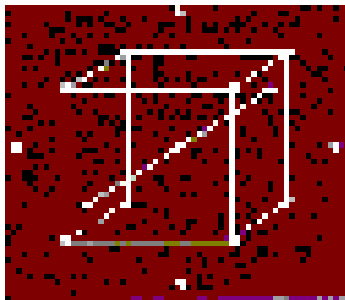


# **Statistical Thinking for Management**

**American Society for Quality  
Annual Quality Congress  
Anaheim, CA**

**May 24-26, 1999**

# Session T102



STATISTICS  
T102

**Janice Shade**

**Nabisco**

# **ASQ Statistics Division**

## **Team on Statistical Thinking:**

**Galen Britz - 3M**

**Don Emerling - Ryobi Die Casting**

**Lynne Hare - Nabisco**

**Roger Hoerl - General Electric**

**Stu Janis - 3M**

**Janice Shade - Nabisco**

**Ron Snee - Sigma Breakthrough Tech.**

# Statistical Thinking Team Contributions

- **The Role of ST in Management, AQC, Boston, '94**
  - Quality Progress, Feb., '95
- **ST for Business Improvement, AQC, Cincinnati, '95**
  - Available through QIC
- **Special Publication, Statistics Division, '96**
  - Available through QIC
- **How to Teach Others to Apply ST, FTC, '96**
  - Quality Progress, June, '97
- **How to Apply ST Effectively, FTC, '97**
- **Improving Performance Through Statistical Thinking, to appear**

# Improving Performance Through Statistical Thinking

- **Why ST is important?**
- **What is ST?**
- **How do you apply ST?**
- **How to begin implementing ST capability in an organization**
- **Summary**
- **Appendix - tools, case studies**

# Statistical Thinking for Management

- **Statistical Thinking Defined - Galen Britz**
- **Statistical Thinking in the Organization - Ron Snee**
- **How to use Statistical Thinking to Improve Management Processes (Workshop) - Stu Janis**
- **Group Summaries - All**
- **Summary- Janice Shade**

**Galen Britz**

**3M**

# 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.**

**Glossary of Statistical Terms - Quality Press, 1996**

# Definition

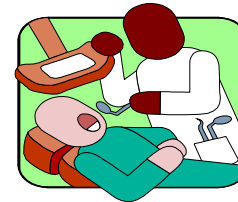
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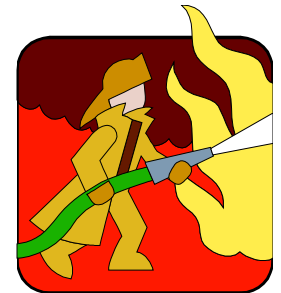
# Evaluation Based on Past Experiences or Perceptions

- **We've always done it this way!**
- **We work with what we get!**
- **We do the best we can!**
- **I never thought about it!**
- **I'm so busy with the day to day troubles, I don't have time to try that!**
- **That has no effect on the finished product (or service)!**

# Evaluation Based on Data

*THE KEY IS TO ASK WHY!!!*

- Why is the material from the fabrication department machine so inconsistent?
- Why do so we constantly firefight?
- Why does our daily output vary so much?
- Why does every job result in a monumental task that takes forever to complete?



# 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,*

# Process

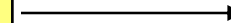
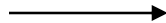
Transforms Inputs into Outputs

## Inputs

## Transformation

## Outputs

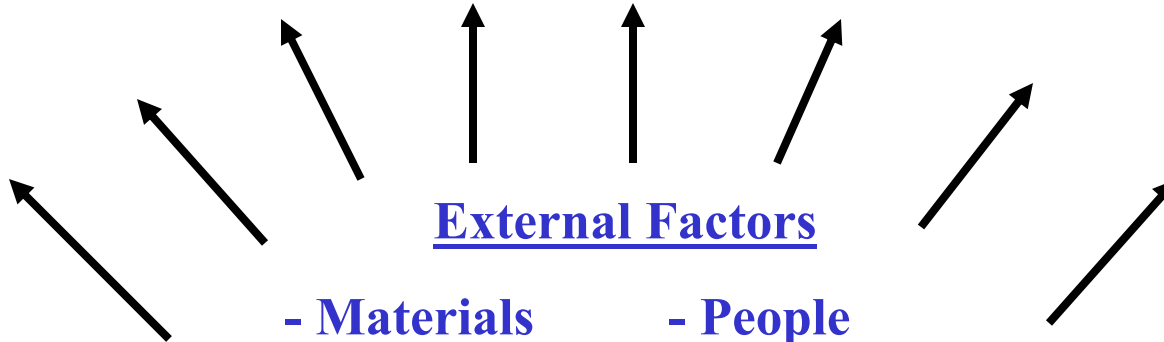
Suppliers  
Information  
Historical Data



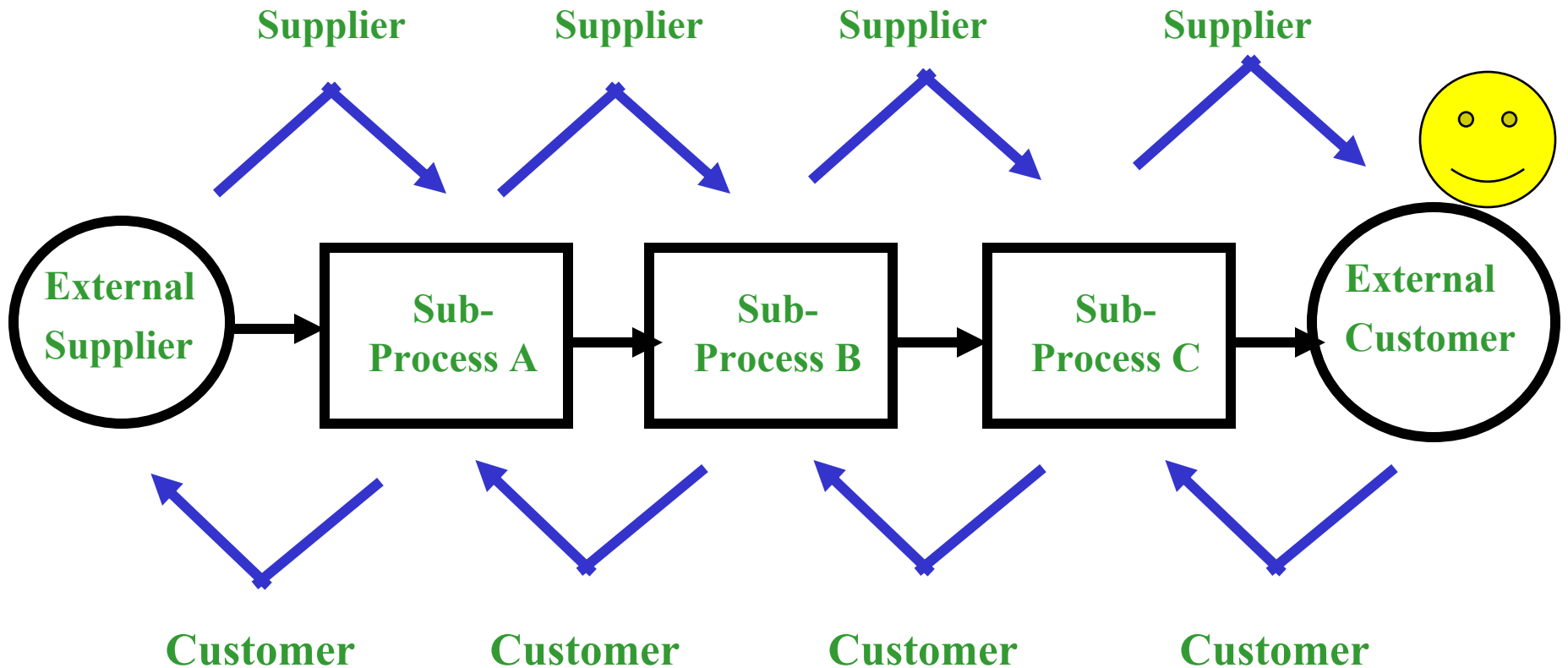
Finished  
Goods  
or Services

## External Factors

- Materials
- Methods
- Environment
- People
- Machines
- Measures



# Processes and Sub-Processes



# Definition

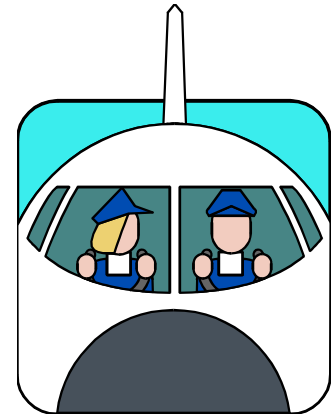
Statistical Thinking is a philosophy of learning and action based on the following fundamental principles:

