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Certified Six Sigma - Black Belt Professional Sample Material

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1. ENTERPRISE-WIDE DEPLOYMENT

A Six Sigma project is applicable across the enterprise due to it's nature. Six sigma is deployed as per results from data analysis which results in affecting different activities to reach an optimum state. An enterprise-wide view is to be established for better implementation of six sigma.

1.1. Enterprise-Wide View

Six sigma is a method on quality, which is focused on results. It's also a technique of measurements which results in lower defects which convert into cost savings and competitive advantage.

Sigma (σ), is an mathematical symbol representing one standard deviation from the average or mean. Most control charts set their range at +3σ, but Six Sigma extends three more standard deviations. With six sigma, there are only 3.4 parts per million (PPM) defective. A 6 Sigma level process is operating at 99.9997% quality level.

History of Continuous Improvement

Continuous improvement involves constantly identifying and eliminating the causes that prevent a system or process from functioning at its optimum level. The concept of continuous improvement originated in Japan in the 1970s. It was adopted in many countries, including U.S.A., in the early 1980s. Continuous improvement—and consequent customer satisfaction—is the principle on which the concept of Lean manufacturing is developed. When this principle is combined with just-in-time technique, it results to Lean manufacturing.. Continuous improvement helps an organization to add value to its products and services by reducing defects, mistakes, etc. and to maximize its potential. As continuous improvement requires constant ongoing efforts, it is essential that the top management takes a long term view and commits itself for its implementation.

Continuous improvement enables organizations identify and rectify problems as and when they occur. Thus, it ensures smooth functioning of the processes. Many modern quality improvement models or tools like control charts, sampling methods, process capability measures, value analysis, design of experiments, etc. have been influenced by the concept of continuous improvement.

History of six sigma encompassed various events which shaped it's formation and spread. Six sigma has evolved over time. It's more than just a quality system like TQM or ISO. The events for six sigma evolution are as

- ✓ Carl Frederick Gauss (1777-1855) introduced the concept of the normal curve.
- ✓ Walter Shewhart in 1920's showed that three sigma from the mean is the point where a process requires correction.
- ✓ Following the defeat of Japan in World War II, America sent leading experts including Dr. W. Edwards Deming to encourage the nation to rebuild. Leveraging his experience in reducing waste in U.S. war manufacture, he offered his advice to struggling emerging industries.
- ✓ By the mid-1950s, he was a regular visitor to Japan. He taught Japanese businesses to concentrate their attention on processes rather than results; concentrate the efforts of everyone in the organization on continually improving imperfection at every stage of the process. By the 1970s many Japanese organizations had embraced Deming's advice. Most notable is Toyota which spawned several improvement practices including JIT and TQM.

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- ✓ Western firms showed little interest until the late 1970s and early 1980s. By then the success of Japanese companies caused other firms to begin to re-examine their own approaches and Kaizen began to emerge in the U.S.
- ✓ Many measurement standards (Zero Defects, etc.) later came on the scene but credit for coining the term "Six Sigma" goes to a Motorola engineer named Bill Smith. ("Six Sigma" is also a registered trademark of Motorola). Bill Smith, along with Mikel Harry from Motorola, had written and codified a research report on the new quality management system that emphasized the interdependence between a product's performance in the market and the adjustments required at the manufacturing point.
- ✓ Motorola, under the direction of Chairman Bob Galvin, used statistical tools to identify and eliminate variation. From Bill Smith's yield theory in 1984, Motorola developed Six Sigma as a key business initiative in 1987.

Various models and tools emerged which are

- ✓ Kaizen – It refers to any improvement, one-time or continuous, large or small
- ✓ TQM – It is Total Quality Management with Organization management of quality consisting of 14 principles
- ✓ PDCA Cycle - Edward Deming's Plan Do Check Act cycle
- ✓ Lean Manufacturing – It focuses on the elimination of waste or "muda" and includes tools such as Value Stream Mapping, the Five S's, Kanban, Poka-Yoke
- ✓ JIT– It is Just in Time Business or catering to needs of customer when it occurs.
- ✓ Six Sigma – It is designed to improve processes and eliminate defects; includes the DMAIC and DMADV models inspired by PDCA

