

Total Quality Management
Mechanical Technology Chapter 4 Notes
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Chapter 4

Performance Measures

Managing an organization without performance measures is like a captain of a ship navigating without instrumentation.

1. Basic Concept of performance measures

- **Objectives:** Typical objectives are- establish baseline measures and trends, determining improvement areas, process gains and losses, compares goals with actual performance, provide information for decision making, etc
- **Typical measurements:** Some of the items to be measured are- human resource, customer, production, R&D, Suppliers, Marketing/sales, Administration
- **Criteria:** Measures should be simple and few in number. They should have relevance to the business and customer. Focus should be on improvement. Cost and time are also important criteria

2. Establishing strategic measurement system

The quality council has the overall responsibility for the performance measures. Often measures are integrated into a total system of measures. For this purpose, appropriate information is obtained from all of the stake-holders. They will utilize the core values, goals, mission, and vision statements as well as the objectives and criteria. With this information, the strategic measurement system is created.

Example of such a system that involves several functions is:

- **Quality:** Reduction in cost of poor quality, percent of certified suppliers, reduction in supplier base, reduction in corrective action cycle time
- **Cost:** increase in inventory turnover, reduction in data transactions, increase in output dollars per employee, reduction in floor space utilization
- **Flexibility:** reduction in cycle time, reduction in lot/batch size, increase in common materials used per product
- **Reliability:** Process capability, reduction in down time, reduction in warranty costs, reduction in design changes
- **Innovation:** reduction in new product introduction time, increase in new patents granted
- “Down time: average time that a system is non-operational.”

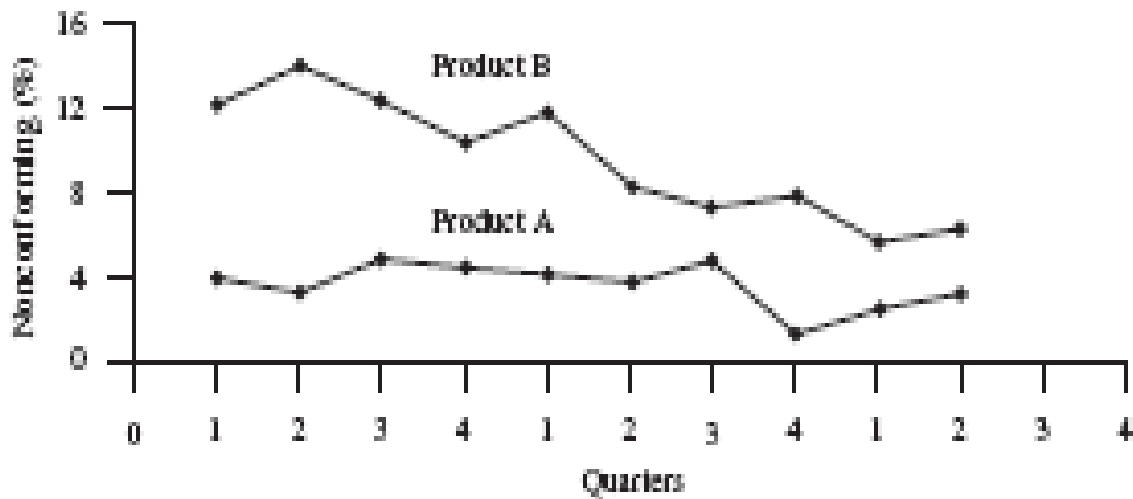
3. Performance Measure Presentation

There are six basic techniques for presenting performance measures:

- Time series graph
- Control Charts
- Capability Index
- Taguchi Loss Function
- Cost of Poor Quality
- performance measurement based on the criteria of national/international
- Quality awards such as Malcolm Baldrige National Quality Award

