Comparison between Lean Six Sigma and Six Sigma

1. Introduction

In today's industrial scenario, the quality of products and services holds utmost importance. Organizations are constantly trying to optimize their processes and leverage methodologies and tools that assist in delivering high-quality products to end customers. The Lean Six Sigma and Six Sigma methodologies are used worldwide to achieve the desired level of efficiency and quality. Thus, it becomes essential to analyze both methodologies from the point of comparison to understand the pros and cons of both methodologies. The objective of this research is to compare Lean Six Sigma and the Six Sigma methodologies. This study also helps to understand the quality of Six Sigma that is required when moving from various types of waste. This research also provides the levels of quality between quality and waste. Both Lean Six Sigma and Six Sigma aim at improvement in business processes and quality enhancement. Both can be used in all types of organizations on all aspects, right from manufacturing to services and public administration. These address process optimization, which benefits the manufacturing, insurance, banking, service sectors, and many other fields. Most importantly, Lean Six Sigma and Six Sigma methodologies contribute to waste reduction in the organization. Lean is more focused on defect reduction, improving machine uptime, and product throughput, whereas Six Sigma is quality-focused and looks at reducing the variation in the process and achieving the targets of mean value.

2. Historical Background

The Lean Six Sigma has been around for more than 20 years, whereas the general Six Sigma has been popular for more than 40 years. So, what took us 20 years to improve or to add? Was Six Sigma flawed in the first place, which needed improvement? Well, to answer all these questions, we must, therefore, comprehend the historical background of how each one of them came into being and the evolutionary efforts that went into the design of the new version. Six Sigma actually saw its dawn back in 1986 at Motorola Inc. It was first used as a business development strategy by their engineer. From then on, with the joint efforts of many

professionals excelling at process engineering, statistics, and operations research, the concept got better through progress and gained worldwide interest.

It was a very hardcore quality management philosophy called the "Black Belt" training, until the adoption by General Electric in the year 1995, where it now started focusing on more converse analysis combined with statistical leadership orientation of the firm. As everyone knows, it was also in General Electric where the company undertook the idea of training thousands of employees to Black Belts, Green Belts, and Yellow Belts. Lean Six Sigma had its inception inspired by Toyota between the years of 1985 and 1990. The Toyota assembly line used this type of methodology of Lean Manufacturing. Later, as Motorola was busy with the development of Six Sigma, the then CEO of General Electric who is credited with revolutionizing Six Sigma points to Kaizen and Muda/visionary ideas as inspiring milestones for initiating the company's transformation. General Electric's continuous improvement movement applied Lean, Six Sigma, and other tools.

2.1. Origins of Six Sigma

2.1. Origins of Six Sigma. In the late 1980s, a company created Six Sigma as an improvement method to combat challenges it was facing at that time. The company was struggling with its automotive sector products, which were seen to be lagging behind its competitors in terms of quality and efficiency. Its other sectors were also facing stiff competition from producers in countries such as Japan. To provide a structured approach to company-wide enhancement of quality, the company initiated the development of a more robust quality tool, which became widely known as Six Sigma. The Six Sigma improvement effort was successful, and case studies reporting improvements in quality, yield, reduction in cycle time, and savings of up to ten times the improvements of other quality initiatives were published. The success with Six Sigma caused significant interest in its application, and the publication of a key paper intensified interest in Six Sigma.

With its emphasis on statistical methods, Six Sigma seeks to reduce the number of defects in company products or processes to one in every six standard deviations away from the desired quality target. Six Sigma deploys highly skilled professionals who use data to help clarify the strategic goals in terms of customer needs and establish how well the present service or product meets these needs. For example, goods should be within specification, have no failures, and should suit the customer in terms of what they want. The highly defined performance standards for quality set in Six Sigma are used to motivate and measure the success of the projects for project leaders. The Six Sigma methodology involves an engineering approach to

quality, although a key tenet of Six Sigma is to recognize that this cannot be achieved unless the overall company culture, such as the top management's commitment to quality and to leading the customer satisfaction improvement effort, is also addressed. An early contributor to the development of Six Sigma created the software and assessment materials that helped shape many of the Six Sigma practices. Further development of Six Sigma occurred, and later work with consultancy involved the first deployments at the company, where groundwork of the Lean Six Sigma process was established. Six Sigma has been said to be one of the most influential management innovations to have influenced world-class companies across a wide range of industries, including healthcare, business, education, and government.

