Quality Management

L_8

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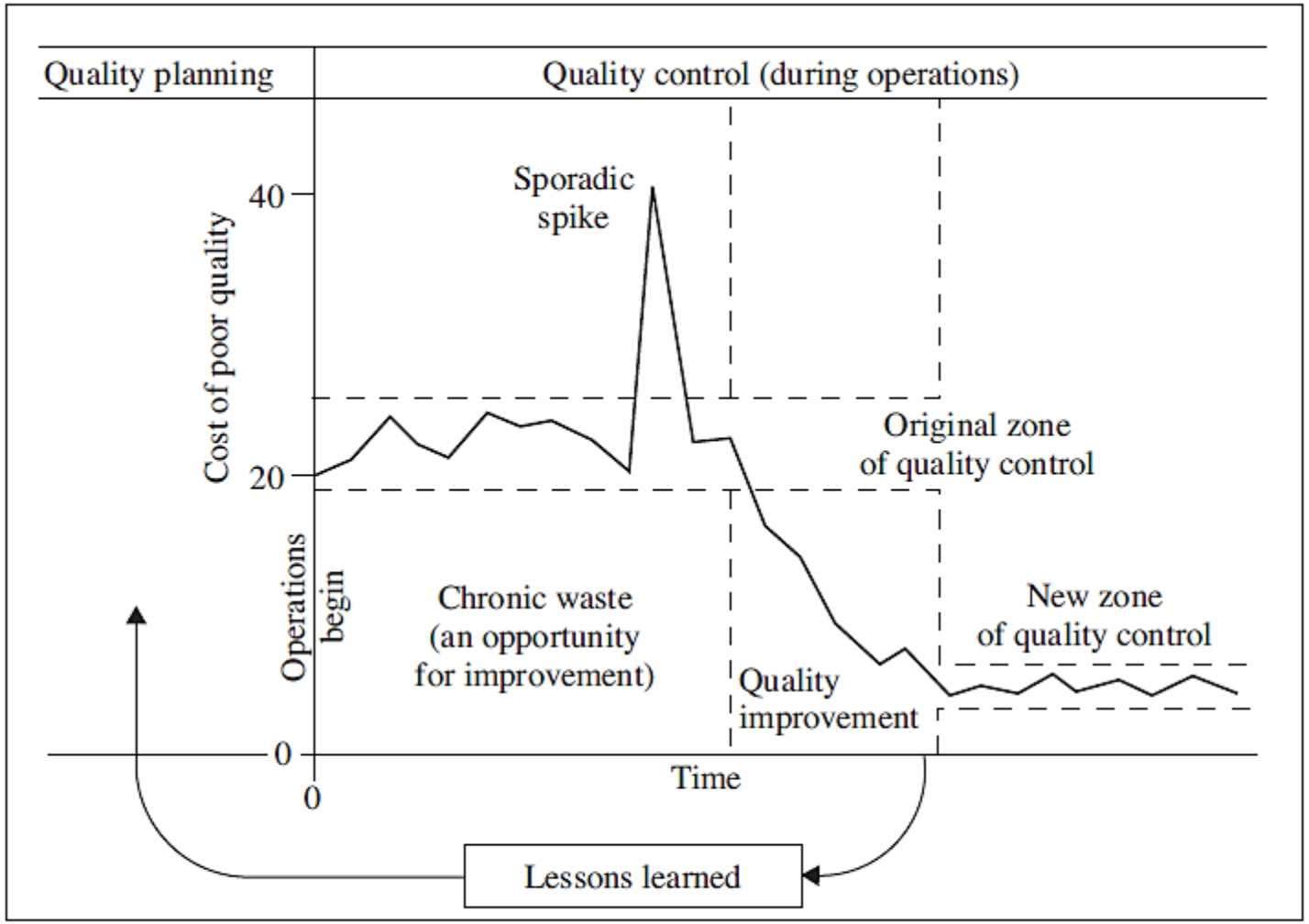
Kaizen

Kaizen is a Japanese word for the philosophy that **defines management's role in continuously encouraging and implementing small improvements involving everyone.** It is the process of continuous improvement in small increments that make the process more—efficient, effective, under control, and adaptable. Improvements are usually accomplished at little or no expense, without sophisticated techniques or expensive equipment. It focuses on simplification by breaking down complex processes into their sub-processes and then improving them.