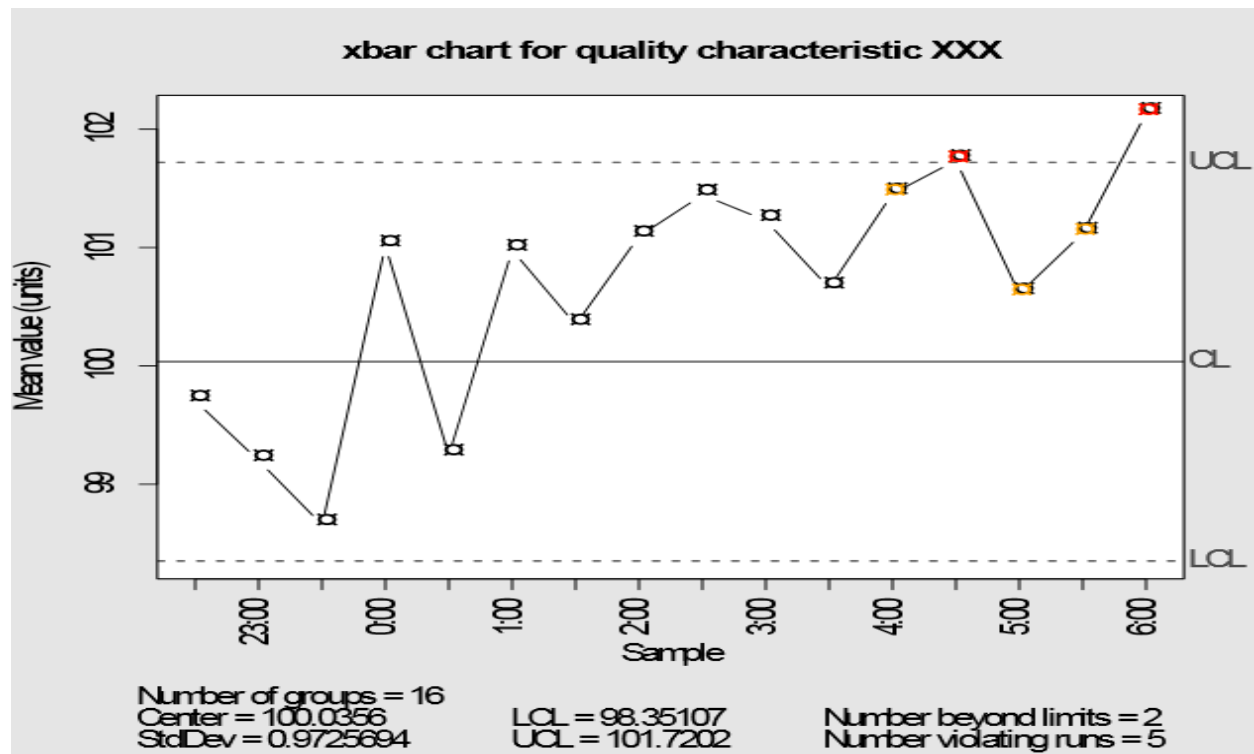
4. Time Series Plot

- The simplest and most common technique is the time series graph
- Time as measured by days, weeks, months, and so forth, is shown on the horizontal axis, and the performance measure is shown on the vertical axis.
- This type of graph benchmarks the process and shows favorable and unfavorable trends in the measure.



5. Control Chart

Control charts, also known as Shewhart charts (after [Walter A. Shewhart](#)) or process-behavior charts, are a [statistical process control](#) tool used to determine if a [manufacturing](#) or [business process](#) is in a state of [control](#). Control charts for variable data are used in pairs. The top chart monitors the average, or the centering of the distribution of data from the process. The bottom chart monitors the range, or the width of the distribution. If your data were shots in target practice, the average is where the shots are clustering, and the range is how tightly they are clustered. Control charts for attribute data are used singly.



When to use a Control Chart

- When controlling ongoing processes by finding and correcting problems as they occur
- When predicting the expected range of outcomes from a process
- When determining whether a process is stable (in statistical control)
- When analyzing patterns of process variation from special causes (non-routine events) or common causes (built into the process)
- When determining whether your quality improvement project should aim to prevent specific problems or to make fundamental changes to the process.

