Introduction to
Total Quality Management
Index

1. Introduction to TQM
2. Need and Applicability of TQM
3. Key Elements of TQM
4. TQM and Six Sigma
Other Definitions for Quality

• The concept and vocabulary of quality are elusive. Different people interpret quality differently. Few can define quality in measurable terms that can be proved operationalize.

• The American National Standards Institute (ANSI) and the American Society for Quality (ASQ) define quality as:
  “The totality of features and characteristics of a product or service that bears on its ability to satisfy given needs.”

• **Quality is Fitness for Use.**
  Evaluates performance for intended use

• **Quality is customer satisfaction and loyalty.**
Introduction

• **What is a customer?**
  Anyone who is impacted by the product or process delivered by an organization.
  **External customer:** The end user as well as intermediate processors. Other external customers may not be purchasers but may have some connection with the product.
  **Internal customer:** Other divisions of the company that receive the processed product.

• **What is a product?**
  The output of the process carried out by the organization. It may be goods (e.g. automobiles, missile), software (e.g. a computer code, a report) or service (e.g. banking, insurance)
Introduction

• How is customer satisfaction achieved?
  Two dimensions: Product features and Freedom from deficiencies.
• **Product features** – Refers to *quality of design*.
  Examples in manufacturing industry: Performance, Reliability, Durability, Ease of use, Esthetics etc.
  Examples in service industry: Accuracy, Timeliness, Friendliness and courtesy, Knowledge of server etc.
• **Freedom from deficiencies** – Refers to *quality of conformance*.
  Higher conformance means fewer complaints and increased customer satisfaction.
History of quality management

...To know the future, know the past!

• Before Industrial Revolution, skilled craftsmen served both as manufacturers and inspectors, building quality into their products through their considerable pride in their workmanship.

• Industrial Revolution changed this basic concept to interchangeable parts. Likes of Thomas Jefferson and F. W. Taylor (“scientific management” fame) emphasized on production efficiency and decomposed jobs into smaller work tasks. Holistic nature of manufacturing rejected!
History of quality management

- Statistical approaches to quality control started at Western Electric with the separation of inspection division. Pioneers like Walter Shewhart, George Edwards, W. Edwards Deming and Joseph M. Juran were all employees of Western Electric.
- After World War II, under General MacArthur's Japan rebuilding plan, Deming and Juran went to Japan.
- Deming and Juran introduced statistical quality control theory to Japanese industry.
- The difference between approaches to quality in USA and Japan: Deming and Juran were able to convince the top managers the importance of quality.
Next 20 odd years, when top managers in USA focused on marketing, production quantity and financial performance, Japanese managers improved quality at an unprecedented rate.

Market started preferring Japanese products and American companies suffered immensely.

America woke up to the quality revolution in early 1980s. Ford Motor Company consulted Dr. Deming to help transform its operations.

(By then, 80-year-old Deming was virtually unknown in USA. Whereas Japanese government had instituted The Deming Prize for Quality in 1950.)
History of quality management

• Managers started to realize that “quality of management” is more important than “management of quality.” Birth of the term *Total Quality Management (TQM)*.

• *TQM – Integration of quality principles into organization’s management systems.*

• Early 1990s: Quality management principles started finding their way in *service industry*. FedEx, The Ritz-Carton Hotel Company were the quality leaders.

• *TQM recognized worldwide*: Countries like Korea, India, Spain and Brazil are mounting efforts to increase quality awareness.
Commonality of Themes of Quality Gurus

- Inspection is never the answer to quality improvement, nor is “policing”.

- Involvement of leadership and top management is essential to the necessary culture of commitment to quality.

- A program for quality requires organization-wide efforts and long term commitment, accompanied by the necessary investment in training.
ISO for example has different standards for different purposes, for security management, for product quality etc. Implementing ISO involves going through certain guided principles to ensure that correct approach is taken while rendering services with lesser effort to focus on the final product.

ITIL (Information Technology Infrastructure Library) is a set of standards for quality. However, they are applicable to IT related products and services only.

