Quality Management Systems

Topics to cover:

- Elements of TQM

- ISO 9000 family of standards (then and now)

- QS 9000

- The Baldrige and Deming Awards

- Quality Management in Service Industries

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Evolution of QA Methods...

Inspection

SPC

DOE

Taguchi

Quality
Mgmt
Systems

Six Sigma...

6σ

1930   1940   ...   1975   1985   1990   1995   2000

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What does the term *Quality* really mean?

Quality is the ability of a product or service to consistently meet or exceed customer expectations.

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Historical Summary

- Quality Assurance
  - Artisanship
    - One person / common purpose among tasks
    - Closeness of producer and consumer
  - Industrial revolution
    - Long supply chains
    - Unskilled labor (division of labor)
      – Mass production
      – Uniform quality
      – Loss of understanding of purpose
    - Eli Whitney and Henry Ford
  - Consumerism: a response
- Quality has emerged now as a business strategy

Total Quality

Total Quality Management

– What does *total* mean?

  • Entire organization
  • All products and processes
  • All aspects (management, design, control)

– Not a *flavor of the month* (i.e., typical management fad)

  • Long term perspectives
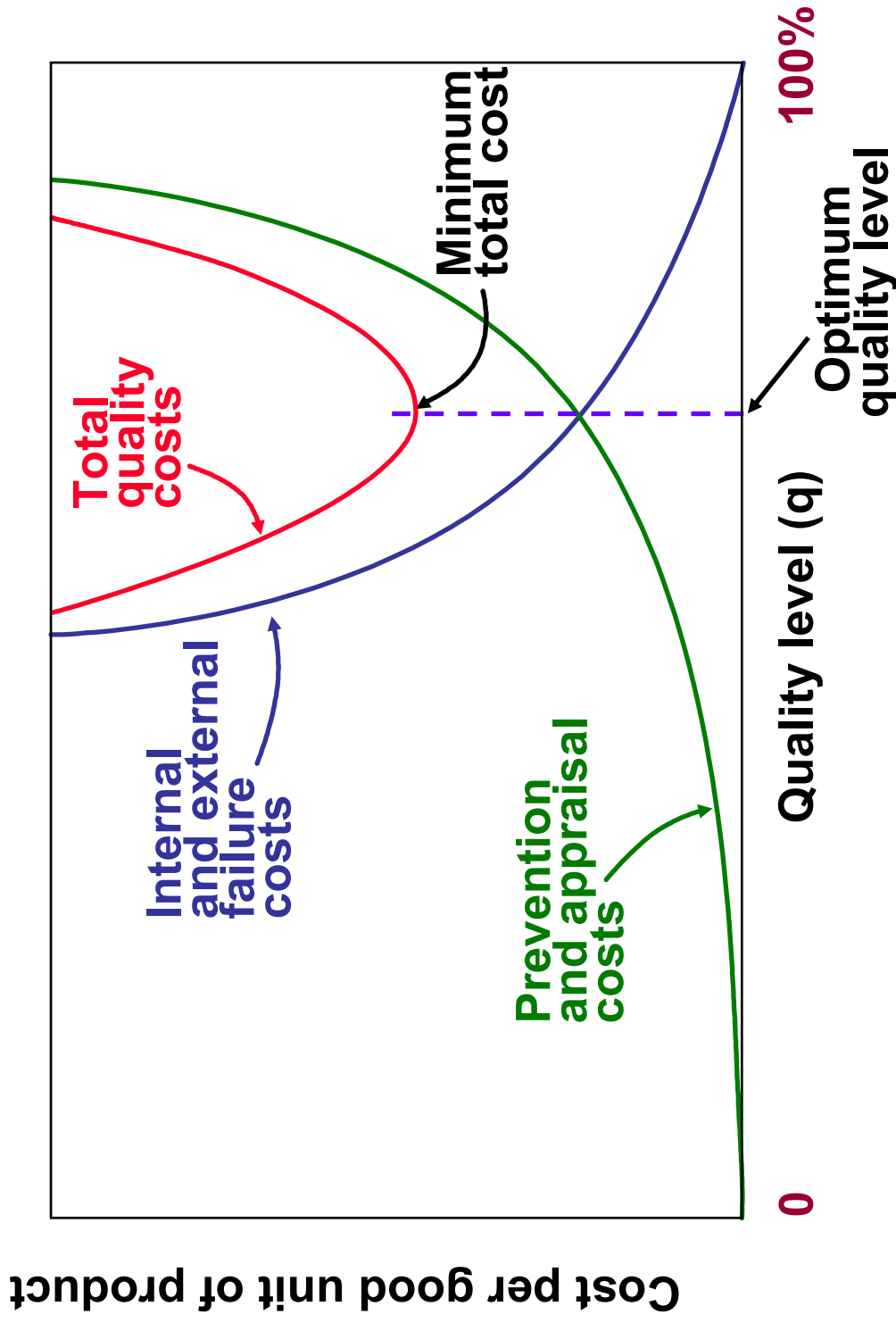 • Consider the Japanese

– Checklist in Summary

Costs of Quality

- Failure Costs - costs incurred by defective parts/products or faulty services.

- Internal Failure Costs
  – Costs incurred to fix problems that are detected before the product/service is delivered to the customer.

- External Failure Costs
  – All costs incurred to fix problems that are detected after the product/service is delivered to the customer.
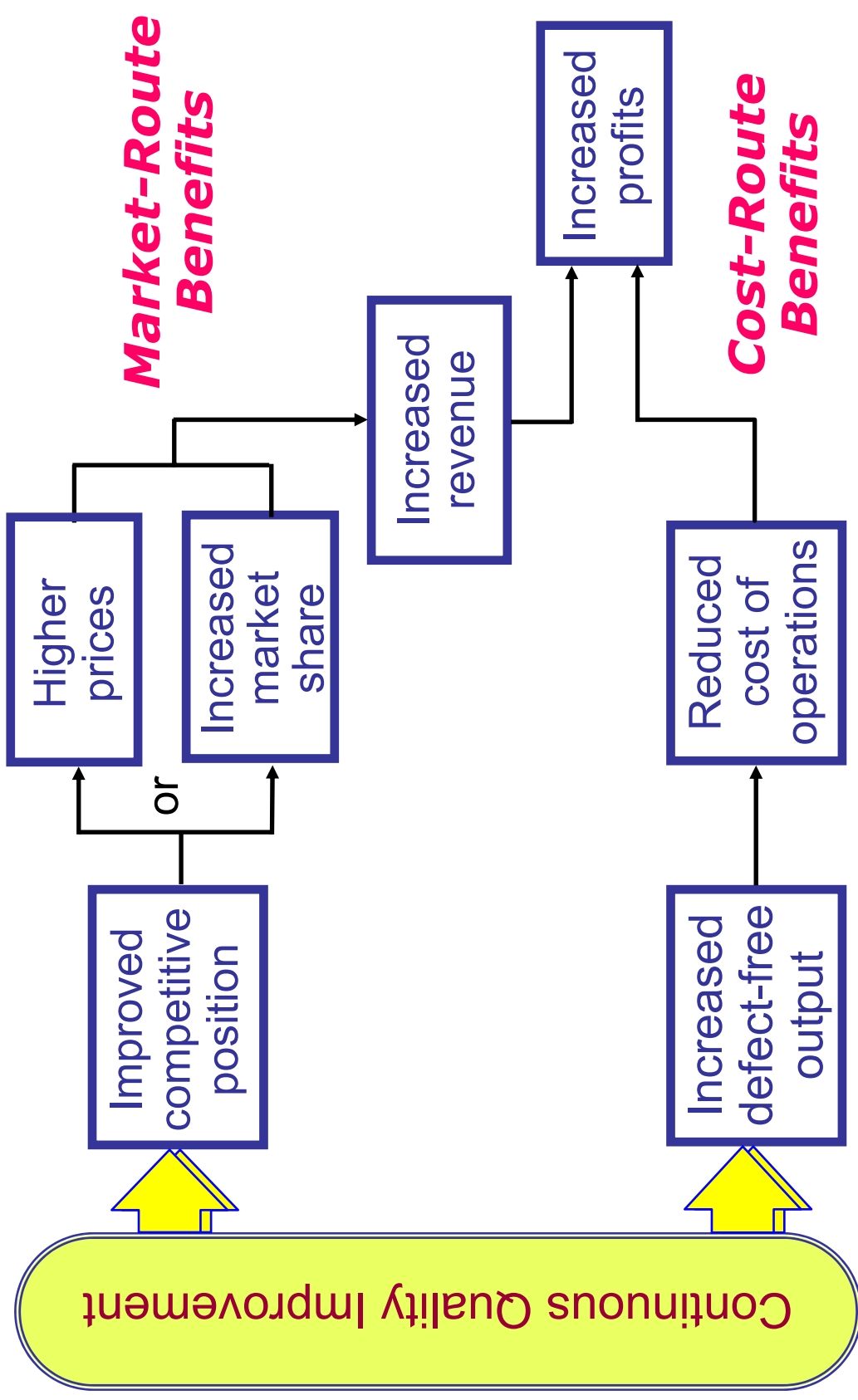
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Costs of Quality (contd)

- Appraisal Costs
  - All product and/or service inspection costs.

