A Discussion of Strategies for Six Sigma* Implementation

Doug Sanders, Cheryl Hild
Six Sigma Associates

Key Words: Six Sigma implementation; Statistical methods for process improvement; Process improvement deployment strategies.

Abstract

Many organizations are implementing Six Sigma (6s) initiatives to improve organizational performance. This article contains observations on 6s implementation strategies based on the authors' experiences over the past five years. We discuss commonalties and differences between various strategies initially used to deploy 6s. We present three major categories of types of deployment strategies, discuss their strengths and weaknesses, and provide suggestions for improving on any of the strategies.

* Six Sigma is a registered trademark of Motorola, Inc.

Published Quality Engineering 2000 12(3) pp.303-310

Sanders 865.448.3002
Hild 865.909.0319

Introduction

Six Sigma efforts originated at Motorola, where the *Six Sigma* process was focused on reducing variability in product and process in order to prevent defects. Motorola's World Wide Web site states their reason for establishing the *Six Sigma* process. "In order to achieve the goal of 'doing it right the first time', we established and communicated the process that we termed Six Sigma".[1] In general, the concepts underlying 6s deal with the fact that process and product variation is known to be a strong factor affecting manufacturing lead times, product and process costs, process yields, product quality, and ultimately customer satisfaction. A crucial part of 6σ work is to define and measure variation with the intent of discovering its causes and to develop efficient, operational means to control and reduce the variation. The expected outcomes of 6σ efforts are faster, more robust product development, more efficient and capable manufacturing processes, and more confident overall business performance.

6σ methods are heavily based on the use of statistical methods to understand product and process performance. Given the use of statistical methods to better understand process performance has been in existence for decades, the creation of the *Six Sigma* process by Motorola meant there must be other characteristics that made it new and unique. The newness of 6σ efforts seem to be in 1) the packaging of the tools, 2) the focused problem-solving projects, and 3) the attention to bottom-line results and to sustaining gains over time. What Motorola created was an effective packaging of problem-solving and data analysis tools in a problem-solving process. This packaged "process" was then taught to a large percentage of the work force.

Since *Six Sigma*'s origin, many other organizations have defined their own *Six Sigma* process to improve organizational performance. (It should be noted here that most senior managers seem to translate "improve organizational performance" into "reduce cost of product or process".) The model or strategy used to deploy the 6σ initiatives vary from organization to organization. In reality, there are as many strategies as there are companies implementing 6σ. The concepts and tools also vary across organizations. It is not necessarily the authors' intent to identify one strategy or set of tools that is better than all others. It would

be just as unreasonable to think a single deployment strategy would be effective across all organizations as it is to argue only one set of tools is needed regardless of process or product.

While it is impossible to perfectly differentiate the many approaches to 6σ training and improvement efforts, there seem to be three general categories of deployment strategies. We define the first of the three deployment categories as the "*Six Sigma* Organization" strategy. The *Six Sigma* Organization category consists of deployment strategies whereby all individuals from all levels and areas are trained in 6σ concepts and tools. The second type of model is characterized by the development of a "*Six Sigma* Engineering Organization", where the focus of the initial training and project work is within the engineering community. In these strategies, the majority of the engineering community is trained and developed. This category typically includes individuals and projects from the manufacturing and product design processes. The third broad category is best characterized as "Strategic Selection". This model involves the development and training of a group of strategically selected individuals. These individuals are assigned complex projects identified by needs and objectives critical to the site or organization.

For some, the implementation of 6σ connotes a specific deployment strategy—that of the *Six Sigma* Organization. However, while it is arguable whether or not all of these approaches can be labeled *Six Sigma*, there is no one strategy that can possibly be optimal across all companies or even across all divisions or plants within a company. Each of these major types of deployment strategies has its own set of potential burdens and contributions to the organization. Even though these categories are quite broad and overlap to some degree, we can utilize this characterization in order to discuss commonalties and differences, strengths and weaknesses, and suggestions for improvement.