COPC (Customer Operations Performance Centre) CSP (Customer Service Provider) and VMO (Vendor Management Organization) are quality standards specifically designed for the processes that are outsourced to a call centre and for the call centre itself.

Six Sigma is used when either there is a defect in existing process or we want process to perform at a higher performance level. So, the approach, is limited to the departments/persons/processes involved in the process and at end. It has a definite problem statement and a defined solution.
TQM is an effective System of Quality Development, Quality Maintenance and Quality improvement efforts involving all the departments and groups in an organization to allow economy in production of goods or rendering of services along with complete customer satisfaction.
Ingredients of TQM

TQM is an effective System of Quality Development, Quality Maintenance and Quality improvement efforts involving all the departments and groups in an organization to allow economy in production of goods or rendering of services along with complete customer satisfaction.

So, the basic ingredients of TQM are:

1. Quality of Products or Processes is responsibility of all involved in the creation and customer (internal and external).

2. Aimed at Economy in the cost level

3. Aimed at Satisfaction at the customer level
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Total Quality Management covers all aspects from Top Down and Helps optimize cost, revenue and ensures Customer satisfaction.
The need of TQM lies in the fact that it is Quality tool that can be:

1. Implemented over a larger area
2. Always the end result aimed at Customer or End User satisfaction
3. All Process from Conceiving Idea to Earning Revenue is taken care of
4. Aims are Long Term Success
5. Caters to Manufacturing Process that is more dynamic
6. Creates Accountability in each entity
Total Quality Management has a close relationship between the below two Quality Parameters

**JIT – Just in Time**

JIT is a manufacturing Program to identify and eliminate all kinds of waste through Just in Time production and involvement of workforce. Two major wastes are WIP inventory and unnecessary delay in flow time. Implementation methodology are Set up time reduction and Pull System production.

**TPM – Total Productive Maintenance**

TPM is a manufacturing Program designed to maximise equipment effectiveness, throughout its entire life through the participation and motivation of entire workforce.

**TQM – Total Quality Management includes the below in light of JIT and TPM**

TQM basic techniques include cross-functional product design, process management, supplier quality management, and customer involvement. JIT basic techniques include set-up time reduction, pull systems production, JIT delivery by suppliers, equipment layout, and daily schedule adherence. TPM basic practices are autonomous and planned maintenance, technology emphasis and proprietary equipment development.
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Key Elements of TQM – TQM Structure in the Org.
Management plans the activities for TQM facilitation

Different applicable Quality Standards are integrated into the Process and Operation

The Quality Standards ensure Supply Chain Management to be correct and smooth

The Quality Standards also ensure the final product to be as per customer requirement or better

Correct inflow and outflow of services and products keep customers satisfied

So, overall Operation runs on its Optimum Capacity always, so that Cost, Revenue and Customer Satisfaction are always on minimum defect level
• Money – The language of management
The "cost of quality" is not the price of creating a quality product or service.

It's the cost of NOT creating a quality product or service.
COQ - Definition

• Cost of Quality is a means to quantify the total cost of:
  ➢ Quality-related efforts 
  and 
  ➢ Deficiencies

Quality costs are the costs associated with
  ➢ Preventing .......... Investing in the prevention of nonconformance to requirements

  ➢ Finding ............. Appraising a product or service for conformance to requirements

  ➢ Failing to meet requirements .......... Correcting defective work
COQ Components

**Preventive Cost**

The costs of all activities specifically designed to prevent poor quality in products or services.

Examples are the costs of:
- New product review
- Quality planning
- Supplier capability surveys
- Quality improvement team meetings
- Quality improvement projects
- Quality education and training

- In the ideal situation, Prevention costs will be the largest portion of the Total Cost of Quality

- Typically, prevention is less than 10% of Total COQ where it should be about 70%
COQ Components

➤ Appraisal Cost

The costs associated with measuring, evaluating or auditing products or services to assure conformance to standards & performance requirements.