Dr. W. Edwards developed 14 points on Quality Management, a core concept on implementing total quality management, is a set of management practices to help companies increase their quality and productivity. The 14 points are

- ✓ Create constancy of purpose for improving products and services.
- ✓ Adopt the new philosophy.
- ✓ Cease dependence on inspection to achieve quality.
- ✓ End the practice of awarding business on price alone; instead, minimize total cost by working with a single supplier.
- ✓ Improve constantly and forever every process for planning, production and service.
- ✓ Institute training on the job.
- ✓ Adopt and institute leadership.
- ✓ Drive out fear.
- ✓ Break down barriers between staff areas.
- ✓ Eliminate slogans, exhortations and targets for the workforce.
- ✓ Eliminate numerical quotas for the workforce and numerical goals for management.
- ✓ Remove barriers that rob people of pride of workmanship, and eliminate the annual rating or merit system.
- ✓ Institute a vigorous program of education and self-improvement for everyone.
- ✓ Put everybody in the company to work accomplishing the transformation.

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Value and Foundation of Six Sigma

The Six Sigma concept was developed at Motorola in the 1980s. Six Sigma can be viewed as a philosophy, a technique, or a goal.

- ✓ Philosophy - Customer-focused breakthrough improvement in processes
- ✓ Technique - Comprehensive set of statistical tools and methodologies
- ✓ Goal - Reduce variation, minimize defects, shorten the cycle time, improve yield, enhance customer satisfaction, and boost the bottom line

Six sigma is not just quality improvements but also providing better value to customers, investors and employees. Six Sigma is a business initiative or a way of doing business which improves quality and productivity, increases competitiveness and reduces cost. By controlling the amount of variation within the allowable upper and lower limits of a process, the frequency of out of control conditions reduces. Making six sigma as part of doing business reduces errors, identifies and corrects deviations in processes and impacts the success of the organization. Six Sigma is a process of asking questions that lead to tangible and quantifiable answers that ultimately produce profitable results. There are four groups of quality costs, which are

- ✓ External failure cost - warranty claims, service cost
- ✓ Internal failure cost - the costs of labor, material associated with scrapped parts and rework
- ✓ Cost of appraisal and inspection - these are materials for samples, test equipment, inspection labor cost, quality audits, etc..
- ✓ Cost related to improving poor quality - quality planning, process planning, process control, and training.

Usually companies are at 3 Sigma level which translates to 25-40% of annual revenue being taken by cost of quality. Thus, if a company can improve its quality by 1 sigma level, its net income will increase hugely, approximately 10 percent net income improvement.

Furthermore, when the level of process complexity increases (eg. output of one sub-process feeds the input of another sub-process), the rolled throughput yield of the process will decrease, then the final outgoing quality level will decline, and the cost of quality will increase. Project teams with well-defined projects improve the company's profits.

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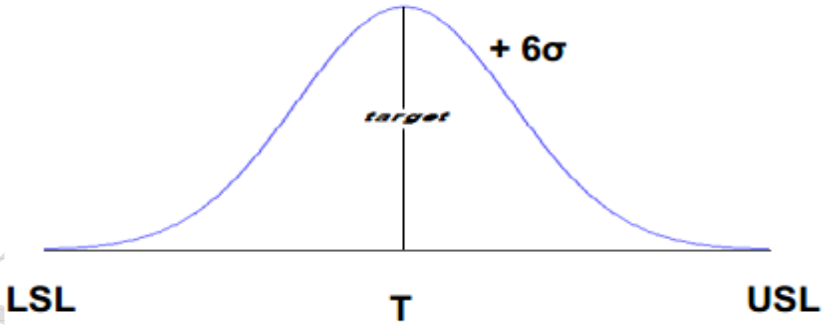
Mathematical Six Sigma - The term 'Six Sigma' is drawn from the statistical discipline 'process capability studies'. Sigma, represented by the Greek alphabet 'σ', stands for standard deviation from the 'mean'. 'Six Sigma' represents six standard deviations from the 'mean.' This implies that if a company produces 1,000,000 parts/units, and its processes are at Six Sigma level, less than 3.4 defects only will result. However, if the processes are at three sigma level, the company ends up with as many as 66,807 defects for every 1,000,000 parts/units produced.