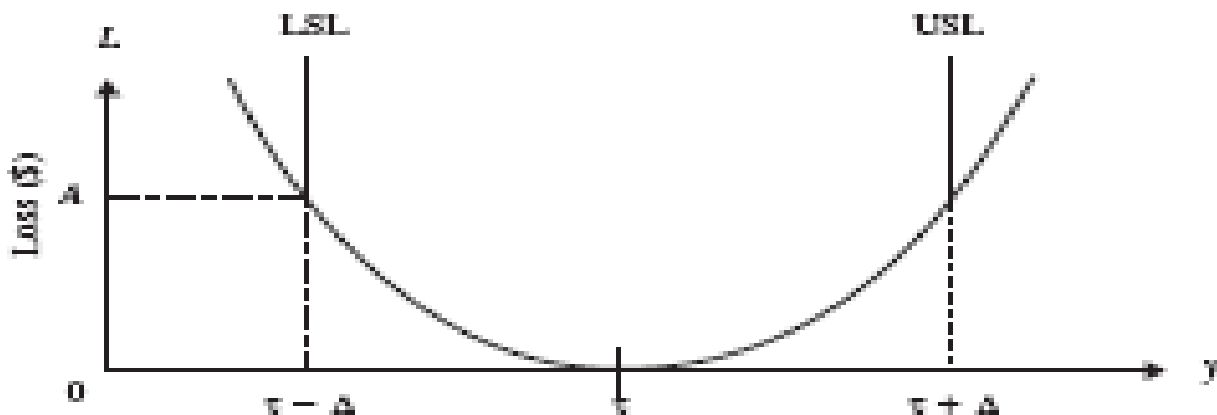
Control Chart Basic Process

- Choose the appropriate control chart for your data.
- Determine the appropriate time period for collecting and plotting data.
- Collect data, construct your chart and analyze the data.
- Look for "out-of-control signals" on the control chart. When one is identified, mark it on the chart and investigate the cause. Document how you investigated, what you learned, the cause and how it was corrected.

6. Taguchi Loss Function

The **Taguchi loss function** is graphical depiction of [loss](#) developed by the Japanese business statistician [Genichi Taguchi](#) to describe a phenomenon affecting the value of products produced by a company.

The Taguchi loss function is important for a number of reasons—primarily, to help engineers better understand the importance of designing for [variation](#).

