An Overview Of The Quality Mega-tools

Total Quality Management

At its core, Total Quality Management (TQM) is a management approach to long-term success through customer satisfaction. In a TQM effort, all members of an organization participate in improving processes, products, services and the culture in which they work.

The methods for implementing this approach come from the teachings of such quality leaders as Philip B. Crosby, W. Edwards Deming, Armand V. Feigenbaum, Kaoru Ishikawa and Joseph M. Juran.

A core concept in implementing TQM is Deming’s 14 points, a set of management practices to help companies increase their quality and productivity:

1. Create constancy of purpose for improving products and services.
2. Adopt the new philosophy.
3. Cease dependence on inspection to achieve quality.
4. End the practice of awarding business on price alone; instead, minimize total cost by working 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 between staff areas.
10. Eliminate slogans, exhortations and targets for the workforce.
11. Eliminate numerical quotas for the workforce and numerical goals for management.
12. Remove barriers that rob people of pride of workmanship, and 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 accomplishing the transformation.

The term “Total Quality Management” has lost favor in the United States in recent years: “Quality management” is commonly substituted. “Total Quality Management,” however, is still used extensively in Europe.
Introduction and Implementation of Total Quality Management (TQM) by Khurram Hashmi

Total Quality Management is a management approach that originated in the 1950's and has steadily become more popular since the early 1980's. Total Quality is a description of the culture, attitude and organization of a company that strives to provide customers with products and services that satisfy their needs. The culture requires quality in all aspects of the company's operations, with processes being done right the first time and defects and waste eradicated from operations.

Total Quality Management, TQM, is a method by which management and employees can become involved in the continuous improvement of the production of goods and services. It is a combination of quality and management tools aimed at increasing business and reducing losses due to wasteful practices.

Some of the companies who have implemented TQM include Ford Motor Company, Phillips Semiconductor, SGL Carbon, Motorola and Toyota Motor Company.

TQM Defined

TQM is a management philosophy that seeks to integrate all organizational functions (marketing, finance, design, engineering, and production, customer service, etc.) to focus on meeting customer needs and organizational objectives.

TQM views an organization as a collection of processes. It maintains that organizations must strive to continuously improve these processes by incorporating the knowledge and experiences of workers.

The simple objective of TQM is "Do the right things, right the first time, every time". TQM is infinitely variable and adaptable. Although originally applied to manufacturing operations, and for a number of years only used in that area, TQM is now becoming recognized as a generic management tool, just as applicable in service and public sector organizations.
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There are a number of evolutionary strands, with different sectors creating their own versions from the common ancestor. TQM is the foundation for activities, which include:

1. Commitment by senior management and all employees
2. Meeting customer requirements
3. Reducing development cycle times
4. Just In Time/Demand Flow Manufacturing
5. Improvement teams
6. Reducing product and service costs
7. Systems to facilitate improvement
8. Line Management ownership
9. Employee involvement and empowerment
10. Recognition and celebration
11. Challenging quantified goals and benchmarking
12. Focus on processes / improvement plans
13. Specific incorporation in strategic planning

This shows that TQM must be practiced in all activities, by all personnel, in Manufacturing, Marketing, Engineering, R&D, Sales, Purchasing, HR, etc.
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Principles of TQM

The key principles of TQM are as following:

A. Management Commitment

1. Plan (drive, direct)
2. Do (deploy, support, participate)
3. Check (review)
4. Act (recognize, communicate, revise)

B. Employee Empowerment

5. Training
6. Suggestion scheme
7. Measurement and recognition
8. Excellence teams

C. Fact Based Decision Making

9. SPC (statistical process control)
10. DOE, FMEA
11. The 7 statistical tools
12. TOPS (FORD 8D - Team Oriented Problem Solving)

D. Continuous Improvement

13. Systematic measurement and focus on CONQ
14. Excellence teams
15. Cross-functional process management
16. Attain, maintain, improve standards

E. Customer Focus

17. Supplier partnership
18. Service relationship with internal customers
19. Never compromise quality
20. Customer driven standards
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The Concept of Continuous Improvement in TQM

TQM is mainly concerned with continuous improvement in all work, from high level strategic planning and decision-making, to detailed execution of work elements on the shop floor. It stems from the belief that mistakes can be avoided and defects can be prevented. It leads to continuously improving results, in all aspects of work, as a result of continuously improving capabilities, people, processes, technology and machine capabilities.