- All work occurs in a system of interconnected processes,
- *Variation exists in all processes, and*

**Glossary of Statistical Terms - Quality Press, 1996**

# Like it or not, variation is everywhere!

- Our drive time to work each day.
- The quantity of production each shift.
- Departure time of our plane.
- .....



*Know it, accept it, learn to deal with it!*

# 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,
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## Deming once said:

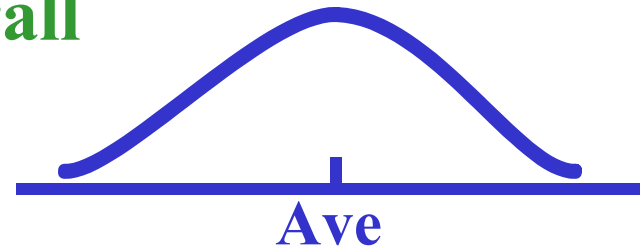
*“If I had to reduce my message for management to just a few words, I’d say it all had to do with reducing variation.”*



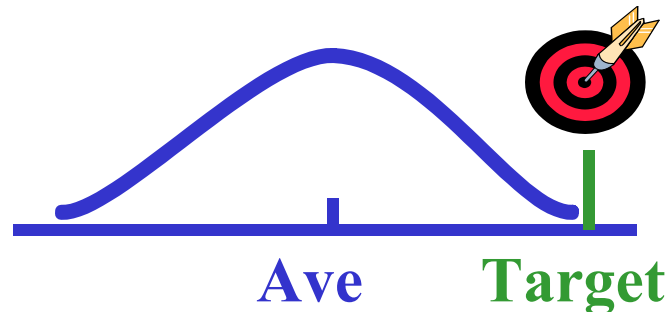
# Variation and Targets

Variation can be thought of as:

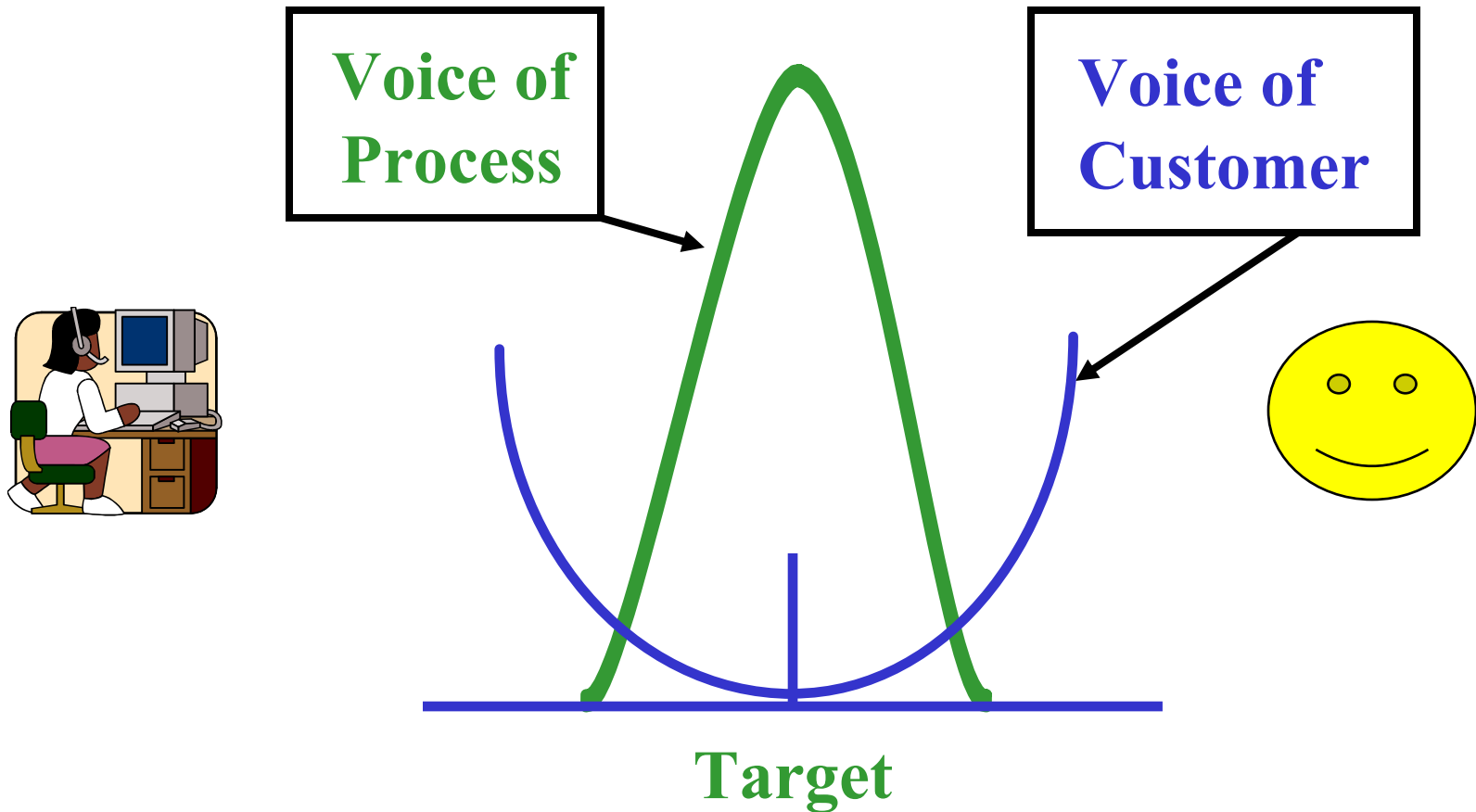
1. Deviations around the overall average or



2. A deviation of the overall average from a desired target.



# Reduced deviation around the Average and on Target



# Types of Variation

- **Common Cause**
- **Special Cause**
- **Structural**

# Pitfall

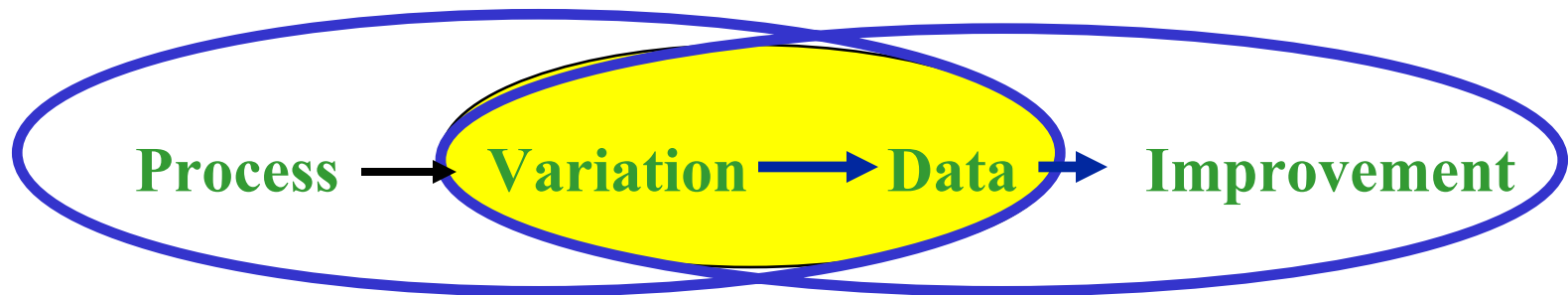
## Valuing only quantitative data

Qualitative data are just as important.