- Prevention Costs
  - All TQ training, TQ planning, customer assessment, process control, and quality improvement costs to prevent defects from occurring
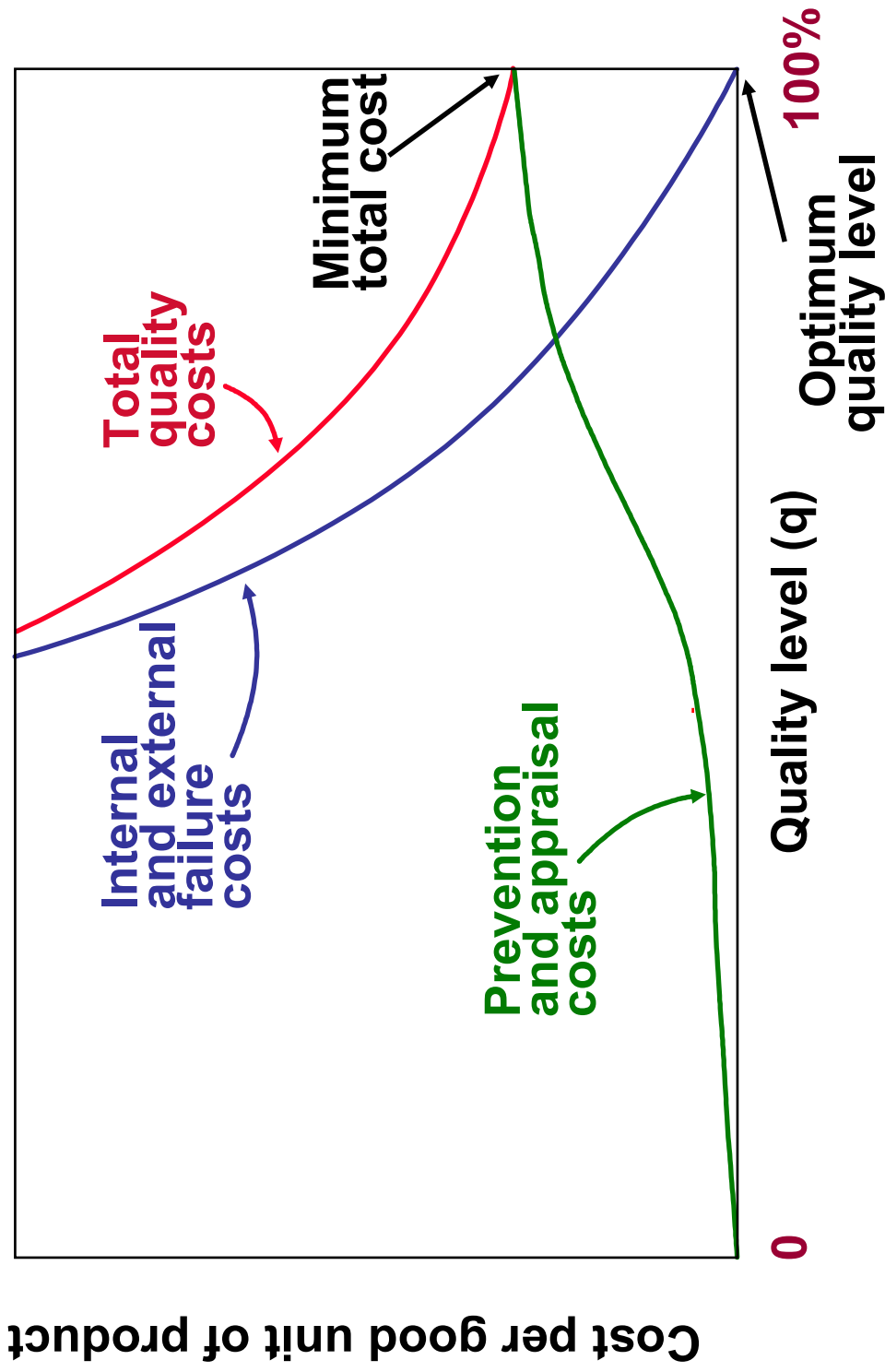
Quality Cost: Traditional View

Cost per good unit of product

- Total quality costs
- Internal and external failure costs
- Prevention and appraisal costs
- Minimum total cost
- Optimum quality level

Quality level (q)

0

100%

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Quality and Competitiveness

Market-Route Benefits

Cost-Route Benefits

Improved competitive position	
Higher prices or Increased market share	
Increased revenue	Increased profits
Increased defect-free output	Reduced cost of operations

Continuous Quality Improvement

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Quality Cost Minimized at Zero Defects

Cost per good unit of product

Total quality costs

Minimum total cost

Internal and external failure costs

Prevention and appraisal costs

Quality level (q)

Optimum quality level

0

100%

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Taguchi's Quality Loss Function

Loss ($)

Customer's Tolerance Band

Loss

Lower Spec Limit

Upper Spec Limit

Target τ

d

L
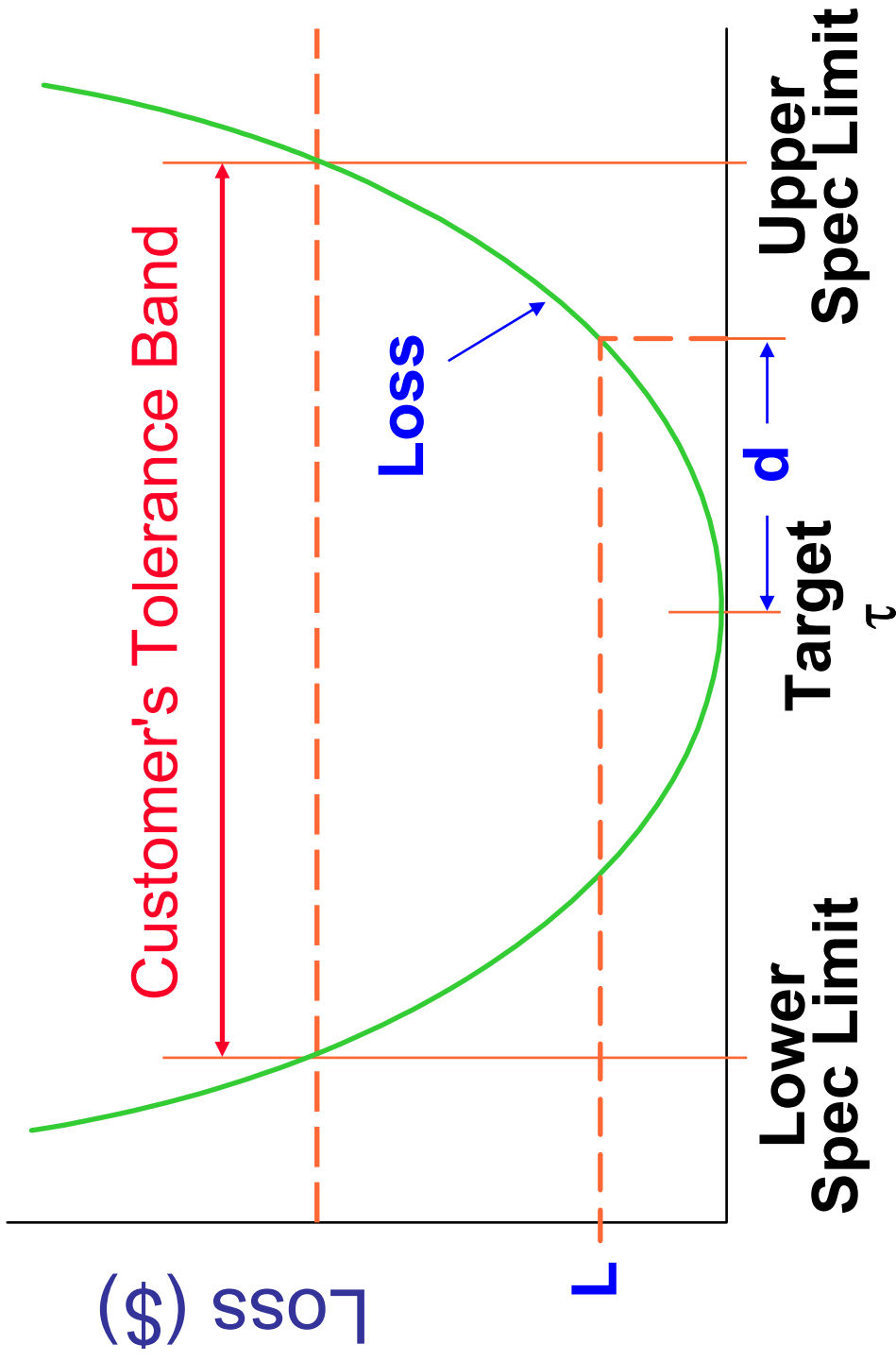
★ Any deviation from target causes a loss to society

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Quality and Competitiveness

- Value of Quality
  - Impacts of quality efforts on performance
    - Market share and profitability
    - Customer satisfaction
    - Quality
    - Costs
    - Employee relations
  - Directly related to ROI
  - Six Sigma programs have proven the value of quality

Total Quality Management Principles

1. Customer-focused Organization
2. Leadership
3. Involvement of People
4. Process Approach
5. System Approach to Management
6. Continual Improvement
7. Factual Approach to Decision Making
8. Mutually Beneficial Supplier Relationships

How do Customers see Quality

- *Performance* - main characteristics of the product/service

- *Aesthetics* - appearance, feel, smell, taste

- *Special features* - extra characteristics

- *Conformance* - how well product/service conforms to customer's expectations

- *Safety* - Risk of injury

- *Reliability* - consistency of performance

Dimensions of Quality (Cont'd)

- *Durability* - useful life of the product/service

- *Perceived Quality* - indirect evaluation of quality (e.g. reputation)

- *Service after sale* - handling of customer complaints or checking on customer satisfaction