2.2. Development of Lean Six Sigma

Originally, Lean Manufacturing was developed in Japan, following World War II, particularly executed by Toyota Motor Corporation. The objective of Lean production was to eliminate the waste caused by overburden and unevenness in working systems. In essence, “lean” means “to do more with less.” Six Sigma, Lean’s predecessor, was developed in the 1980s and became extremely popular in the corporate sector. Six Sigma focused on reducing variability of a process while quality improvement was the primary essence of the framework. Instead, Lean Six Sigma is a combination of the best of the Six Sigma and Lean methodologies. The implementation of Lean principles within the Six Sigma framework was initially implemented in 2004 and was later named “Lean Six Sigma.” Another landmark is credited to organizations such as General Electric, which concentrated on implementing Lean Six Sigma principles, with a number of companies adopting the same methodologies after witnessing benefits in terms of increased performance.

It merged Lean and Six Sigma due to the success of the Lean movement in manufacturing, reducing defect levels by removing non-value-added activities. Losing weight had become much easier than older weighted products. Initially an experimental union of the two systematized methodologies, Lean and Six Sigma, the discipline of Lean Six Sigma is now seen as a new method of producing products and additional services that reduce cost and increase quality. There is an argument that Lean and Six Sigma are stronger together than apart because, alone, Lean always focuses more on “process flow” and provision of smoother customer service, while Six Sigma focuses more on the use of statistical methods to reduce defects in product lines. Besides improved quality, faster delivery, and lower cost, pioneer Lean Six Sigma initiatives have noticed additional benefits including increased sales growth and higher share price growth. In recent years, Lean Six Sigma has

continually become more and more important in its applicability across the public and not-for-profit sectors. However, the implementation of this particular technique does not always come without its challenges.

3. Key Concepts

Methodology and Main Findings: Lean Six Sigma is an operational excellence approach. Both Lean and Six Sigma are designed to address challenges and improve the performance of an organization. Six Sigma is a set of principles, methods, and techniques developed over the years in different contexts. It has gained popularity because of contributions at Motorola. Its main goal is to reduce process variation and implement technological applications and standard process design. Data analysis is the basis of Six Sigma practices. Six Sigma improves the performance of products and services by targeting zero defects.

Lean Manufacturing is most often attributed to Toyota. It includes the elimination of waste, respect for people, and continuous improvement. It is a systematic approach to identifying and eliminating waste through continuous improvement, providing an opportunity for people, equipment, and processes to achieve the required performance. The combination of both Lean and Six Sigma strategies results in Lean Six Sigma. In LSS, tools from both strategies are used to improve processes at maximum rate. Both Six Sigma and Lean identify two different types of waste. Lean Sigma methodology focuses on the complete value stream process from customer to supplier. Lean methodology strives for the elimination of waste. Waste can be defined as activities that do not add value to the customer. Waste in a process will result in increased costs with little or no benefit to the customer. With the DMAIC approach, Six Sigma is used to reduce variations in processes; this results in proper functioning, which further leads to reduced cycle times and other benefits. In the Lean methodology, tools of value stream mapping are used to identify where value is added along the process chain.

3.1. Six Sigma Methodology

3.1. Six Sigma Methodology. Quality, time, money, and leadership are some of the top concerns for business owners. With the introduction of the Six Sigma concept, the meticulous approach to process improvement is having its standards redefined. This principle, a statistically based rigorous methodology, and its quantifiable metrics are already spreading across the world as more and more businesses begin adopting this notion. Six Sigma is not an approach for breakthrough improvements or revolutionary management practices, although it yields such results. Rather, it is a disciplined, data-driven, systematic method for profoundly altering an

organization's underlying processes; thus, it provides the vehicle for the organization to close systematic performance gaps and continuously improve key internal processes. The powerful foundation of the Six Sigma management system is the DMAIC Process (Define, Measure, Analyze, Improve, Control). DMAIC is a structured approach for continuous process improvement or problem-solving initiatives, and it takes into account the variability of processes. DMAIC is mostly used for the improvement of dissatisfactory performance measures or problem resolution. In order to substantiate solutions, statistical analysis is one of the key principles underlying all five phases. The “Control” phase is put in place to continue the improvement itself and to make sure that the results achieved are sustained. In short, Six Sigma is a failed approach to problem-solving and process optimization when used to address a defect that does not yet exist, as the aim of Six Sigma is to retain customers by delivering rated output, to maintain or improve the new level of performance of the process, and to reduce waste.