The table below shows the number of defects observed for every 1,000,000 parts produced (also referred to as defects per million opportunities or DPMO).

Sigma Level	Defects per million opportunities
Two Sigma	308,507 DPMO
Three Sigma	66,807 DPMO
Four Sigma	6,210 DPMO
Five Sigma	233 DPMO
Six Sigma	3.4 DPMO

Process standard deviation (σ) should be so minimal that the process performance should be able to scale up to 12σ within the customer specified limits. So, no matter how widely the process deviates from the target, it must still deliver results that meet the customer requirements. Few terms used are

- ✓ USL – It is upper specification limit for a performance standard and deviation away is a defect.
- ✓ LSL – It is lower specification limit for a performance standard and deviation below is a defect.
- ✓ Target – Ideally, this will be the middle point between USL and LSL.



Six Sigma approach is to find out the root causes of the problem, symbolically represented by Y = F(X). Here, Y represents the problem that occurs due to cause (s) X.

Y	x1, x2, x3, …., xn
Dependent	Independent
Customer related output	Input-process
Effect	Cause
Symptom	Problem
Monitor	Control

Benefits of Six Sigma

- ✓ Continuous defect reduction in products and services
- ✓ Enhanced customer satisfaction
- ✓ Performance dashboards and metrics
- ✓ Process sustenance
- ✓ Project based improvement, with visible milestones
- ✓ Sustainable competitive edge
- ✓ Helpful in making right decisions

Value and Foundation of Lean

Lean manufacturing evolved from 17th century by Eli Whitney, who developed the idea of interchangeable parts. Henry Ford in early 19th century arranged all the elements of a manufacturing system in a continuous system and the Toyota Production System (TPS) by Toyota combined all process and techniques as lean manufacturing.

Lean manufacturing focuses on lean philosophy which is about elimination of waste in all forms at the workplace. Specific lean methods include just-in-time inventory management, Kanban scheduling systems and 5S workplace organization.

Manufacturing industries in these ever competitive times face immense pressure to minimize turn around time or cycle time, provide greater product variety and maintain product quality with the most economical output.

Hence, a system is needed which results in continual improvement and simultaneous extension of the bottom line profits without extreme initial costs or increase in administrative costs. Lean Manufacturing systems, which implemented can serve this purpose in easing out manufacturing challenges.

Lean manufacturing reduces waste by focusing on team with well informed employees, clean and organized workspaces, flow for every system, making systems pull in nature so as to adapt to consumer demand and reducing lead times.

Lean and Six Sigma Integration

Both Six Sigma and Lean have combined and concepts such as "Lean-Six Sigma" have emerged as process improvement needs both for getting better results. Both the Lean and the Six Sigma methodologies have proven to achieve dramatic improvements in cost, quality, and time by focusing on process performance. As Six Sigma focuses on reducing variation and improving process yield by following a problem-solving approach using statistical tools, Lean is primarily concerned with eliminating waste and improving flow by following the Lean principles and a defined approach to implement each of these principles.

Six Sigma eliminate defects but will not optimize the process flow and the Lean principles exclude the advanced statistical tools often required to achieve the process capabilities needed to be truly 'lean'. Hence both methods are considered as complementing each other. Therefore, many firms are looking for an approach that allows to combines both methodologies into an integrated system or improvement roadmap.

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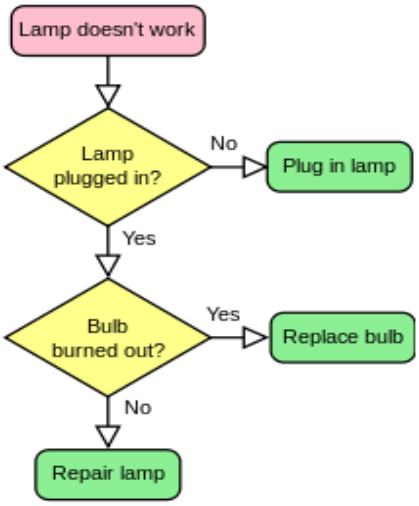
Business Processes and Systems

A business process is a group of tasks which result in a specific service or product for customers. It can be visualized with a flowchart or a process matrix. Business processes are fundamental to every company's performance. Understanding and optimizing the business process is the aim of six sigma. It is a series of actions, changes, or functions bringing about a result. A business has various core functions or processes like Sales, Marketing, Engineering, Production and Customer Service.