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Determinants of Quality

Design

Ease of use

Conform-ance to design

Service

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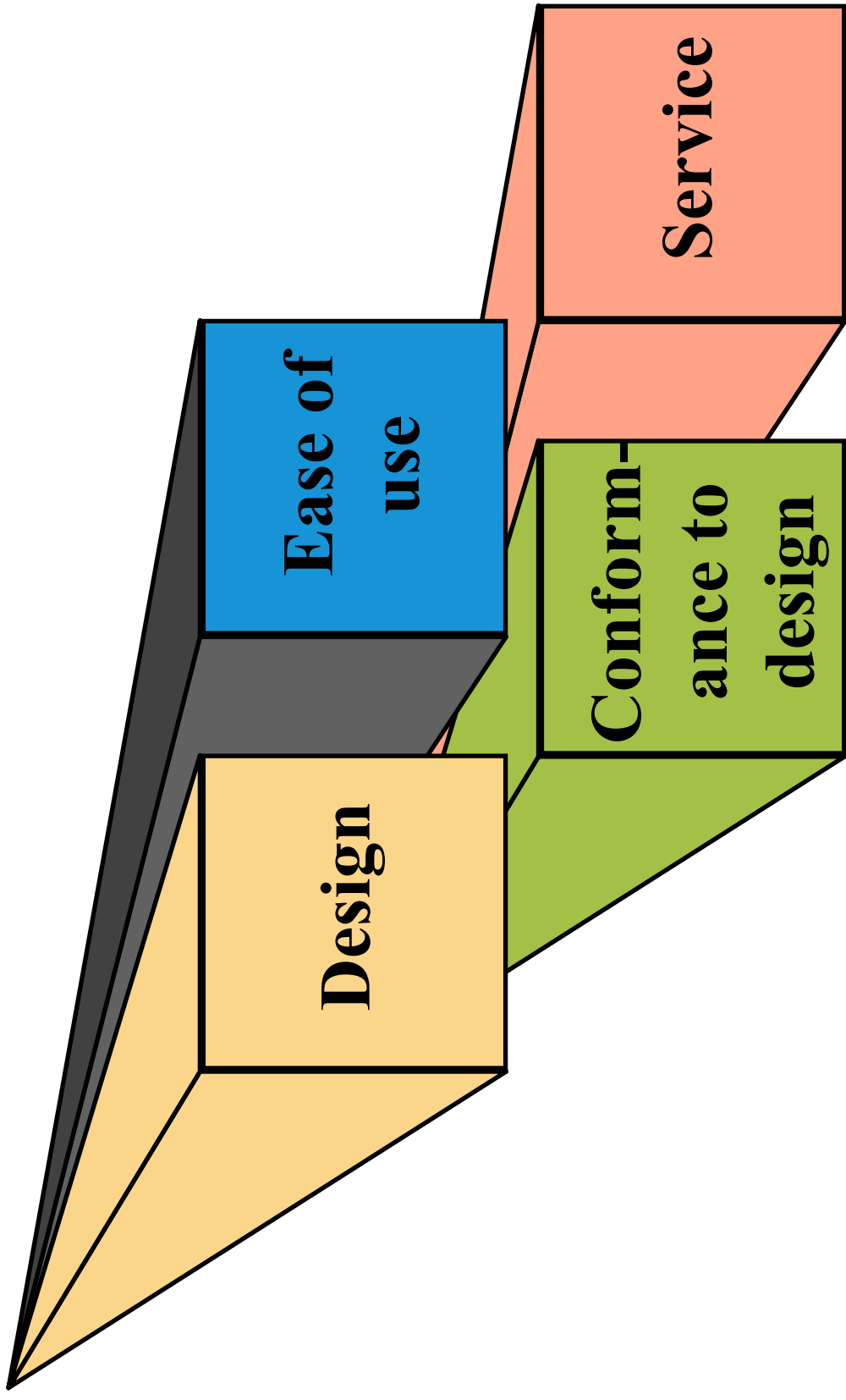
Consequences of Poor Quality

Recall that Quality is…

The ability of a product or service to consistently meet or exceed customer expectations

Not meeting Quality is…

Loss of business:

Poor designs or defective products or services can results in loss of business

Liability:

Damage or injures resulting from faulty design

Productivity:

Productivity and quality are often closely related

Costs:

Poor quality increases certain costs incurred by the organization

Responsibility for Quality

- Top management
- Design
- Procurement
- Production/operations
- Quality assurance
- Packaging and shipping
- Marketing and sales
- Customer service

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Ethics and Quality

- Substandard work
  - Defective products
  - Substandard service
  - Poor designs
  - Shoddy workmanship
  - Substandard parts and materials

> **Having knowledge of this and failing to correct and report it in a timely manner is unethical.**

Quality Gurus

- **Edward Deming**
  - Plan - Do- Check – Act; statistical methods
  - Fourteen Points for Transformation Management

- **J. M Juran**
  - Managerial Practices, Training, Cost of Quality

- **Armand Feigenbaum**
  - Total Quality Control, "hidden plant"

- **Kaoru Ishikawa**
  - Quality Circles, 7 Tools

- **Philip Crosby**
  - Zero defects and Quality is free

- **Genichi Taguchi**
  - Design of experiments
  - Quality loss function
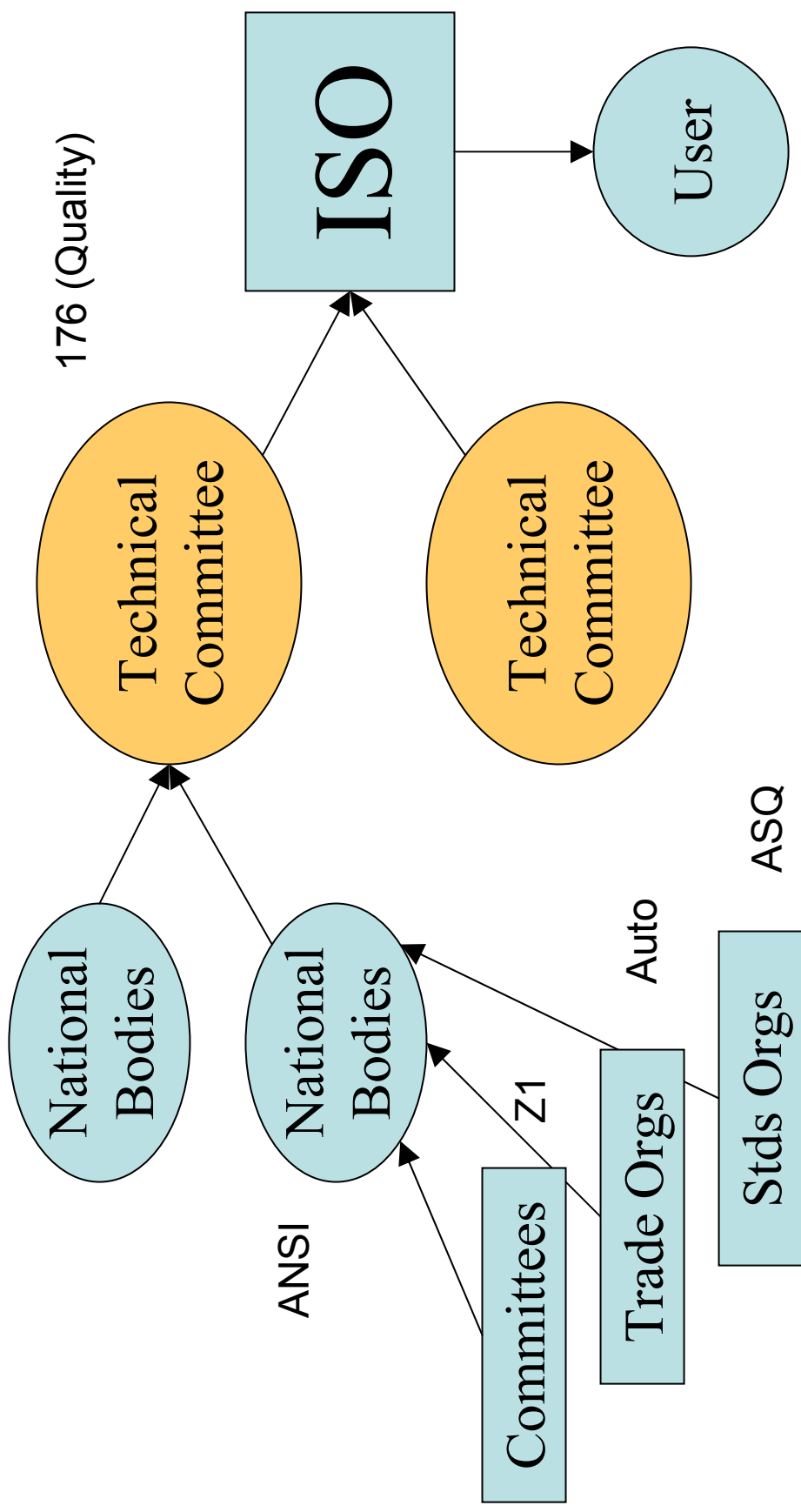 - Robust design

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Quality Certification

- ISO 9000, QS 9000

- Set of international standards on quality management and Quality assurance, critical to international Business

- ISO 9000 series standards, briefly, require firms to document their quality-control systems at every step (incoming raw materials, product design, in-process monitoring and so forth) so that they'll be able to identify those areas that are causing quality problems and correct them.

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The ISO 9000 Series Standards

- ISO 9000 requires companies to document everything they do that affects the quality of goods and services.