The Juran Trilogy

Process improvement involves planning. One of the best approaches is the one developed by Dr. Joseph Juran. It has three components: planning, control, and improvement, and is referred to as the Juran Trilogy. It is based loosely on financial processes such as budgeting (planning), expense measurement (control), and cost reduction (improvement).

The Juran Trilogy: Improvement Strategies



The Juran Trilogy Diagram

The Juran Trilogy: Planning

The planning component begins with external customers. Once quality goals are established, marketing determines the external customers, and all organizational personnel (managers, members of multifunctional teams, or work groups) determine the internal customers.

External customers may be quite numerous, as is the case of a bank supply organization, where they include tellers, financial planners, loan officers, auditors, managers, and the bank's customers. Where there are numerous customers, a Pareto diagram might be useful to determine the vital few.

The Juran Trilogy: Control

Control is used by operating forces to help meet the product, process, and service requirements. It uses the feedback loop and consists of the following steps:

1. Determine items/subjects to be controlled and their units of measure.

2. Set goals for the controls and determine what sensors need to be put in place to measure the product, process, or service.

3. Measure actual performance.

4. Compare actual performance to goals.

5. Act on the difference.

Statistical process control is the primary technique for achieving control. The basic statistical process control (SPC) tools are Pareto diagrams, flow diagrams, cause-and-effect diagrams, check sheets, histograms, control charts, and scatter diagrams.

The Juran Trilogy: Improvement

The third part of the trilogy aims to attain levels of performance that are significantly higher than current levels. Process improvements be Two of the duties of the council are to identify the improvement projects and establish the project teams with a project owner. In addition, the quality council needs to provide the teams with the resources to determine the causes, create solutions, and establish controls to hold the gains in with the establishment of an effective infrastructure such as the quality council

The Juran Trilogy: Improvement Strategies

There are four primary improvement strategies—repair, refinement, renovation, and reinvention. Choosing the right strategy for the right situation is critical. It is also true that proper integration of the strategies will produce never-ending improvement.

Repair

This strategy is simple—anything broken must be fixed so that it functions as designed. There are two levels to this strategy. If a customer receives a damaged product, a quick fix is required. This level is a temporary or short-term measure. Although short-term measures shore up the problem, they should not become permanent. The second level occurs when an individual or team identifies and eliminates the root cause(s) of the problem and effects a permanent solution. It is important to note that the repair strategy does not make the process better than the original design.

The Juran Trilogy: Improvement Strategies

Refinement

This strategy involves activities that continually improve a process that is not broken. Improvements to processes, products, and services are accomplished on an incremental basis. Refinement improves efficiency and effectiveness.

It should become an integral part of every employee's job. Both individuals and teams can use this strategy. Typically, it relies on doing things just a bit quicker, better, easier, or with less waste. **This is the concept behind Kaizen**. The change may be so gradual that there is no appearance of change. The primary benefit of gradual change is that it produces little resistance from employees. However, because the change is so gradual, management may not recognize and reward the affected employees. Also, minor changes may not be documented or properly communicated.

The Juran Trilogy: Improvement Strategies

Renovation

This strategy results in major or breakthrough improvements. Although the resulting product, service, process, or activity might often appear to be different from the original, it is basically the same.

Innovation and technological advancements are key factors in this approach. For example, the process of drilling a hole was originally done by hand with a cranking mechanism; however, with the advent of the electric motor, the electric drill was born. The electric drill has been continually refined by improved bits, chucks, and materials.

More recently, another renovation occurred that was brought about by the development of rechargeable batteries. The rechargeable electric drill is basically the same as the old hand drill. Renovation is more costly than the previous strategies and is usually undertaken by teams rather than individuals.