The "Six Sigma Organization"

The first category of 6σ implementation strategies includes those that work towards training the entire organization on 6σ philosophy and methods. In organizations that choose these strategies, 6σ serves both as a motivational device and as a metric. Goals are often defined in terms of "Sigma". In fact, it is common in these strategies for *Six Sigma* to be

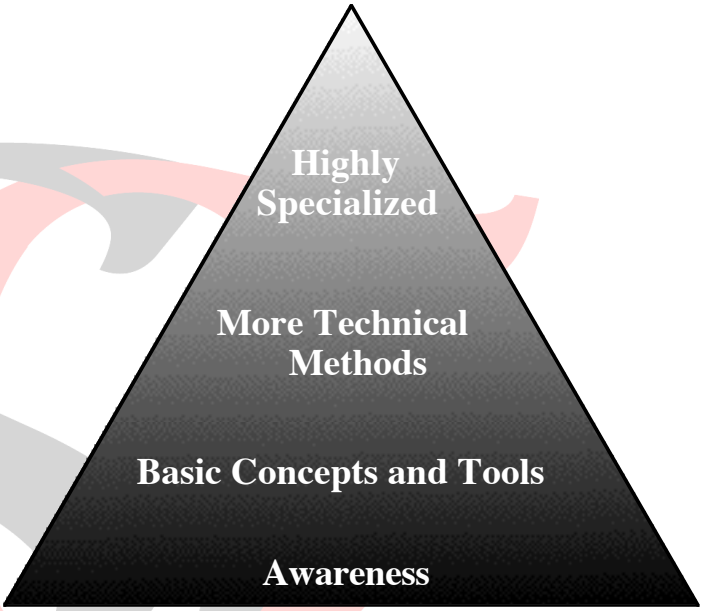

Figure 1. The Six Sigma Organization's Training Hierarchy

defined as the quality process for the entire organization. Motorola's implementation approach would fall into this category. "To Motorolans, the term Six Sigma has become synonymous with quality."[1]

In the *Six Sigma* Organization, a large amount of resources is focused on increasing awareness across all functions and levels of the organization. Hence, these approaches require a large percentage of the overall personnel be trained, to some extent, 6σ. Much of the training is motivational in nature, primarily communicating the philosophy, fundamental ideas, and vocabulary of 6σ. As illustrated in Figure 1, these organizations often define different "levels" of 6σ expertise with the training content and project work differing across the levels. At the lower levels of the pyramid, specialized statistical tools are not taught. As one moves up the hierarchy, more in-depth training in specialized tools is provided. Often, a small group of 6σ "experts" is developed in order to be able to train others at lower levels of the hierarchy.

The major strength of the *Six Sigma* Organization deployment approach is the possible creation of a "constancy of purpose".[2] A common language and a common improvement process is put in place. A high level of awareness is developed both internal and external to

the organization. Quality improvement initiatives are usually integrated under the 6σ framework. Participation in training and project work is encouraged and sometimes even required. The widespread focus on improvement methodologies may facilitate cross-functional project work. Finally, due to the large number of projects being worked and improvement ideas being attributed to the 6σ initiative, there are reports of large gains both in terms of process performance and efficiencies. The *Six Sigma* Organization approaches are often used to reenergize or motivate an entire organization to focus on improving performance and reducing cost.

Two of the most common failure modes associated with the *Six Sigma* Organization are due to the creation of a strong expectation for "results" (i.e., dollars saved) that can be attributed to the *Six Sigma* initiative. In response, almost all projects and improvement ideas get credited to the *Six Sigma* methodology regardless of the tool set or approach actually used. (There are many different tools and approaches that can be utilized to increase process knowledge.) The more Six Sigma gets erroneously credited with all gains and ideas, cynicism and disinterest seems to develop among members of the organization. A second related failure mode is individuals begin to focus on how to show project savings rather than on how to transfer process knowledge and sustain gains over time. When Six Sigma gets treated as a goal, people quickly learn how to show attainment of the goal. As paraphrased from Brian Joiner, you can change the system, distort the system, or distort the data.[3]

A final organizational issue that must be at least noted with this choice of implementation approach is the amount of resources required to train such a large portion of the organization. In addition to the high cost required for the mass training efforts, an organization must also consider the amount of time and focus allotted to Six Sigma activities. These costs must include the potential opportunity costs with respect to activities delayed and/or sometimes replaced.