3.2. Lean Methodology

The Lean Methodology focuses on principles and practices designed to eliminate waste from the process and then maximize the value. This is done by streamlining the process and reducing non-value-adding activities, focusing on the efficiency aspect of the Six Sigma concept. Lean is represented by concepts such as Value Stream Mapping and 5S. The underlying principles for Lean Manufacturing are: define value from the customer perspective, identify the value stream, and study the consumer's request for products and services. The next principle is to activate the holonomic model structure of cell production and to be aligned with the flexible cell production system. Following this, create the "flow structures" based on the pull demand flow. This principle shifts all the principles' active members into letting the workers decide when they should stop making any engineering and manufacturing products instead of controlling the production flow. The last two principles are perfection, where the Lean company's resources need to be minimized to operate the system, and excellence in lean manufacturing involving continuous improvements in resources, celebration, and successes.

The Lean concept within Six Sigma also focuses on making the process efficient by understanding the flow of work and removing or reducing the seven wastes. In that sense, it is a tool used within Six Sigma to focus on areas to reduce complexity or make steps more efficient. Lean focuses on teaching flow management and helps companies identify and implement reduced cycle times and zero inventories. Lean incorporates tools like Value Stream Mapping and 5S to help organizations streamline their processes. Lean stops the flow and defects reaching the customer in

the Optimas system with an error-proofed "cell" work environment. The application of the lean methodology is the skillful use of common sense with support from employees, top to bottom, in the organization. Moreover, Lean healthcare adopted and implemented various techniques. It stops underproduction. In this regard, it integrates customer feedback by balancing the 4Ps: Patients, Providers, Payers, and Public Health. In addition, it can lead to changing the skills of the "near-certainty" approach.

4. Methodologies Comparison

Lean Six Sigma and Six Sigma are two distinct methodologies. These methodologies approach processes and the problems they pose from different angles and concern themselves with distinct outcomes. There is some crossover and cross-pollination, but in their purest forms, LSS looks to reduce waste while Six Sigma seeks to improve quality. With Six Sigma, the objective is to reduce and minimize the variation in outputs in order to improve customer satisfaction and loyalty. With Lean, the goal is the removal of excess waste leading to efficiency gains.

We know that Six Sigma concentrates on what and drives us toward effect answers, telling us what could be accomplished while LSS concentrates on the how that drives us towards cause and capability. In this section of the report, we will investigate major differences between both methodologies in a structured manner. As a result, we will mention the primary objective of both methodologies before identifying the main process or tool utilized. Particular attention will be paid to the differences noted, along with the outcomes, and the distinctive aspects of these methods on the respective workforce engagement and culture. Furthermore, we will provide the territory metaphor by defining the metric references used to assess this. Finally, we will provide a synthesis and a conclusion on the effectiveness of both methodologies and our decision making.

4.1. Approach and Focus

Whereas the previous subchapter served to set the boundaries of Lean Six Sigma and Six Sigma as knowledge fields and practices, this subchapter provides an in-depth treatment of the individual methodologies' respective approaches and focuses. To facilitate comprehension, the essential differentiating features between Lean Six Sigma and Six Sigma will be highlighted briefly. For an item inspection, this means that Six Sigma focuses on improving the traditional service quality that stresses the lack of defects, while Lean focuses on reducing the time that the customer must wait for value production. The Lean matrix-based perspective/project approach looks at a company, i.e., a project that utilizes either

the Lean or Six Sigma tools and serves to reach a specific objective. It maintains that there is no Lean tool in nature; it argues that the focus of LPS was on aligning the different practices toward a common goal. In most of the literature, the authors state that Lean is to identify and eliminate waste and to improve the process flow and speed. The focus of Six Sigma, on the other hand, is on identifying and reducing variation.

