SIX SIGMA FOR MANUFACTURING AND NON-MANUFACTURING PROCESSES

Six Sigma is a quality improvement and business strategy that began in the 1980's at Motorola. Emphasis is on reducing defects to less than 4 per million, reducing cycle time with aggressive goals such as 30-50% reduction per year, and reducing costs to dramatically impact the bottom line. The statistical and problem solving tools are similar to other modern day quality improvement strategies. However, Six Sigma stresses the ***application*** of these tools in a methodical and systematic fashion to gain knowledge that leads to breakthrough improvements with dramatic, measurable impact on the bottom line. The secret ingredient that really makes Six Sigma work is the infrastructure that is built within the organization. It is this infrastructure that motivates and produces a Six Sigma culture or "thought process" throughout the entire organization. The power of a Six Sigma approach is best described by proven return-on-investment (ROI) as shown next from Motorola, AlliedSignal, and General Electric (GE).

Motorola ROI
1987-1994
- ✍ Reduced in-process defect levels by a factor of 200.
- ✍ Reduced manufacturing costs by $1.4 billion.
- ✍ Increased employee production on a dollar basis by 126%.
- ✍ Increased stockholders share value fourfold.

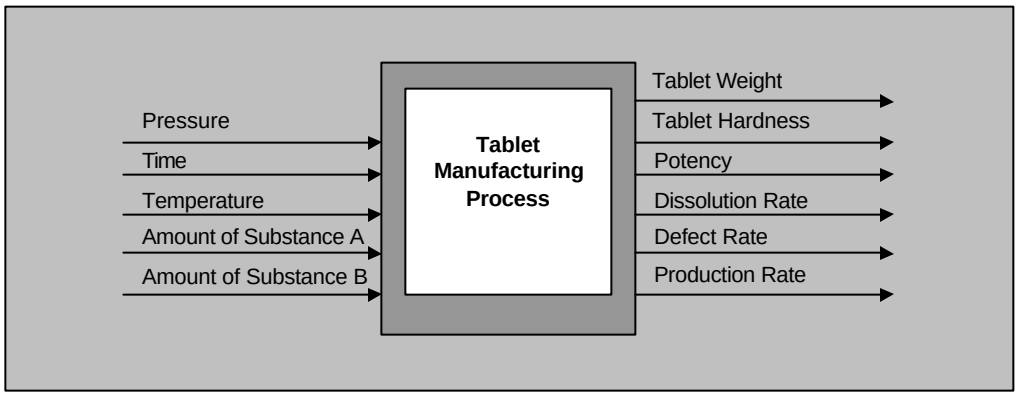
AlliedSignal ROI
1992-1996
- ✍ $1.4 Billion cost reduction.
- ✍ 14% growth per quarter.
- ✍ 520% price/share growth.
- ✍ Reduced new product introduction time by 16%.
- ✍ 24% bill/cycle reduction.

General Electric ROI
1995-1998
- ✍ Company wide savings of over $1 Billion.
- ✍ Estimated annual savings to be $6.6 Billion by the year 2000.

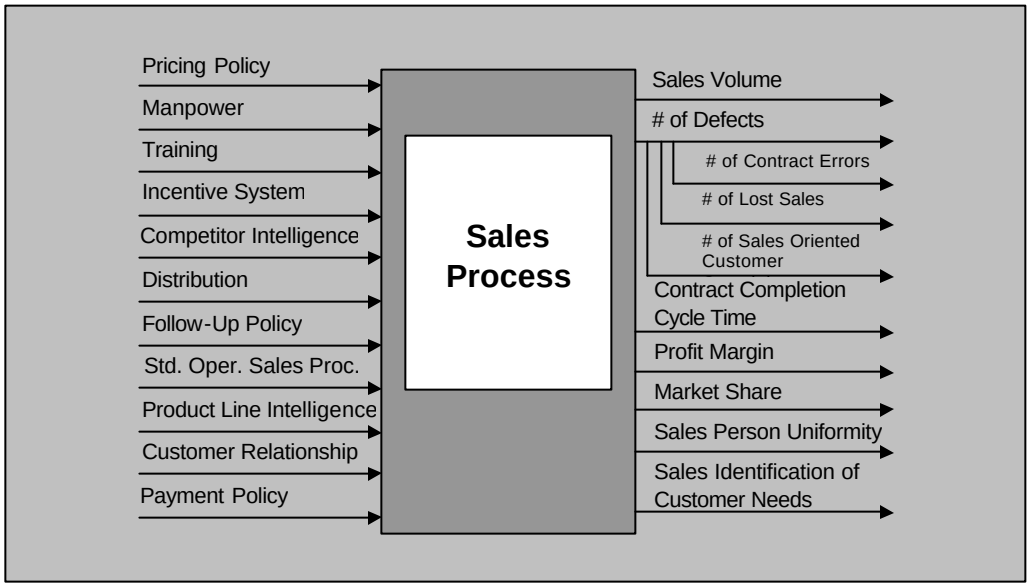
Based on the number of articles written the last two years about GE and its CEO, Jack Welch, GE has now become the standard bearer for how Six Sigma is implemented to successfully drive positive bottom line impact along with recognized "World Class" status. Other highly respected and successful companies such as SONY are benchmarking off of GE and implementing a similar strategy.