  – Hierarchical approach to documentation of the Quality Management System

International Organization for Standardization (ISO)

176 (Quality)

ISO

User

Technical Committee

Technical Committee

National Bodies

National Bodies

ANSI

Committees

Z1

Trade Orgs

Auto

Stds Orgs

ASQ
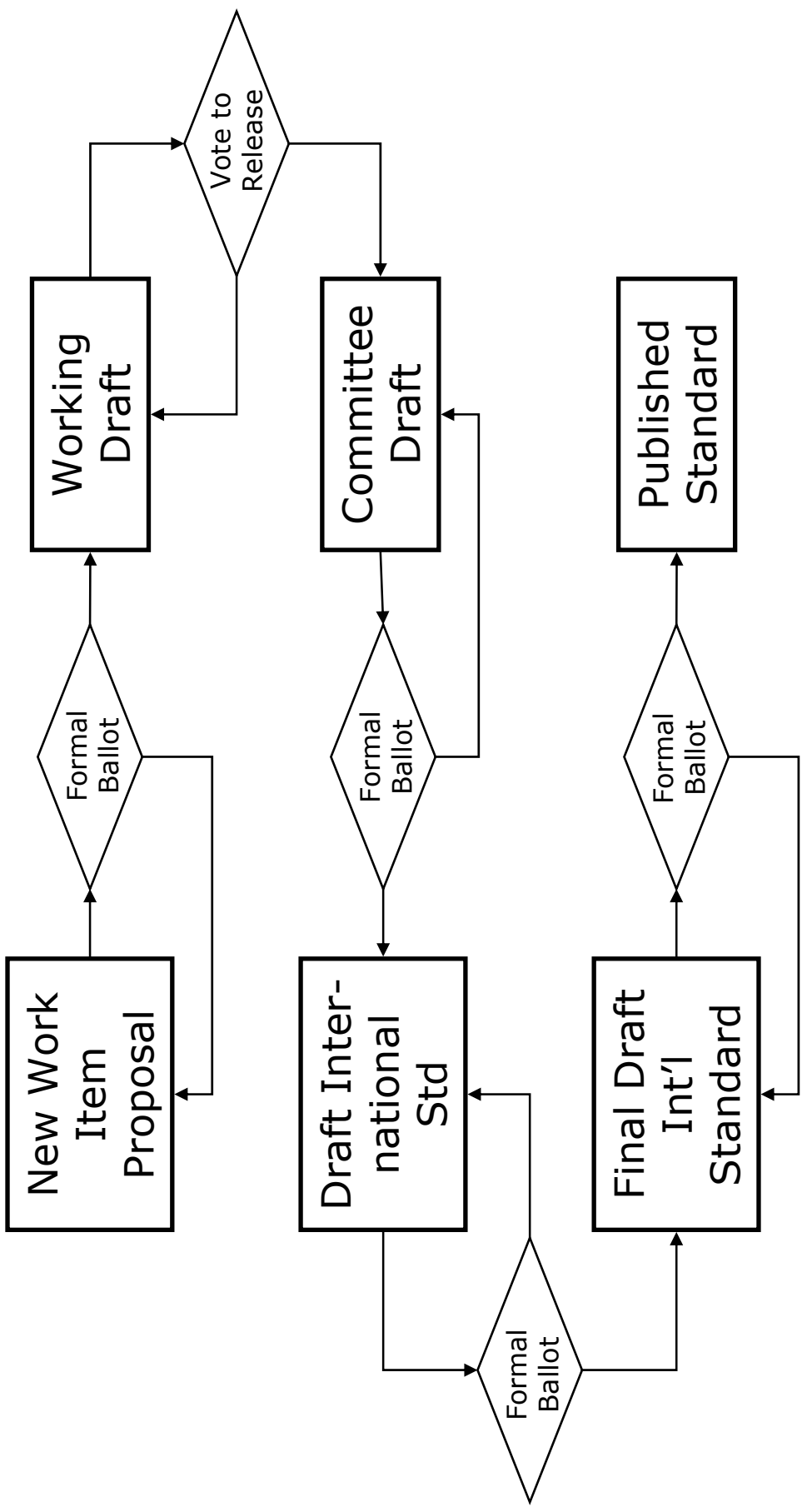
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Why International Standards?

✓ They promote trade and cooperation

✓ Product standards allow consumers to purchase items from different manufacturers and know those items will perform equally

✓ Management system standards promote common approaches to managing quality and the environment. They promote dependability and a consistent use of statistics

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ISO 9000 Consensus Process

New Work Item Proposal → Formal Ballot → Working Draft → Vote to Release → Committee Draft → Formal Ballot → Draft International Std → Formal Ballot → Final Draft Int'l Standard → Formal Ballot → Published Standard
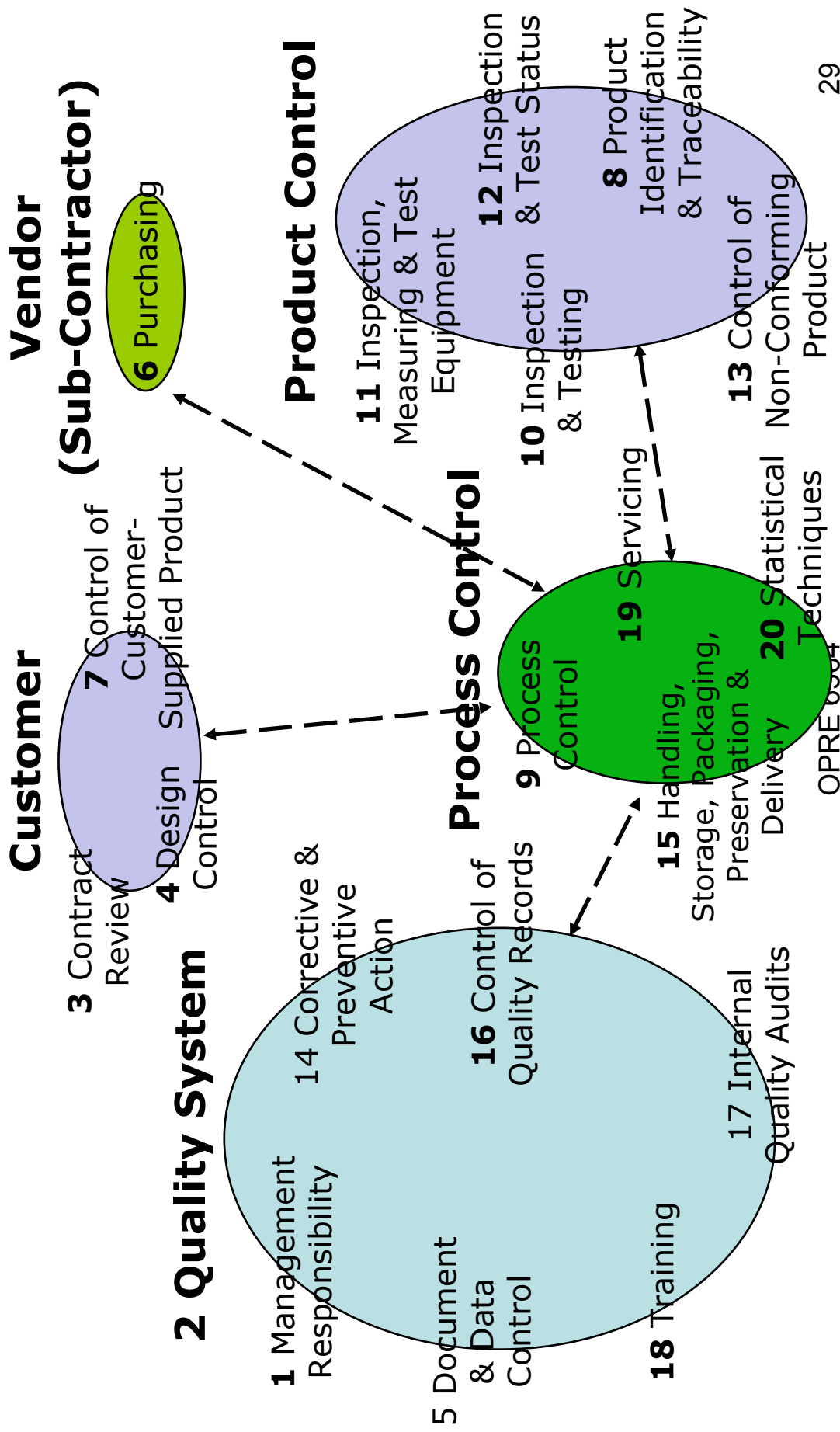
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ISO 9000 Series

ISO 9000   Helps companies determine which standard of ISO 9001, 9002, and 9003 applies

ISO 9001   Outlines guidelines for companies that engaged in design, development, production, installation, and servicing of products or service

ISO 9002   Similar to 9001, but excludes companies engaged in design and development

ISO 9003   Covers companies engaged in final inspection and testing

ISO 9004   The guidelines for applying the elements of the Quality Management System

ISO 10000 Series

ISO 10011   **Quality system auditing guide**

ISO 10013   **Quality manual development guide**

The ISO 9001:1994 Clauses

Vendor (Sub-Contractor)