The Juran Trilogy: Improvement Strategies

Reinvention

Reinvention is the most demanding improvement strategy. It is preceded by the feeling that the current approach will never satisfy customer requirements. A new product, ser-vice, process, or activity is developed using teams based on a complete understanding of the customer's requirements and expectations. Reinvention or reengineering begins by imagining that the previous condition does not exist—in other words, a clean sheet of paper. Then the team uses in-depth knowledge of the customer's requirements and expectations and invents a new product, service, process, or activity. For example, the process of drilling holes using lasers or water jets was a reinvention.

Kaizen

The Kaizen improvement focuses on the use of:

1. Value-added and non-value-added work activities.

2. *Muda*, which refers to the seven classes of waste—over-production, delay, transportation, processing,

inventory, wasted motion, and defective parts.

3. Principles of motion study and the use of cell technology.

4. Principles of materials handling and use of one-piece flow.

5. Documentation of standard operating procedures.

Kaizen

6. The five S's for workplace organization, which are five Japanese words that mean proper arrangement (*seiko*), orderliness (*seiton*), personal cleanliness (*seiketso*), cleanup (*seiso*), and discipline (*shitsuke*).

7. Visual management by means of visual displays that everyone in the plant can use for better communications.

8. Just-in-time principles to produce only the units in the right quantities, at the right time, and with the right resources.

9. *Poka-yoke* to prevent or detect errors.

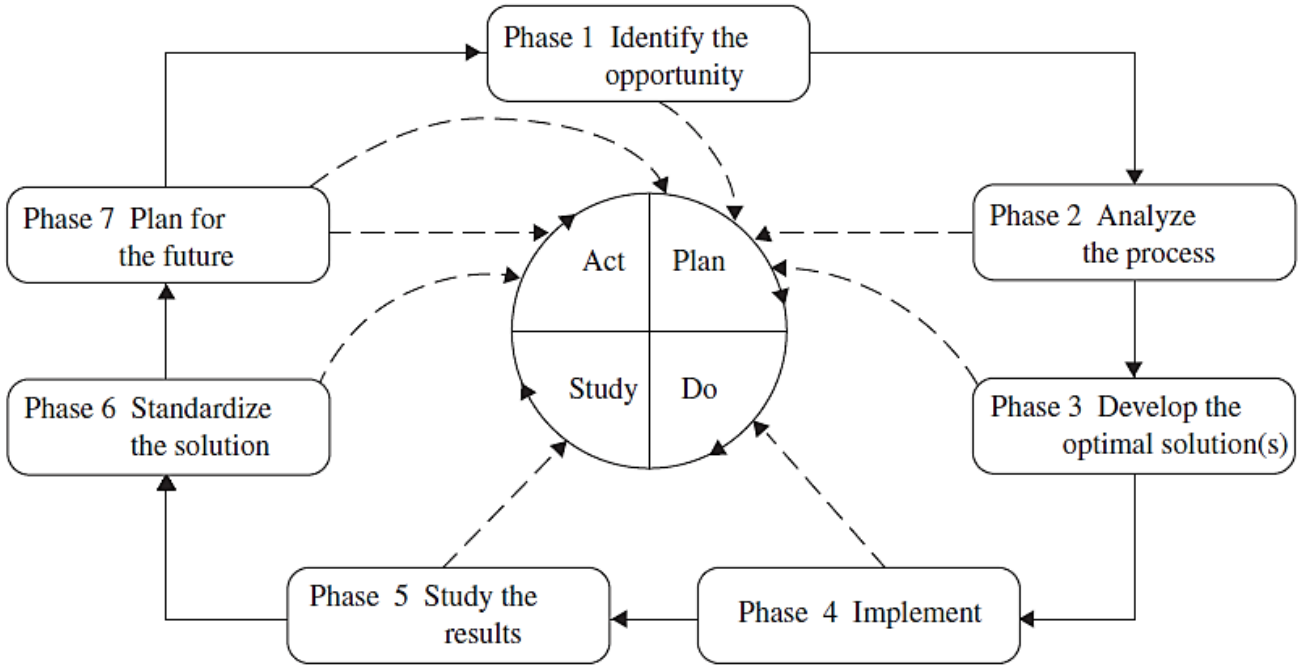
10. Team dynamics, which include problem solving, communication skills, and conflict resolution.