Continuous improvement must deal not only with improving results, but more importantly with improving capabilities to produce better results in the future. The five major areas of focus for capability improvement are demand generation, supply generation, technology, operations and people capability.

A central principle of TQM is that mistakes may be made by people, but most of them are caused, or at least permitted, by faulty systems and processes. This means that the root cause of such mistakes can be identified and eliminated, and repetition can be prevented by changing the process. There are three major mechanisms of prevention:

1. Preventing mistakes (defects) from occurring (Mistake - proofing or Poka-Yoke).
2. Where mistakes can't be absolutely prevented, detecting them early to prevent them being passed down the value added chain (Inspection at source or by the next operation).
3. Where mistakes recur, stopping production until the process can be corrected, to prevent the production of more defects. (Stop in time).

Implementation Principles and Processes

A preliminary step in TQM implementation is to assess the organization's current reality. Relevant preconditions have to do with the organization's history, its current needs, precipitating events leading to TQM, and the existing employee quality of working life. If the current reality does not include important preconditions, TQM implementation should be delayed until the organization is in a state in which TQM is likely to succeed. If an organization has a track record of effective responsiveness to the environment, and if it has been able to successfully change the way it operates when needed, TQM will be easier to implement. If an organization
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has been historically reactive and has no skill at improving its operating systems, there will be both employee skepticism and a lack of skilled change agents. If this condition prevails, a comprehensive program of management and leadership development may be instituted. A management audit is a good assessment tool to identify current levels of organizational functioning and areas in need of change. An organization should be basically healthy before beginning TQM. If it has significant problems such as a very unstable funding base, weak administrative systems, lack of managerial skill, or poor employee morale, TQM would not be appropriate.

However, a certain level of stress is probably desirable to initiate TQM. People need to feel a need for a change. Kanter (1983) addresses this phenomenon by describing building blocks which are present in effective organizational change. These forces include departures from tradition, a crisis or galvanizing event, strategic decisions, individual "prime movers," and action vehicles. Departures from tradition are activities, usually at lower levels of the organization, which occur when entrepreneurs move outside the normal ways of operating to solve a problem. A crisis, if it is not too disabling, can also help create a sense of urgency which can mobilize people to act.

In the case of TQM, this may be a funding cut or threat, or demands from consumers or other stakeholders for improved quality of service. After a crisis, a leader may intervene strategically by articulating a new vision of the future to help the organization deal with it. A plan to implement TQM may be such a strategic decision. Such a leader may then become a prime mover, who takes charge in championing the new idea and showing others how it will help them get where they want to go. Finally, action vehicles are needed and mechanisms or structures to enable the change to occur and become institutionalized.

Steps in Managing the Transition

Beckhard and Pritchard (1992) have outlined the basic steps in managing a transition to a new system such as TQM: identifying tasks to be done, creating necessary management structures, developing strategies for building commitment, designing mechanisms to communicate the change, and assigning resources.

Task identification would include a study of present conditions (assessing current reality, as described above); assessing readiness, such as through a
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force field analysis; creating a model of the desired state, in this case, implementation of TQM; announcing the change goals to the organization; and assigning responsibilities and resources. This final step would include securing outside consultation and training and assigning someone within the organization to oversee the effort. This should be a responsibility of top management. In fact, the next step, designing transition management structures, is also a responsibility of top management. In fact, Cohen and Brand (1993) and Hyde (1992) assert that management must be heavily involved as leaders rather than relying on a separate staff person or function to shepherd the effort. An organization wide steering committee to oversee the effort may be appropriate. Developing commitment strategies was discussed above in the sections on resistance and on visionary leadership.

To communicate the change, mechanisms beyond existing processes will need to be developed. Special all-staff meetings attended by executives, sometimes designed as input or dialog sessions, may be used to kick off the process, and TQM newsletters may be an effective ongoing communication tool to keep employees aware of activities and accomplishments.

