

## LEAN SIX SIGMA AND INNOVATION

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**Abstract.** In today's marketplace, increased globalization, constant technological advances and other competitive pressures, innovation is a proven success factor for many firms. The resulting opportunities and threats have placed innovation near the top of manager's priority lists. This paper will show that the right operations strategy can help companies make innovation a regular occurrence. To survive in today's marketplace, manufacturers must embrace new ideas and processes. Lean Six Sigma is a business improvement methodology that maximizes shareholder value by achieving the fastest rate of improvement in customer satisfaction, cost, quality, process speed, and invested capital.

### 1. THE INNOVATION PROCESS

In today's high-tech world, innovation has become a driving force for individual firms and entire economies [2]. Businesses see it as a key to survival because long-term success requires that the customer be excited by innovations provided by a company's product and services, hence continued survival requires continuous innovation.

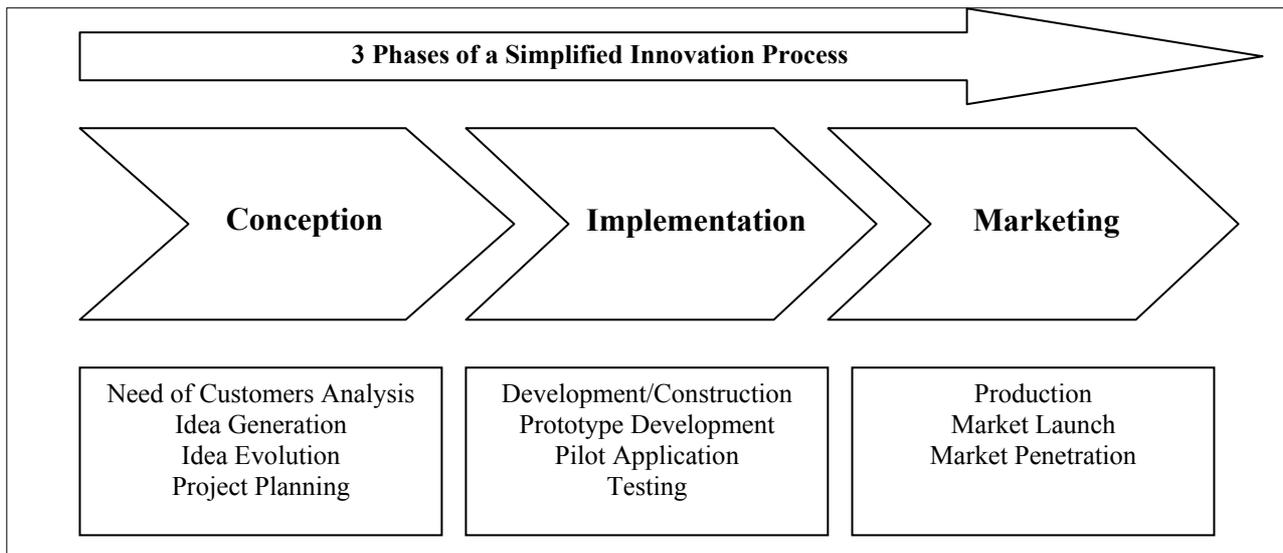
Innovation is defined as "an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention which leads to development, production, and marketing tasks striving for the commercial success of the invention" [4]. In his work on innovation, researcher and author Everett M. Rogers[10] points to the following:

- **Relative advantage** - The innovation is perceived as better than what came before.
- **Simplicity** - The innovation is perceived to be simple to understand and use.
- **Compatibility** - The innovation is perceived to be consistent with the existing values, past experiences and needs of potential adopters.
- **Ease of experimentation** - The innovation can be experimented with on a limited basis.
- **Observability** - The results of the innovation are visible to others.

The current rapid rate of change in technology places a higher premium on being able to quickly offer new product to the marketplace, "With the rapid and widespread diffusion of technologies used to produce goods and services speed to market may be the only source of competitive advantage" [7].

