TQM 15.760

TOTAL QUALITY MANAGEMENT

FOUR LEVELS OF QUALITY

FOUR THOUGHT REVOLUTIONS
Customers first
Continuous Improvement
Total Participation
Societal Learning

ORGANIZATIONAL MANAGEMENT
Information & Measurement Systems
Education
Incentive Systems
Organizational Change
Four Levels of Quality

1. FITTEST FOR STANDARD
   - inspection oriented
   - no consciousness to customer/mkt

2. FITTEST FOR USE
   - Must satisfy customer need for use
   - Hotel shampoo & body oil

3. FITTEST FOR MARKET
   - Must achieve low cost as well as 1 & 2

4. FITTEST FOR LATENT REQ'TS
   - Listening to the voice of the customer
   - V-8 engine, Swatch
   - Uncovering latent req't adds value
     ==> need continuous innovation
TQM: Four Thought Revolutions

1. Customer-First Revolution

From "Product-out (PUSH what you can do)"

to

"Market-in" (Learn and develop what the market wants)
PRODUCT DEVELOPMENT LEVERAGE

APPROXIMATELY 75% OF LIFE CYCLE (DESIGN AND MANUFACTURING) COSTS ARE DETERMINED DURING THE PRODUCT DEVELOPMENT PROCESS

See *Concurrent Design of Products and Processes*

PRODUCT DEVELOPMENT IN THE JAPANESE AUTO INDUSTRY (COMPAARED WITH U.S.):

--25% FASTER
--50% FEWER ENGINEERING HOURS

(EUROPEANS ARE FARTHER BEHIND)

see *Product Development Performance*
Clark, K. & Fujimoto, T.
HBS Press 1991
DEMONSTRATE TO CUSTOMERS:

Quality at the Source
Process Capability
Declining Nonconformities
Declining WIP, LT, Space, Flow Dists
Operators
  - cross-trained, doing Prev Maint
  - presenting on SPC, Setup Reduction
  - charting probs, processes/methods
  - trained in JIT/TQC
Concurrent Design
Competitive Analysis
Flexibility of labor and equipment
Dedicated Capacity
Exact counts in standard containers
2. Continuous Improvement Revolution

Fundamental Concept: PDCA
(Observe, Assess, Design, Intervene)

Quality Control:
Manage known sources of variation
- process control charts
- management by exception
- ROI control

Reactive Quality Management:
Problem solving
- application of SQC tools
  (Pareto analysis, process flow chart, fishbone diagrams, histograms)

Proactive Quality Management:
Finding hidden opportunities

MANAGEMENT BY FACT:
"IN GOD WE TRUST;
ALL OTHERS BRING DATA"
QUALITY DECISION TOOLS AND DATA ANALYSIS

DEMING: SIX SQC TOOLS THAT EVERYONE SHOULD KNOW AND USE

1. Pareto Analysis
2. Process Flow Chart
3. Fishbone (Cause & Effect) Diagrams
4. Histograms
5. Control Charts
6. Scatter Plots
Donald Berwick

"Controlling Variation in Health Care"

Subject: Control & Reduction of Variation

TQM = customer satisfaction + organ. culture (empowerment) + continuous improvement

Concept of variation categorized by
- special causes
- common causes

Identify disconnected alarm systems

Beware: local excellence, systemic garbage

Tells what (articulately) but not how
QUALITY INFORMATION SYSTEMS

OBJECTIVE: RAPID FEEDBACK

From Customers:  
- Field personnel reports
  - Customer interviews & surveys

From Competitors/External Studies: 
  - Benchmarking

In the Production/Delivery System: 

*Rapid Feedback Systems: Detailed, Comprehensive, Fast*
  - Who are customers/suppliers?
  - Faster flow times ==> less tracking
  - Tight Feedback Loops

Provide Data on: 
  - Defects, Downtime, Warranties, Returns
  - Inventories, Lead Times, Cycle Times
  - Injuries, Absenteeism, Turnover
  - Process Capability, Learning Rates
  - Vendor Quality
  - Quality Costs
Measuring Quality

- Customer Satisfaction
- Defect Rates
- Cost of Poor Quality
- Inventory
- Productivity
- Innovativeness
- Complexity
- Order Lead Times
- Manufacturing Cycle Times
- Product Development Cycle Times
- Injuries
- Machine Downtime
- Absenteeism and Turnover
- Changeover time improvements
- Rate of Product Introduction
- Rates of Learning and Process Imp.
- Workforce Training and Education
- Workforce Suggestions
- Teamwork, Morale, Pride
- Vendor Cooperation
WE HAVE TOOLS FOR TWO TYPES OF DATA:

1. NUMERICAL DATA
   - HISTOGRAMS
   - PARETO DIAGRAMS
   - CONTROL CHARTS
   - SCATTER PLOTS
   - PROCESS CAPABILITY

2. LANGUAGE DATA
   - CAUSE & EFFECT DIAGRAMS
   - KJ (or “LP” PROCESS
     (AFFINITY DIAGRAMS)

MANY OF THE LANGUAGE DATA TOOLS ARE NOT WIDELY TAUGHT IN THE WEST.
Quality Economics

-Macro: International Competitiveness
-Micro: Quality/Productivity Relation
   (Economics of DIRTFT)

-Cost of Quality:
   Careful Analysis and Accounting
   -Failure Costs
   -Appraisal Costs
   -Prevention Investments
   -Revenue effects of quality

Contributions of Taguchi

- Quality Loss Function
- Two-step process for parameter optimization
  (control variance and mean)
- Orthogonal Arrays for experimental design
3. Total Participation Revolution
   - Total Involvement of CEO (Leadership)
   - Quality Specialist ----> All Employees
   - Build Infrastructure: goals, training, promotion, feedback, diagnosis, etc.

Customer-driven Requirements
Suppliers (Vendor Management)
Company-wide Involvement
   - Manufacturing
   - Marketing
   - Engineering (Design of Products, Processes, Systems)
   - Purchasing
   - Quality Assurance
   - Workforce Participation
   - Distribution and Field Service
   - Personnel
EMPLOYEE INVOLVEMENT

"IF A FIRM THAT UTILIZES THE MINDS OF ONLY 50% OF ITS EMPLOYEES COMPETES WITH A FIRM THAT UTILIZES THE MINDS OF 100% OF ITS EMPLOYEES, WHICH DO YOU THINK WILL PREVAIL?"

EI OBJECTIVES:

EMPLOYEE INITIATIVE
OWNERSHIP
ENThusIASM
LOYALTY

EI METHODS:

STRONG LEADERSHIP
TEAMWORK PROGRAMS
RECOGNITION AND REWARDS
INDIVIDUAL RESPONSIBILITY
TRAINING AND TOOLS
INCENTIVES
PRINCIPLES OF LEADERSHIP

1. LEADERS LEAD BY EXAMPLE
   - LEADERS MUST BE ROLE MODELS
   - LIVE YOUR LIFE AS A LEADER

2. LEADERS LEAD BY THEIR COMMITMENT
   - STATE CLEARLY YOUR COMMITMENTS
   - DEMONSTRATE YOUR COMMITMENT
   - HONOR YOUR COMMITMENTS

3. SET STANDARDS FOR
   - DISCIPLINE
   - ETHICS
   - ENTHUSIASM

4. MAKE EACH EMPLOYEE FEEL THAT HE/SHE MATTERS

5. CELEBRATE/RECOGNIZE ACHIEVEMENTS

6. BE A GOOD LISTENER

7. BE CONSISTENT AND PREDICTABLE
CONTINUOUS TRAINING AND EDUCATION

- General Quality Concepts
- Statistical Quality Control
- Cost of Quality
- Problem Solving
- Decision Making
- Teamwork
- Experimental Design
- Parameter Optimization
- Customer/Supplier Analysis
- Design for Manufacturability

WHO GETS WHAT TRAINING?
WHO DOES THE TRAINING?
WHO DESIGNS THE CURRICULUM?
MOTIVATION FOR LEARNING
TQM GOAL:
HABITUAL, CONTINUOUS IMPROVEMENT IN PURSUIT OF
PERFECT PRODUCTION

- Zero Defects
- Zero Inventories
- Zero Lead Times & Cycle Times
- Zero Injuries
- Zero Machine Downtime
- Zero Customer Returns
- Zero Warranty Costs
- Zero Absenteeism
- Process Capability > 2 and incr.
- Rapid Product Introduction
- Rapid Learning
- Teamwork
- High Morale
- Pride
4. Societal Learning Revolution

Success stories need wide diffusion  
(Baldridge, Deming Awards)

In Japan: progression through
- Process industries
- Mass Production
- Small Volume Manufacturing
- Construction
- Services