If a deployment strategy of this type is used, management must take care to address the potential of cynicism. Cynicism spreads quickly when communications are mainly inclusive of buzzwords (e.g., "what's your sigma level?") and targets (e.g., dpu's) instead of attained process knowledge and ways to use the knowledge gained. (Remember, there are multiple tools and approaches that can take one to the same end.) The leadership should carefully

consider the implications of using "sigma" levels as goals. If we become a *Six Sigma* organization, what does that really mean? What information does "sigma" as a metric provide to allow for better management of processes and business policies? Management must ensure that "sigma" as a metric truly provides information about the consistency and reliability of process and product performance. They must understand what information "sigma levels" provide to know what to change, when to change, how much to change, and what to control. It must be clear to the organization's members how the attainment of various "sigma levels" translate into increased customer value.

Additional reasons for widespread cynicism among employees is the use of numerical targets and quotas to determine the rate or speed of implementation in the organization. For example, companies sometime use the percentage of workforce trained as a metric to evaluate the rate of implementation. Instead of using such a metric, organizations might consider the allocation of resources along a timeline that supports work on projects identified as critical to the overall organizational strategy. When projects are selected at particular points in time to support organizational or site objectives, certain people must be trained to support those projects. Thus, the individuals trained as well as the number trained are more aligned with strategic objectives.

The previously discussed failure modes along with the development of cynicism with respect to Six Sigma efforts is usually due to a lack of understanding or lack of planning on the part of the management team. Careful planning will address both metrics associated with 6σ efforts as well as the allocation of resources.

The Six Sigma *Engineering Organization*

A second set of strategies for 6σ has as their common thread the focus on training a large percentage of the company's design and manufacturing engineers. Instead of attempting to motivate the entire organization, attention is given to developing a skill set in the engineering community. Hence, the project objectives are almost always based on new products, product changes, or on problem-solving efforts on the manufacturing floor. In these types of strategies, the term *Six Sigma* is typically associated with a technical set of skills meant to supplement engineering knowledge in order to more efficiently and effectively solve

problems or implement changes. Hence, 6σ is not treated as a motivational device or used to set goals or targets. Rather, the driving force behind the training and project work are products introduced quicker and more reliably, dollars saved, and solutions found to plaguing problems.

One of the distinct advantages of the *Six Sigma* Engineering strategy is the similar educational and technical backgrounds of the individuals undergoing the training. The common quantitative background allows more mathematical and technical tools to be taught at a faster pace. While fundamental ideas concepts, language, and philosophy are still taught, more time is spent teaching in-depth technical tools and methods appropriate for typical engineering problems. Also, since the projects tend to be similar in nature (either product design changes or manufacturing problems), it is easier to have training discussions around the appropriate application and applied interpretations of the concepts and methods.

Another strength of this type of deployment strategy is the movement of the knowledge back into the manufacturing and design functions of the organization. When a large percentage of the engineering population is trained, the use of methods and tools transfers more quickly from 6σ projects to daily design and line work efforts. Finally, due to the focus of large amount of engineering resources on larger problems, there seems to be a sufficient number of "successful" projects that provide large dollar savings to manufacturing divisions of the organization. These savings, when sustained over time, bring much attention and merit to the 6σ process or initiative.

Of course, with every advantage comes a disadvantage. When most of the organization is not explicitly trained, a lack of understanding of the philosophy and the purpose of the initiative outside of the engineering community typically results. In return, the organization cannot take full advantage of the new knowledge. If resources are not adequately provided to train managers, engineering leaders will not understand the new methodologies and so will be poorly equipped to guide and question the application of the new methods. Additionally, without an in-depth understanding of the methodology and its applications, managers cannot be expected to make wise resource allocation decisions.