4.2. Tools and Techniques

Six Sigma is a methodology for quality management, and it is widely known for the use of statistical tools. The different tools and techniques used in Six Sigma are DMAIC, hypothesis testing, regression analysis, control charts, process mapping, and root cause analysis. The effectiveness of the tools used in Six Sigma depends on the objective of quality. Lean revolves fundamentally around process improvements. To create value, an organization has activities and non-value-generating activities, and for performing the effective activities, there is a demand, and all these process activities fall under the wider definition of processes. The different Lean tools related to process improvement are Value Stream Mapping for process improvement, Kanban for inventory control, and Just-In-Time to operate and implement a smooth process. The Lean tools and techniques complement Six Sigma, as the focus is on process improvement that leads to an increase in performance and a reduction of process errors and reworks.

The usefulness of the different tools used in Six Sigma and Lean has advantages and limitations for an organization. For most of the tools, they cannot be implemented without training. Also, most of the tools need skilled practitioners for solving quality issues in an efficient and effective manner. Tools compared from different methods are used for eliminating waste in processes, improving quality, and lowering costs versus reducing costs, lead time, and working towards achieving the organization's objectives. Lean philosophy helps Six Sigma by producing a continuous flow, which is very helpful for Six Sigma because the variance is less, and thus the organization can achieve minimized levels of inventory. The tools and techniques help the organization in achieving reduced lead and process times. Examples of tools and techniques used include Process Mapping for processes, DMAIC, Value Stream Mapping, Statistical Process Control, and Root Cause Analysis, given their alignment with problem-solving. The use of examples is very practical and will be engaging to potential readers.

5. Benefits and Limitations

5.1 Benefits of Six Sigma Methodology With Six Sigma, many success stories have been reported in both manufacturing and service organizations. The key benefits include reducing defects, improving processes, increasing efficiency and the bottom line, improving customer satisfaction, enhancing brand reputation, and increasing revenue. Therefore, it provides benefits to society at large. A reduction in defects also means improving quality and thus aligns with sustainable total quality management requirements. Six Sigma is primarily directed towards improving quality in the organization.

5.2 Advantages of Lean Six Sigma Methodology The advantages of Lean Six Sigma come from a perspective of reduced lead time and increased operational efficiency. There are many compelling attributes of the Lean Six Sigma system.

Faster Turnaround Times Some leading Lean Six Sigma strategists acknowledge that the implementation of Lean Six Sigma yields significant improvements in lead time, due in large measure to the implementation of Lean tools aimed at essentially reducing waste in the process. As lead time is one of the critical success factors for many healthcare providers, this is a compelling argument for the implementation of Lean Six Sigma tools and methods. Furthermore, shorter lead times will also translate to improvements in provider flexibility, as they will be able to move workload through the system more quickly to meet their capacity and resource constraints.

5.1. Advantages of Six Sigma

All in all, Six Sigma is a good strategy, allowing focus on and eliminate process variability, while comprising phases that help in attaining a real overall improvement in quality.

Advantages of the Six Sigma approach:
- Reducing variability: The adoption of tools, techniques, and statistical analyses makes it feasible to direct attention to each component of a process, beginning from the input variables to variables that impact directly on the project's outputs. As such, when variability is reduced, the output becomes more predictable, and high quality can be achieved. This reduction in the variability of the different stages, subsequent to the process and in the process itself, enables the development of products or services that actually offer what customers need, expect, and value.
- Data-driven decision making: Six Sigma focuses on reliable data and effective measurements in order to support decisions at every process stage. These

measurements provide a clear idea of the performance of the process.
- Customer satisfaction and customer loyalty: By controlling and decreasing the process variability, it is possible to optimize customer satisfaction.
- Financial benefits: Six Sigma projects are basically designed for the reduction or elimination of defects in the improvement of the processes and activities, resulting in a reduction in costs, the elimination of rework, reduction in warranty costs, reduction of time, and a reduction in the enhancement of life cycles among other factors.
- Training and certification: This teaching of the basic methodology and mechanisms allows the acquirement of a system in the company, starting with Yellow Belts, moving onto Green Belts, and making their way to Black Belts, Managers, and Master Black Belts, creating a quality culture within the company.
- Implementation success stories: Several organizations that implemented the Six Sigma strategy successfully include various automobile manufacturers and other companies.
- Provides metrics and reporting: Improved metrics and reporting provide continual improvement measurement for projects and for management support.