Sales Relationship/Process (SRP) Matrix™

Trusted Partner				
Strategic Contributor				
Solutions Consultant				
Preferred Supplier				
Approved Vendor				
	Random Process	Informal Process	Formal Process	Dynamic Process

Flowchart to change a bulb. Process Matrix

Dissecting and truly understanding root cause for process performance is critical to effective process improvement which is can be accomplished by six sigma. Each process, have the three elements of inputs, process and outputs that affect its function. A business process is a collection of related activities that produce something of value to the organization, its stakeholders or its customers. Processes are definable portions of a system or subsystem that consist of a number of individual elements, actions, or steps.

Having a standard model such as DMAIC (Define-Measure-Analyze-Improve-Control) makes process improvement and optimization much easier by providing the teams with an easy roadmap. This disciplined, structured, rigorous approach consists of steps which are linked logically to the previous step and to the next step. It is not enough for organizations to treat process improvement as one-time or periodic events. A sustaining focus on process management and continuous improvement is the key.

Types of Processes - Processes can be classified as management processes, operational processes and supporting processes.

- ✓ Management processes - These processes administer the operation of a system. Some examples of management processes are planning, corporate governance, etc.
- ✓ Operational processes - These processes create the primary value stream for the customers. Hence, they are also called 'core business processes'. Some examples of operational processes are purchasing of raw materials, manufacturing of goods, rendering of services, marketing, etc.

- ✓ Supporting processes - These processes support the core business processes of the organization. Some examples of supporting processes are accounting, technical support, etc.

These processes can be divided into many sub-processes that play their intended roles to successfully complete the respective head processes.

Business System - A business system is a group of business processes which combine to form a single and identifiable unit of business for a common mission. It is composed of processes, which in turn are composed of sub-processes and which are further composed of individual tasks.

A business system is a system that implements a process or a set of processes. It ensures that all the processes operate smoothly without delays or lack of resources like a PC system. The basic aim of a business system is to ensure that the processes, products, and services are subjected to continuous improvement. To ensure that continuous improvement takes place in processes, products, and services, a business system must provide scope for collection and analysis of data from processes and other reliable sources.

It is important to have an appropriate business system in place and the relevant processes under the system are well-documented. The documentation of the processes must be done in such a way that every task, activity, and their sequence are taken into account for proper execution as planned for in the business system.

Each process has it's endpoints defined by inputs and outputs that are monitored and their measurements are used for it's optimization. Measurements within the process are used to effectively control the process.

Lean and Six Sigma Applications

Lean and Six Sigma, when both combined, make the process improvement project much richer than either of them taken individually. Six Sigma has its origins to the application of statistical methods in an industrial context whereas Lean has its origins to Japanese quality concepts of waste removal.

The integrated approach of six sigma and Lean principles to process improvement should include implementing value stream mapping for having a pipeline of projects to applying Six Sigma or Lean.

Recent applications of Lean and Six Sigma in health care attempt to improve the health care delivery by making project deliverables more discrete and measurable, retaining a strong customer focus, quantifying results, and attempting to deliver specific quality improvements within a designated time frame.

Programs utilizing Lean approaches resulted in substantially reduced turnaround time for pathologist reports from an anatomical pathology lab and Lean-facilitated improvements included reducing IV backlog in the pharmacy, reducing the time needed to perform glucose checks on patients, decreasing time to enter new medication orders and complete chart entries, and streamlining electronic payment for large vendor accounts.

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An integrated Lean and Six Sigma approach also led to reducing the complexity of hiring part-time clinical staff, optimizing operating room scheduling by designing a new pre-surgical admissions process, and developing a new work planning system to expedited completion of equipment maintenance requests. The UK's National Health System adopted a variety of Lean strategies, including redesigning the number of steps, and hence the time, needed for collection and processing of blood samples at it's hospitals.

Lean and Six Sigma methodologies are well suited for application to laboratory settings because of the inherent need for statistical precision and quality control in laboratory testing and measurement activities, as well as the highly repetitive nature of laboratory work.