Example: Idea data!!



# Improvement using Statistical Thinking



**Statistical Thinking**

**Statistical Methods**

**Philosophy**



**Analysis**



**Action**

# Benefits of Statistical Thinking

**Provides a theory and methodology for improvement:**

- **Helps identify where improvement is needed.**
- **Provides a general approach to take.**
- **Suggests tools to use.**

**A complete improvement approach includes all elements of Statistical Thinking:**

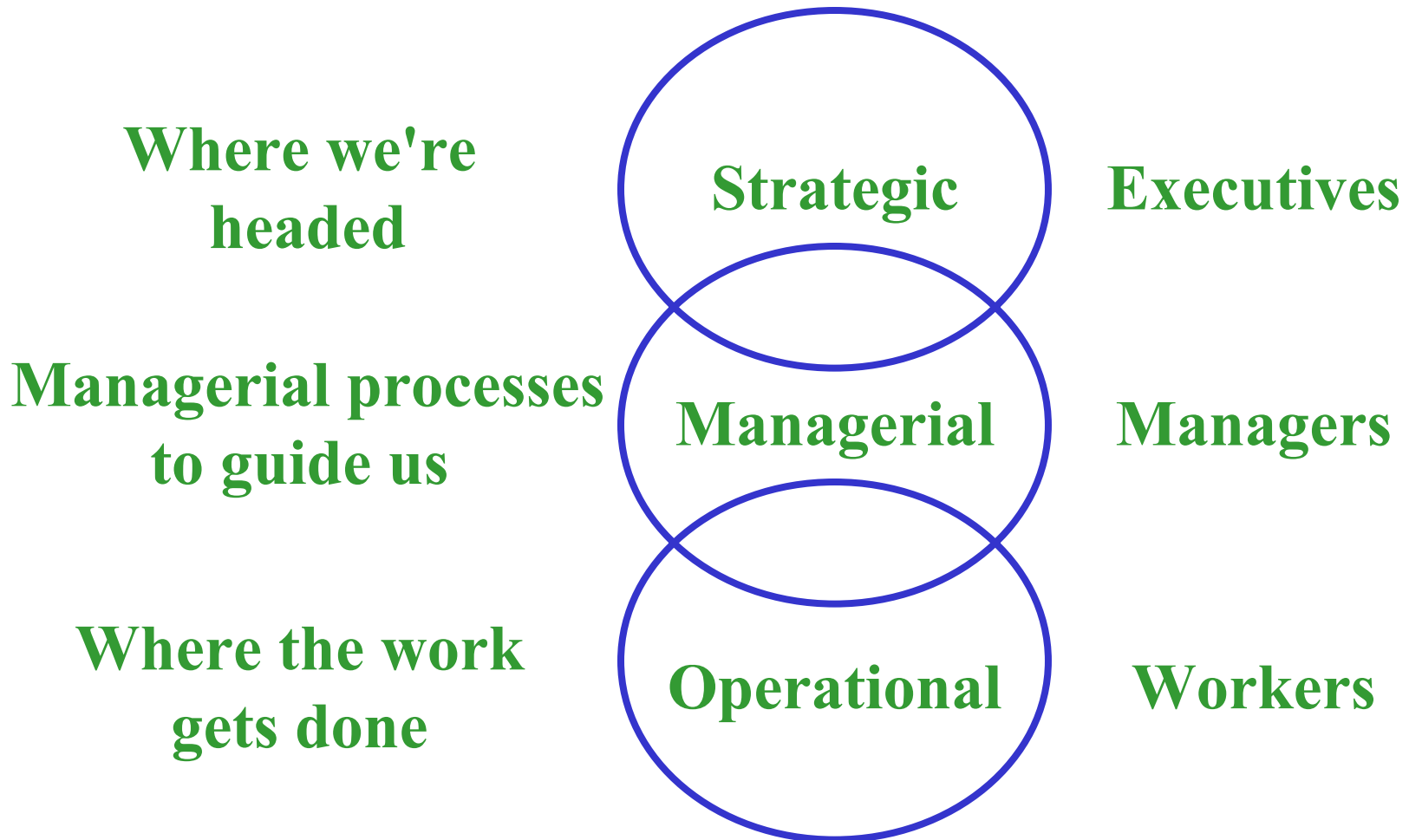
**Process - Variation - Data**

**Ron Snee**

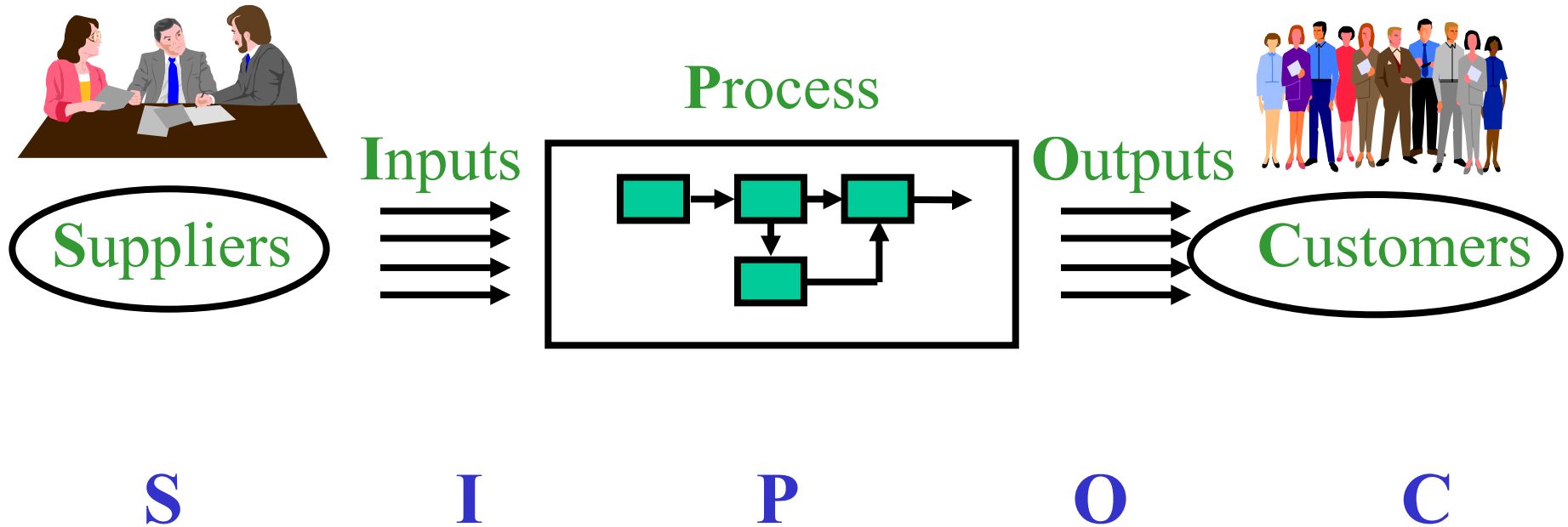
**Sigma Breakthrough Technologies, Inc.**

# Use of Statistical Thinking

Depends on levels of activity and job responsibility.