Kaizen

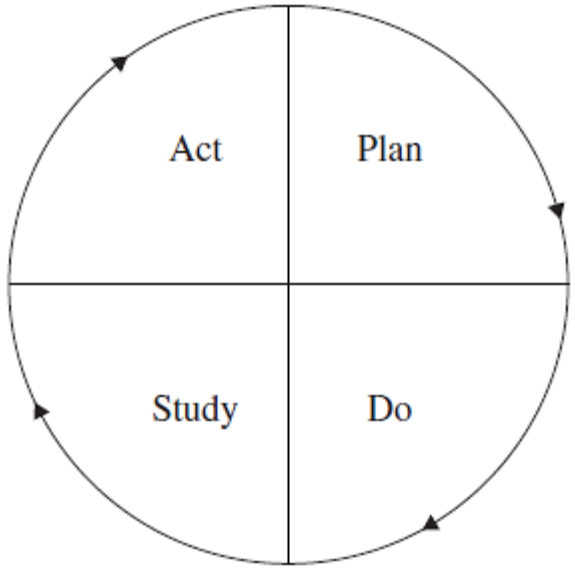
Kaizen relies heavily on a culture that encourages suggestions by operators who continually try to incrementally improve their job or process. An example of a Kaizen-type improvement would be the change in color of a welding booth from black to white to improve operator visibility. This change results in a small improvement in weld quality and a substantial improvement in operator satisfaction. The PDSA cycle may be used to help implement Kaizen concepts.

PDSA :Plan-Do-Study-Act

The basic Plan-Do-Study-Act (PDSA) cycle was first developed by Shewhart and then modified by Deming.6 It is an effective improvement technique. Figure illustrates the cycle



Continuous Process Improvement Cycle



Kaizen

Kaizen traditionally involves slow incremental improvements; however, with the influence of Toyota and the now-infamous Toyota Production System that incorporates lean manufacturing principles, many of the concepts of Kaizen can be implemented in a more rapid fashion.

An example, of such concepts being implemented is Zydus Cadila India, which is a pharmaceutical company with its headquarters at Ahmedabad. The company with the help of their Kaizen consultants identified “muda” in the forms of overproduction, unnecessary transportation, excess inventory, waiting for parts or machines, overprocessing, rework and failure to fully utilize the time and talents of the people. Their new plant was planned and based on the Kaizen principles to minimize wastes involving the shop-floor managers and workers.

Kaizen

The new plant was based on cellular flow concepts, continuous material movement and no in-process storage with full visibility of operations from the same floor. Each process was based on pull system instead of the conventional push system. With the Kaizen overhaul of the plant,

- The capacity improved five times
- Cycle time improved to 80 from 600 i.e. 1/5th of original and
- The distance travelled by the batch of tablets reduced to 73 from 220 meters.

Later, the Kaizen initiative was extended further to the vaccine packing and injectables manufacturing units. The new practice resulted in 30% productivity improvement in vaccine division and 50% reduction in cycle time in the injectables unit.

The Juran Trilogy: Improvement Strategies

Reengineering

According to Hammer and Champy, reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical measures of performance. Many practitioners believe that TQM is associated with only incremental improvements. Nothing could be further from the truth—for many years, the Malcolm Baldrige National Quality Award has defined continuous improvement as referring to both incremental and “breakthrough” improvement.

The Japanese have not only relied on *kaizen* but have developed policy management (*hoshin kanri*) and policy deployment (*hoshin tenkai*) in large part to produce the kind of large-scale breakthroughs that Hammer and Champy promote.