6 Purchasing

Product Control

11 Inspection, Measuring & Test Equipment

12 Inspection & Test Status

8 Product Identification & Traceability

10 Inspection & Testing

13 Control of Non-Conforming Product

Customer

3 Contract Review

7 Control of Customer-Supplied Product

4 Design Control

Process Control

9 Process Control

19 Servicing

20 Statistical Techniques

15 Handling, Storage, Packaging, Preservation & Delivery

2 Quality System

1 Management Responsibility

14 Corrective & Preventive Action

16 Control of Quality Records

17 Internal Quality Audits

5 Document & Data Control

18 Training

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New ISO 9001:2000
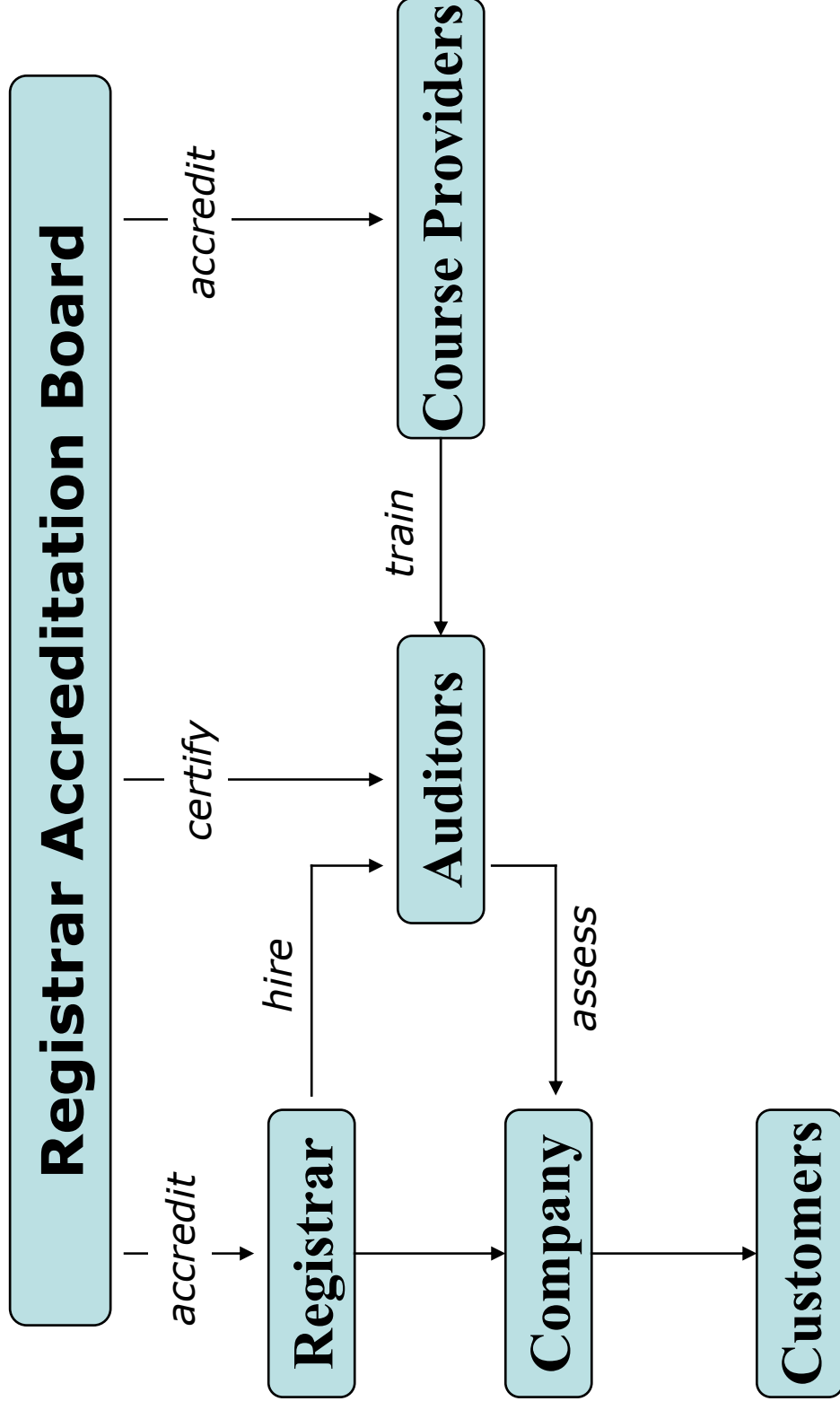
- Quality management system
  - Put structure in what you do
- Management responsibility
  - Put someone in charge
- Resource management
  - Provide the resources to achieve goals
- Product realization
  - Design and make it to requirements
- Measurement, analysis and improvement
  - Know where you are and get better

The Grand Vision: 2000

9000   Fundamentals And Vocabulary

9001   Requirements

9004   Guidelines For Performance Improvements

10012   Measurement Control

19011   QMS/EMS Auditing

❧ *Technical Reports on Everything Else*

❧ *Greater Compatibility with Environmental Management*

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Third party registration

Registrar Accreditation Board

accredit → **Course Providers**

certify → **Auditors**

Course Providers — *train* → **Auditors**

accredit → **Registrar**

Registrar — *hire* → **Auditors**

Auditors — *assess* → **Company**

Registrar → **Company** → **Customers**

Registration steps

The *Registrar* will:

- Request information from you
- Review your documents (mostly QA manual)
- Review your application
- Audit your facility
- Issue your certificate
- Conduct periodic surveillance
- Renew certificate after three years
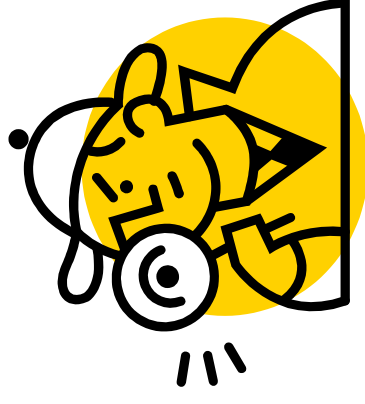
ISO 9000 Registration Process

- The final audit begins with a review of the company's Quality Manual, which the accredited registrar or third party audit team typically uses as its guide.

- The audit team checks to see that the documented quality system meets the requirement of ISO 9000 and that the organization is practicing what is documented.

ISO 9000 Registration Process

- When an organization feels that its quality system is good enough, it may ask an accredited registrar or other third party audit team for pre-assessment.

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Timeline for registration

0.0 Decide to go for registration

Form a steering committee

0.5 Write your QA Manual

Write process procedures

1.0 Conduct internal reviews

Refine your processes

1.5 Conduct system audits

Undergo a "mock" audit

2.0 Receive registration

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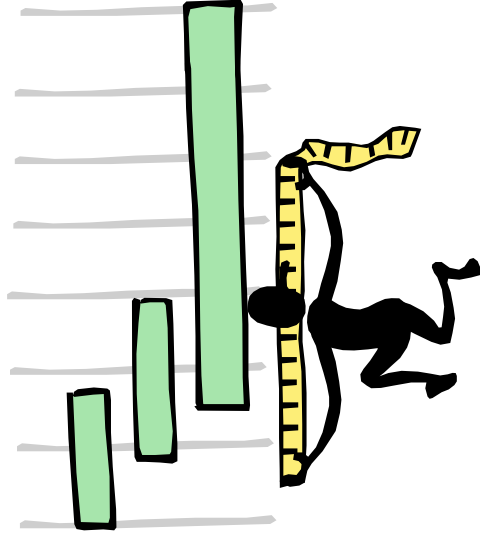
Where to Inspect the Process

- Raw materials and purchased parts

- Finished products

- Before a costly operation

- Before an irreversible process

- Before a covering process

Examples of Inspection Points

Type of business	Inspection points	Characteristics
Fast Food	Cashier	Accuracy
	Counter area	Appearance, productivity
	Eating area	Cleanliness
	Building	Appearance
	Kitchen	Health regulations
Hotel/motel	Parking lot	Safe, well lighted
	Accounting	Accuracy, timeliness
	Building	Appearance, safety
	Main desk	Waiting times
Supermarket	Cashiers	Accuracy, courtesy
	Deliveries	Quality, quantity

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ISO 9000 Registration Process

- When the registrar is satisfied with the favorable recommendation of the audit team, it grants registration and issues a registration document to the company.

International issues

- Environmental management systems

- Occupational health & safety

- Regulated industries
  - medical devices
  - pharmaceutical
  - health care

- Sector-specific applications
  - automotive (QS-9000 and TS-16949)
  - aerospace (AS-9000 / AS-9100)
  - telecommunications (TL-9000)
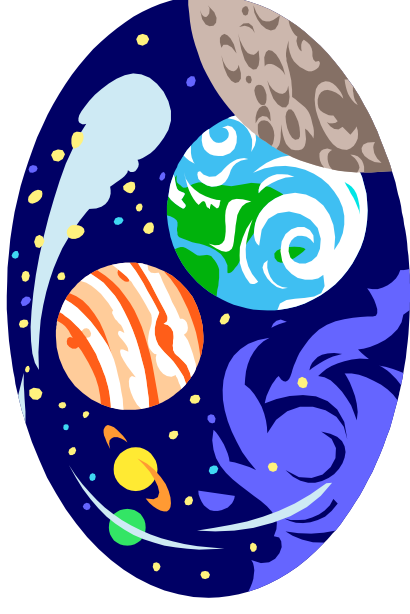
ISO 14000

- ISO 14000 - A set of international standards for assessing a company's environmental performance

- Standards in three major areas
  - Management systems
  - Operations
  - Environmental systems

ISO 14000

- Management systems
  - Systems development and integration of environmental responsibilities into business planning
- Operations
  - Consumption of natural resources and energy
- Environmental systems
  - Measuring, assessing and managing emissions, effluents, and other waste

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QS 9000

- Common Supplier Quality Standard established by the Big Three automakers: Chrysler, Ford, GM.