# Process

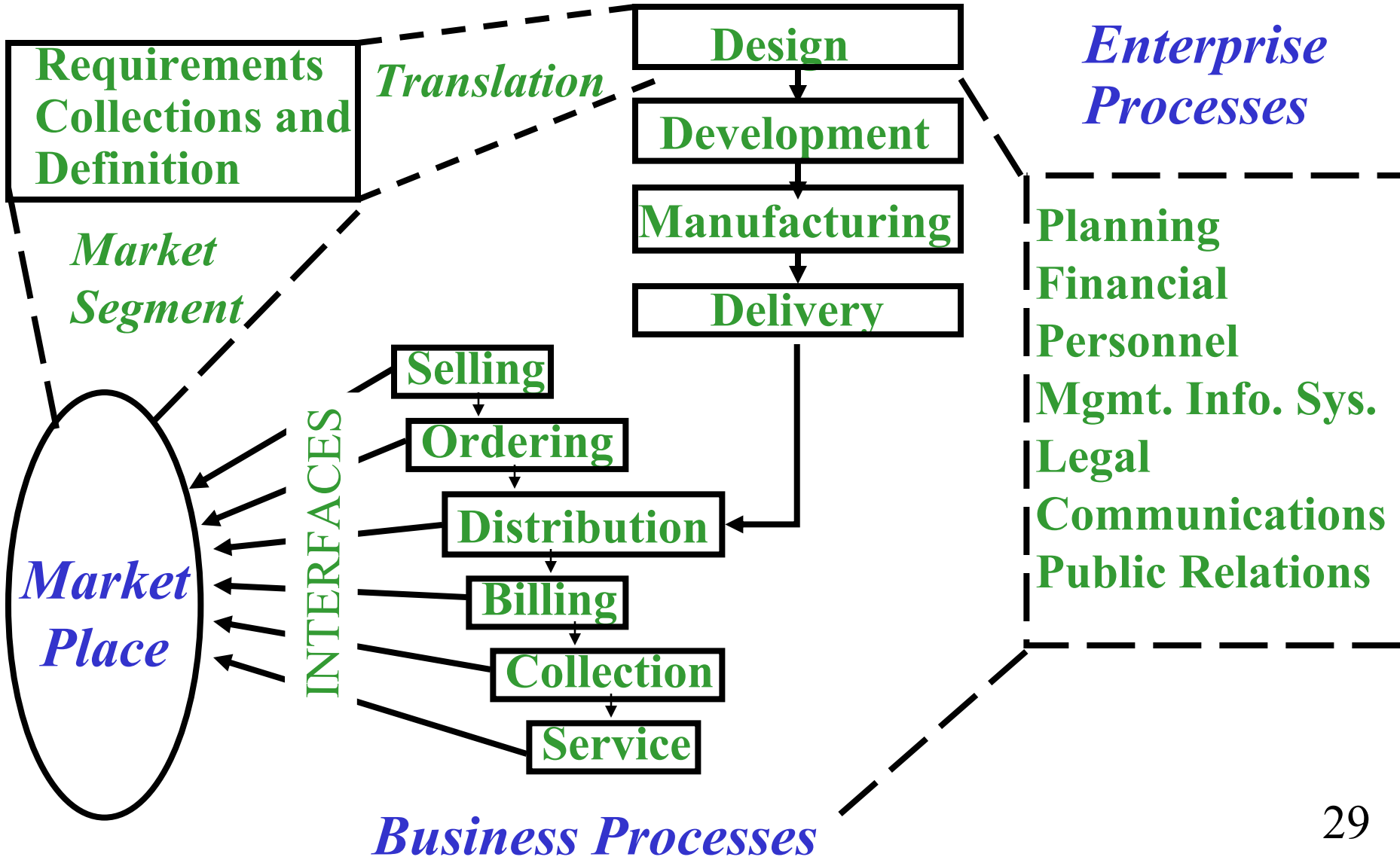


**A series of activities that converts inputs into outputs**

# IBM Core Processes

## *Product Processes*

## *Enterprise Processes*



# Examples of Operational Processes

- **Manufacturing**
- **Order Entry**
- **Delivery**
- **Distribution**
- **Billing**
- **Collection**
- **Service**

# 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.**

# Examples of Strategic Processes

- **Strategic Plan Development**
- **Strategic Plan Deployment**
- **Acquisitions**
- **Corporate Budget Development**
- **Communications - Internal and External**
- **Succession Planning and Deployment**
- **Organizational Improvement**

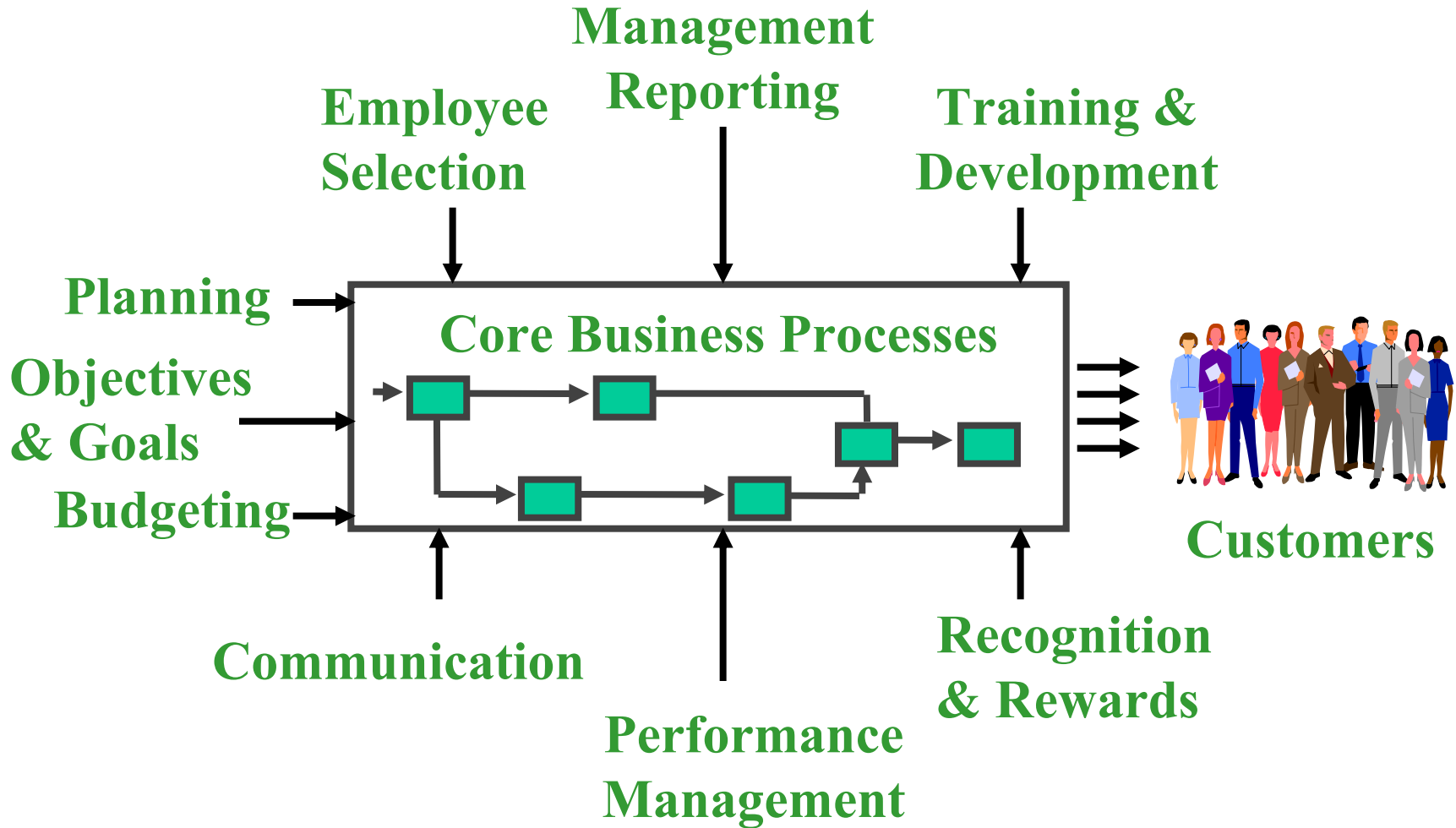
# Examples of Statistical Thinking at the Strategic Level