There are different ways to grow managerial understanding. The most common strategy is to conduct short management training courses in parallel with the technical training. Managers are exposed to typical project work and an overview of the tools and methodology. Other organizations train managers along with the engineers. The managers' assignments over the course of the training are to develop 1) a good understanding of the appropriate application of tools, 2) their new roles and responsibilities for communicating outside of the boundaries of the engineering functions, and 3) their responsibilities in terms of guiding project selection, project work, and the transfer of knowledge within their areas. From such efforts stems informal training of other engineering managers, encouragement of appropriate application and interpretation of analyses, and the integration of the concepts and ideas in design reviews and formal project debriefs.

It is not uncommon for manufacturing projects to highlight inefficiencies and waste in non-manufacturing support processes. When the non-manufacturing personnel are not provided the opportunities to work on improving these processes, huge improvement opportunities are ignored. Also, non-manufacturing functions often feel isolated or "left out" and, in return, develop apathy towards the 6σ initiative and its concepts and tools. Similar issues apply when operators and technicians are expected to participate in and help sustain the improvement activities, but are not taught the reasons behind the tools and activities. Opportunities identified outside of design and manufacturing engineering should be prioritized by the management staff and, if appropriate, addressed by the organization. With respect to the inadequate exposure of the operators and technicians to the methodology, the engineers who have been trained should be expected to communicate the intent and fundamentals to their process and design teams.

Strategic Selection of Individuals and Projects

Some organizations choose to deploy 6σ activities through the careful selection of individuals and projects aligned to the overall organizational strategy. These organizations are typically comfortable that their strategic plans and objectives are inclusive of their quality plans and objectives. The senior management often feels that the existing quality process is working well in terms of supporting the overall strategic plan. Hence, they want to use

6σ concepts and tools to enhance the existing quality process and supplement the skill sets of key individuals within the organization. The strategic selection of projects is a major prerequisite to the training and, often, to the selection of the individuals to be trained. This deployment model is one where the critical mass is determined by who and why rather than by how many.

With strategic selection deployment, the projects are often chosen to align with organizational or site needs. Projects are strategically selected to support overall organizational initiatives, plans and objectives or, at a minimum, to support site objectives and resolution of major issues. The appropriate individuals to be trained are often determined after project selection as dictated by the project definitions and objectives. Hence, the number trained, the training timeline, and content are largely determined by the identified projects, their scope and objectives, and the level of knowledge that currently exists about the associated processes.

Advantages to these approaches that are characterized by strategic selection of projects and persons are:

- They allow for flexibility in training content. The training content can be customized to the individuals and their associated projects. Tools appropriate to specific problems in the projects can be taught at a level necessitated by the issue.
- Complex strategic projects get the resources, in terms of time and help, needed to cover the multiple parallel paths involved in fully addressing all of the areas and issues within the projects.
- They require less initial outlay of resources for training, in terms of monetary costs and the reallocation of individuals from their daily responsibilities.

For these types of efforts to be successful, it is important, however, for the organization to dedicate some of its most valuable people over the course of the training and project work. Hence, it is necessary for many of their daily responsibilities to be moved to other individuals. From this need stems one of the most likely failure modes with this type of deployment strategy—the individuals are not allowed the focus and dedication to learn the methods in-depth and to work all of the many issues associated with larger projects. This failure mode typically exists in organizations with large numbers of short-term crises and “fires”. The same

people who are called upon repeatedly to deal with urgent issues are often the same valuable employees who are chosen to work on the larger, more complex 6σ projects.

Other potential weaknesses of the Strategic Selection approaches are similar to those previously discussed under the *Six Sigma* Engineering Organization. It is not uncommon for engineers trained in the 6σ methodologies to be somewhat isolated from their engineering colleagues. When key individuals are taken out of their regular responsibilities, taught advanced, technical tools, and resources are dedicated to their work on a specific large-scale project, there is often a communication barrier established both with their colleagues and with their managers. Due to the selective nature of the training, the lack of awareness and of a common language is even greater with this type of deployment. Hence, there are greater difficulties in integrating the concepts, tools, and methods beyond 6σ projects. Finally, the greatest potential failure mode with this strategy is the issue of developing management understanding.