These include the costs of:

• Inspection/test of purchased material
• In-process and final inspection/test
• Product, process or service audits
• Calibration of measuring and test equipment

These are all planned activities

➤ Appraisal Costs should be the second largest category, but should not exceed prevention costs
COQ Components

Failure Costs
The costs resulting from products or services not conforming to requirements or customer/user needs. Failure costs are divided into internal and external failure categories.

Internal Failure Costs
Failure costs occurring prior to delivery or shipment of the product, or the furnishing of a service, to the customer.

Examples are the costs of:

✓ Scrap  ✓ Rework  ✓ Re-inspection  ✓ Re-testing
COQ Components

- **Failure Costs (Contd.)**

  - **External Failure Costs**
    Failure costs occurring after delivery or shipment of the product — and during or after furnishing of a service — to the customer.

    Examples are the costs of:
    - ✓ Processing customer complaints
    - ✓ Customer returns
    - ✓ Warranty claims
    - ✓ Product recalls

These are non-value added and reactive
The size of various quality cost elements:

- Preventive costs: 1%
- Appraisal costs: 4-6%
- Internal failure costs: 10-12%
- External failure costs: 10-15%

The total quality costs are 25-35% of turnover.
Impact of TQM on costs.

- TQM is primarily aimed to improve the quality of the product, higher customer satisfaction and better working environment for the employees. The most dramatic impact of TQM is on reduction of quality costs which directly affect the profitability.

- This is demonstrated by the results of TQM program in Xerox Corp. The change in various elements of quality cost before and after launching TQM by Xerox Corp is shown on the next slide.
Impact of TQM on costs.

An example from Xerox Corp.

Before TQM

<table>
<thead>
<tr>
<th>% of sales</th>
<th>Internal Failure</th>
<th>Appraisal</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After TQM

<table>
<thead>
<tr>
<th>% of sales</th>
<th>Internal Failure</th>
<th>Appraisal</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Why measure COQ?

Measure COQ - Why?

- COQ can be used to identify quality improvement candidates
- COQ provides one measure of comparing the success of projects
- COQ can provide cost data for motivational purpose
- Money is the language of management, you need to show them the numbers - Crosby
Steps in implementing TQM

1. Obtain CEO Commitment
2. Educate Upper-Level Management
3. Create Steering Committee
4. Outline the Vision Statement, Mission Statement, & Guiding Principles
5. Prepare a Flow Diagram of Company Processes
6. Focus on the Owner/Customer (External) & Surveys
7. Consider the Employee as an Internal Owner/customer
8. Provide a Quality Training Program
9. Establish Quality Improvement Teams
10. Implement Process Improvements
11. Use the Tools of TQM
12. Know the Benefits of TQM

Continuous Improvement
The implementation of TQM its impact on manufacturing performance

They derived 16 Principles which are essential elements of TQM

1. Cross-Functional Product Design
2. Process Management
3. Supplier Quality Management
4. Customer Involvement
5. Information and Feedback
6. Committed Leadership
7. Strategic Planning
8. Cross-Functional Training
9. Employee Involvement
10. Set-up time reduction
11. Pull System Production
12. Delivery by Supplies
13. Equipment Layout
14. Daily Schedule Adherence
15. Autonomous & Planned Maintenance
16. Technology Emphasis
The implementation of TQM its impact on manufacturing performance. They derived 16 Principles which are essential elements of TQM:

1. Cross-Functional Product Design
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14. Daily Schedule Adherence
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16. Technology Emphasis
TQM for Top Management

1-Strategic Quality Management (SQM).

Vision/Mission statement
Quality policies.
Quality goals
Measurement feedback
Review of progress
Training
Strategy or Policies are made at the uppermost levels of Leadership. TQM wants that there should be a Strategic Plan for the organization which is clear and motivated. Generally an organizations strategy revolves around its Vision and Mission. With a clear strategy, it is easy for the Management, Manufacturing Plant and other departments to develop their own pointers to drive towards the common goal. This requires a methodical approach, that is TQM or any other Quality initiative.

