

# Integrating Lean and Six Sigma Methodologies for Business Excellence

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Do you belong to an organization that has been implementing Six Sigma methodologies for several years and suddenly are beginning to hear conversations about “Lean Six Sigma”? Or maybe your organization has trained shop-floor staff and supervisors in Lean techniques, and now you are hearing about different colored “Belts” that have nothing to do with those on your machines. Or perhaps you are just beginning to implement process improvement in your organization, and the old Six Sigma conferences that you used to attend are now being repackaged with the word “Lean” in front of them.

If you are feeling some confusion about the transformation of Six Sigma into “Lean Six Sigma,” you are not alone. Ever since Michael George of the George Group wrote his books about how Lean and Six Sigma methods are complementary and can be used by organizations to increase throughput and reduce defects (for example, see George’s *Lean Six Sigma: Combining Six Sigma Quality with Lean Production Speed*<sup>1</sup>), books and articles about Lean Six Sigma have proliferated. Six Sigma conference producers have added the “L” word to every presentation topic on their agendas, and much to everyone’s bafflement, topics such as QFD or DFSS are making a new appearance dressed as “Design for Lean Six Sigma” or “Lean Quality Function Deployment.”

<sup>1</sup> *Lean Six Sigma Quality with Lean Production Speed*, McGraw-Hill, 2002.

In the midst of this activity, we have noticed that practitioners need more information. Those on the receiving end of “new-and-improved” methodologies have very practical questions related to the number of new tools they need to learn, or any additional training burden they should plan for. Those responsible for implementing Lean Six Sigma or for transitioning to an integrated methodology are interested in the details of deployment: how to successfully integrate two complementary, yet different, methodologies without causing undue organizational stress. And finally, senior management is interested in the payoff: how can we ensure that the organization will benefit from the best aspects of both approaches without independent parallel investments in implementation and training?

In this paper, we attempt to address some of these practical issues about successful Lean Six Sigma implementation. We start by describing some of the key principles of the two approaches, and what makes them compatible. We then describe different approaches that organizations have used to integrate the two methodologies and the advantages and limitations of these approaches. And finally, we present our own approach that addresses some of these limitations.

We wish to warn in advance that we are not presenting any magic formula for seamless integration. We have found, as many others have, that Lean Six Sigma comes in many forms depending on the organizational context, the maturity in applying



process improvement tools, and the critical business issues and opportunities facing the organization. In our experience, however, there are some key principles and systematic steps that enable successful deployment, and we will be sharing these in this paper.

## Comparing Six Sigma and Lean Methodologies

Everybody who has read Lean Six Sigma literature knows

*“Six Sigma is a management philosophy that seeks to increase profitability and customer satisfaction by improving business processes through the use of data and statistical analysis to decrease process variation and to reduce defects...”<sup>2</sup>*

*“Lean enables the production and delivery of the right amount of high-quality products and services (as defined by your customers) at the right time, the first time, while minimizing waste and being open to change...”<sup>3</sup>*

Comparing these two definitions, it is apparent that there is a difference in the way they sound. The definition of Six Sigma sounds *analytical*, while the definition of Lean sounds *operational*. This does not mean that one approach is better than the other—they are just different. And in our experience, organizations that incorporate these differences into their deployment plan are the ones that launch the most successful Lean Six Sigma programs. Deployment initiatives that extract the best tools from either approach can certainly be successful, but these approaches do not leverage the variations in

that Six Sigma methodology focuses on defect and variation reduction and that Lean approaches are used to eliminate waste and to improve flow and throughput. But to really compare the two methods, it is useful to look more deeply at some definitions. A search for Six Sigma or Lean definitions on the web produces thousands of hits, but there are some definitions that are more resonant with our thinking than others. We present the following definitions for Six Sigma and for Lean that we have adapted from the literature:

*principles between Lean and Six Sigma that make their applications different. As the definitions indicate, Lean and Six Sigma are both management philosophies, and they embody different, yet overlapping, ways of thinking about how best to manage a business. Paying attention to these principles in addition to tools will result in a deeper, more sustainable deployment.*

The difference in the management philosophies of the two approaches can also be seen in the 10 rules of Lean and Sigma shown in Figure 1. We obtained the 10 rules of Six Sigma from discussions with expert practitioners. The 10 rules of Lean come from Jeffrey Liker’s excellent book on the Toyota Production System.<sup>4</sup>

<sup>2</sup>Adapted from a definition on [www.isixsigma.com](http://www.isixsigma.com).