To ensure success of Lean and Six Sigma implementations, it is always preferable that a group representing the top management oversees the implementation. This group will identify and rank the difficulties that come in the way of efficient implementation, and assemble teams to solve them on a priority basis. This group is responsible to train, support, recognize, and reward the teams involved in the Lean and Six Sigma applications. The various areas in which Six Sigma and Lean applications can be implemented are given below, as

- ✓ A services organization can make use of Six Sigma and Lean for various purposes like determining ideal lead time, meeting tight schedules, etc.
- ✓ A manufacturing organization can use Six Sigma and Lean for various purposes like reducing cycle time on assembly lines, improving productivity, etc.

1.2. Leadership

Effective and efficient leadership plays a vital role in implementation and management of six sigma projects. Successful implementation of Six Sigma projects requires the top leadership's commitment. Six Sigma focuses on cross-functional and enterprise-wide processes thus, requiring leadership and support from the executive staff. Various facets of leadership are discussed in this chapter.

Enterprise Leadership Responsibilities

The most essential characteristic of a six sigma project leader is of being a problem solver. A leader should have the expertise and skills to identify and remove any problems or bottlenecks which crop up smooth functioning of the team.

A leader should be knowledgeable and tactical in resource allotment to balance team dynamics and synergies to achieve the objectives of the project. Team dynamics is needed for teams to succeed and is a part of teamwork. Team dynamics is built by harmonious relationships within the team and outside of it. Healthy relationships are built by establishing communication channels and which makes accepting and adopting changes or new ideas in unison by the team. The crucial responsibilities of leadership are to allocate resources for problem identification, solution and correction for future.

Organizational Roadblocks

Various external and internal factors in the organization stall Six Sigma projects and are called as organizational roadblocks.

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Some of the common internal roadblocks are
- ✓ Structure and culture of the organization
- ✓ Policies of the organization
- ✓ Stakeholder resistance

Some of the common external roadblocks are
- ✓ Rules and regulations imposed by the government
- ✓ Market conditions
- ✓ Customer acceptance trends

Usually internal roadblocks act as greater roadblocks for implementation of Six Sigma as it imposes new and radical changes within the organization. Different organizations have different structures and the level of resistance to the implementation of Six Sigma depends on the type of the organizational structure. As in a rigid centralized organizational structure is more resistant to the changes for implementation of Six Sigma project.

Various techniques can be used to overcome organizational roadblocks and which are

- ✓ Modify organizational structure and culture - One of the simplest techniques to overcome organizational roadblocks is to modify the organizational structure and culture to an extent that the roadblocks cease to exist.
- ✓ Improve infrastructure - Effective communication infrastructure can nullify the effects of organizational roadblocks. Proper and efficient communication channels ensure smooth flow of information so that ambiguities within and outside the team are resolved.
- ✓ Provide training on change management - Providing adequate training on change management at managerial levels will help influencing the mindsets to regard change as an organizational necessity and accept it.

Change management

Managing changes has become an integral part of a project leader's job. It has taken precedence over many other aspects of project management. Change management helps organizations to rework their organizational structures, objectives and tactical and strategic approaches to doing business in step with changing times, evolving technologies, heightened customer expectations, and rapidly transforming political, social, and cultural trends.

Change management process primarily aims at changing living mindsets by drawing upon the principles of industrial psychology. The changed minds, in turn, can be trusted to bring about the required organizational transformation.

Some of the characteristics of ineffective change management are as follows

- ✓ Inadequate resources - Non-allocation of adequate resources necessary to implement the assigned changes is a major constraint to manage change.
- ✓ Improper communication - Information on changes to be implemented is not communicated or is miscommunicated to the concerned personnel. This can result in anxiety and unrest among the employees who may resist these well-intentioned changes fearing threats to job security.

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Some of the characteristics of effective change management are as follows

- ✓ For change management to be effective, it is always preferable that it is entrusted to executives from senior management.
- ✓ The need for change, and both its positive and negative implications must be explained by the management in order to make the employees realize the importance of change.
- ✓ The change agents within the organization have to be identified and used to smoothen the change management process. Similarly, strategies to overcome the resistors to change have to be planned and implemented.