Management of resources for the change effort is important with TQM because outside consultants will almost always be required. Choose consultants based on their prior relevant experience and their commitment to adapting the process to fit unique organizational needs. While consultants will be invaluable with initial training of staff and TQM system design, employees (management and others) should be actively involved in TQM implementation, perhaps after receiving training in change management which they can then pass on to other employees. A collaborative relationship with consultants and clear role definitions and specification of activities must be established.

In summary, first assess preconditions and the current state of the organization to make sure the need for change is clear and that TQM is an appropriate strategy. Leadership styles and organizational culture must be congruent with TQM. If they are not, this should be worked on or TQM implementation should be avoided or delayed until favorable conditions exist.

Remember that this will be a difficult, comprehensive, and long-term process. Leaders will need to maintain their commitment, keep the process visible, provide necessary support, and hold people accountable for results. Use input from stakeholder (clients, referring agencies, funding sources, etc.) as possible; and, of course, maximize employee involvement in design of the system.
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Always keep in mind that TQM should be purpose driven. Be clear on the organization's vision for the future and stay focused on it. TQM can be a powerful technique for unleashing employee creativity and potential, reducing bureaucracy and costs, and improving service to clients and the community.

Conclusion

TQM encourages participation amongst shop floor workers and managers. There is no single theoretical formalization of total quality, but Deming, Juran and Ishikawa provide the core assumptions, as a "...discipline and philosophy of management which institutionalizes planned and continuous... improvement ... and assumes that quality is the outcome of all activities that take place within an organization; that all functions and all employees have to participate in the improvement process; that organizations need both quality systems and a quality culture."

About The Author

Khurram Hashmi is an avionics engineer currently working in the Pakistan Air Force Academy. Mr. Hashmi has an inclination in electronics and Quality Management.

Bibliography


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Quality Function Deployment

Quality function deployment (QFD) was originally developed by Yoji Akao in 1966 when the author combined his work in quality assurance and quality control points with function deployment used in Value Engineering. Mr. Akao described QFD as “method to transform user demands into design quality, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elements of the manufacturing process.” QFD is designed to help planners focus on characteristics of a new or existing product or service from the viewpoints of market segments, company, or technology-development needs. The technique yields graphs and matrices.

QFD has been used by several corporations and organizations.

The technique

1. Identify customer needs and wants as voice of the customer (VOC)
2. Identify the engineering characteristics of products or services that meets VOC
3. Setting development targets and test methods for the products or services

QFD helps transform customer needs (the voice of the customer [VOC]) into engineering characteristics (and appropriate test methods) for a product or service, prioritizing each product or service characteristic while simultaneously setting development targets for product or service.

Areas of application

QFD is applied in a wide variety of services, consumer products, military needs (such as the F-35 Joint Strike Fighter), and emerging technology products. The technique is also used to identify and document competitive marketing strategies and tactics (see example QFD House of Quality for Enterprise Product Development, at right). QFD is considered a key practice of Design for Six Sigma (DFSS). It is also implicated in the new ISO 9000:2000 standard which focuses on customer satisfaction. Results of QFD have been applied in Japan and elsewhere into deploying the high-impact controllable factors in Strategic planning and Strategic management (also known as Hoshin Kanri, Hoshin Planning, or Policy Deployment).
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Acquiring market needs by listening to the Voice of Customer (VOC), sorting the needs, and numerically prioritizing them (using techniques such as the Analytic Hierarchy Process) are the early tasks in QFD. Traditionally, going to the Gemba (the "real place" where value is created for the customer) is where these customer needs are evidenced and compiled.

QFD matrices become highly proprietary due to the high density of product or service information found therein. Notable U.S. companies using QFD techniques include the U.S. automobile manufacturers (GM, Ford, Daimler Chrysler) and their suppliers, IBM, Raytheon, General Electric, Boeing, Lockheed Martin, and many others.