**The advantages are:**

1. Goal is defined
2. Misinterpretation of Key deliverables are avoided
3. Larger goal of the organization makes the smaller missions well defined and time bound
4. Leadership’s ease of maneuvering the teams and management is increased towards the Vision
1-Process Management

Planning and administrating the activities necessary to achieve high quality in business processes; and also identifying opportunities for improving quality and operational performance – ultimately, customer satisfaction.

- Processes are of two types – value-added processes and support processes.
- Value-added processes – those essential for running the business and achieving and maintaining competitive advantage. (Design process, Production/Delivery process).
- Support processes – Those that are important to an organization’s value-creation processes, employees and daily operations.
- Value creation processes are driven by external customer needs while support processes are driven by internal needs.
Process management is the application of knowledge, skills, tools, techniques and systems. Its primary motive is to define, visualize, measure, control, report and improve processes. The goal of PM is to meet customer requirements profitably. It is also called BPM (Business Process Management).

The advantages are:

1. Processes are defined as per Quality Parameters and has defined SOPs.
2. It is an ongoing Process, and helps to keep pace with the market change and demand.
3. Defects are minimized, Cost and Revenue Optimized and Customer Satisfaction Maximized.
2-Statistical Process Control (SPC).

Statistics and probability
Confidence interval.
Control chart
Mil standard
Quality tools
Use the Tools of TQM

Seven *classical* tools of quality and process improvement, plus one, are presented below.

<table>
<thead>
<tr>
<th>Tool</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flowchart</td>
<td>Portrays all the steps in a process. Helps understand the process.</td>
</tr>
<tr>
<td>Control Chart</td>
<td>Shows if a process has too much variation.</td>
</tr>
<tr>
<td>Histogram</td>
<td>Portrays the frequency of occurrence.</td>
</tr>
<tr>
<td>Check Sheet</td>
<td>Tabulates frequency of occurrence.</td>
</tr>
<tr>
<td>Pareto Diagram</td>
<td>Visually portrays problems and causes in order of severity or frequency. Helps determine which problem or cause to tackle first.</td>
</tr>
<tr>
<td>Scatter Diagram</td>
<td>Helps determine if two variables are related.</td>
</tr>
<tr>
<td>Run Chart</td>
<td>Shows variation and trends with time. Provides baseline data, and helps to determine if a process is improving or not.</td>
</tr>
</tbody>
</table>
1. Cause-and-Effect Diagram

- Suppliers
- Workers
- Machines
- Environment
- Process
- Material
- Quality Problems

2. Flowchart

3. Checklist

<table>
<thead>
<tr>
<th>Defect Type</th>
<th>No. of Defects</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broken zipper</td>
<td>★★★</td>
<td>3</td>
</tr>
<tr>
<td>Ripped material</td>
<td>★★★★★</td>
<td>7</td>
</tr>
<tr>
<td>Missing buttons</td>
<td>★★★</td>
<td>3</td>
</tr>
<tr>
<td>Faded color</td>
<td>★★</td>
<td>2</td>
</tr>
</tbody>
</table>

4. Control Chart

- UCL
- LCL

5. Scatter Diagram

6. Pareto Chart

7. Histogram

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Pareto Chart - ranked histogram

- Invented by Joseph Juran
- Beer defects
Wilfredo Pareto 1848-1923

- Italian Economist
- “80/20” rule: 80% of the wealth is controlled by 20% of the people
  *Cours d'économie politique* (1896-7)
- 80/20 rule believed to apply much more widely
- 1906- “Pareto Optimality” – not possible to make anyone better off (in his own estimation) without making someone else worse off
Cause & Effect Diagram Example

Too Many Defects
Cause & Effect Diagram Example

Method

Main Cause

Manpower

Main Cause

Material

Main Cause

Machinery

Too Many Defects
Cause & Effect Diagram Example

- Method
  - Drill
- Manpower
  - Tired
  - Lathe
- Material
  - Wood
  - Steel
- Machinery
  - Too Many Defects
  - Steel
Cause & Effect Diagram Example