Role of outside change agents
- Deming, Juran, Shiba

Role of University/Industry Consortia
- MIT: Center for Quality Management Leaders for Manufacturing
Baldridge Quality Award

Categories for Scoring

1. Leadership--symbolism & involvement
2. Info systems/analysis--internal, benchmk
3. Strategic Quality Planning
   Plans and Goals that are concrete, focused, integrated, aggressive
4. Human Resource Utilization
   -empowerment, teamwork, skills
5. Quality Assurance of Pdts & Services
   -process quality drives product quality
6. Quality Results
   -data on quality and defects, etc.
7. Customer Satisfaction
   -systems and results
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<th>Award's Merits</th>
<th>Award's Demerits</th>
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<tr>
<td>stimulate debate</td>
<td>ignores finan. perf.</td>
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<td>raise consciousness</td>
<td>downplays product qua.</td>
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Baldridge Quality Award

Criticisms
1. requires large expenditures
2. fails to predict financial performance
3. not focused on superior product or service quality

Judging
1. Deployment - horizontal and vertical
2. Integration - alignment, communication, speed

Legacy

Spirit of Cooperation
IMPLEMENTATION OF TQM

- Major Cultural Transition
  (Trust as the lubricant)

- Education and Training are Critical

- Tailor the process to the specific firm

- Quality Improvement Teams
  (Harnessing the Collective Genius)

Top Management Leadership:
- Importance of Quality
- Goals and Objectives
- Commitment to these Goals
- Responsibility for these Goals
DEMING’S FOURTEEN POINTS

1. Create constancy of purpose for improvement of product and service.
2. Adopt the new philosophy -- poor quality cannot be tolerated.
3. Cease dependence on inspection to achieve quality.
4. End the practice of awarding contracts on the price tag alone; work with a single supplier.
5. Improve constantly and forever every process for planning, production, and service.
6. Institute training on the job.
7. Adopt and institute leadership.
8. Drive out fear.
9. Break down barriers among staff areas.
10. Eliminate slogans, exhortations , and targets for workers.
11. Eliminate numerical quotas for the workforce and numerical goals for management.
12. Remove barriers that rob people of their pride of workmanship. Eliminate the annual rating or merit system.
13. Institute a vigorous program of education and self-improvement for everyone.
14. Put everybody in the company to work to accomplish the transformation.
“The prevailing system of management has destroyed our people. People are born with intrinsic motivation, self-esteem, dignity, curiosity to learn, joy in learning. The forces of destruction begins with toddlers--a prize for the best Halloween costume, grades in school, gold stars--and on up through the university. On the job, people, teams, divisions are ranked--reward for the one at the top, punishment for the one at the bottom.”
- Top Management Leadership
  - Habitual Continuous Improvement
  - Rapid Feedback Systems
    (Who are customers/suppliers?)
  - Data-Driven Decision Support Tools
    (Statistical Quality Control, Cost of Quality, Taguchi Methods)
  - Continuous training and education
  - Company-wide participation
  - Supply-Chain Management
  - TQM Implementation
  - Employee Involvement
Peter Senge

"Building Learning Organizations: The Real Message of the Quality Movement"

First Wave of Quality:
- champion continuous improvement
- remove impediments that disempower people
- support new practices

Second Wave of Quality:
Improve Management Processes
The industrial engineering of management work

Third Wave of Quality
- institutionalize learning w/5 disciplines:
  Shared Vision
  Personal Mastery
  Mental Models
  Team Learning
  Systems Modeling

Intrinsic vs. Extrinsic motivation
Schaffer and Thompson

*Successful Change Programs Begin with Results*

**The Activity-Centered Fallacy:**

1. Not keyed to specific results

2. Too large-scale and diffused

3. Results is a four-letter word
   (avoid appearance of short-termism)

4. Delusional Measurements

5. Staff and Consultant Driven

6. Bias to orthodoxy, not empiricism
Results Driven

1. Introduce Managerial and Process innovations only as needed
2. Empirical testing reveals what works
3. Frequent reinforcement energizes
4. Use lessons of each phase to design next phase (i.e., continuous process)

How to get started

1. Create the context and Identify the crucial business challenges
2. Ask each unit for a few ambitious short-term goals
3. Monitor progress, capture the essential learning, reformulate strategy