5.2. Advantages of Lean Six Sigma

Some of the major advantages of a Lean Six Sigma approach include: dual focus (quality and efficiency), streamlined processes, reduction of waste, and providing organizations with a quicker response time to their customer base. By using Lean principles, Lean Six Sigma ensures that customers get more of what they want while reducing resource costs. In looking at companies that have implemented Lean Six Sigma, employee engagement has risen considerably. The concept of Lean has also spawned additional work in the field of Service Management. Lean concepts can help prioritize and execute those facets of quality IT governance. Coupled together, Six Sigma focuses on improving performance by reducing variation of products and/or services. Together, Lean Six Sigma provides a unified approach for simultaneously improving both efficiency and effectiveness and, in so doing, facilitates the dual focus on quality and cost associated with customer satisfaction. Continuous improvement via Lean Six Sigma principles can produce outcomes remarkable enough to fuel an organizational change in culture from one of simple compliance with quality standards to one of true quality improvement. Lean Six Sigma projects have provided breakdown reductions in cycle time, have reduced volumes of work-in-process, and have slashed defects by up to 70%. In commercial settings, these improvements have helped reduce costs; in healthcare organizations, the improvements have helped to save lives. While the specific results of any

implementation can and will vary, the promise and potential of Lean Six Sigma are undeniable.

5.3. Limitations of Six Sigma

Equal attention needs to be paid to the limitations and challenges experienced during implementation. Six Sigma is complex and difficult to manage; organizations tend to experience some resistance among employees, and the implementation is often met with cynicism and disbelief. The technical nature of Six Sigma makes people feel vulnerable, and individuals have a natural resistance to change. The cross-functional nature of Six Sigma requires numerous and diverse skills and areas of expertise that previously did not, or perhaps only marginally, exist. Organizations and individuals not comfortable with dealing with numerous technical tools or complex statistical problem-solving methods would perceive that Six Sigma is difficult to implement. Training and development in the quantitative and technical areas can be expensive, take time, and are difficult to quantify and evaluate.

The implementation of Six Sigma requires the appointment and commitment of staff, often on a full-time basis. Many would argue that they can't afford to lose resources in this manner, especially while the organization may already be experiencing issues such as downsizing and rightsizing. Resistance to change is experienced across many of the individual elements identified in the sections listed. As mentioned, Six Sigma is seen by many as a complex and technical problem-solving technique that requires quality professionals behind the wheel. Therefore, other qualitative and desirable factors may be overlooked that, in practice, might have a different impact on process improvement. Areas such as customer service, relationship management, and cost are targeted areas that may also be overlooked if a purely Six Sigma focus is taken. In addition, Six Sigma is often considered a time-consuming, lengthy, and bureaucratic process. It is heavily reliant on emphasis from the leadership.

5.4. Limitations of Lean Six Sigma

This section is about the limitations of Lean Six Sigma, which is the advanced form of Six Sigma. Incorporating Lean and Six Sigma sometimes creates a major issue since both originated from two different philosophies and will have a different culture that makes implementation even more difficult. Implementing Lean Six Sigma will have an issue with the level of training that is required and the involvement of employees and managers. Coordinated use of Lean and Six Sigma is intended to attack process waste from a speed and quality perspective. There's always a perceived conflict between focusing on Lean (speed) and focusing on Six

Sigma (quality). Many believe that Lean is a manufacturing process improvement program that does not have to involve a change in cultural values. As such, they are willing to focus on speed without concern for detail to achieve this goal. Though this is a simplistic view of Lean operation, the bigger question is whether this attitude is bad or not. This is contrary to the philosophy of Six Sigma. Six Sigma says you can't change the defects and say that everything else is acceptable. If you improve quality, everything improves.

The implementation of Lean Six Sigma involves the improvement of terms v, T, and w. According to the integrated definition of Little's Law, if we increase the units completed per hour (in a single location) and the cycle time remains constant, more units started are needed to maintain the same inventory. Often, vendors rush to implement the latest technique without embracing the principles; many rushed to implement the latest systems without really understanding the basic elements required to improve their organizations. There will be pressure to see everything that is being done to utilize Lean Six Sigma, and if it is not adequate, then it may be removed and investment in this approach withdrawn. This is in no way consistent with the principle of continual improvement. This does, however, require teams who have worked closely with management to use effective measurement to demonstrate the impact of Lean Six Sigma deployment.