- First introduced in North America in Aug 1994

- Consists of :

  - Section I   ISO 9000 based requirements

  - Section II   Customer-specific requirements

- Meeting mandatory requirements for the auto industry

- Emphasis on Continuous Improvement and Defect Prevention

- Moving closer to TQM

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* Implement Failure Mode and Effect Analysis (FMEA)

* Advance Product Quality Planning (APQP)
  Control Plan (CP)
  APQP is required for new and changed products.
  CP covers Prototype, Pre-launch & Production

* Feasibility Review
  Confirm manufacturing feasibility

* Production Part Approval Process (PPAP)
  Compilation of data for new or changed product
  (Cpk, FMEA, Test Results etc)
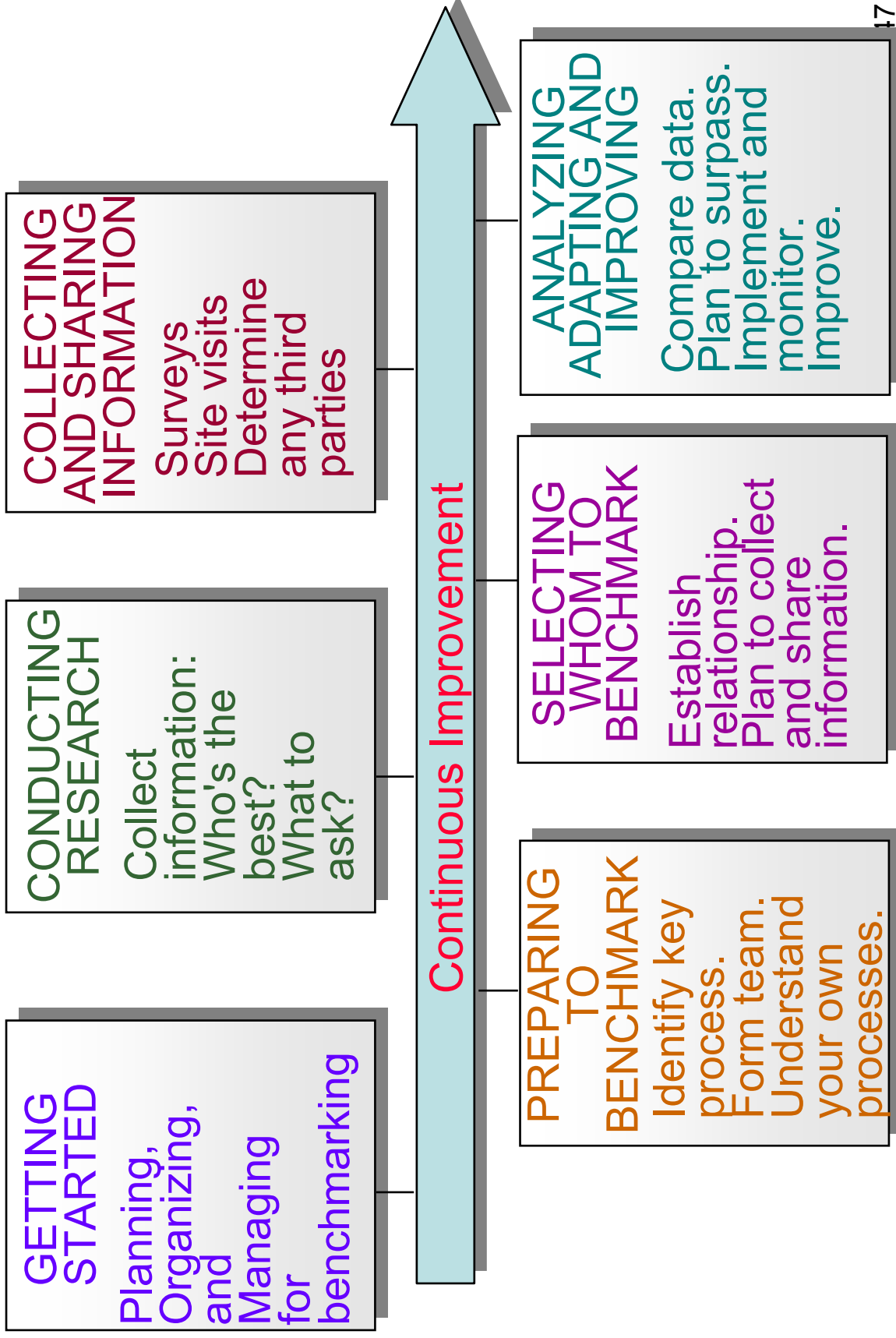
QS 9000 in Summary

- QS 9000 emphasizes on meeting customer requirements. In long run, this will improve competitiveness.

- QS 9000 put focus on
- * Continuous Improvement
  * Defect Prevention
  * Reduction of variation and waste

The standard possesses tremendous potential in term of Business Excellent.

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Recognizing Quality

- Benchmarking
  - Definition: Identifying and documenting *best* practices
    - Competitors (OM Principle 4)
    - Other industries
  - Start by selecting and benchmarking *own* process
    - Metrics: comparisons (e.g., LT:Content ratio)
    - Practices: steps, errors, delays, etc.
  - Typical steps summarized in the next slide
 - Concept and methods are evolving

The Benchmarking Process: Common Steps

GETTING STARTED

Planning, Organizing, and Managing for benchmarking

CONDUCTING RESEARCH

Collect information:
Who's the best?
What to ask?

COLLECTING AND SHARING INFORMATION

Surveys
Site visits
Determine any third parties

PREPARING TO BENCHMARK

Identify key process.
Form team.
Understand your own processes.

SELECTING WHOM TO BENCHMARK

Establish relationship.
Plan to collect and share information.

ANALYZING ADAPTING AND IMPROVING

Compare data.
Plan to surpass.
Implement and monitor.
Improve.

Continuous Improvement

Recognizing Quality

- Quality Awards
  - Include:
    - Deming Prize (first major award)
    - Baldrige Award (established by Congress)
    - Statewide awards
  - Provide
    - Recognition (shouldn't be primary goal)
    - Path to improved quality
  - Baldrige Award criteria
    - Juran: criteria summarize TQM

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Quality Awards

Deming Prize

Baldrige Award

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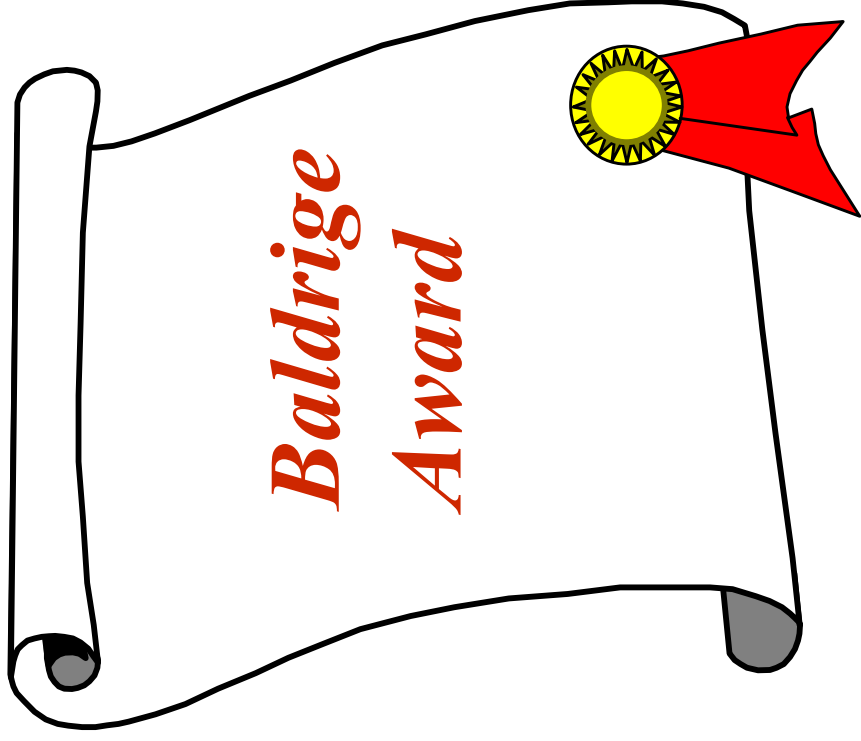
Malcolm Baldrige National Quality Award

1.0 Leadership

2.0 Strategic Planning

3.0 Customer and Market Focus

4.0 Information and Analysis

5.0 Human Resource Development and Management

6.0 Process Management

7.0 Business Results

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Baldrige Award details

✓ A US National Quality Award

✓ Started in 1987

✓ Awards in three categories – manufacturing, service, small business – no more than two awards per category per year

✓ Stresses 'management by fact'

✓ Consists of a three level judging process

✓ Is a seven-category, 1000-point scoring system

- Leadership, information and analysis, strategic quality planning, human resource utilization, quality assurance of products and services, quality results, customer satisfaction

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Leadership

- Contributes 100 points

  – Senior executive leadership

  – Quality values

  – Management for quality

  – Public responsibility

- Symbolism and Active involvement

- Intimate knowledge of how the work actually gets done

- Impressive listening skills

  – Skip-level communication

Information and analysis

- Contributes 70 points

  – Scope and management of quality data and information

  – Competitive comparisons and benchmarks

  – Analysis of quality data and information

- Must demonstrate fact-based management

- Information base must be comprehensive, accessible, and well validated.

- Use benchmarking as a enabler of change, a learning process

Strategic Quality Planning

- Contributes 60 points
  - Strategic quality planning process
  - Quality goals and plans

Human Resource Utilization

- Contributes 150 points
  - Human resource management
  - Employee involvement
  - Quality education and training
  - Employee recognition and performance measurement
  - Employee well-being and morale
- Empower the employees and unleash the full potential of the work force
- Quality training involves increased awareness, problem-solving tools, group process skills, and job-specific skills
- "Empowerment is in the eyes of the empowered."