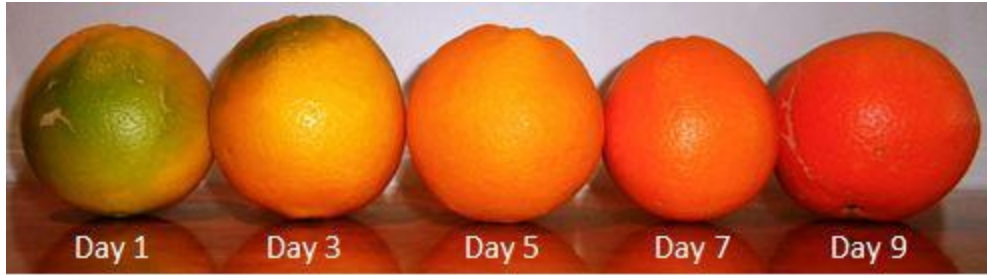


Taguchi Loss Function for Nominal-the-best

Real Life Example of Taguchi Loss Function

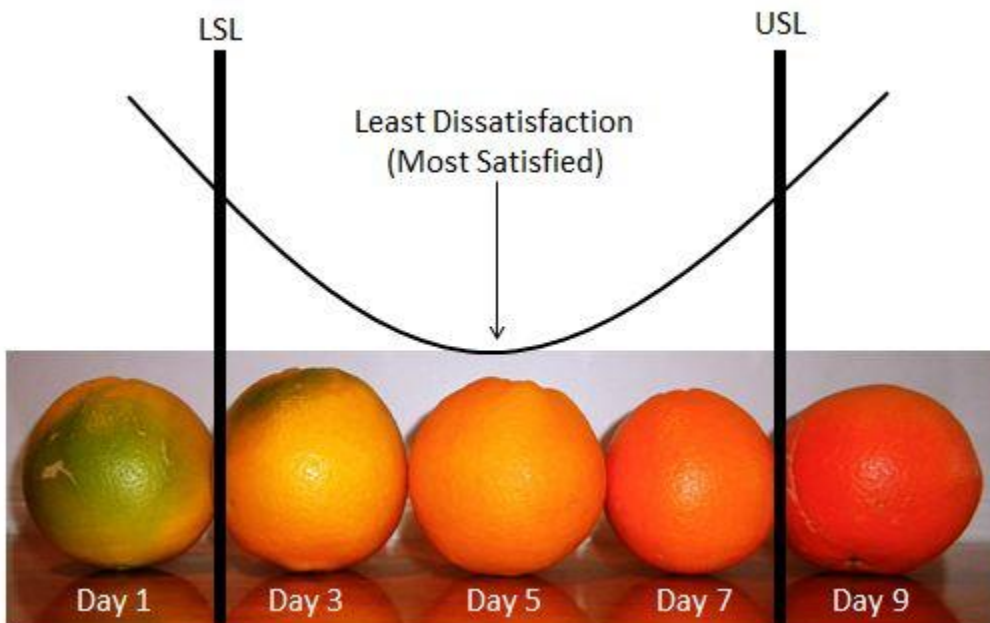
A real life example of the Taguchi Loss Function would be the quality of food compared to expiration dates.

If you purchase an orange at the supermarket, there is a certain date that is ideal to eat it. That would be the target date. There will also be limits for when to eat the orange (within three days of the target date, Day 2 to Day 8).



For this example, Day 5 represents the target date to eat the orange. That is when the orange will taste the best (customer satisfaction).

You purchase the orange on Day 1, but if you eat the orange you will be very dissatisfied, as it is not ready to eat. This would fall below the lower limit. On Day 3 it would be acceptable to eat, but you are still dissatisfied because it doesn't taste as good as eating on the target date. If you wait for Day 5, you will be satisfied, because it is eaten on the ideal date. If you wait until Day 7, you will be slightly dissatisfied, because it is one day past the ideal date, but it will still be within the limits provided by the supermarket. If you wait until Day 9, you will be very dissatisfied, as it will be too far past the ideal date.



You are slightly dissatisfied from Day 2 through 4, and from Day 6 through 8, even though technically you are within the limits provided by the supermarket. The least amount of dissatisfaction occurs on the target date, and each day removed from the target date incurs slightly more dissatisfaction. Contrary to most discussions around specification limits, you are NOT completely satisfied from Days 2 through 8, and only dissatisfied on Day 1 and 9.

7. Quality Costs

- The value of quality must be based on its ability to contribute to profits.
- The goal of most organizations is to make money therefore, decisions are made based on evaluating alternatives and the effect each alternative will have on the expense and income of the entity.
- The efficiency of a business is measured in terms of dollars. The cost of poor quality can add to the other costs used in decision making, such as maintenance, production, design, inspection, sales, and other activities.
- A reduction in quality costs leads to increased profit

Quality costs are defined as those costs associated with the non-achievement of product or service quality as defined by the requirements established by the organization and its contracts with customers and society. **Simply stated, quality cost is the cost of poor products or services.**

8. Quality Cost Program

Quality costs are used by management in its pursuit of quality improvement, customer satisfaction, market share and profit enhancement. It is the economic common denominator that forms the basic data for TQM. When quality costs are too high, it is a sign of management ineffectiveness, which can affect the organization's competitive position. A quality cost program provides warnings against oncoming, dangerous financial situations.