The companies mentioned thus far are certainly well known for their engineering and manufacturing excellence. What is not as well known is their view of the importance of Six Sigma in non-manufacturing or transactional areas. Bob Galvin, former President and CEO of Motorola, has stated that the lack of initial Six Sigma emphasis in the non-manufacturing areas was a mistake that cost Motorola at least $5 Billion over a 4-year period. It is common these days to hear comments like, "Yes, Company X has a great product, but they sure are a pain to do business with!" Consequently, Jack Welch is mandating Six Sigma in all aspects of his business, most recently in sales and other transactional (non-manufacturing) processes. Unfortunately, the typical response from non-manufacturing employees has been, "*We're different. Six Sigma makes sense for manufacturing but does not apply to us!*" This is simply an excuse in order to avoid being held to the same accountability standards as manufacturing.

The point to be made here is that any process can be represented as a set of inputs which, when used together, generates a corresponding set of outputs. An abbreviated pharmaceutical tablet manufacturing process might appear as shown below:



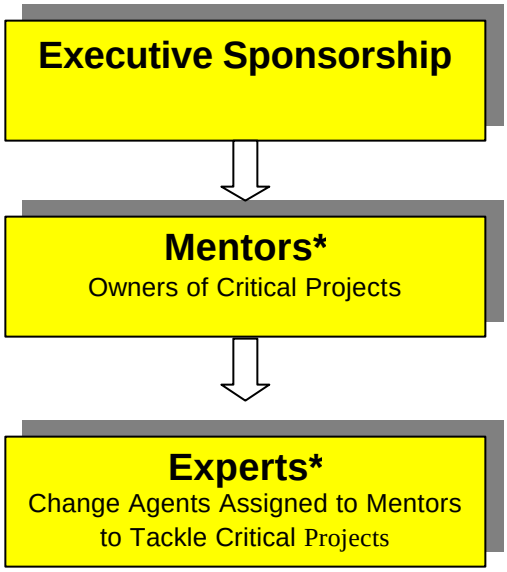
Transactional organizations simply are not accustomed to looking at their processes in this manner and thus will struggle a little in developing a similar abbreviated diagnosis of a transactional process. An Input-Process-Output (IPO) diagram for a sales process is shown below:



Thus, a process is a process, regardless of the type of organization or function. All processes have inputs and outputs. All processes have customers and suppliers, and all processes exhibit variation. Since the purpose of Six Sigma is to gain breakthrough knowledge on how to improve processes to do things **Better**, **Faster**, and at **Lower Cost**, it applies to everyone. Furthermore, since processes such as sales have historically relied less on scientific methods than engineering and manufacturing, the need for Six Sigma (i.e., a structured and systematic methodology) is even stronger here. This has been and is being recognized by World Class CEO's such as Bob Galvin, Larry Bossidy, Dan Burnham, Nobuyuki Idei, and Jack Welch.

The method to implement Six Sigma for non-manufacturing processes is simple: the same way we implement it for engineering and manufacturing processes at Motorola, Texas Instruments, GE, Lockheed Martin, Corning, Sony, etc., with only slight modifications. These modifications are typically confined to the type and depth of statistical tools that need to be included in the training. Obviously, the slant on applications must also be directed toward the non-manufacturing processes.

A specific strategy for Six Sigma manufacturing and non-manufacturing processes would look similar to what is shown below:



* Other commonly used terms for "Mentor" are "Champion" or "Sponsor" and for "Expert" are "Black Belt," "Change Agent," or "Top Gun."

The executives must have a total commitment to the implementation of Six Sigma and accomplish the following:

1. Establish a Six Sigma Leadership Team.
2. Identify key business issues.
3. Assign Mentors to each key business issue.
4. Assist the Mentors and Leadership Team in identifying critical projects that are tied to the key business issues.
5. Assist the Mentors and Leadership Team in selecting Expert candidates.

6. Allocate time for change agents (Experts) to make breakthrough improvements.
7. Set aggressive Six Sigma goals.
8. Incorporate Six Sigma performance into the reward system.
9. Direct finance to validate all Six Sigma ROI.
10. Evaluate the corporate culture to determine if intellectual capital is being infused into the company.
11. Continuously evaluate the Six Sigma implementation and deployment process and make changes if necessary.