The innovation process encompasses systematic steps, beginning from problem/requirement analysis to idea generation, idea evaluation, project planning, product development and testing to finally product marketing. The steps may overlap each other. These steps may be categorised into three broad phases, which represent a simplified innovation process -see Figure 1. [12]

The management of innovation process has therefore many dimensions. Generally, innovation process management is the management of all activities involved in the process from the idea generation to the successful innovation [11]. An effective innovation management includes scanning of external environment, strategy formation and implementation, resource management, and continuous learning.



**Figure 1: Three phases of a simplified innovation process**

As innovation is pushed into this rapid product development cycle, heightened expectations of the marketplace call for better tools to improve the productivity of the innovation process. Actually, innovation coupled with Six Sigma discipline and data can be the best way to get results, and with Lean techniques to simplify this process. Companies across the world are successfully using the techniques for improving business performance through product and process excellence.

## 2. WHAT IS LEAN SIX SIGMA?

As its name suggests, Lean Six Sigma is a combination of two business-improvement systems, Lean and Six Sigma. Lean refers to the reduction of waste, or the elimination of unnecessary steps to increase speed and productivity. Six Sigma is the reduction of variance to improve system performance.

With all the fervor of the freshly converted, proponents of Six Sigma and lean manufacturing have frequently clashed over the alleged superiority of one ideology above the other, fighting over resources and conflicting cultural approaches to improvement. But in recent years practitioners have begun to integrate elements of the two strategies. Both the Lean and the Six Sigma methodologies have proven over the last years that it is possible to achieve a lot of improvements in cost, quality, and time by focusing on process performance. Whereas Six Sigma is focused 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. Lean redesigns processes for efficiency while Six Sigma optimizes the reliability of processes. The synergies are clear. Together, they add up to highly efficient workflows that produce high-quality products.

### 2.1. SIX SIGMA CONCEPT

Developed by Motorola in the 1980s, Six Sigma is a business concept that touts improving quality and business processes. Specifically, it is "a disciplined method of using extremely rigorous data-gathering and statistical analysis to pinpoint sources of errors and ways of eliminating them" [6]. The Greek letter *sigma* is sometimes used to denote

variation from a standard. The philosophy behind Six Sigma is that if you measure how many defects are in a process, you can figure out how to systematically eliminate them and get as close to perfection as possible. In order for a company to achieve Six Sigma, it cannot produce more than 3.4 defects per million opportunities, where an opportunity is defined as a chance for nonconformance.

It provides specific methods to re-create the process itself so that defects are never produced in the first place. This is the reason Wall Street and corporations as diverse as Allied Signal, Honda, Maytag, Raytheon, Texas Instruments, Canon Hitachi, Lockheed Martin, American Express, Toshiba, Du Pont, and Polaroid have embarked on corporate wide SIX SIGMA programs [8].

Six Sigma is about asking tougher and tougher questions until we receive quantifiable answers that change behavior. Through Six Sigma, companies relentlessly question every process, every number, every step along the way to creating a final product. Managers, employees, and customers ask different kinds of questions of each other than they've asked before. As Six Sigma takes hold across an organization, it creates an internal infrastructure that includes executives, managers, engineers, and operations and service personnel. Six Sigma tells us [9]:

- We don't know what we don't know.
- We can't do what we don't know.
- We won't know until we measure.
- We don't measure what we don't value.
- We don't value what we don't measure.

So, in a general way, Six Sigma is a process of asking questions that lead to tangible, quantifiable answers that ultimately produce profitable results.

## 2.2. LEAN MANUFACTURING CONCEPT

Lean manufacturing is a proven approach to reduce waste and streamline operations. It embraces a philosophy of continually increasing the proportion of value added activity of their business through ongoing waste elimination. Lean production is an assembly-line manufacturing methodology developed originally for Toyota and the manufacture of automobiles. It is also known as the Toyota Production System. The goal of lean manufacturing is described as "to get the right things to the right place at the right time, the first time, while minimizing waste and being open to change". Engineer Ohno, who is credited with developing the principles of lean production, discovered that in addition to eliminating waste, his methodology led to improved product flow and better quality. Lean is founded on a mathematical result known as Little's Law [5]:

$$\text{Lead Time Of Any Process} = \frac{\text{Quantity Of Things In Process}}{\text{Average Completion Rate/Unit Of Time}}$$

The lead-time is the amount of time taken between the entry of work into a process (which may consist of many activities) to the time the work exits the process. In procurement the Things in Process are the number of requisitions, in product development the number of Projects In Process, and in manufacturing the amount of Work In Process.