The Juran Trilogy: Improvement Strategies

Reengineering

- Nor is this concept uniquely Japanese. Joseph Juran has had a long-standing emphasis on breakthrough efforts aimed at achieving unprecedented levels of performance.
- In 1997, EM Jorgensen Company applied reengineering using a five-phased problem-solving approach that ultimately reduced operating costs by 12%. The focus of the project was to identify and eliminate non-value added work and reduce corresponding costs while maintaining quality

Six-Sigma

In 1999, M. Harry and R. Schroeder published *Six Sigma: The Breakthrough Management Strategy Revolutionizing the World's Top Corporations*. Since that time, there has been considerable interest in the subject; therefore, the authors have devoted much space to a review of the concept

Statistical Aspects

According to James Harrington, "Six sigma was simply a TQM process that uses process capability analysis as a way of measuring progress." Sigma is the Greek symbol for the statistical measurement of dispersion called standard deviation.

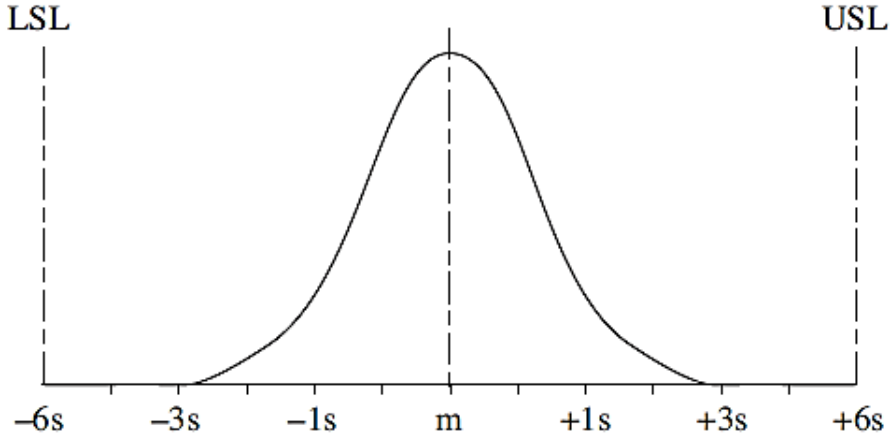
Six-Sigma: Statistical Aspects

It is the best measurement of process variability, because the smaller the deviation value, the less variability in the process. Figure shows a process that is normally distributed and centered with the upper and lower specification limits (USL and LSL) established at 6 . For this situation, 99.9999998% of the product or service will be between specifications, and the nonconformance rate will be 0.002 parts per million, or 2.0 per billion.

The situation diagrammed represents a process capability index (Cp) of 2.0. A Cp of 1.33 has been a defacto standard. Table shows the percent between specifications, the nonconformance rate, and process capability for different specification limit locations.

Six-Sigma: Statistical Aspects

- According to the six-sigma philosophy, processes rarely stay centered—the center tends to "shift" above and below the target.
- Figure shows a process that is normally distributed but has shifted within a range of 1.5 above and 1.5 below the target. For the diagrammed situation, 99.9996600% of the product or service will be between specifications and the nonconformance rate will be 3.4 ppm.
- This off-center situation gives a **process capability index (Cpk)** of 1.5 with 1.0 being the defacto standard. Note that the index is calculated differently and, therefore, has a different symbol (Cp vs. Cpk).