History

Since its early use in the United States, QFD met with initial enthusiasm then plummeting popularity when it was discovered that much time could be wasted if poor group decision making techniques were employed. Organizational culture/corporate culture has an effect on the ability to change organizational human processes and on the sustainability of the changes. In particular, in organizations exhibiting strong cultural norms and rich sets of tacit assumptions that prevent objective discussion of historical courses of action, QFD may be resisted due to its ability to expose tacit assumptions and unspoken rules. It has been suggested that a learning organization can more easily overcome these issues due to the more transparent nature of the organizational culture and to the readiness of the membership to discuss relevant cultural norms.
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Techniques and tools based on QFD

The House of Quality

Auxiliary Power Unit Product Planning Matrix

<table>
<thead>
<tr>
<th>Customer Needs</th>
<th>Priority</th>
<th>Bleed air ducting location</th>
<th>Maximum APU weight</th>
<th>Low turbine wheel weight</th>
<th>High equivalent shaft horsepower</th>
<th>Controlled turbine inlet temp.</th>
<th>Bleed air</th>
<th>Electrical power output</th>
<th>Turbine assy in-hub containment</th>
<th>Strong containment ring</th>
<th>Lightweight containment ring</th>
<th>Competitive Evaluation (1-Low, 5-High)</th>
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<tbody>
<tr>
<td>Interface</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 3 5</td>
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<tr>
<td>Fit with customer envelop/interface</td>
<td>3 5</td>
<td>3</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Support oil-cooled generator</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>3</td>
<td>5</td>
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<td>T</td>
<td>W</td>
<td>T</td>
<td></td>
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<tr>
<td>Oper.</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide bleed air</td>
<td>4 3 5 5 5</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
<td>W</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide electrical power</td>
<td>3 5 5 5 5</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>W</td>
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<td>W</td>
<td></td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>W</td>
<td></td>
<td></td>
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</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>W - We</td>
<td>T - They</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target Value / Specification Value</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
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<td>Mass 360 lbs.</td>
<td>360 KVA 1850 degrees F</td>
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<td>2.5 lbs at power</td>
<td>2.5 lbs at power</td>
<td>2.5 lbs at power</td>
<td>&lt; 6 lbs.</td>
<td></td>
<td>W - We</td>
<td>T - They</td>
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<td>5</td>
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<td>4</td>
<td>2</td>
<td>4</td>
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<td>34</td>
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</tbody>
</table>
QFD House of Quality for Enterprise Product Development Processes

House of Quality appeared in 1972 in the design of an oil tanker by Mitsubishi Heavy Industries. Akao has reiterated numerous times that a House of Quality is not QFD; it is just an example of one tool.

Other tools extend the analysis beyond quality to cost, technology, reliability, function, parts, technology, manufacturing, and service deployments. In addition, the same technique can extend the method into the constituent product subsystems, configuration items, assemblies, and parts. From these detail level components, fabrication and assembly process QFD charts can be developed to support statistical process control techniques.
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ISO 9000

Quality professionals use the term “standards” to mean many things, such as metrics, specifications, gages, statements, categories, segments, groupings or behaviors. But usually when they talk about standards, they’re talking about quality management.

Management standards address the needs of organizations in training, quality auditing and quality-management systems. The ISO 9000 Series, for example, is a set of international standards for quality management and quality assurance. The standards were developed to help companies effectively document the elements they need to maintain an efficient quality system. They are not specific to any one industry.

The ISO 9000 Series

ISO 9000 can help a company satisfy its customers, meet regulatory requirements and achieve continual improvement. But it’s a first step, many quality professionals will tell you, the base level of a quality system, not a complete guarantee of quality.

ISO 9000 Facts

- Originally published in 1987 by the International Organization for Standardization (ISO), a specialized international agency for standardization composed of the national standards bodies of 90 countries.

- Underwent major revision in 2000.

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The revised ISO 9000:2000 series of standards is based on eight quality management principles that senior management can apply for organizational improvement:

1. Customer focus
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

Resources on the ISO 9000 Series

ISO’s Frequently Asked Questions on ISO 9000

The eight quality management principles of ISO 9000

Publicizing an ISO 9000 certification

Other Standards

Standards addressing the specialized needs and circumstances of certain industries and applications also exist:

Environmental. The ISO 14000 series of international standards integrate environmental considerations into operations and product standards. The standards specify requirements for establishing an environmental policy, determining environmental impacts of products or services, planning environmental objectives, implementation of programs to meet objectives, corrective action and management review.