6. Industry Applications

Both lean and Six Sigma have been successfully applied in a wide variety of industries. These include the manufacturing industries of aerospace, automotive, and healthcare. They have also been successfully applied to services, such as those in the financial, government, healthcare, and information technology areas. Many organizations have seen substantial improvements in their operations through the applications of lean and Six Sigma principles and tools. Some of these improvements include: errors and omissions reduced by 50% and throughput a fivefold increase for a legal firm via lean and Six Sigma; reduced defect level from 200 PPM to less than 60 PPM, realizing a near 100% improvement in OTD within three to six months, and 20% to 40% productivity increases at Georgia-Pacific; 95% level of customer satisfaction, with a decreasing number of customer complaints related to insurance policy cancellation.

It is clear that lean and Six Sigma have benefits in many industries of all types. Though many of the tools are common to both methods, the motivations and focuses of these two methods differ so that each can present a slightly different approach to solving the same behavioral problems. By educating professionals in both lean and

Six Sigma in a more general yet practical way, programs such as Six Sigma Leadership and Black Belt training should also include some type of industry education or certification within the same class. This would strengthen the skills and build on the job-specific knowledge most Belts will draw upon when improving their organizations. There is agreement that industries are also moving to 'continual improvement' as opposed to making larger leaps in quality, product, service, or process improvements. The new trend is small improvements enacted on a recurring schedule: preferably daily or monthly, depending on the industry and product developments.

6.1. Examples in Manufacturing

Manufacturing is one of the most common applications for quality management, and hence for quality management methodologies. Its flagship methodologies are Six Sigma and Lean, or more usually, Lean Six Sigma. In this section, we will present several examples on their use in manufacturing. Both Lean and Six Sigma originated in manufacturing. It is therefore not surprising that we find many examples from this area. The manufacturing environment is subject to high degrees of standardization and automation. This makes it more susceptible to small changes and bug signals, if something goes wrong. As such, there are many parameters that need to be continuously monitored, and a lot of data is generated. All this information makes the principles of Lean and Six Sigma easier to apply, as the success of both methodologies depends on the effectiveness of the data analysis.

Specific areas where Six Sigma and Lean Six Sigma are most commonly used in manufacturing include advance quality planning, asset optimization, continuous flow, customer complaint problem solving, decision-making for site selection, fast response, food manufacturing, human resource performance reviews, injection molding, inventory management, mistake error proofing, packaging defects, product design, product quality problems, food processing, production scheduling, purchasing, receiving, returnable container management, replenishment, shipment processing, total productive maintenance, warehousing, and welding. A comparison of two companies showed that one had reduced its backlog of delayed flights by 91 percent and had extracted a net benefit in terms of cost savings and extra sales.

It is important for an organization to choose the appropriate quality methodology as per their requirement. This can be achieved by analyzing the organization's requirement as well as by critically examining the feasibility of implementing a quality methodology within a given organization. To support the implementation of the quality methodology, the organizational structure, process, as well as the

mindset of people, need to be taken into account. The focus should be to initiate a change in the mindset of the employees. The employees should be encouraged to take the initiative to solve quality-related issues, and all efforts should be made to improve the existing benchmark of the best product offered by an organization. It is necessary to motivate employees to use the concept of continuous improvement and other tools defined under quality methodologies to maintain the competitive advantage in the market.

6.2. Examples in Service Industry

If you've ever been admitted to a crowded hospital emergency department, perhaps you endured long waits and a harried, inefficient system of care. If you've applied for a home mortgage or credit card, you may have waited for long decisions. If you have been on a plane during a missed connection, you may have dealt with one of those customer service representatives who could not have cared or performed more poorly if their next pay raise depended on it. Yet healthcare, financial services, and customer service are but a few of the areas in the service sector where Lean Six Sigma or Six Sigma have taken root. Indeed, the tools, results, and conversation around these improvement methodologies have migrated from manufacturing to affect a broad swath of the service world. The service sector is no longer just another target of continuous process improvement approaches. We have moved to a new stage in the evolution of continuous improvement in healthcare and other service sectors. Process improvement has moved from demonstration projects in health services, airlines, rental car companies, insurance companies, banks, and motor pool operations into the mainstream of operational and quality improvement. When the topic of Lean Six Sigma or Six Sigma comes up, it is assumed each has something to contribute. For services, process is paramount. Managers who impress upon the workforce the importance of understanding and improving the organizational processes for delivering care, value, and service send signals that a service philosophy is being translated from talk to action. What's a process? It is what it takes to take care of people who need help. In the production of services, using tools and techniques common to designing more efficient manufacturing processes might help. But the very nature of service encounters, involving customer or patient contact with humans, brings an extra dimension of variability and unpredictability that requires some adaptation of these tools. Variability is the reason for and the necessity of our understanding of variations in the processes of care. Enterprise is all about the customer. Whether the customer is looking for critical medical services or a place to have dinner while taking in a theater arts event, the facility, the staff, the amenities, and the information and activities are