- **Method**
  - Drill
  - Slow

- **Manpower**
  - Over Time
  - Tired

- **Material**
  - Wood
  - Not dried

- **Machinery**
  - Steel
  - Not maintained
  - Lathe

**Too Many Defects**
Control Chart Example

Time

X

UCL

LCL

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Checklist

- Simple data check-off sheet designed to identify type of quality problems at each work station; per shift, per machine, per operator

<table>
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<td>✅✅✅</td>
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</tr>
<tr>
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<td>✅✅</td>
<td>2</td>
</tr>
</tbody>
</table>
Histograms

• A chart that shows the frequency distribution of observed values of a variable like service time at a bank drive-up window

• Displays whether the distribution is symmetrical (normal) or skewed
Scatter diagrams

- Graphical components of the regression analysis.
- Often used to point out *relationship between variables*. Statistical correlation analysis used to interpret scatter diagrams.
Flow chart

Start

Alarm Rings

Delay

Set for 5 Min.

Ready to Get Up?

Hit Snooze Button

Average 3 Times

Climb Out of Bed

End

Created by EDraw

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Cross-functional product design is a widely used method for involving different functional areas in new product/process development.

It is used when either an existing product has to undergo change or a new product is planned or conceived to be launched.

**The advantages are:**

1. Previous Experience are used
2. Buy in of all departments ensures minimum resistance and ease in change management
3. All factors, including Finance, Engineering, Maintenance, Marketing, Operations etc. are taken care of
4. Sustainability of the Product increases
5. Any setback in future is handled with planned procedures
3 – Cross-Functional Product Design (TQM)

The Cross-Functional Product Design should be measured to eliminate chances of a Product design or re-design to miss out on inputs of any Function and to ensure, it is adhered to, at first place.

The advantages are:

1. Direct labour employees are involved to a great extent (on teams or consulted) before introducing new products or making product changes.

2. Manufacturing are involved to a great extent before the introduction of new products.

3. Design is conceived in teams, with members from a variety of areas (marketing, manufacturing, etc.) to introduce new products.

4. The time to introduce new products is reduced by designing product and process together.
Supplier Quality Management ensures that the supplier of raw materials is certified for Quality, example ISO certified. Or the Organization has its own Quality check mechanism that has certified the Supplier. Management Guru’s have created a separate chain called SCM (Supply Chain Management) that studies the efforts in improving the standards and maintaining the high standards of Supplier so that the basic input to the Process Management is flawless and optimized.

The advantages are:

1. Quality of raw materials are ensured.
2. Timely delivery is ensured.
3. Cost effective inventory management can be done.
4. Supplier back up ensure least disruption in production
5. Competitive price can be negotiated
TQM for the Workforce

- **Kaizen teams**
  - An intense and rapid improvement process in which a team or a department throws all its resources into an improvement project over a short period of time.

- **Blitz teams**
  - Usually comprise of employees from all areas involved in the process who understand it and can implement the changes on the spot.

- **Quality Circles**
  - *Teams of workers and supervisors* that meet regularly to address work-related problems involving quality and productivity.
  
  Typically small day-to-day problems are given to quality circles. Since workers are most familiar with the routine tasks, they are asked to identify, analyze and solve quality problems in the routine processes.
Employee Involvement

As per the name, it simply means that the employees are involved in problem solving and getting around issues that may or are cause of production to go down or stop. Employee Involvement ensures that the solution derived has the accent of employees and any issue faced by the employees in the production are addressed automatically.

The advantages are:

1. Less Negative turnover
2. Skill bank enhancement
3. Increase in accountability of employees due to being engaged in problem solving and product design
4. Solutioning is fast due to prior knowledge of product engineering and quality enhancement
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TQM is a Framework of Principles and Systems Approach. All nine Elements we discussed for TQM, there are few which can use Six Sigma as a method of usage. Generally, a Six Sigma approach covers one or more areas of TQM Elements

As per Philip Crosby:
Pre-determined requirements, design activities and manufacturing practices are the basis of quality product and quality definition with be ‘conformance to requirement’. This definition ensures zero defect product as 100% conformance to requirement is the only acceptable quality measure. So it is Management’s responsibility to create correct requirements.