Instead of devoting resources to planning what would be required for future manufacturing, Toyota focused on reducing system response time so that the production system was capable of immediately changing and adapting to market demands. In effect,

their automobiles became made-to-order. The principles of lean manufacturing enabled the company to deliver on demand, minimize inventory, maximize the use of multi-skilled employees, flatten the management structure, and focus resources where they were needed.

During the 1980s, the set of practices summarized in the ten rules of lean manufacturing were adopted by many companies in the U.S.A. and Europe. The management style was tried out with varying degrees of success by service organizations, logistics organizations and supply chains. Dell Computers and Boeing Aircraft have embraced the philosophy of lean production with great success.

The ten rules of lean production can be summarized:

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

### **2.3. INTEGRATING LEAN AND SIX SIGMA IN THE INNOVATION PROCESS**

As we know, the processes of all companies and organizations must: become faster and more responsive to customers, achieve Six Sigma capability and operate at world class cost. Only the combination of Six Sigma and Lean can fulfill all three goals. In any process, Lean Six Sigma creates a value stream map of the process identifying value add and non-value add costs, and captures the Voice of the customer to define the customer Critical To Quality issues.

Developing an integrated improvement program that incorporates both Lean and Six Sigma tools requires more than including a few Lean principles in a Six Sigma curriculum or training Lean Experts as Black Belts. An integrated improvement strategy has to take into consideration the differences and use them effectively [1]:

- Lean projects are very tangible, visible, and can oftentimes be completed within a few days (whereas Six Sigma projects typically require a few months). An integrated approach should emphasize Lean projects during the initial phase of the deployment to increase momentum.
- Lean emphasizes broad principles coupled with practical recommendations to achieve improvements.
- An integrated improvement program needs to be fueled by a vision of the future state and by a pipeline of specific projects that will help close the gap between current and future state.
- Whereas the Six Sigma process and tools can be applied to virtually every process and industry, the Lean approach is much more specific and the content needs to be adjusted to industry needs: For example, reducing set-up time in a plant that has lines dedicated to a single product is pointless. Therefore, the Lean curriculum needs to be adjusted to meet the needs of the specific business.

At the companies that used Lean Six Sigma to achieve broad-based innovation and superior financial performance, IBM Institute for Business Value study [3] identified several

distinguishing characteristics of their approaches that set them apart from those with a traditional operational improvement mindset. Successful innovators had:

- **An innovation vision based on factual customer and market insights** – Leaders crafted a compelling vision based on a keen understanding of market demands and their own capabilities. Their objectives were explicit and few in number to enable focus.
- **Leadership committed to perpetual innovation** – CEOs and business unit leaders played active, enthusiastic roles. They were clearly committed to making an indelible organizational change, not just launching another initiative.
- **Alignment across the extended enterprise** – The strategic innovation vision was used as a unifying force to align disparate business units and influence supplier and customer relationships.
- **Organizational capabilities that made innovation habitual** – At the outset, these companies' Lean Six Sigma initiatives involved an intense period of training, dedicated resources and an initial bubble of projects to jumpstart their transformation. But over time, as the mindset became more mainstream these companies established enduring processes that helped drive continuous innovation throughout the organization.

### 3. CONCLUSION

In today's competitive business environment even the best companies are searching for ways to gain and maintain an advantage. Managers in every organization have a responsibility for initiating and directing change in addition to their regular objectives. Everyone has the shared responsibility of changing the organization to make it better equipped to meet the needs of its customers and to keep finding innovative ways to deliver its products or services.

Lean Six Sigma has a proven track record of delivering massive financial results across all business sectors. Leaders engaged in Lean Six Sigma also value the growth & development of their people; they ask better questions, get better data, make better decisions, and lead higher performing teams. Lean Six Sigma combines the power of Six Sigma – strategic alignment, customer focus and rigorous analytical tools – with Lean's focus on speed, and delivers breakthrough results.

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