examples of Statistical Thinking at the Operational Level

- Work processes are flowcharted and documented
- Key measurements are identified.
 - Time plots displayed
- Process management and improvement utilize:
 - Knowledge of variation, and
 - Data
- Improvement activities focus on the process, not blaming employees.

Statistical Thinking at the Operational Level

A Recent Experience

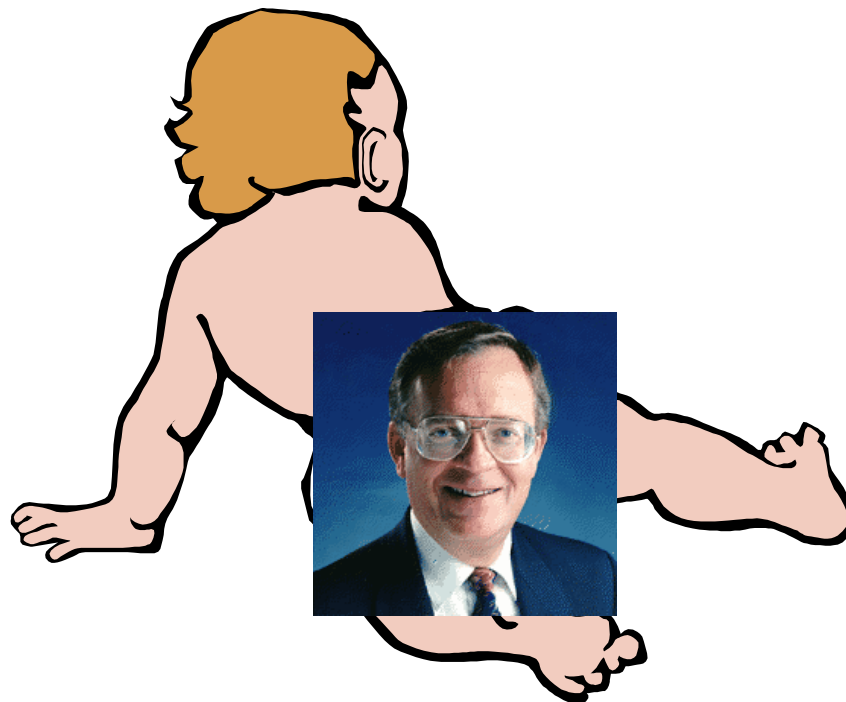
- Huge quantities of data
- Limited understanding of structure
- Consultants applied artificial neural nets
- Didn't work

Statistical Thinking at the Operational Level

A Recent Experience

- Artificial Neural Nets apply nicely in many situations (NIST Examples):
 - Optical Character Recognition
 - Finger Printing
 - Face Printing for the FBI
- Example

WANTED
BY THE FBI
Baby Face Hare



.... But,

Unless you sample the process taking the right amount of the right kind of data (rational subgroups) you will never approach process understanding.

Without process understanding, there is no process control.

Key Learnings from ST Efforts

- Statisticians don't understand ST as well as they think they do.
- Those who do understand it have limited access to managerial and strategic levels.
- There's much more work to be done.
 - Spread the word
 - Focus on process