Kaizen Events

The broad objectives of the organization must be aligned with its long term strategies. One of the techniques that an organization can use to align its objectives with long term strategies is 'hoshin planning'. Hoshin planning helps an organization to develop its business plan and deploy the same across the organization in order to reach the set goals.

Project selection is a testimony to a leader's role in successfully aligning the broad objectives of the organization with its long term strategies. A project selection committee or group can be formed to screen and select projects. It can include Champions, Master Black Belts, Black Belts, and important executive supporters.

The project selection committee sets the criteria to select the projects. The project selection criteria are framed on the basis of the key factors that define the business case and business need of an organization. After selecting the projects, the project selection committee matches the projects selected with teams assigned to execute them.

The projects assigned to a Six Sigma team will generally be characterized by extensive data analysis, use of design of experiments etc. whereas those involving process improvement without the use of Six Sigma techniques will be assigned to lean manufacturing teams using kaizen tools.

The projects assigned to a kaizen team will be distinctly different from the Six Sigma projects. The kaizen projects that aim to produce a new product design will generally adhere to the guidelines for Design for Six Sigma. Kaizen projects using Lean principles are normally undertaken to bring swift improvement and reduce waste in the organization.

Six Sigma Roles and Responsibilities

Roles and responsibilities are defined before six sigma program for implementation, various roles as outlined are

- ✓ **Champion**
  - ✓ Sets and maintains broad goals for improvement projects in area of responsibility
  - ✓ Owns the process
  - ✓ Coaches and approves changes, if needed, in direction or scope of a project
  - ✓ Finds (and negotiates) resources for projects
  - ✓ Represents the team to the Leadership group and serves as its advocate
  - ✓ Helps smooth out issues and overlaps

- ✓ Works with Process Owners to ensure a smooth handoff at the conclusion of the project
- ✓ Regular reviews with Process Owner on key process inputs and outputs
- ✓ Uses DMAIC tools in everyday problem solving

✓ **Process Owner**
- ✓ Maximizes high level process performance
- ✓ Launches and sponsors improvement efforts
- ✓ Tracks financial benefit of project
- ✓ Understands key process inputs and outputs and their relationship to other processes
- ✓ Key driver to achieve Six Sigma levels of quality, efficiency and flexibility for this process
- ✓ Uses DMAIC tools in everyday problem solving
- ✓ Participates on GB/BB teams

✓ **Team Member**
- ✓ Participates with project leader (GB or BB)
- ✓ Provides expertise on the process being addressed
- ✓ Performs action items and tasks as identified
- ✓ Uses DMAIC tools in everyday problem solving
- ✓ Subject matter expert (SME)

✓ **Green Belt (GB)**
- ✓ Leads and/or participates on Six Sigma project teams
- ✓ Identifies project opportunities within their organization
- ✓ Know and applies Six Sigma methodologies and tools appropriately

✓ **Black Belt (BB)**
- ✓ Proficient in Six Sigma tools and their application
- ✓ Leads/supports high impact projects to bottom line full-time
- ✓ Directly supports MBB's culture change activities
- ✓ Mentors and coaches Green Belts to optimize functioning of Six Sigma teams
- ✓ Facilitates, communicates, and teaches
- ✓ Looks for applicability of tools and methods to areas outside of current focus
- ✓ Supports Process Owners and Champions

✓ **Master Black Belt (MBB)**
- ✓ Owns Six Sigma deployment plan and project results for their organization
- ✓ Responsible for BB certification
- ✓ Supervisor for DMAIC BBs; may be supervisor for DFSS BBs
- ✓ Influences senior management and Champions to support organizational engagement
- ✓ Leads culture change – communicates Six Sigma methodology and tools
- ✓ Supports Champions in managing project and project prioritization
- ✓ Ensures that project progress check, gate review, and closing processes meet corporate requirements and meet division needs
- ✓ Communicates, teaches, and coaches

✓ **Coach**
- ✓ Some businesses have coaches who support the GBs and others coach the BBs.
- ✓ Trains Green Belts with help from BBs and MBB
- ✓ Coaches BBs and GBs in proper use of tools for project success
- ✓ Is a consulting resource for project teams

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