<sup>3</sup>Adapted from the Toyota Production System definition by Taiichi Ohno.

<sup>4</sup>*The Toyota Way*. Mc-Graw Hill, 2004.



**Figure 1: 10 rules of Lean and Six Sigma**

**10 RULES OF SIX SIGMA**

1. View performance from the position of the customer
2. Understand the process
3. Make decisions based on data and analysis
4. Focus on the most important issues
5. Use statistical models
6. Pay attention to variation
7. Use standard methodologies
8. Select projects for financial impact
9. Establish project governance structure
10. Enlist senior management support

**10 RULES OF LEAN**

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

Compare the rules on the left column of Figure 1 to the verbs on the right column. The rules on the Six Sigma side focus more on *planning and analysis* (focusing on issues, using methodologies and models, selecting projects, etc.), while those on the Lean side are more focused on *taking action* (minimizing inventory, maximizing flow, etc.). This obviously does not mean that Six Sigma initiatives are not about taking action, or that Lean initiatives do not require planning. The point is that Six Sigma methods begin with explicitly collecting and analyzing data to gain insights about causes of problems before taking action, while Lean approaches use accumulated experience from daily work to make changes and improvements as necessary. This difference in approaches is often misinterpreted by saying that Six Sigma tools are applicable when the root cause of the problem is not known, and that Lean tools are applicable when the cause is apparent—but that does not truly capture the essence of the two methodologies.

The reason that the cause of problems is known when using Lean methods is that the methods are applied in an environment where careful attention is paid to the everyday rhythm of operations; therefore the causes of problems that upset that rhythm (such as waste or imbalance) are more likely to be evident, or may be more readily determined without special data collection and detailed statistical analysis. The short, focused data collection of Six Sigma methods is replaced by longer-term, careful observation in Lean, but in both approaches,

improvement decisions are based on a deep understanding of the drivers of waste, defects, or variability that negatively affect performance and cause customer dissatisfaction. This means that the types of business problems that lend themselves to Lean approaches are different from those that lend themselves to Six Sigma approaches. But this difference in problem types also supports the difference in implementation philosophy—Lean problems are more likely to be solved quickly on the ground or in short “blitz”-like events, and therefore are more amenable to integration into daily work.

In our experience, many organizations’ Lean Six Sigma integrations do not take full advantage of each methodology, because organizational constraints or philosophy affect the way that companies approach the integration. On one hand, many organizations try to create a Lean Six Sigma program by extending their current Lean or Six Sigma infrastructure and forcing the other methodology into it. This results in a constrained model that mitigates the benefits that can be achieved. On the other hand, some organizations believe that the two methods require drastically different organizational cultures and create separate organizational infrastructures to support Lean and Six Sigma efforts, without making an attempt to integrate them. Without integration, they miss the opportunity to simultaneously launch an improvement program that engages all levels of the organization.



## Integrating Lean and Six Sigma

We believe that organizations have the opportunity to achieve business excellence by combining the data-driven, analytical aspects of Six Sigma with the operational and cultural aspects of Lean through a Lean Six Sigma deployment model that utilizes the best features of each methodology. We have observed that the most successful integrations are those that apply Lean and Six Sigma in a way that is best aligned with each of their philosophies. The integration challenge is to create the best process and organizational infrastructures to support each of these methods, and to align these infrastructures so that the Lean and Six Sigma initiatives are complementary. We will describe our approach for doing this in a later section of this paper. But before we get there, we are first going to discuss approaches that organizations typically employ to integrate Lean and Six Sigma and reflect on their advantages and limitations.