Aerospace. AS9100, the international quality management standard for the aerospace industry, was released in November 1999.
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**Automotive.** There are three popular standards used in the automotive industry:

- QS-9000 is a quality management system developed by Daimler-Chrysler, Ford and General Motors for suppliers of production parts, materials and services to the automotive industry.
- ISO/TS 16949, developed by the International Automotive Task Force, aligns existing American, German, French and Italian automotive quality standards within the global automotive industry.
- ISO 14001 environmental standards are being applied by automotive suppliers as a requirement from Ford and General Motors.

**Statistics.** Statistical standards provide methods for collecting, analyzing and interpreting data. ANSI/ASQ Z1.4-2003 establishes sampling plans and procedures for inspection by attributes. ANSI/ASQ Z1.9-2003 establishes sampling plans and procedures for inspection by variables.

**Telecommunications.** TL 9000 defines the telecommunications quality system requirements for the design, development, production, delivery, installation and maintenance of products and services in the telecommunications industry. It uses ISO 9000 as a foundation but goes a step further to include industry-specific requirements and metrics.
Malcolm Baldrige National Quality Awards

The Malcolm Baldrige National Quality Award (MBNQA) is presented annually by the President of the United States to organizations that demonstrate quality and performance excellence. Three awards may be given annually in each of six categories:

- Manufacturing
- Service company
- Small business
- Education
- Healthcare
- Nonprofit

Established by Congress in 1987 for manufacturers, service businesses and small businesses, the Baldrige Award was designed to raise awareness of quality management and recognize U.S. companies that have implemented successful quality-management systems.

The education and healthcare categories were added in 1999. A government and nonprofit category was added in 2007.

The Baldrige Award is named after the late Secretary of Commerce Malcolm Baldrige, a proponent of quality management. The U.S. Commerce Department's National Institute of Standards and Technology manages the award and ASQ administers it.

Organizations that apply for the Baldrige Award are judged by an independent board of examiners. Recipients are selected based on achievement and improvement in seven areas, known as the Baldrige Criteria for Performance Excellence:

1. **Leadership:** How upper management leads the organization, and how the organization leads within the community.

2. **Strategic planning:** How the organization establishes and plans to implement strategic directions.

3. **Customer and market focus:** How the organization builds and maintains strong, lasting relationships with customers.
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4. **Measurement, analysis, and knowledge management:** How the organization uses data to support key processes and manage performance.

5. **Human resource focus:** How the organization empowers and involves its workforce.

6. **Process management:** How the organization designs, manages and improves key processes.

7. **Business/organizational performance results:** How the organization performs in terms of customer satisfaction, finances, human resources, supplier and partner performance, operations, governance and social responsibility, and how the organization compares to its competitors.
Benchmarking

Benchmarking is the search for best practices, the ones that will lead to superior performance. Establishing operating targets based on the best possible industry practices is a critical component in the success of every organization.

The basic steps of benchmarking:

- Know your operation. You need to accurately assess your strengths and weaknesses.

- Know your industry leaders or competitors. Understanding and comparing yourself to, the best practices in the industry.

- Incorporate the best. Learn from industry leaders and your competition. If they are strong in given areas, uncover why and how they got that way. Find best practices wherever they exist and do not hesitate to copy or modify and incorporate them in your own operation. Emulate their strengths.

- Gain superiority. If careful investigations of best practices have been performed, and if the best of those best practices have been installed, then you will have incorporated the best of the best.

Benchmarking can be divided into two parts:

1. Practices: the methods that are used.

2. Metrics: the quantified effect of installing the practices.

Benchmarking should be approached by investigating industry practices first. The metrics can be obtained or created later. One cannot determine why a gap exists from the metrics alone: Only the practices on which the metric is based will reveal why. Essential to the benchmarking process are carefully designed communications throughout the organization and concerted management support. There is also a definite place for employee involvement in benchmarking: The findings need to be implemented. What better way to do so smoothly than through the efforts of those closest to the work process?