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Quality Assurance of Products & Services

- Contributes 140 points
  - Design and introduction of quality products and services
  - Process quality control
  - Continuous improvement of processes
  - Quality assessment
  - Documentation
  - Business process and support service quality
  - Supplier quality
- Instead of functional lines, emphasize on process

Quality Results

- Contributes 180 points
  - Product and Service Quality results
  - Business process, operational, and support service quality results
  - Supplier quality results
- Look for 'meaning trends'
- Sustained improvements on critical measures over a period of at least three years
- Use statistical methods to correlate objective quality results with measures of customer satisfaction

Customer Satisfaction

- Contributes 300 points
  - Determining customer requirements and expectations
  - Customer relationship management
  - Customer service standards
  - Commitment to customers
  - Complaint resolution for quality improvement
  - Determining customer satisfaction
  - Customer satisfaction results
  - Customer satisfaction comparison
- Customer information from a wide range of sources – focus groups, surveys, one-to-one meetings, sales visits etc.
- Measures are objective and validated, not anecdotal

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The Deming Prize

- Honoring W. Edwards Deming
- Japan's highly coveted award
- Main focus on statistical quality control

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Employee-Driven Quality

- Training (and education)
  - Involves
    - Basic job skills
    - Tools for continuous improvement, SPC, etc.
    - Cross-training (OM Principle 7)
  - Must be considered as *investment*, not expense!
  - Old (and still prevalent) approach
    - Exploit division of labor (hire unskilled)
    - Inhibits pride in workmanship
  - Cross-training can build better understanding

Employee-Driven Quality

- Organization
  - Involves
    - Close supplier/customer (next process) contact
    - Multi-functional teams, etc.
  - Uniting workers for constancy of purpose
    - Typical formats
      - Quality circles
      - Cells and teams (pioneered in manufacturing)
      - Project teams: when work flows are separated
    - *Gangs* versus *teams*
  - Team training: team dynamics; problem-solving; quality tools

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Deming's 14 Points (I)

- Focus On Management
  - Quality problems lie with the *system*
  - The system is under the control of management
- The 14 Points -- Not a *Menu!*
  - Constancy of purpose
  - New philosophy
  - Mass inspection
  - Price tag
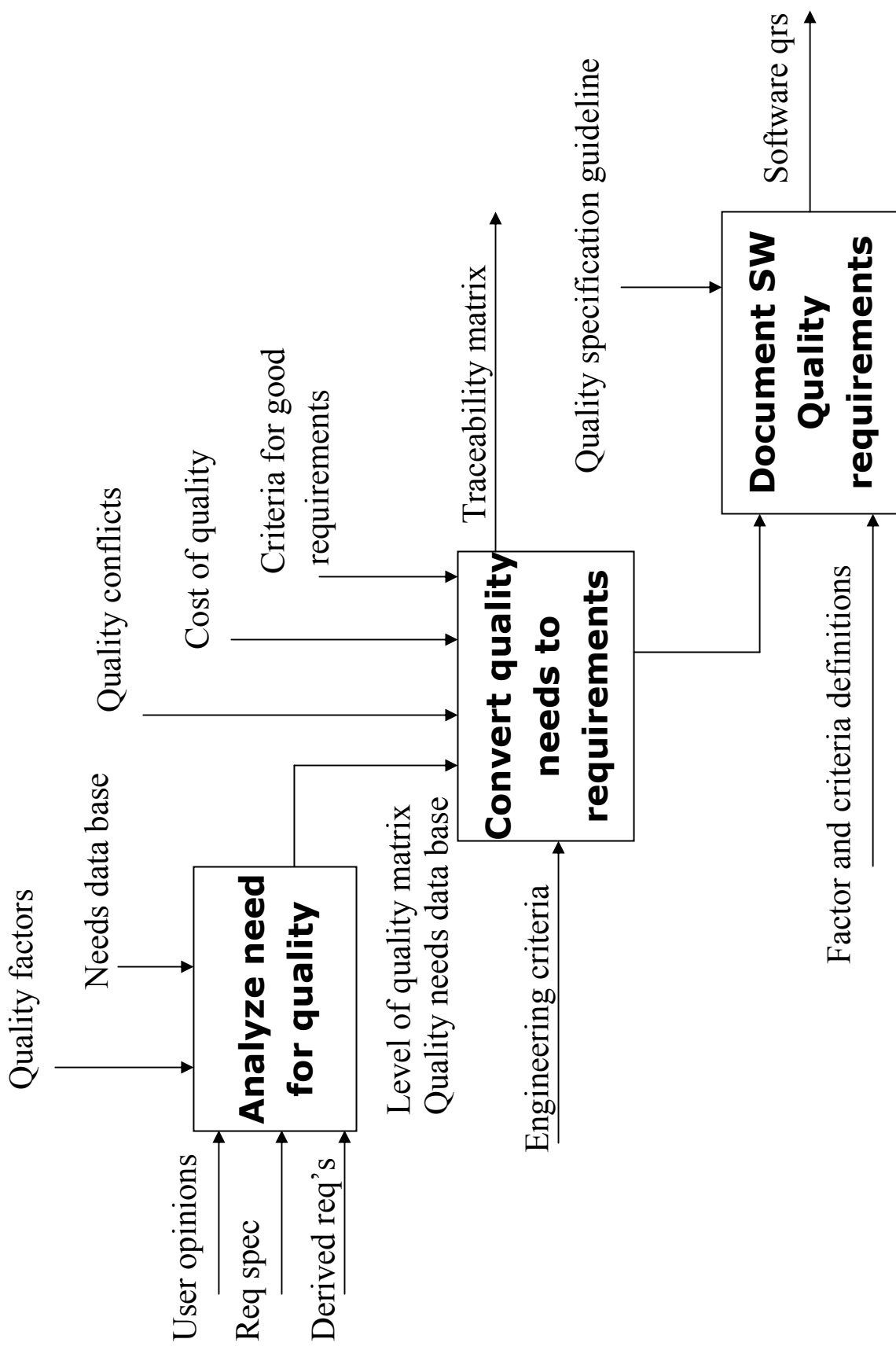 - Continuous improvement
  - Training

Deming's 14 Points (II)

- The 14 Points (Continued)
  - Supervision (leadership)
  - Fear
  - Barriers
  - Slogans
  - Quotas
  - Pride in workmanship
    - Management
    - Front-line
  - Education
  - Organizational structure/culture; top management

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Software Quality

- Process Quality
  - Ensuring conformance with user requirements
  - Identifying defects
  - Monitoring the product through its phases of development

- Product Quality
  - Identifying user specified quality needs
  - Prioritizing quality needs
  - Resolving quality conflicts, if any
  - Building them into the development process
  - Allocating effort and time for them

A Step in Assuring Software Quality

Quality factors

Needs data base

User opinions

Req spec

Derived req's

Analyze need for quality

Level of quality matrix
Quality needs data base

Engineering criteria

Quality conflicts

Cost of quality

Criteria for good requirements

Convert quality needs to requirements

Traceability matrix

Quality specification guideline

Document SW Quality requirements

Software qrs

Factor and criteria definitions

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Approaches to Attain Quality

Traditional Approach to Quality

→ Control the quality of the product by inspection.

→ Acceptable quality levels (AQL).

→ Some defects will slip through.

World-Class Approach to Quality

→ The product is only the result of the process which makes it.

→ If the process is correct, the product will be good.

→ No need to inspect.

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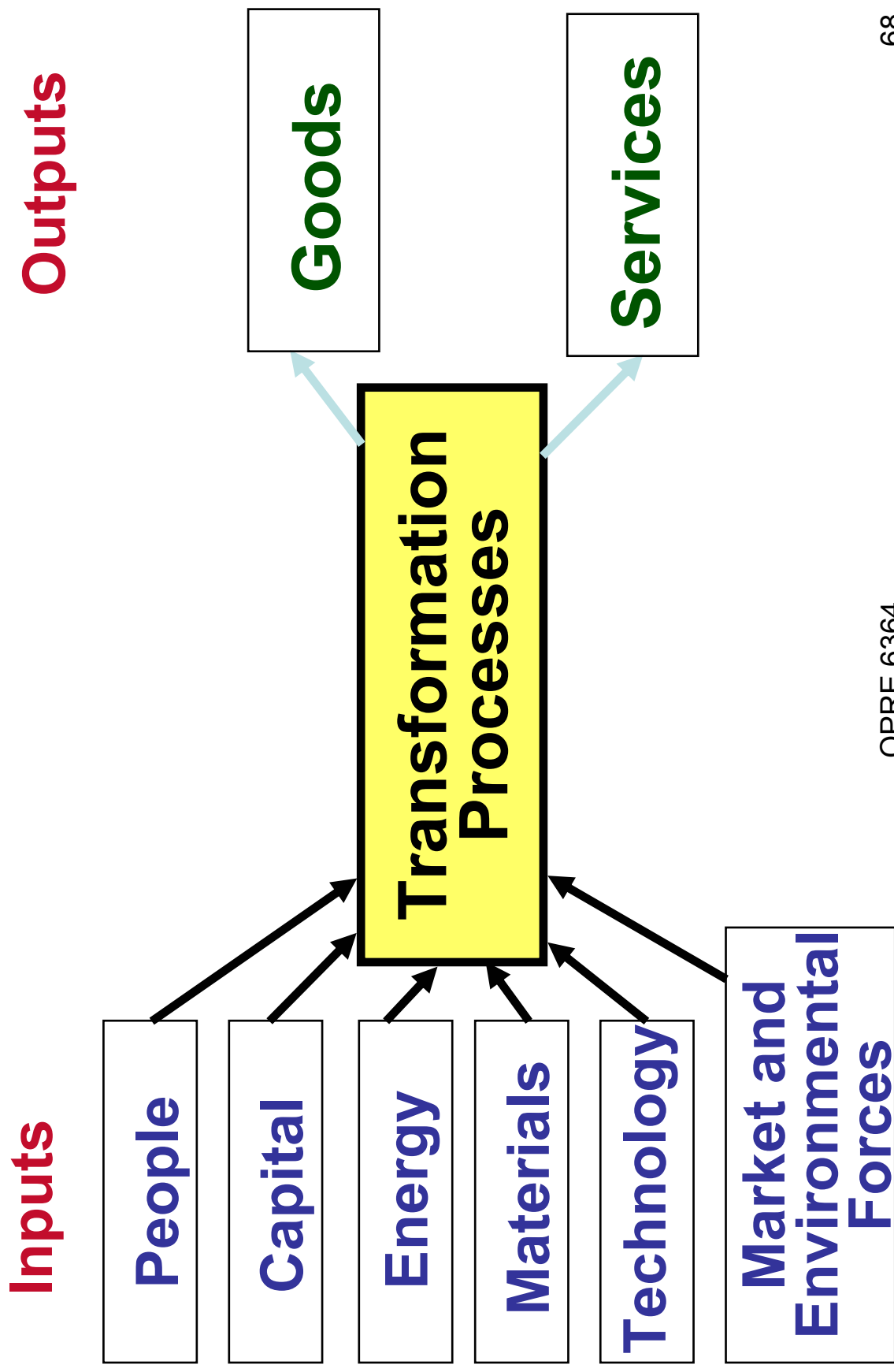
Quality Control Modes a Company can be in