- 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 Managerial Processes

1. Employee Selection
2. Training and Development
3. Performance Management (including coaching)
4. Recognition and Reward
5. Budgeting
6. Setting Objectives and Goals
7. Project Management
8. Communications
9. Management Reporting
10. Planning

# Examples of Managerial Processes

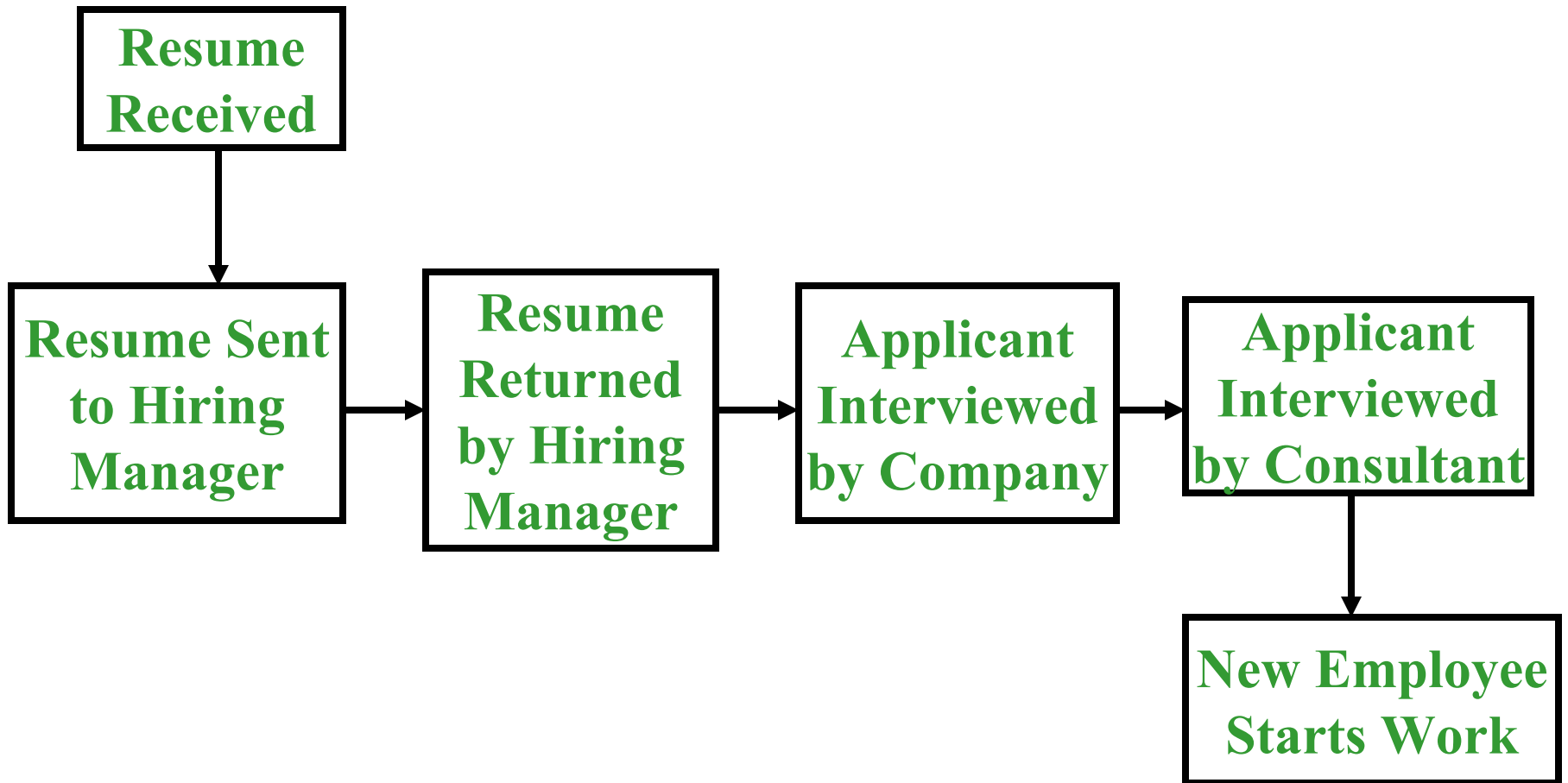


# **Examples of Statistical Thinking at the Managerial Level**

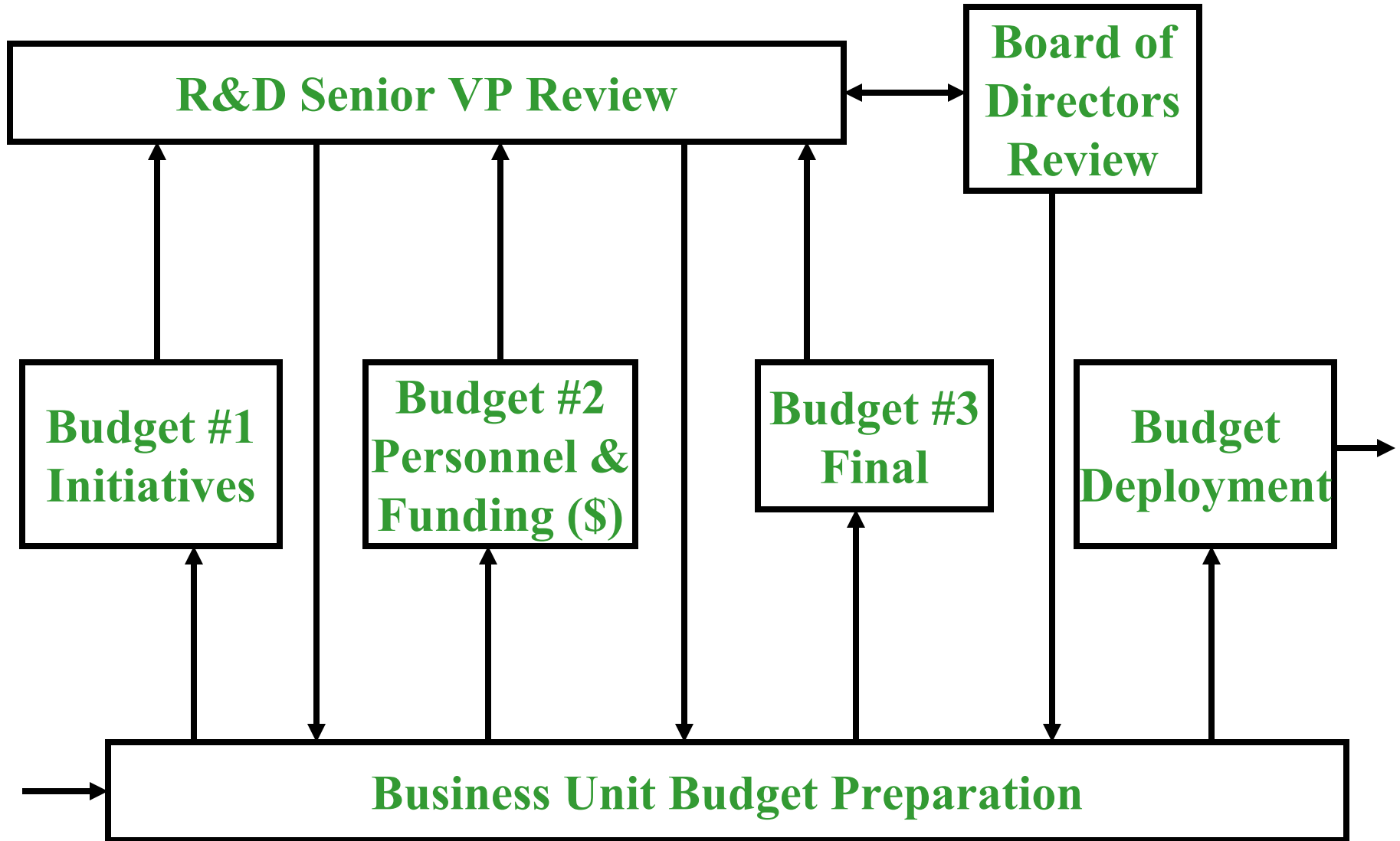
- **Managers use meeting management techniques**
- **Standardized project management systems are in place.**
- **Both project process and results are reviewed.**
- **Process variation is considered when setting goals.**
- **Measurement is viewed as a process.**
- **The number of suppliers is reduced**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