## Lean Six Sigma Deployment Models

As we worked with organizations on their Lean Six Sigma programs over the past few years, we asked practitioners why their organization felt the need to deploy a Lean Six Sigma program. Some of the most common answers we received are:

*“My management wants to implement Lean because it takes less time...”*

*“Statistical analysis does not really apply to our organization...”*

*“We need Six Sigma to certify our Black Belts...”*

*“My management wants a Lean Six Sigma deployment...”*

*“Black Belts need a new set of tools...”*

*“We want to cover all tools in a single training session...”*

We have discovered that these reasons affect the way in which organizations think about their Lean Six Sigma deployment strategy. Typically, the approach is either to add Lean tools to existing Six Sigma programs, to incorporate Lean as a quick problem-solving method, or to have separate and unconnected Lean and Six Sigma initiatives. We have given

these deployment approaches fancy technical names. They are:

- *Augmented deployment*
- *Parallel deployment*
- *Sequential deployment*<sup>5</sup>

*Augmented deployment* is the tool-based approach. Lean tools are added to DMAIC or DFSS methodologies to create a “Lean GB” or “Lean BB” curriculum. These tools are typically introduced into the Measure and Improve step of DMAIC to help create new process solutions that focus on flow as well as on defects. Similarly, Lean principles are introduced in the Design Step of DMADV to ensure that new processes are designed to minimize waste and maximize flow.

*Parallel deployment* involves separate Lean and Six Sigma deployments. There are two ways in which this can take place. One way is where organizations have a Six Sigma program and a Lean program running simultaneously. These are usually in different parts of the organization. For example, manufacturing organizations may have Lean programs in their factories, and may also launch an enterprise-wide Six Sigma program. The other way in which parallel deployment takes place is through the use of an integrated project selection model, where projects either follow Six Sigma or Lean methods depending on the nature of the problem (i.e., Six Sigma where defect reduction or variation reduction is the objective, and Lean where cycle time decrease or throughput increase is desired). In this case, Lean is used as a parallel problem-solving approach to DMAIC, and Lean projects are conducted as short-term “events” where a particular problem is defined and solved. The full suite of Lean tools and the Lean philosophy of integrating improvement into daily work do not typically come into play in these events—they tend to be more like DMAIC projects with a less rigorous Measure and Analyze step.

*Sequential deployment* is typically used by organizations that are beginning to implement process improvement initiatives. In this kind of deployment, organizations begin with Lean



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**Table I: Summary of Lean Six Sigma Deployment Strategies**

DEPLOYMENT APPROACH	USED WHEN	ADVANTAGES	LIMITATIONS
Augmented	Organization has an ongoing Six Sigma program which is highly visible	Easy to incorporate into training program	Focus is only on tools, not on an optimal integration strategy
Parallel – Separate Lean and Six Sigma Deployments	Deployment is decentralized and established Lean or Six Sigma programs already exist	Both Lean and Six Sigma are deployed where they are most needed	Lack of integration fails to optimize benefits
Parallel – Integrated Project Selection	Centralized Six Sigma program is mature and there is a need for speed of execution and for new tools	Broader selection of projects can cover a wider range of issues more quickly	Lean is primarily deployed as “projects” and does not exploit continual improvement in daily work
Sequential Deployment	Organization is just embarking on a process improvement effort	Quick wins through Lean projects help to demonstrate benefits	Lean is used as a problem-solving methodology with a limited toolset

projects to streamline processes and reduce waste and then graduate to Six Sigma projects to address problems and improvement opportunities that require greater analysis.

**DEPLOYMENT APPROACH**

- Augmented
- Parallel – Separate Lean and Six Sigma Deployments
- Parallel – Integrated Project Selection
- Sequential Deployment

**USED WHEN**

- Organization has an ongoing Six Sigma program which is highly visible
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**ADVANTAGES**

- Easy to incorporate into training program
- Both Lean and Six Sigma are deployed where they are most needed
- Broader selection of projects can cover a wider range of issues more quickly
- Quick wins through Lean projects help to demonstrate benefits

**LIMITATIONS**

- Focus is only on tools, not on an optimal integration strategy
- Lack of integration fails to optimize benefits
- Lean is primarily deployed as “projects” and does not exploit continual improvement in daily work
- Lean is used as a problem-solving methodology with a limited toolset
- If your organization has been deploying Lean Six Sigma using one of these strategies, does it mean that you need to stop your efforts immediately?