offered and must perform in the best possible way to deliver the customer's experience. Each point of contact is a moment of truth. Department and process managers are critical to the moment of truth. Staff members at points of customer contact are encouraged to identify what results in a positive customer encounter and to make recommendations on how to make those results a production standard. Customer surveys play a prominent role in assessing the customer experience. Some customer data are collected in real time. Understanding what a customer is trying to accomplish, what is going well and not so well to achieve a good or poor customer experience in that moment is a strength of Lean Six Sigma, Six Sigma, or any other approach that uses such data for main processes and moments of truth. The real-time data can best be addressed by a system of continuous improvement.

7. Case Studies

The case studies prove the principles of both approaches, Lean Six Sigma and Six Sigma improvement efforts. All these examples should give us separate insights into the complementarities and disparities of Lean Six Sigma and Six Sigma. All these examples are easily measurable by means of statistical analyses and tests, which denote the level of success that both approaches provided in the investigated environments. Below you will find very detailed examples of practical implementation of both approaches. Most of them show performance improvements after the implementation of appropriate methodology in comparison to the analysis period. The cases are uniform in terms of the improvement process. We presented only the successful implementation, mainly to avoid any misinterpretation of the financial data that could be harmful for the companies presented. However, our researchers prepared a vast analysis regarding questions and solutions in case of failed results, case studies where the project would have gone a different way and the things that the organization would have done differently.

In one case in the chemical industry sector, a team of workers took over the challenge of reducing cycle times for the qualifying tests of the raw material lots. The resulting implementation of the Six Sigma methodology resulted in improvements in the ratio of qualified material. Inter-processed finished goods increased by 1%, a direct gain. Customer complaints dropped by 19%. Emotions decreased by 27% and overtime dropped by 11%. On-time delivery of the end product improved by 11%. These measurements are taken over the average of all the projects completed. In a case in the banking industry, a Six Sigma project was initiated in the back-office securities service department to reduce the cycle time for the processing of corporate loan interest payments. No specific statistics are

available in terms of cycle time, but clients were able to evaluate any stock 12 days earlier than the traditional process had allowed.

7.1. Successful Implementation of Six Sigma

The factors affecting the successful implementation of Six Sigma have been investigated and discussed in the previous subsections. However, depending on the root cause of incompatibility, solutions can be crafted. Successful approaches to the implementation of Six Sigma indicate that successful implementations are not only found in the manufacturing sector but also in the public sector, retail industry, telecommunications, healthcare, automotive, and several others. High-impact outcomes have been obtained from the implementation of Six Sigma. These include a decrease of 51% in the total claim administration time for Short-Term Disability, improved call center performance (reduced average handle time by 7 seconds in 1 week), a decrease in operation cost variance by 120% over 24 months, a reduction in the amount of scrap produced per ton of steel by 86%, a reduction in the defect rate of camera film 5 times lower than 6 Sigma, a 475% average return on investment, and customer satisfaction improvements.

Some of the best practices of successful Six Sigma implementations include starting with strong executives who are committed to reducing costs and improving production in order to achieve world-class status in the industry. Putting a high level of emphasis on training at different levels as well as the use of Six Sigma professionals outside the organization can also contribute to successful implementation. Furthermore, the use of a data-driven approach is important to identify and define what areas must be improved rather than dwelling on manufacturing inefficiencies in terms of defects and throughput. Success was achieved in this particular case study by organizing a Six Sigma project to get started. Measurements of the current process and the impact of these processes on the finances of the organization enhance management's value for process improvement and better understanding. Moreover, informal recognition of great performances is a motivating factor.