# Personnel Requisition Process

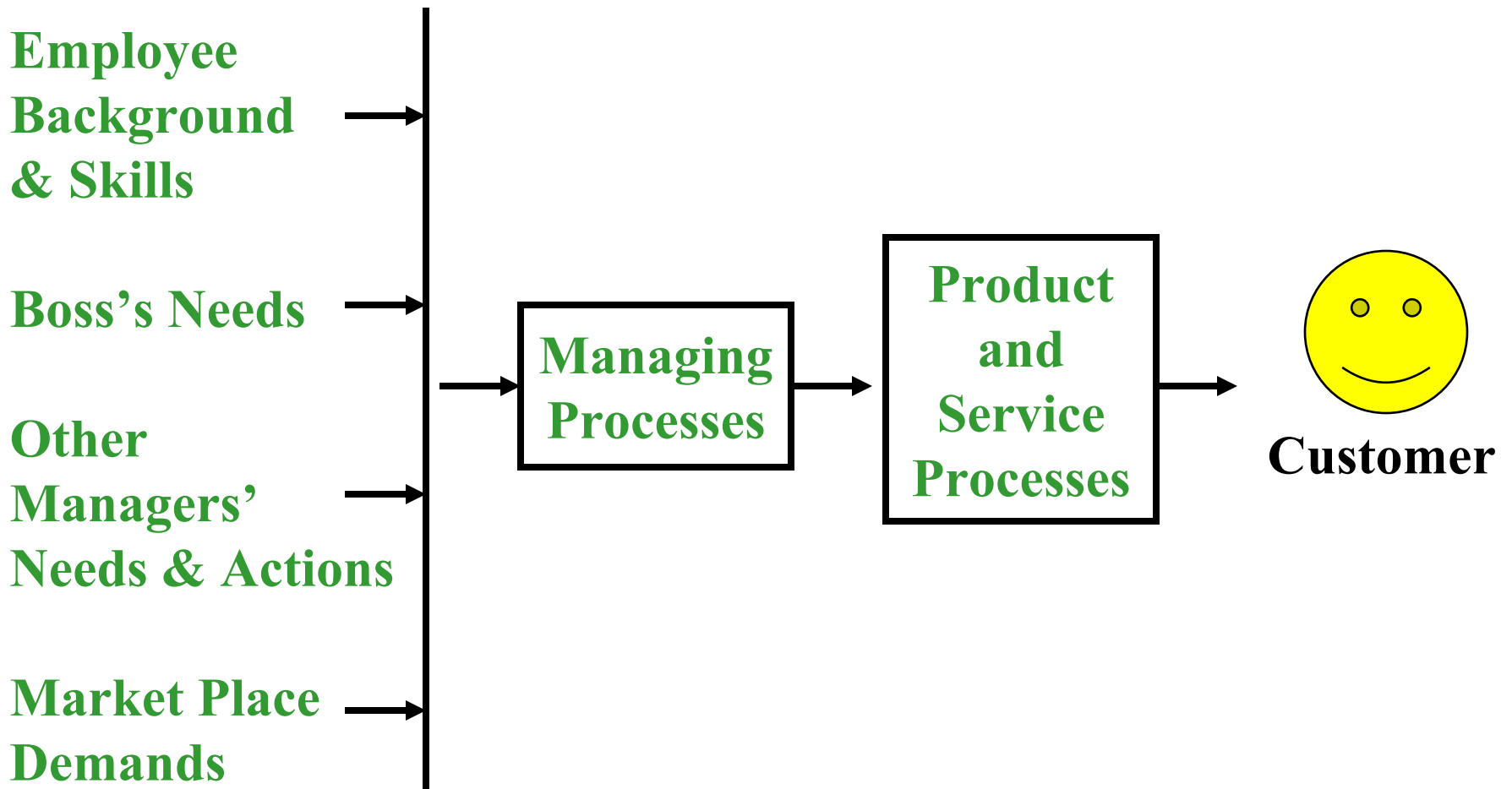
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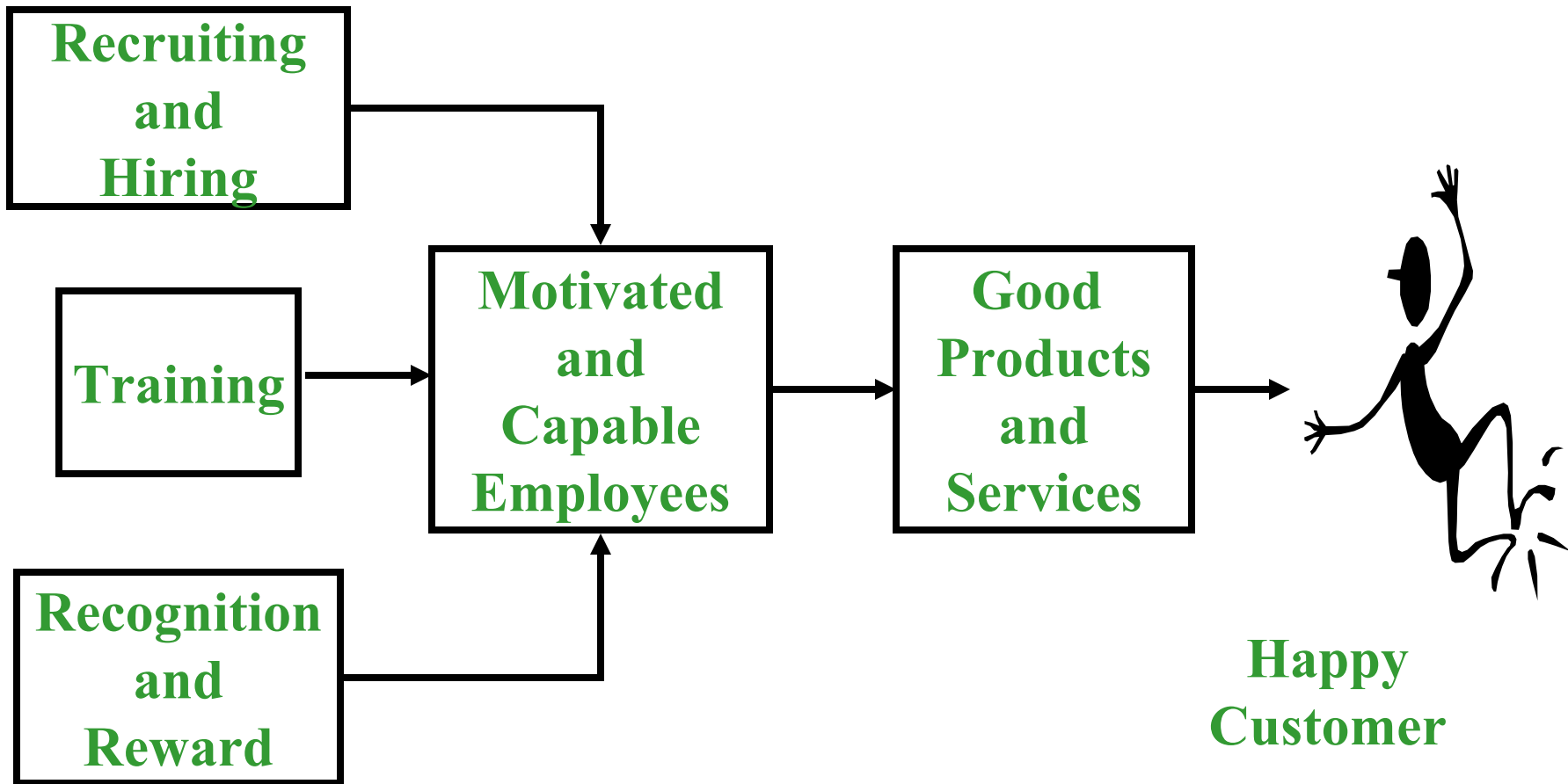
# R&D Budgeting Process