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**Six Sigma**

Six Sigma is a fact-based, data-driven philosophy of quality improvement that values defect prevention over defect detection. It drives customer satisfaction and bottom-line results by reducing variation and waste, thereby promoting a competitive advantage. It applies anywhere variation and waste exist, and every employee should be involved.

In simple terms, Six Sigma quality performance means no more than 3.4 defects per million opportunities.

Several different definitions have been proposed for Six Sigma, but they all share some common themes:

- Use of teams that are assigned well-defined projects that have direct impact on the organization’s bottom line.

- Training in “statistical thinking” at all levels and providing key people with extensive training in advanced statistics and project management. These key people are designated black belts (PDF, 755KB). Review the different Six Sigma belts, levels and roles.

- Emphasis on the DMAIC approach (define, measure, analyze, improve and control) to problem solving.

- A management environment that supports these initiatives as a business strategy.

**Differing opinions on the definition of Six Sigma:**

**Six Sigma is a philosophy**— This perspective views all work as processes that can be defined, measured, analyzed, improved and controlled. Processes require inputs \((x)\) and produce outputs \((y)\). If you control the inputs, you will control the outputs: This is generally expressed as \(y = f(x)\).

**Six Sigma is a set of tools**— The Six Sigma expert uses qualitative and quantitative techniques to drive process improvement. A few such tools include statistical process control (SPC), control charts, failure mode and effects analysis and flowcharting.
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Six Sigma is a methodology— This view of Six Sigma recognizes the underlying and rigorous approach known as DMAIC (define, measure, analyze, improve and control). DMAIC defines the steps a Six Sigma practitioner is expected to follow, starting with identifying the problem and ending with the implementation of long-lasting solutions. While DMAIC is not the only Six Sigma methodology in use, it is certainly the most widely adopted and recognized.


DMAIC Versus DMADV (DMEDI)

We know that everything in business is a process, right? Sales people have a list of companies and contacts that they work in a certain fashion to produce a sale, production receives an order and schedules the manufacturing, the product is built, packaged, shipped and invoiced. When the packing department has a problem with their process, though, should they fix it with a DMAIC or DMADV (also referred to as DFSS) type project?

The Similarities of DMAIC and DMADV

Let's first look at the DMAIC and DMADV methodologies and talk about how they're alike. DMAIC and DMADV are both:

- Six Sigma methodologies used to drive defects to less than 3.4 per million opportunities.
- Data intensive solution approaches. Intuition has no place in Six Sigma -- only cold, hard facts.
- Implemented by Green Belts, Black Belts and Master Black Belts.
- Ways to help meet the business/financial bottom-line numbers.
- Implemented with the support of a champion and process owner.
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The Differences of DMAIC and DMADV

DMAIC and DMADV sound very similar, don't they? The acronyms even share the first three letters. But that's about where the similarities stop.

**DMAIC**

**Define** Define the project goals and customer (internal and external) deliverables

**Measure** Measure the process to determine current performance

**Analyze** Analyze and determine the root cause(s) of the defects

**Improve** Improve the process by eliminating defects

**Control** Control future process performance

**When To Use DMAIC**

The DMAIC methodology, instead of the DMADV methodology, should be used when a product or process is in existence at your company but is not meeting customer specification or is not performing adequately.

**DMADV**

**Define** Define the project goals and customer (internal and external) deliverables

**Measure** Measure and determine customer needs and specifications

**Analyze** Analyze the process options to meet the customer needs

**Design** Design (detailed) the process to meet the customer needs

**Verify** Verify the design performance and ability to meet customer needs
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When To Use DMADV

The DMADV methodology, instead of the DMAIC methodology, should be used when:

- A product or process is not in existence at your company and one needs to be developed
- The existing product or process exists and has been optimized (using either DMAIC or not) and still doesn't meet the level of customer specification or six sigma level

"I Thought it was a DMAIC, But it Turned Out to be a DMADV!"

Occasionally a project is scoped as a DMAIC for incremental process improvement when it really required a DMADV methodology improvement. And it was a month into the project that you realized this! Don't be discouraged about the work you put into the DMAIC because

1) it's happened to more businesses than just yours,

2) you understand the process at a much greater detail than you did initially, and

3) you were able to practice not just DMAIC skills but also DMADV!
Lean Manufacturing

Lean production is an assembly-line manufacturing methodology developed originally for Toyota and the manufacture of automobiles. It is also known as the Toyota Production System. The goal of lean production is described as "to get the right things to the right place at the right time, the first time, while minimizing waste and being open to change". Engineer Ohno, who is credited with developing the principles of lean production, discovered that in addition to eliminating waste, his methodology led to improved product flow and better quality.