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The answer is obviously no. As shown in Table 1, there is a context in which each deployment strategy is advantageous, and your organization may be implementing a Lean Six Sigma program that is effective for you. The point we want to emphasize, and that we already have highlighted several times in this paper, is that since Six Sigma and Lean are management principles, they are much more than just a collection of tools and projects. A Lean Six Sigma implementation that pays attention to the essence of these principles can have a transformative impact on the business. The Integrated Lean Six Sigma approach that we describe below is one way to do this—but it is not intended to replace any existing approaches that you may currently be successfully using. The approach that we present here is intended to complement and enhance your current efforts.

## Integrated Lean Six Sigma Approach

An integrated Lean Six Sigma deployment approach should be designed around the following basic principles:

- Deploy Lean to create a continual improvement mindset in the organization's daily work
- Deploy Six Sigma to enhance analytical problem-solving capability in the organization
- Integrate the two methodologies by linking them to enterprise processes
- Monitor process performance regularly to assess effectiveness

How do these principles work in practice? In order to embed both Lean and Six Sigma philosophies into the organization, your integrated Lean Six Sigma deployment needs to include two sets of activities. The first set constitutes *improvement activities requiring statistical analysis*. The appropriate methodology for these activities is Six Sigma. The second set involves activities that encompass *improvement in daily work*. This lends itself well to Lean practices. There are two ways in which these practices can be accomplished in your organization. First, you develop a culture and train your employees with tools to carry out small incremental improvements every day on their own. Second, you train people to

identify problems that may require a more targeted effort. These efforts can be either a two- to three-day problem-solving event involving the appropriate players, or can be diagnosed as potential Six Sigma projects that need to be staffed accordingly. Only by implementing both sets of activities together in a connected way can you have an integrated Lean Six Sigma application. This is where the traditional deployment strategies fall short: either they implement a single set of activities (augmented or sequential deployment), or if they implement both, they are not connected (parallel deployment).

The point that we want to emphasize is that an integrated Lean Six Sigma approach should involve improvement activities that are identified through traditional Six Sigma project selection efforts as well as improvement activities that take place as part of daily work. The connection between these two sets of activities is made by applying them to *processes*, rather than implementing them as independent *projects*. Organizational improvement activities should focus on one or more processes, rather than on one or more projects. The process improvement efforts should include Six Sigma projects implemented in conjunction with improvement activities that use Lean principles.

The Integrated Lean Six Sigma approach therefore begins with documenting the key core and enabling processes for your organization, if this documentation does not already exist. This documentation does not need to be very detailed—you can use process maps at the SIPOC level or a high-level Value Stream Map.

Each cycle of Lean Six Sigma improvement involves three steps:

1. **Selection** of a process (or processes) for improvement
2. **Identification** of process issues that need to be addressed
3. **Implementation** of improvement activities and monitoring

In the *Select* step, we choose the process or processes that need to be improved in the current *Lean Six Sigma* improve-