# Variables Affecting Managerial Processes



# Example - Effect of Managerial Processes on Customers



# Robustness - An Underused Concept

- **Key aspect of Statistical Thinking**
- **Reduce the effects of uncontrollable variation in:**
  - **Product design**
  - **Process design**
  - **Management practices**
- **Anticipate variation and reduce its effects**

# Robustness of Product and Process Design

- **A third way to reduce variation**
- **Anticipate variation**
  - **Design the process or product to be insensitive to variation**
- **A robust process or product is more likely to perform as expected**
- **100% inspection cannot provide robustness**

# **Robust Products are Designed in Anticipation of Customer Use**

- **Washing machine tops**
- **User-friendly computers and software**
- **Low-maintenance automobiles**
- **5 mph bumpers**
- **Medical instruments for home use**

# Product and Process Robustness

- **Product Performance is insensitive to variations in conditions of manufacture, distribution, use and disposal.**
- **Process Performance is insensitive to uncontrollable variations in process**
  - **Inputs**
  - **Transformations - activities - steps**
  - **External factors**

# Robustness in Management

- **Develop strategies that are insensitive to economic trends and cycles**
- **Design a project system that is insensitive to**
  - **Personnel changes**
  - **Changes in project scope**
  - **Variations in business conditions**
- **Respond to differing employee needs**
  - **Adopt flexible work hours**
  - **Provide “cafeteria” benefits package**

**More ...**

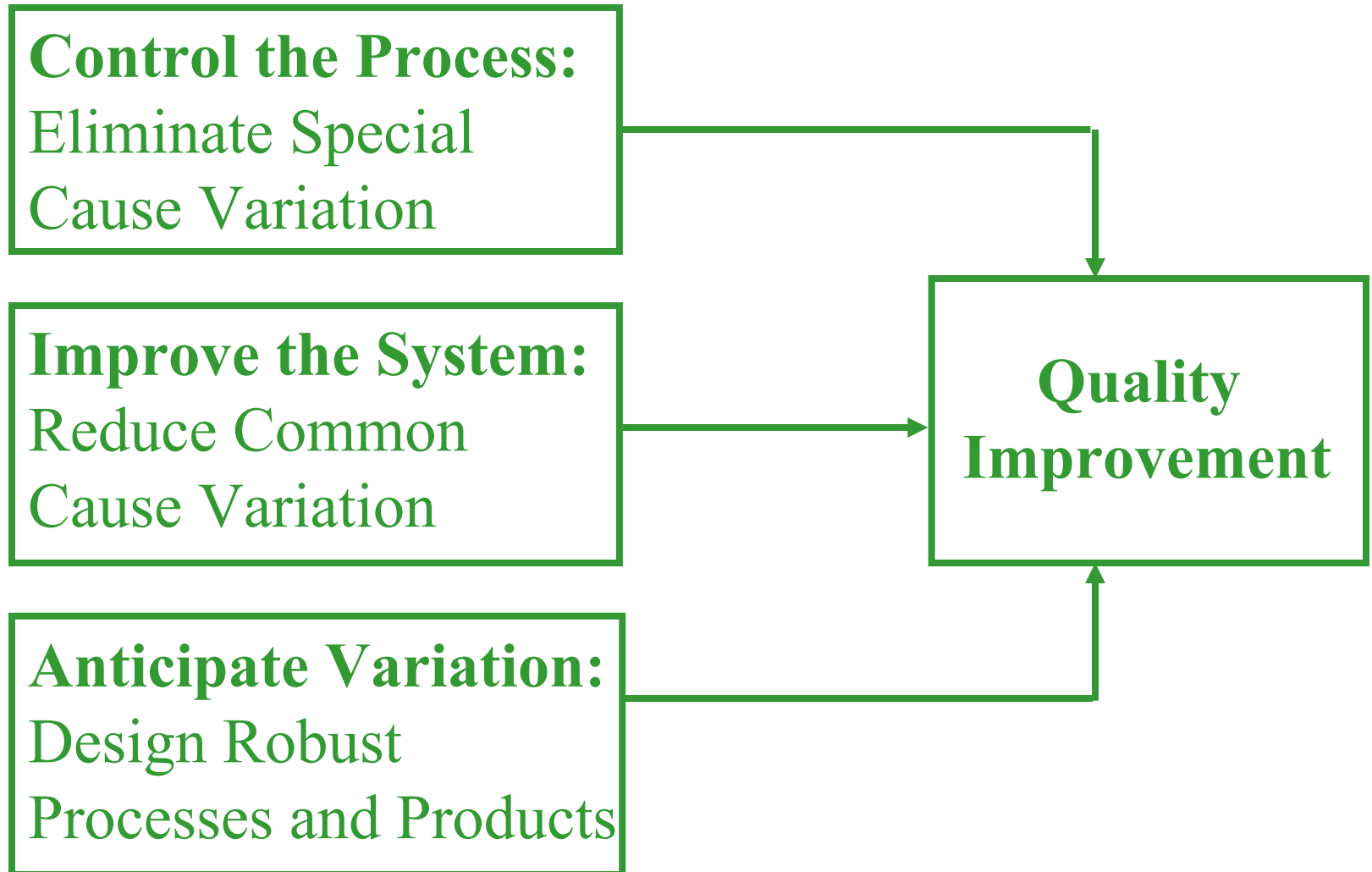
# **Robustness in Management (Continued)**

- **Enable personnel to adapt to changing business needs**
- **Ensure meeting effectiveness is not dependent on facilities, equipment, or participants**

# Understanding Human Behavior

- **Different people have different methods and styles of working, learning and thinking**
- **Different people take in, process and communicate information in different ways**
- **People vary --- they are different:**
  - **Day to day**
  - **Person to person**
  - **Group to group**
  - **Organization to organization**

# Three Ways to Reduce Variation and Improve Quality



# Process Robustness Analysis

- **Identify Those Uncontrollable Factors that Affect Process Performance**
  - **Weather**
  - **Customer Use of Products**
  - **Employee Knowledge, Skills, Experience, Work Habit**
  - **Age of Equipment**
- **Design the Process to be Insensitive to the Uncontrollable Variations in the Factors**

**Stu Janis**

**3M**

# Workshop Activities

- **Objective**
  - Apply concepts to a managerial process in your organization
- **Concept**
  - Groups will discuss how statistical thinking can be applied to a managerial process.
  - Results will be presented at the end.