When this approach is used, engineers trained in the 6σ methodology should not be separated from their peers. They should maintain working space with their colleagues. After the training, they should still be held accountable for the overall performance of their area. Exceptional performance should be identified and assessed by the same mechanism used to evaluate all individuals. Similarly, their projects should require interaction with and education of peers. Other recommendations for dealing with these disadvantages are the same as those discussed under the *Six Sigma* Engineering Organization.

Improving* Six Sigma *Implementation

Each of the three broad categories of 6σ implementation strategies are summarized in Table 1. As with any effort or initiative, there are potential failures and burdens to the organization. Many of these can be overcome by the establishment of a deployment plan that is defined and therefore owned by the entire senior management team prior to the start of any training efforts. To take full advantage of the opportunities generated by 6σ efforts, something more than training is required. Since organizations are typically involved simultaneously in other initiatives, such as lean manufacturing and reengineering of business processes, it is

	SIX SIGMA ORGANIZATION	SIX SIGMA ENGINEERING ORGANIZATION	STRATEGICALLY SELECTED PROJECTS & INDIVIDUALS
Personnel trained	"Everybody" ⇨ Senior managers ⇨ Area managers ⇨ Some from business process areas ⇨ Engineers ⇨ Individuals from operations	A large percentage of the engineering staff ⇨ Design/product ⇨ Manufacturing/ process	Strategically selected individuals ⇨ Project driven ⇨ Informal leaders
Typical course content*	⇨ Overview ⇨ **Philosophy and basic concepts** ⇨ **Fundamental tools and methods** ⇨ Project work	⇨ Overview ⇨ Philosophy and basic concepts ⇨ **Fundamental tools and methods** ⇨ **Advanced-fundamental tools** ⇨ **Project work**	⇨ Overview ⇨ Philosophy and basic concepts ⇨ **Fundamental and advanced tools and methods** ⇨ **Specific methods and tools as needed for individual projects** ⇨ **Project work**
Strengths	⇨ High level of awareness ⇨ Common language ⇨ Common tool set and problem-solving approach	⇨ Focused resources ⇨ Larger set of tools for engineers ⇨ Similar backgrounds among individuals in training ⇨ More attention given to project application	⇨ Projects aligned with organizational objectives ⇨ Less initial dollars required for training ⇨ High amount of flexibility in training content (as needed) ⇨ Strongest project focus
Common weaknesses	⇨ Tendency for cynicism to develop ⇨ A focus on "buzzwords" and slogans ⇨ Large amounts of resources required for mass training ⇨ An inflexible roadmap for process improvement or problem solving	⇨ Lack of common language across all areas of organization ⇨ Difficulty in deployment outside of operations and engineering ⇨ Managers not provided training to effectively integrate skills learned into everyday engineering responsibilities	⇨ Isolation of those trained ⇨ Lack of common language ⇨ Difficulty in integrating beyond "six sigma projects" ⇨ Tendency for attitude of elitism to develop

* Major areas of concentration within training efforts

TABLE 1. Summary of Six Sigma Implementation Strategies

necessary to understand and communicate the integration of the initiatives across the organization and how each of the initiatives supports strategic imperatives. Communication forums sometimes include newsletters, short courses, and weekly meetings where managers involve staff members in discussions on the initiatives and their integration.

It is also important that senior management not sell the 6σ initiative as a "silver bullet" (i.e., a magical solution to any problem or issue). Often, when 6σ efforts are being introduced to managers across the areas of the organization, the focus is on the language and buzzwords with the methods and tools treated as "black boxes". As with Total Quality Management (TQM), Continuous Process Improvement (CPI), Quality Circles, and other past quality initiatives, when 6σ is treated as a short-term program with its own goals, buzzwords, and slogans, the tendency of many individuals within the organization will be to work towards proving "this stuff doesn't work". The objective should be on increasing skill sets and process knowledge and thereby establishing a more efficient and effective means to manage processes within organizations.