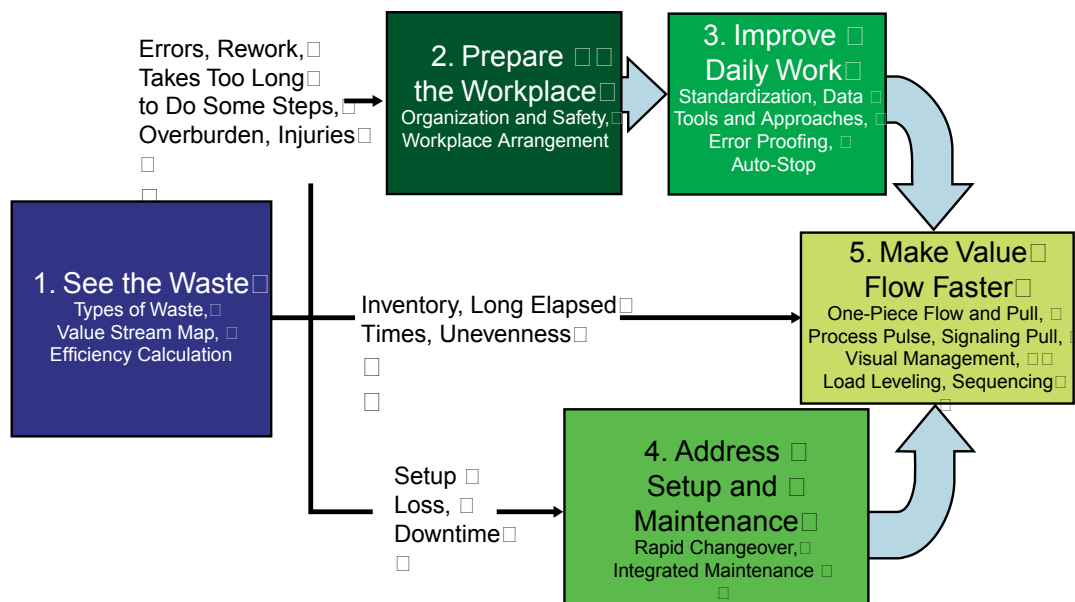
ment cycle. Some guidelines for project selection could be:

- Process is customer-facing and market is changing
- Critical business issues or pain points exist that need to be addressed
- Process is not well documented, or needs to be designed
- Process performance is not stable and a lot of variability exists
- Process has large amount of rework
- Process is alternately under- and over-utilized
- High turnover or burnout rate of process staff
- Process does not respond quickly to change in product
- Flow of materials or information in the process is not uniform

In the *Identify* step, we list the specific issues that need to be addressed in the improvement effort. This identification needs to be done at all levels of the organization contributing to the process and must be done with upstream and downstream processes in mind. This identification is a “laundry list” of all possible improvement issues, big and small, and requires participation of senior managers of the process or associated organizational business unit, Six Sigma Black Belts, operational level managers, and staff. For example, for a customer service process, the list of issues could include:

1. Reduce average speed of answer
2. Reduce the number of customer transfers
3. Reduce the number of pieces of paper on a customer service agent’s desk

**Figure 2: The Lean Pathway Model**



The Implement step should also involve a monitoring component. We track the completion of the processes that are being improved using Six Sigma methods, and train the operators of the process on any daily improvement activities that need to be carried on after the Verify and Control

steps. Similarly, we make sure that the use of job aids or better practices that arise from the Lean activities are integrated into daily practice. Over time, operators should continue to make small, incremental improvements in their everyday work using the Lean principles of improvement.

<sup>6</sup> For more detail on the Lean Pathway model, download the White Paper *Achieving Lean Success: A Pathway for Implementation* from the Oriel website at [www.orielinc.com](http://www.orielinc.com).



4. Allow customer service agents to be able to reach out to “buddies” to ask a question
5. Make sure that all necessary items (job aids, incoming work orders, outgoing work orders, fax in-tray, etc.) for doing work are organized in the work space
6. Reduce the time taken to log in after breaks
7. Reduce the number of incorrect answers provided to customers

You can see that the issues that are described in the list are at different levels of complexity. For example, reducing the number of incorrect answers would require a detailed analysis of the number and distribution of incorrect answers and may require establishing correlations between incorrect answers and explanatory variables like call complexity, training levels, or experience. This is an issue that would require a Six Sigma approach. An issue such as allowing customer service agents to reach out to buddies may require a reconfiguration of workspace. This could be achieved in a two- to three-day event where different configurations are attempted. For the issue of creating a more organized workspace, each customer service agent might be provided with a template and be asked to ensure that their workspace remains organized each day. The idea is that identifying all issues for a process will allow you to distinguish between those activities that need Six Sigma and those that need Lean and will allow you to deploy them in an integrated manner.