# Workshop Process

- Form into groups of about 10.
- Your group will be assigned a managerial process.
- Answer the question: *How can Statistical Thinking be applied to improve the \_\_\_\_\_ process in my organization?*
- Record results on transparency.
- Appoint a representative (the person with the next birthday?) to present the results.

# Things to Think About... (and Present)

- What is the ***PROCESS***?
  - Suppliers --> Inputs --> Process --> Outputs --> Customers
- What could cause ***VARIATION*** in the process and its outputs?
- What ***DATA*** would you use to monitor and improve the process?
- How could the process be made more ***ROBUST***?

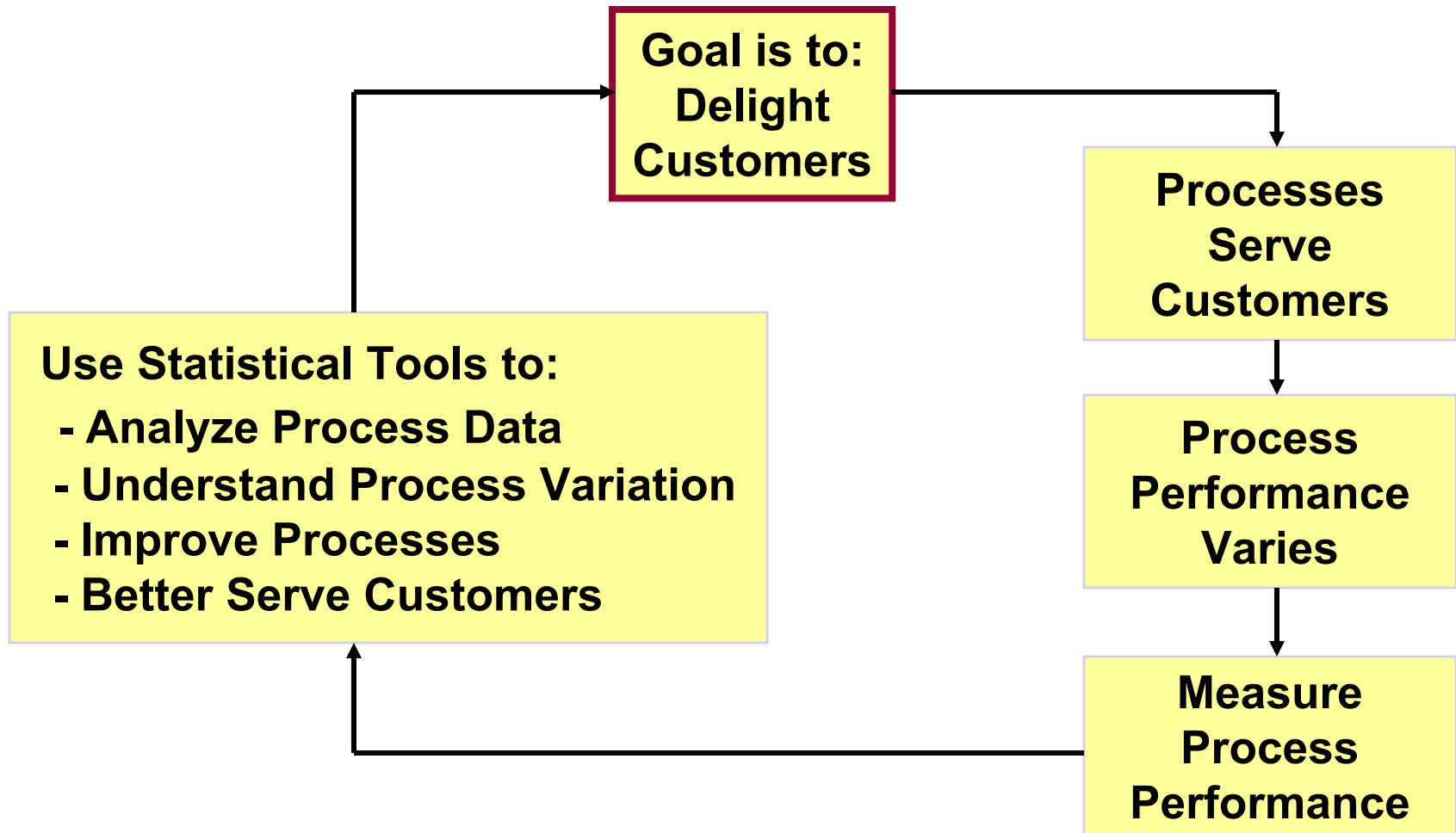
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10. Planning

**Janice Shade**

**Nabisco**

# Using Statistical Thinking To Improve Processes



# Tips for Statistical Thinking

## CAPDo Diagnostic

### Check

Assess major problems and root causes

Define the scope of the project,

Identify the people who will be affected by the project

### Act

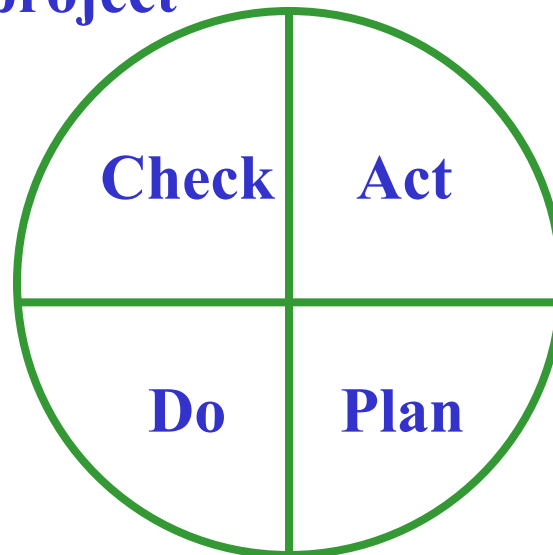
Fix the obvious.

Decide how to approach the issue or problem.

### Do

Implement the plan.

Assure continued process performance.



### Plan

Set project goals and expectations.

Develop the project plan.

# Tips for Statistical Thinking

## Quality Tools

- Flow Diagram
- Pareto Charts
- Cause & Effect
- Histograms
- Run Charts
- Control Charts
- Scatter Diagram

## Management Tools

- Affinity Diagram
- InterRelationship Diagram
- Tree Diagram
- Matrix Charts
- Arrow Diagram
- Process Decision

# Tips for Statistical Thinking

## **Start with the customer.**

**Identify customer requirements and expectations.**

## **Start small.**

**Pick a process that is not very detailed and does not involve many functions or work groups. Small “wins” build confidence and teamwork.**

# Tips for Statistical Thinking

**If a process or system is stable -- showing only common causes of variation.**

Use the tools of improvement to study all the data (not just the “good” or the “bad” points) and identify factors that cause variation. Determine what needs to be permanently changed to achieve a different level of quality.

# Tips for Statistical Thinking

**If a process or system is not stable -- showing signs of special cause ...**

- **Use the tools of problem-solving to identify the root cause. Try to identify exactly when, where, how, and why the process changed.**
- **If a Special Cause hurts the process, develop procedures to eliminate the return of the problem. If a Special Cause is beneficial, develop procedures to make it a permanent part of the process.**

Watch for:  
“Improving Performance Through  
Statistical Thinking”