Instead of devoting resources to planning what would be required for future manufacturing, Toyota focused on reducing system response time so that the production system was capable of immediately changing and adapting to market demands. In effect, their automobiles became made-to-order. The principles of lean production enabled the company to deliver on demand, minimize inventory, maximize the use of multi-skilled employee, flatten the management structure, and focus resources where they were needed.

During the 1980s, the set of practices summarized in the ten rules of lean production were adopted by many manufacturing plants in the U.S. and Europe. The management style was tried out with varying degrees of success by service organizations, logistics organizations and supply chains.

Since the demise of many dot.coms, there has been a renewed interest in the principles of lean production, particularly since the philosophy encourages the reduction of inventory. Dell Computers and Boeing Aircraft have embraced the philosophy of lean production with great success.

The ten rules of lean production can be summarized:

1. Eliminate waste
2. Minimize inventory
3. Maximize flow
4. Pull production from customer demand
5. Meet customer requirements
6. Do it right the first time
7. Empower workers
8. Design for rapid changeover
9. Partner with suppliers
10. Create a culture of continuous improvement
Ford’s Definition of Lean

Henry Ford defined the lean concept in one sentence: “We will not put into our establishment anything that is useless.” Lean manufacturing is a system of techniques and activities for running a manufacturing or service operation. The techniques and activities differ according to the application at hand but they have the same underlying principle: the elimination of all non-value-adding activities and waste from the business.

Lean enterprise extends this concept through the entire value stream or supply chain: The leanest factory cannot achieve its full potential if it has to work with non-lean suppliers and subcontractors.

Types of Waste

1. Overproduction
2. Waiting, time in queue
3. Transportation
4. Non-value-adding processes
5. Inventory
6. Motion
7. Costs of quality: scrap, rework and inspection


Types of Waste Targeted by Lean Methods

Lean methods typically target eight types of waste. Each of these wastes has a potential environmental impact, shown below. It is interesting to note that the "wastes" typically targeted by environmental management agencies, such as non-product output and raw material wastes, are not explicitly included in the list of manufacturing wastes that lean practitioners routinely target.
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## Types of Waste Targeted by Lean Methods

<table>
<thead>
<tr>
<th>Waste Type</th>
<th>Manufacturing Sector</th>
<th>Service Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defects</td>
<td>Scrap, rework, replacement production, inspection</td>
<td>Order entry, design, or engineering errors</td>
</tr>
<tr>
<td>Waiting</td>
<td>Stock-outs, lot processing delays, equipment downtime, capacity bottlenecks</td>
<td>System downtime, response time, approvals</td>
</tr>
<tr>
<td>Overproduction</td>
<td>Manufacturing items for which there are no orders</td>
<td>Printing paperwork, purchasing items before they are needed; processing paperwork before the next person is ready for it</td>
</tr>
<tr>
<td>Transportation</td>
<td>Transporting work-in-process (WIP) long distances, trucking to and from an off-site storage facility</td>
<td>Multiple sites outside of walking distance, Off-site training</td>
</tr>
<tr>
<td>Inventory</td>
<td>Excess raw material, WIP, or finished goods</td>
<td>Office supplies, sales literature, and reports</td>
</tr>
<tr>
<td>Complexity</td>
<td>More parts, process steps, or time than necessary to meet customer needs</td>
<td>Re-entry of data, extra copies, excessive reporting, etc.</td>
</tr>
<tr>
<td>Unused creativity</td>
<td>Lost time, ideas, skills, improvements, and suggestions from employees</td>
<td>Limited tools or authority available to employees to carry-out basic tasks</td>
</tr>
</tbody>
</table>
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Balanced ScoreCard

The balanced scorecard (BSC) is a strategic management tool that views the organization from different perspectives, usually the following:

- **Financial**: The perspective of your shareholders
- **Customer**: What your customers experience and perceive
- **Business Process**: The key processes you use to meet and exceed customer and shareholder requirements
- **Learning and Growth**: How you foster ongoing change and continuous improvement

For each of these perspectives, the balanced scorecard prompts you to develop metrics, set performance targets and collect and analyze data. Your scorecard thus offers an efficient mechanism for reviewing strategy implementation based on measurement.