Finally, in the *Implement* step, you can use your organization’s Lean and Six Sigma governance structures to make the improvements. For the issues that require Six Sigma, we can use DMAIC or DMADV. For the issues that require Lean, we train the people who operate the selected processes to use the Lean Pathway<sup>6</sup> model shown in Figure 3. This model presents a systematic way of undertaking everyday process improvement using Lean concepts. The model begins with changes in one’s work area, links up these changes with upstream and downstream improvements, and finally looks at ways of increasing throughput and reducing waste across the entire process. Some of the activities suggested by the Lean

Pathway may be changes to daily work; others may require targeted events, and still others may turn out to require more sophisticated analysis and may be re-chartered as Six Sigma projects.

As we mentioned earlier in this paper, the approach that we present here does not require you to stop your current Lean Six Sigma implementation. If you are already using Lean tools, or want to incorporate them into your Six Sigma program, there is no reason not to do so as long as the activities associated with improvement in daily work are considered as well.

The Implement step should also involve a monitoring component. We track the completion of the processes that are being improved using Six Sigma methods, and train the operators of the process on any daily improvement activities that need to be carried on after the Verify and Control steps. Similarly, we make sure that the use of job aids or better practices that arise from the Lean activities are integrated into daily practice. Over time, operators should continue to make small, incremental improvements in their everyday work using the Lean principles of improvement. We continue to monitor the performance of processes we have improved until it is time for another improvement cycle. Based on our monitoring, we return to the Select step as needed. In this way, we continue to integrate Lean and Six Sigma methodologies in a systematic way over time, and incorporate the two methodologies into all the organization’s processes.

## Conclusion

In this paper, we have described an approach for integrating Lean and Six Sigma methodologies that captures the key principles and philosophies of each method. This approach will work both when an organization is deploying Lean Six Sigma from scratch and when an organization wants to overlay an integrated methodology on an existing Lean or Six Sigma program. But obviously, the ultimate test for you is whether it will work in your organization. We can say with confidence that by following the approach we have presented, you will be able to build skills in your organization in both Six Sigma and Lean, and will have the capability to



leverage these skills in a strategic and aligned way. But whether this approach moves your organization one step further in your Lean Six Sigma integration objective, or whether it helps you to transform your organization to a new level of business excellence depends on your organizational culture and your organization's willingness to support the behavioral changes that are needed to truly take advantage of this approach.

Achieving the transformational possibilities of this approach requires a significant change in organizational mindset in a variety of ways. It requires moving away from selecting random Six Sigma projects and instead focusing Six Sigma efforts on processes. It requires the effort of high-level process documentation to link every Six Sigma and Lean activity to a process. It requires diligent training and application of the Lean Pathway as an everyday activity and not as a special improvement initiative. It requires a focus away from tools and a deeper concentration

on the philosophies underlying the tools. And finally, it requires regular monitoring and assessment of impacts to ensure that the processes remain defect-free, stable, and competitive in the market.

Is this asking for too much? We think not. These are enabling conditions for business excellence that all organizations should eventually meet. Your organization may not have all these elements in place at this time, but irrespective of whether you implement a Lean Six Sigma program, process thinking, commitment to continual improvement, and performance monitoring are all good practices that are important to cultivate in any organization. And so, even while you launch your Integrated Lean Six Sigma program, it helps to work at building up these enablers. This will ensure that over time, you will have not only an effective Lean Six Sigma implementation, but also the organizational maturity to exploit it to the greatest benefit.

In addition to publishing white papers and guidebooks for instructors and students to use in Lean, Six Sigma, and process excellence training, Oriel Incorporated offers consulting and training services to help organizations develop, implement, and sustain the methodologies needed to improve organizational performance. Expertise includes leadership development, change management, teambuilding, Six Sigma, process and product design, Lean, process improvement, and problem solving. Oriel publishes several well-known off-the-shelf books including *The Team<sup>®</sup> Handbook Third Edition*, which has sold more than one million copies.

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