In order to sustain the initiative over time, it necessary to move the application of the concepts and tools from 6σ projects to everyday work efforts and decisions. A great way to accomplish this transfer is to focus on developing in individuals the ability to integrate their experience, process knowledge, and professional tools with the tools taught in the 6σ training. Hence, it is important that the 6σ training does not set up an inflexible roadmap for all project work and problem-solving efforts. Pre-work should be done to ensure that critical thinking and the appropriate application of any tool or method is preferable to the sequential, repetitive use of a standardized set of tools.

In most 6σ implementation efforts, there is a tendency to define the initiative as a cost-reduction effort. As with any goal, if a specific goal of minimum dollars saved per project is the primary driver for project selection, then what will result is a focus on how to justify and document the savings. Another result of this tendency is for project work to focus on implementing only changes that will result in large accounting dollars. Paths containing more robust solutions or solutions that are easier to sustain over time are sometimes ignored because they are more difficult to cost justify. It is not uncommon to see the same issue worked several times with each "project" showing associated dollars saved. For example, on

one assembled product, an engineer worked on reducing final product cost. The solution was to change to a cheaper supplier for one of the components. Huge dollar savings were documented. One year later, another individual was assigned a project to reduce the failure rates in the same assembly. The identified cause of the failure was the component supplied by the newer supplier. In order to eliminate the failure, another supplier change was made. Again, savings were documented. What about process knowledge gained? What are the critical characteristics that must be maintained by any supplier of that component? Without such knowledge, change in supplier will continue to be a "solution" to a reoccurring problem.

Increasingly, organizations are sending one or two individuals to 6σ training seminars in order to understand if 6σ can provide tools useful to the organization. The intent is to use a few individuals to make a strategic decision on whether or not 6σ should be implemented in the organization. Rarely can one or two individuals effectively learn the concepts, adopt a new philosophy and apply the tools and methods in isolation. With little organizational focus and opportunity for application of concepts, it is unreasonable for the individuals to be expected to advise the organization on implementation decisions. This approach is doomed to fail.

The following is a list of some of the key features of successful 6σ efforts. Even though this list is by no means complete, it covers some of the critical aspects of effective implementation.

- A focus on the development of critical thinking and the integration of current knowledge and experience with tools;
- Education of the management ranks in the philosophy, methods, applications, and their roles;
- Support for any goals established with the means, opportunities, and mechanisms to attain the goals;
- Integration of all concurrent initiatives and communication throughout the organization how each initiative aligns with the overall strategic plans and objectives;
- Translation of internal objectives to external customer values;
- Alignment of project objectives with site/area objectives and then with organizational objectives.

- Valuing and rewarding the attainment and the transfer of process/product knowledge in addition to dollars saved on projects.

Obviously, it is the responsibility of senior management to define "success" for the implementation of 6σ and then to put in place systems, values, and any necessary changes to ensure "constancy of purpose" and alignment of goals and metrics.

Summary

The concept of *Six Sigma* is defined in managerial goals and procedures, engineering theory and practice, and statistical techniques and implementation. In its ideal formulation, the content of 6σ as a process is built around the creative union of managerial objectives for process or product, confirming and expanding engineering and operational knowledge, and the practical and immediate application of basic and advanced statistical procedures. Process and product knowledge along with statistical techniques are directed towards identifying known and unknown causes of variation in current process and product with the intent of managing, controlling, and finally decreasing variation.

The definition of *Six Sigma* by design or evolution varies across organizations. No matter how an organization defines and scopes its "sigma" efforts, there are potentially great advantages that can be gained from the integration of theory, practical knowledge, and statistical thinking and methods. At the same time, there are some disadvantages and potential failure modes that must be addressed. To address these issues, it is not necessary for the leaders of the organization to be fully versed in the technical methodologies. Rather, the role of the senior management becomes that of developer of systems that will ensure the ability of the organization to attain and apply new knowledge and skills and to continue growing knowledge well into the future.

---

[1] Motorola World Wide Web site at www.motorola.com.

[2] Deming, W. Edwards, Out of the Crisis, MIT Center for Advanced Engineering Study, 1986.

[3] Wheeler, D J, Understanding Variation; The Key to Managing Chaos, SPC Press Knoxville, TN 1993