Benefits of a Measurement-Based System

A balanced scorecard can help your organization both articulate and act upon your vision and strategy. Use it to take these actions.

- Facilitate effective and consistent communication because everyone speaks a shared language of metrics.
- Drive focus around key requirements.
- Facilitate reviews on a regular basis.
- Ensure organizational alignment.

More than Financials

Developed by Robert Kaplan and David Norton in the early 1990s, the balanced scorecard is more than a measurement system. It is a management system. By bringing together measures around internal
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processes and external outcomes, a balanced scorecard supports continuous improvement at the level of strategic performance and results.

In their book *The Balanced Scorecard: Translating Strategy into Action*, Kaplan and Norton describe the balanced scorecard as a necessary move away from overreliance on financial measures. According to Kaplan and Norton, because financial measures report on the past, they offer “an adequate story for industrial age companies” but not “information age companies.” In the information age, organizations must “create future value through investment in customers, suppliers, employees, processes, technology, and innovation.”

A strictly financial approach for managing organizations is not complete, as it doesn’t capture the landscape of the business and isn’t an indicator of the future. Evaluating organizational performance in a balanced manner on the parameters that influence your business becomes crucial for better management.

Contributed by C. L. N. Prabhu, a Six Sigma Consultant, ASQ Six Sigma Black Belt and BSC practitioner. Prabhu represents the Six Sigma Consulting Group of Satyam Computer Services Limited.

**Example of a Balanced Scorecard**

In this simple example, an organization created a spreadsheet to offer a snapshot view of its scorecard. The scorecard contains a list of metrics related to the four perspectives: customer, financial, process, learning/growth. (Only two sample metrics are shown here for each category.)

This organization analyzes its measures quarterly, documenting targets and tracking performance data. In the example, color coding indicates the level of performance at a glance.

- Red means behind target.
- Yellow means at the threshold.
- Green means meeting the target.
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<table>
<thead>
<tr>
<th>Measure</th>
<th>Unit</th>
<th>FY Target</th>
<th>1st Quarter</th>
<th>2nd Quarter</th>
<th>3rd Quarter</th>
<th>4th Quarter</th>
<th>Year total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Actual</td>
<td>Target</td>
<td>Actual</td>
<td>Target</td>
<td>Actual</td>
</tr>
<tr>
<td>Customer Perspective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfied customers</td>
<td>%</td>
<td>55%</td>
<td>55.6%</td>
<td>55.6%</td>
<td>55.6%</td>
<td>55.6%</td>
<td>NA</td>
</tr>
<tr>
<td>C2 Complaints</td>
<td>No.</td>
<td>&lt;3600</td>
<td>960</td>
<td>&lt;1000</td>
<td>1004</td>
<td>&lt;1000</td>
<td>&lt;800</td>
</tr>
<tr>
<td>Business Process Perspective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1 Calls answered before abandoned</td>
<td>%</td>
<td>90%</td>
<td>93%</td>
<td>90%</td>
<td>98%</td>
<td>99%</td>
<td>98%</td>
</tr>
<tr>
<td>P2 Products delivered on time</td>
<td>%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Learning &amp; Growth Perspective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L1 Staff satisfaction score</td>
<td>%</td>
<td>70%</td>
<td>NA</td>
<td>NA</td>
<td>68%</td>
<td>70%</td>
<td>NA</td>
</tr>
<tr>
<td>L2 Scheduled training completed</td>
<td>%</td>
<td>100%</td>
<td>70%</td>
<td>100%</td>
<td>97%</td>
<td>100%</td>
<td>NA</td>
</tr>
<tr>
<td>Financial Perspective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F1 Operating revenue</td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
<td>#</td>
</tr>
<tr>
<td>F2 Revenue</td>
<td>%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>