Categories and Elements:

- **PREVENTIVE COST:** The experience gained from the identification and elimination of specific causes of failure and their costs is utilized to prevent the recurrence of the same or similar failures in other products or services.
- **APPRAISAL COST:** The costs of poor quality which includes all costs incurred in the planned conduct of product or service appraisals to determine compliance to requirements.
- **INTERNAL FAILURE COST:** Whenever quality appraisals are performed, the possibility exists for discovery of a failure to meet requirements. When this happens, unscheduled and possibly unbudgeted expenses are automatically incurred.
- **EXTERNAL FAILURE COST:** This category includes all costs incurred due to actual or suspected nonconforming product or service after delivery to the customer. These costs consist primarily of costs associated with the product or service not meeting customer or user requirements.

9. Quality Costs: Collection, Reporting and Analysis

- **Collection and Reporting:**

- **Collection System Design:** The development of the collection system requires the close interaction of the quality and accounting departments. Because accounting cost data are established by departmental cost codes, a significant amount of quality cost can be obtained from this source.
- **Quality Cost Bases:** Quality costs by themselves present insufficient information for analysis. A baseline is required that will relate quality costs to some aspect of the business that is sensitive to change. Typical bases are labor, production, sales, and unit. When these baselines are compared with quality costs, an index is obtained.
- **Quality Cost Report:** The basic quality cost control instrument is the quality cost report, which is usually issued by the accounting department. Provision is made to report the quality costs for the current month for each cost element as well as the current and prior year-to-date values. Applicable indexes and ratios are shown at the bottom of the report.
- **Analysis**
 - **Trend Analysis:** It involves simply comparing present cost levels to past levels
 - **Pareto Analysis:** This analysis identifies Vital Few. Once the vital few are known, projects can be developed to reduce their quality costs. Vital few indicates that many defects come from relatively few causes.
- **Optimizing Costs**
 - Compare performance with other organizations
 - Optimize the individual categories
 - Analyze relationship using Economic Model defined by Juran

10. Quality Improvement Strategy

The idea of a quality improvement strategy is that each failure has a root cause, causes are preventable, and prevention is cheaper.

Based on this concept, the following strategy is used:

- Reduce failure costs by problem solving
- Invest in the “right” prevention activities
- Reduce appraisal costs where appropriate and in a statistically sound manner.
- Continuously evaluate and redirect the prevention effort to gain further quality improvement.

11. Program Implementation

Organizations take following steps for implementation:

- Decide about potential benefits
- Seek approval from top management
- Ensure involvement and commitment of top management
- Carry out pilot/ trial implementation
- Provide requisite training to key personnel
- Revise basic accounting procedures to accommodate changes
- Expand trial program to entire organization

12. Malcolm Baldrige National Quality Award

The Malcolm Baldrige National Quality Award (MBNQA) is an annual award to recognize U.S. organizations for performance excellence.



13. Key characteristics of MBNQA

- The criteria are directed toward results. They focus principally on seven key areas of business performance. Results are a composite of
 - Product
 - Customer
 - Market and financial
 - Internal operational performance results
 - Workforce

- Leadership
 - Governance
 - Societal responsibility
- Criteria are non-prescriptive and adaptable
 - The criteria support a systems approach to maintaining organization-wide goal alignment.

The criteria support goal-based diagnosis.

Scoring System of MBNQA

The system for scoring applicant responses is based on three evaluation dimensions:

- **Approach:** Approach refers to how the applicant addresses the item requirements
- **Deployment:** Deployment refers to the extent to which the applicant's approach is applied to all requirements of the item.
- **Results:** Results refer to outcomes in achieving the purposes given in the item.

14. Balanced Score Card

A new approach to strategic management was developed in the early 1990s by Robert Kaplan and David Norton. They named this system as **Balanced Score Card (BSC)**. Recognizing some of the weaknesses and vagueness of previous management approaches, this approach provides a prescription as to what companies should measure in order to 'balance' the financial perspective.

BSC is a medium to convert vision and objectives into a strategy and measurable objectives to provide direction to the organization. In today's world mere balance sheet is not adequate to read the performance. BSC suggests that we review the organization from **four perspectives** to develop metrics, collect data and analyze it relative to each of these perspectives:

- The learning and growth perspective
- The business process perspective
- The customer perspective
- The financial perspective