Detection Mode

- Heavy use of inspection
- Manufacturing & QC are adversaries
- Firefighting
- Management by crisis
- High costs
- Lost sales
- Loss of competitive position

Prevention Mode

- Very little inspection
- QC is a resource of Manufacturing - teamwork
- Problem elimination
- Smooth operations - continual improvement
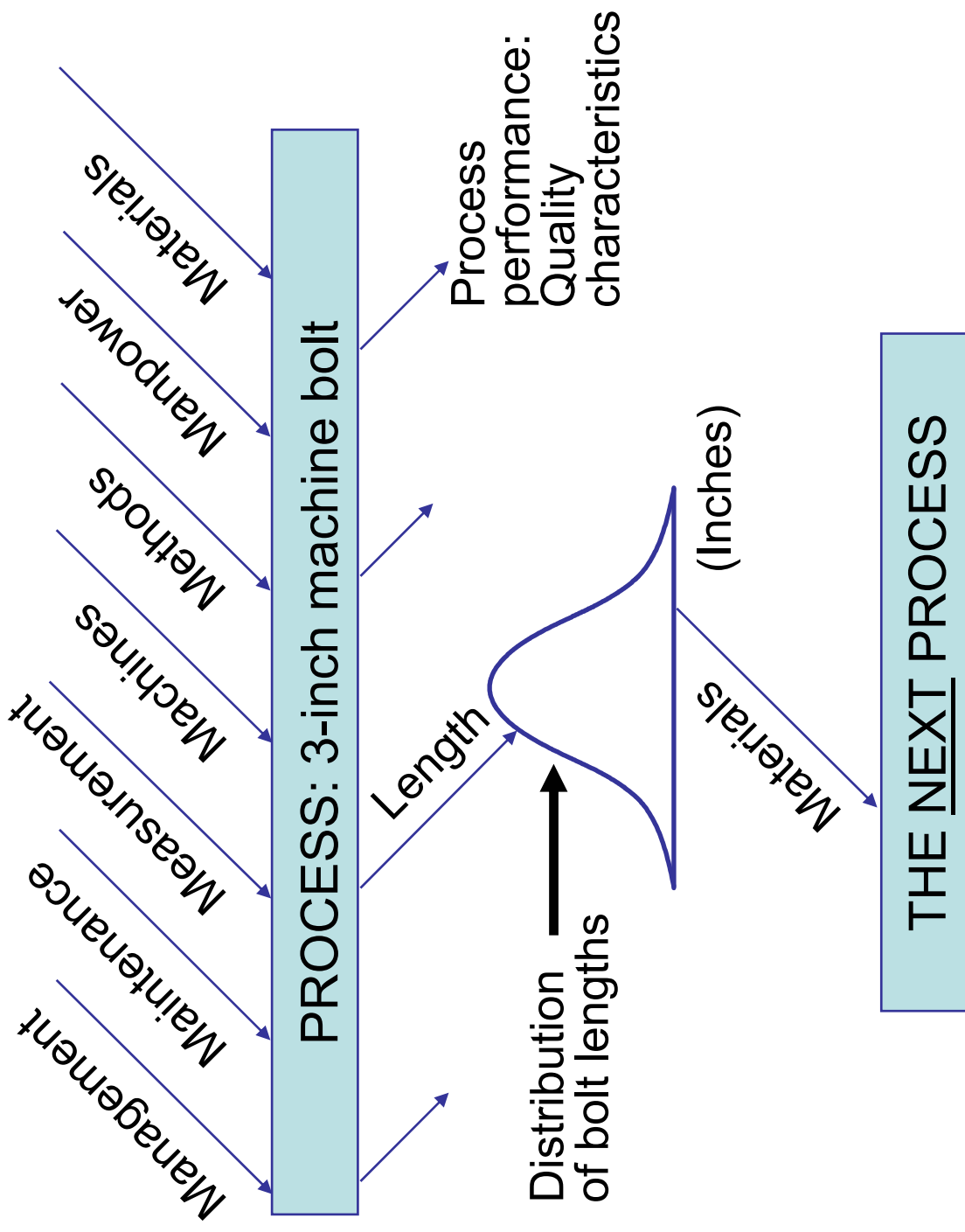- Decreasing costs
- Increased sales
- More competitive

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5 7

Operations are a Transformation Process

Inputs

Outputs

- People
- Capital
- Energy
- Materials
- Technology
- Market and Environmental Forces

Transformation Processes

Goods

Services

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The *Process* Focus

- Operation = Transformation Process
  - Process inputs
    - Management
    - Methods
    - Materials
    - Machines
    - Maintenance
    - Personnel
    - Information
    - Energy
  - Transformation (macro/micro views)
  - Outputs (components / finished goods / services)

The Process Focus: Contributing Variables

Management

Maintenance

Measurement

Machines

Methods

Manpower

Materials

PROCESS: 3-inch machine bolt

Process performance: Quality characteristics

Length

(Inches)

Distribution of bolt lengths

Materials

THE NEXT PROCESS

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Managing the Process

- Problems
  - Result from series of activities (process)
  - Not from single aspect (e.g., physician)
  - Therefore, for each product, entire process needs study for improvement

- Process
  - Recall Input/Process/Output model:
  - Input components change over time
    - → instability

Process Improvement and Control in a nutshell

- Apply Scientific Method
- Incorporate Tools
  - General tools
  - Coarse grained tools
  - Fine grained tools

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Scientific Method for Process Improvement

1. **Identify and define the problem.**

2. **Study the existing situation;collect necessary data.**

3. **Generate possible solution alternatives.**

4. **Evaluate alternatives and choose the preferred one.**

5. **Implement the improvement and measure results.**

6. **Evaluate and revise if required.**

7. **Otherwise, return to step 1 and start again with a new problem.**

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Tools for Process Improvement

General Tools
1. Team-building and group-interaction tools.
2. Specific process/technology tools.

Coarse-grained Tools
3. Process flowchart.
4. Check sheets and histograms.
5. Pareto analysis.
6. Fishbone charts.

Fine-grained Tools
7. Fail-safing (Pokayoke).
8. Design of Experiments (DOE)
9. Scattergrams.
10. Run diagram.
11. Process control chart.

UPRE 0304

The Six Sigma Methodology

A 4-Step Methodology for Process Improvement

Process Characterization

1) Measure
- Identify Project Scope / Goal
- Define Key Process Elements
- Establish Process Capability
- Validate Measurement System

2) Evaluate
- Benchmark Process Entitlement
- Data Analysis
- Determine Critical Factors

Process Optimization

3) Improvement
- Develop Improvement Plan
- Understand/Optimize Vital Process Elements
- Reduce Variation / Defects
- Verify Impact

4) Control
- Implement Long Term Control Plan
- Leverage to Similar Products/Processes
- Document & Standardize

Control

Measure

Improvement

Evaluate

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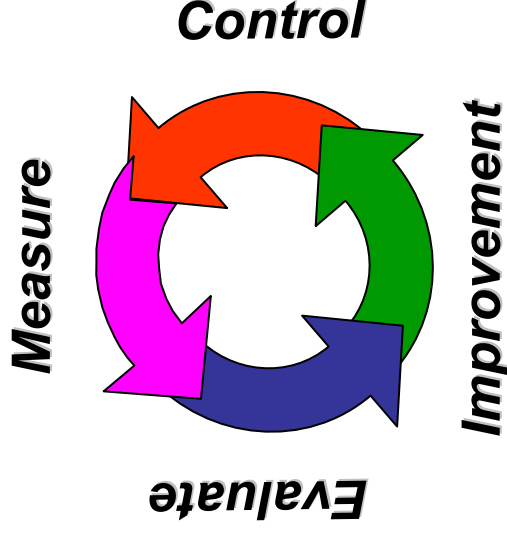
TQM

- Top management's direct involvement

- Strong customer orientation

- Companywide participation to meet or exceed customer expectations; empowerment

- Systematic problem solving

- A philosophy of Continuous Improvement: Never-ending push to improve

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Obstacles to Implementing TQM

Lack of

- Companywide definition of quality
- Strategic plan for change
- Customer focus
- Real employee empowerment
- Strong strong motivation
- Time to devote to quality initiatives
- Leadership

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Obstacles to Implementing TQM

- Poor intraorganizational communication
- View of quality as a "quick fix"
- Emphasis on short-term financial results
- Internal political and "turf" wars

Summary

TQM requires

❑ Top management's direct involvement

❑ Strong customer orientation

❑ Everyone participates: empowerment

❑ Systematic problem solving

❑ Continuous improvement

➢ TQM is a great foundation, but TQM does not directly relate to business results

➢ Six Sigma is the latest quality management innovation: It is a *focused method + a philosophy*

Useful links

http://www.mindtools.com/swot.html

SWOT analysis for strategy development

http://www.iqs.com/Presentations/SALE6108_files/frame.htm

Overview of QS 9000

http://home.att.net/~iso9k1/tqm/tqm.html

An overview of TQM