Institutionalize only what works
FALSE STARTS & FAILURE MODES IN TQM PROGRAMS

1. TRAINING CAPACITY
2. RESISTANCE TO CHANGE
3. FEAR OF FIRING
4. CAPITAL CRUNCH
5. WORK OVERLOAD
6. SATISFIED CUSTOMERS
7. COST OF QUALITY
8. LOVED TO DEATH (institutionalized)
JUST-IN-TIME PRODUCTION

OBJECTIVE:

- Constant Improvement of the Production/Delivery System, as measured by **Quality, Cost, Lead Times, Service, Flexibility**

METHOD:

- Simplify the Production System
- Rapid Feedback on Problems Thru Tightly Integrated Production
- Pull System for Inventory Control
- Exploratory Stress to Drive Improvement
- Effective Management of Capital Equipment
SIMPLIFY THE PRODUCTION SYSTEM

Fewer Suppliers
Reduced Parts Counts
Focused Factories
Scheduling by rate, not lots
Fewer storage containers
More Frequent Deliveries
Smaller Plants
Shorter Distances
Less Reporting
Fewer Inspectors
Less Buffer Stock
Fewer Job Classifications
RAPID FEEDBACK

"A DEFECT IS A TREASURE"

ACTION STEPS:

1. REMOVE FEEDBACK DELAYS
   --ESPECIALLY WIP INVENTORIES

2. LINE WORKERS STOP PRODUCTION
   WHEN PROBLEMS ARISE

BENEFITS:

INSTANT FEEDBACK TO PROBLEM SOURCE

JOB ENRICHMENT
   -UTILIZE MENTAL POWERS

INCENTIVES TO AVOID DEFECTS
   -CAUSE IS EASILY TRACEABLE
PULL SYSTEM FOR PRODUCTION AND INVENTORY CONTROL

PRODUCE EXACTLY
- WHAT IS NEEDED
- WHEN IT IS NEEDED

KANBAN OR CARD CONTROL REPLACES COSTLY COMPUTERIZED PLANNING AND TRACKING SYSTEM

PROBLEMS ARE QUICKLY FELT THROUGHOUT THE SYSTEM

ELIMINATES JUST-IN-CASE INVENTORIES

REQUIRES
- FLEXIBILITY
- FAST CHANGEOVERS
- SMALL LOT SIZES
EXPLORATORY STRESS TO DRIVE IMPROVEMENT TO EXPOSE PROBLEMS

REDUCE BUFFERS
REDUCE CYCLE TIME TARGETS
REDUCE LABOR ALLOCATIONS

PROBLEM EXPOSURE DRIVES EMPLOYEES TO WORK ON
SETUP REDUCTION
VARIABILITY REDUCTION
CYCLE TIME REDUCTION
MANAGING CAPITAL EQUIPMENT

TOTAL PREVENTIVE MAINTENANCE

-ASSURES BETTER UPTIME RELIABILITY
-OFTEN PROVIDES MORE TOTAL UPTIME
-OPERATORS PERFORM REGULAR MAINT.

PRE-AUTOMATION

-PRODUCT DESIGN FOR ASSEMBLY
  -REDUCE PARTS COUNT
  -UTILIZE MODULARITY
  -SET SPECIFICATIONS EFFICIENTLY
    Know cust. needs and mfg capability

-PROCESS DESIGN FOR ASSEMBLY
  -REDUCE FLOW DISTANCES
  -UTILIZE FAIL-SAFE DEVICES
  -LOCATE TOOLS CONVENIENTLY
  -STREAMLINE BEFORE AUTOMATING

ADD CAPITAL INCREMENTALLY

-SEVERAL SMALL MACHINES MORE FLEXIBLE
  -MATCH SUPPLY WITH DEMAND
  -LESS CYCLE INVENTORY NEEDED

  -MOVABILITY PERMITS DEDICATED CELLS
JIT IMPLEMENTATION ISSUES

1. INVENTORY AS A SECURITY BLANKET
2. REDUCE INVENTORY CARRYING COSTS VS.
REDUCE SOURCES OF VARIABILITY
3. SUPPLIER MANAGEMENT
   -BULLYING VS. COOPERATION
   -HOW TO SHARE THE PAINS & GAINS
   -GET OWN HOUSE IN ORDER FIRST?
4. PHYSICAL DISTANCES
   -BETWEEN PLANTS
   -BETWEEN WORKSTATIONS
5. COOPERATIVE EFFORTS AMONG
   -MANUFACTURING
   -MARKETING
   -PURCHASING
   -ENGINEERING
6. PATIENCE