As per Joseph M. Juran:
Quality is the final product being in ‘conformance to specifications’ or ‘conformance to standards’. However, in terms of manufacturing, this definition is not accurate to T because at a Managerial Level, conformance to specification is only one of the many means to reach at end product that is 100% defect free.
Six sigma is a business statistical Strategy.
Is to identifying defects and removing them from the process of products to improve quality.
A defect is defined as any process output that does not meet customer specifications.
Statistical measure to objectively evaluate processes.
Six Sigma Definition

- Quality management program developed by Motorola in the 1980s.
- Management philosophy focused on business process improvements to:
  - Eliminate waste, rework, and mistakes
  - Increase customer satisfaction
  - Increase profitability and competitiveness
The Six sigma was founded by Motorola in the 1970s. Out of senior executive Art Sundry's criticism of Motorola’s bad quality. They founded a connection between increases in quality and decreases in costs of production. Bill Smith, “Father of six sigma” introduce this quality improvement Methodology to Motorola.
Six Sigma + Lean Manufacturing

### Six Sigma
- **Goal**: Improve quality
- **Approach**: Focus on part of process
- **Benefits**: Reduce defects, Increase Capability & Productivity

### Lean
- **Goal**: Reduced waste
- **Approach**: Holistic view of process
- **Benefits**: Reduce lead time, Increase Capacity & Lower Inventory

**1st**
- Reduced Variation

**2nd**
- Improved Flow

**Process**
- **Effective**
- **Efficient**

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Six Sigma DMAIC Tools

- Define
  - Project Scope
  - Project Charter
  - Business Impact
  - Voice of the Customer (VOC)
  - Affinity Diagram
  - Kano Model
  - CTQ Tree diagram

- Measure
  - Process Map
  - Data Collection
  - Control Charts
  - Pareto Charts
  - Prioritization Matrix
  - Measurement System Analysis
  - Process Capability
  - Yields (RTY)

- Analyze
  - Multivari Analysis
  - Cause & Effect Matrix
  - FMEA
  - Hypothesis testing
  - ANOVA
  - Noise Variables
  - Scatter plots
  - Design of Experiments

- Improve
  - Brainstorming & Creativity tools
  - Design of Experiments (DOE)
  - Full Factorial
  - Fractional Factorial
  - Response Surface
  - Pilot Trials
  - Implementation Plan

- Control
  - Statistical Process Control (SPC)
  - Standard Operating procedures (SOP)
  - Data Collection & sampling plans
  - Control Plans
  - Measurement Systems Analysis (recheck)
  - Project summary & lessons learned
A Specification is a document that contains requirements for a product or a service!
TQM System Approach

Quality Planning starts from Leadership, enforced by Management and Implemented by work force

Quality Control is specific to the Center of Excellence of QC and forms major part of Routine Quality Job

Quality Improvement is a Cycle in which all Departments and Individuals play equally important role
COMPANY THAT PRACTICES TQM
Is an American multinational automaker based in Dearborn, Michigan, a suburb of Detroit. The automaker was founded by Henry Ford and incorporated on June 16, 1903.

Ford is the second largest automaker in the U.S. and the fifth-largest in the world based on annual vehicle sales in 2010. At the end of 2010, Ford was the fifth largest automaker in Europe. Ford is the eighth-ranked overall American-based company in the 2010 Fortune 500 list, based on global revenues in 2009 of $118.3 billion.
TQM techniques that Ford used:

- Six Sigma
- Quality Operating System or (QOS)
- developed their own quality process or 5S.
- The DMAIC process, or define, measure, analyze, improve, and control has built an overall strategy for consistency in their teams,
Xerox has established a program called Leadership Through Quality (LTQ) and a Quality Training Task Force for its company’s leadership teams. "Today, more than 100,000 Xerox employees worldwide have been trained in this process, which stresses continuous improvement and defines quality precisely as meeting customer requirements" (Evans-Correia, 1997, 135).
The XEROX Corporation focuses on:

- Benchmarking
- a reduced supplier base
- and leadership teams
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