The roles of the Leadership Team, Mentors, and Experts are defined next.

	EXPERT	MENTOR	LEADERSHIP TEAM
PROFILE	• technically oriented • respected by peers and management • master of basic and advanced tools	• senior manager • respected leader and mentor business issues • strong proponent of Six Sigma who asks the right questions	✍highly visible in company ✍trained in Six Sigma ✍respected leaders and mentors for Experts
ROLE	• leads strategic, high impact process improvement projects • change agent trains and coaches on tools and analysis • teaches and mentors cross-functional team members • full-time project leader • converts gains into $	• selects projects and Experts • provides resources and strong leadership for projects • inspires a shared vision • establishes plan and creates infrastructure • develops metrics • converts gains into $	✍• develop a training Master Plan to implement Six Sigma ✍schedule training ✍select projects and Experts ✍determine certification requirements and certify Experts ✍develop an Expert network to enhance communication ✍ review and improve the Six Sigma process
TRAINING	• three to four 1-week sessions with three to six weeks in between to apply • project review in every session	• 4 days of Mentor training • Six Sigma development and implementation plan	✍ one day of Basics of Six Sigma training or 4 days of Mentor training
NUMBERS	1 per 50 employees (2 %)	1 per business group or major working site	4 - 6 member team

The overall approach to obtaining the **right kind of knowledge** is focused on finding the **answers to the 14 questions** shown next. These questions, which are partitioned into a strategy (**P**rioritize, **C**haracterize, **O**ptimize, and **R**ealize (PCOR)), form the Six Sigma Project Master Strategy.

Six Sigma Project Master Strategy (PCOR)

Prioritize

1. What processes (activities) are you responsible for? Who is the owner of these processes? Who are the team members? How well does the team work together?
2. Which processes have the highest priority for improvement? How did you come to this conclusion? Where is the data that supports this conclusion?

Characterize

3. How is the process performed?
4. What are the process performance measures? Why? How accurate and precise is the measurement system?
5. What are the customer driven specifications for all of the performance measures? How good or bad is the current performance? Show me the data. What are the improvement goals for the process?
6. What are all the sources of variability in the process? Show me what they are.
7. Which sources of variability do you control? How do you control them and what is your method of documentation?
8. Are any sources of variability supplier-dependent? If so, what are they, who is the supplier and what is being done about it?
9. What are the key variables that affect the average and variation of the measures of performance? How do you know this? Show me the data.
10. What are the relationships between the measures of performance and the key input variables? Do any key variables interact? How do you know for sure? Show me the data.

Optimize

11. What setting for the key variables will optimize the measures of performance? How do you know this? Show me the data.
12. For the optimal settings of the key variables, what kind of variability exists in the performance measures? How do you know? Show me the data.

Realize

13. How much improvement has the process shown in the last 6 months? How do you know this? Show me the data.
14. How much time and/or money have your efforts saved or generated for the company? How did you document all of your efforts? Show me the data.

The Six Sigma tools and methodology must be taught to Mentors, Experts and other managers at a level they can grasp and feel confident to apply. A proven instructional approach developed by Air Academy Associates is shown below:

A Keep-It-Simple-Statistically (KISS) approach is used, with the intention to avoid statistical complexity. Statistics is not presented as an “end”, but rather the means to gaining knowledge for making good decisions that are critical for success. There are a variety of Six Sigma tools and techniques, and we will use the "Present/Practice/Apply/ Review" instructional strategy. That is, we will *present* a tool or method, give you a chance to *practice* that tool in class, then have you *apply* that tool to your project, and finally have you *review* the results of the application to

your project. A final report will be written to document your success story and its impact to the company's bottom line.

Another critical piece to a successful Six Sigma experience is the reward structure. Recall that many companies struggled to engage the entire organization in implementing TQM. To overcome this problem, Jack Welch has made the following statements:

1. To get promoted you must be Six Sigma trained.
2. Forty percent of top management bonuses are tied to Six Sigma goals.
3. Stock options are tied to Six Sigma performance.

As you can imagine, General Electric has very few problems engaging the entire organization in its Six Sigma initiative.

Thus, the modern day Six Sigma movement has fully embraced a Knowledge Based Management approach. Numerous companies, such as General Electric, Raytheon, and Sony, are demonstrating that this approach has a high return on investment. This new and improved Six Sigma business strategy is much more powerful than the original Six Sigma developed at Motorola. For more information on the power of Six Sigma, see General Electric's 1997 and 1998 Annual Reports to its share holders, employees, and customers. The following dual Input Process Output (IPO) diagram, a Six Sigma tool, summarizes the essence and power of a Six Sigma business strategy.

Using a Six Sigma Tool to Summarize Six Sigma