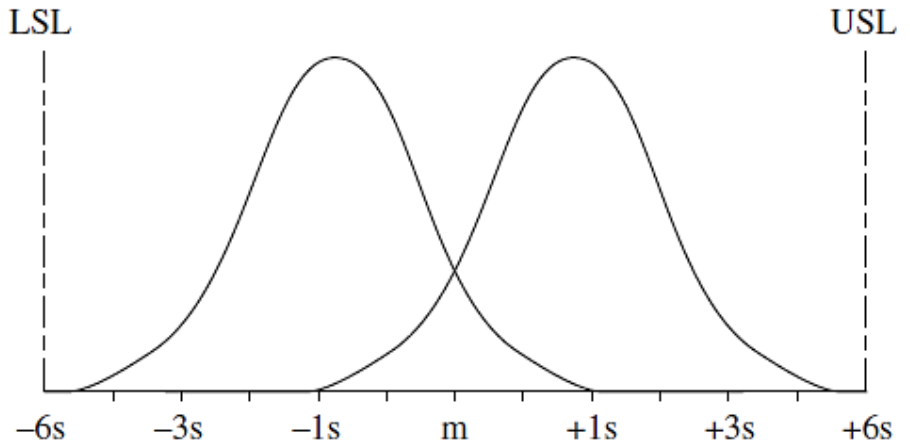


Nonconformance Rate When Process is Centered

Six-Sigma: Statistical Aspects

Nonconformance Rate and Process Capability When the Process is Off-Center ±1.5σ.

Specification Limit	*Percent Conformance*	*Nonconformance Rate (ppm)*	*Process Capability (C_{pk})*
±1σ	30.23	697700	− 0.167
±2σ	69.13	308700	0.167
±3σ	93.32	66810	0.500
±4σ	99.3790	6210	0.834
±5σ	99.97670	2330	1.167
±6σ	99.9996600	3.4	1.500



Nonconformance Rate When Process is Off-Center ± 1.5σ.

Six-Sigma: Statistical Aspects

Table shows the percent between specifications, the nonconformance rate, and process capability for different specification limit locations. The magnitude and type of shift is a matter of discovery and should not be assumed ahead of time. None of the case studies in the literature have indicated a shift as great as 1.5. The automotive industry recognized the concept in the mid-1980's, evaluated it and deemed it unacceptable.

In fact, the original work of six sigma was based on only a few empirical studies of a single process. The statistical aspects of six-sigma tell us that we should reduce the process variability and try to keep the process centered on the target, μ;. These concepts are not new. They have been long advocated by Shewhart, Deming, and Taguchi.

Six Sigma: Problems

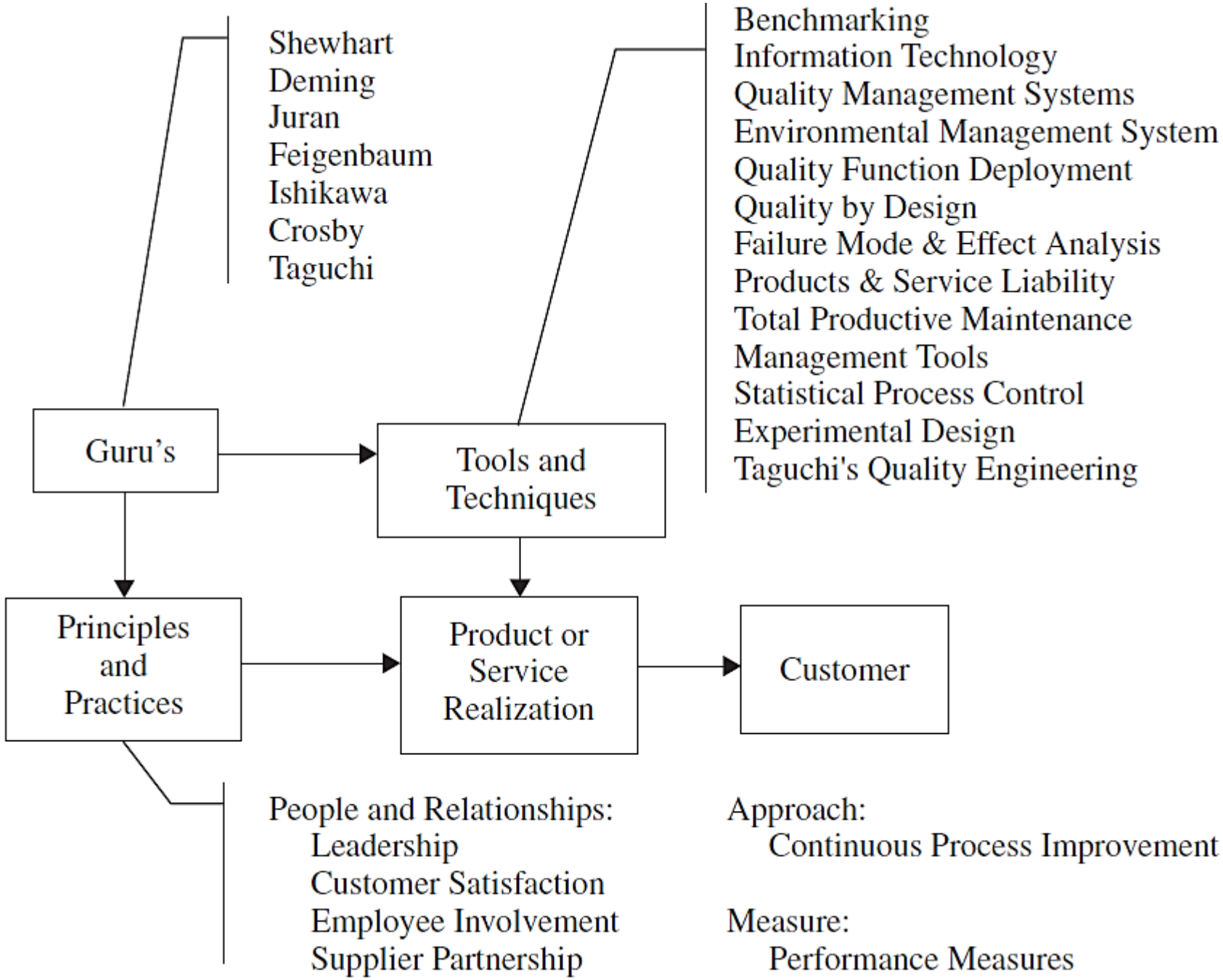
There are a number of problems associated with the six-sigma methodology.

It would be very difficult and not very cost effective for a small business to develop the required infrastructure. Even a medium-sized business would have difficulty paying for the high cost of the training. General Electric has spent over two billion dollars to develop their infrastructure.

In large companies, there is a great danger that the infrastructure will become a bureaucracy. At one flagship six-sigma company, a technical employee was admonished by a Black Belt for fixing several processes rather than turn them into six-sigma projects. It is possible that operating personnel who know the most about the process will be outside the improvement loop. Certainly, the concept of Kaizen is not compatible with having projects that average $175,000 in savings.

Total Productive Maintenance

TQM Framework



Total Productive Maintenance

• Appreciate the need for total productive maintenance for the continued productivity and the basic goals of

Total Productive Maintenance (TPM)

• Understand how to plan and manage the change

• Quantify the six major losses, identify the gaps and set the goal for improvement

TPM

Analyzing TPM into its three words, we have:

Total = All encompassing by maintenance and production individuals working together.

Productive = Production of goods and services that meet or exceed customers' expectations.

Maintenance = Keeping equi pment and plant in as good as or better than the original condition at all times.

The overall goals of TPM are:

1. Maintaining and improving equipment capacity.
2. Maintaining equipment for life.
3. Using support from all areas of the operation.
4. Encouraging input from all employees.
5. Using teams for continuous improvement.

The Plan

The first activity in any assessment of performance is to determine the current operating parameters. Where are we today? What systems do we have in place, and how do they work? What is the current condition of the plant and equipment? Are we starting from scratch, or do we have workable systems that only need to be improved?

TPM

Total Productive Maintenance (TPM) is an extension of the Total Quality Management (TQM) philosophy to the maintenance function. Seven basic steps get an organization started toward TPM:

1. Management learns the new philosophy.
2. Management promotes the new philosophy.
3. Training is funded and developed for everyone in the organization.
4. Areas of needed improvement are identified.
5. Performance goals are formulated.
6. An implementation plan is developed.
7. Autonomous work groups are established.