7.2. Successful Implementation of Lean Six Sigma

Nine West Holdings, Inc. deployed Lean Six Sigma in 2001 to produce and distribute brand footwear, handbags, and jewelry products across the United States. An integration of Lean and Six Sigma distinguished Lean Six Sigma as a results-driven and customer-centric process improvement discipline. Lean Six Sigma aims at improving efficiency through speed enhancements and cycle time reduction, as well

as simplifying and optimizing processes. This seamless integration avoids the pitfalls of embarking on concurrent Lean and Six Sigma projects.

Various companies had already implemented Lean Six Sigma and realized positive results. Improvements made by three organizations are noted among industries such as aeronautics and defense, automotive, electronics, fast-moving consumer goods, healthcare, retail, and heavy industry. The DMAIC methodology (define, measure, analyze, improve, and control) is known for the successful implementation of Lean projects that eventually lead to greater value, and it is especially utilized by those organizations that have not previously implemented Six Sigma. One organization used this methodology to reduce high workload, leading to threats and errors related to a water jet machining process through a cross-functional team. Another company aimed at eliminating waste and non-value-adding steps through a manufacturing study focused on reducing wasteful materials. It was highlighted that deploying Lean Six Sigma at a healthcare system rolled out the transformation methodology at four healthcare systems and developed a consulting arm that demonstrated the approach to over 70 other healthcare facilities with impressive results. It was remarked that well in excess of 1,000 healthcare professionals were trained or briefed on Lean Six Sigma. The rollout has created a Lean Six Sigma community, the members of which share common tools, language, and processes. Further referenced a report that stated a study observed the partnership comprised cross-functional teams, functional teams, data analysts, process design staff, and Lean Six Sigma black belts, denoting a significant effort.

8. Future Trends and Outlook

The popularity of Lean Six Sigma and Six Sigma is increasing in business and industry, as it offers a strategic solution model for evolving internal and external business challenges. Over time, industries are getting accustomed to and adapting their processes to Lean Six Sigma and Six Sigma tools, implementing various technologies. The upcoming trends and revolutionary requirements in the field of Lean Six Sigma and Six Sigma are outlined below to stay ahead in stability as well as capability and to support the sustained development of businesses with innovative aspects. The trends in the field of Lean Six Sigma and Six Sigma are evolving based on the requirements of today's global business dimensions. Lean Six Sigma and Six Sigma, when combined with various techniques and technologies, provide sustainable excellence. Various innovative approaches are in the formation stage, such as creating a hybrid model of Lean Six Sigma, Axiomatic Design, sustainability, project management, SMART techniques, and multi-methodology. There is ample room to prove and provide next-dimensional business strategic solutions in the

future. Willingness to change does not include words like 'no' and 'standstill.' The most successful companies that create sustainable models will be those that can adapt and embrace change as a challenge. The most challenging companies create opportunities at every stage. This era brings demands and new markets to foster revolutionary innovation. The automotive industry adopted Six Sigma and the Lean Six Sigma model at its highest level. Lean Six Sigma and Six Sigma were originally called data-based initiatives, where automotive companies used a wide variety of components through electronic databases, eliminating non-value-added activities directly and managing recalls.

9. Conclusion

This paper has provided a comprehensive comparison and analysis of Lean Six Sigma and Six Sigma. Throughout this essay, it has become clear that the objective of these methodologies is common, that is, to improve the efficiency and quality of businesses. Process improvement is the central theme in both Lean Six Sigma and Six Sigma. Process improvement is based on the principles of increasing customer value, reducing variation, eliminating waste, and continuous improvement. It is evident that Six Sigma focuses on reducing the level of defects in a process, while Lean identifies and mitigates activities that do not add value to a process. Thus, managers must decide which methodology best suits their business objectives and will achieve the identified results more quickly.

It was concluded that a process improvement culture is necessary for the long-term effectiveness of both quality management philosophies, Lean Six Sigma and Six Sigma, in an organization. Results of the case studies show that by establishing such cultures, improving the business they are operating in, and developing and instilling the methodology into their respective organizations are all possible. In addition, applying the Lean Six Sigma quality tool can successfully increase efficiency, quality, service, and speed. The application of Lean Six Sigma to a business produces results that are sustainable for the long term, such as a competitive advantage. With the application of Lean Six Sigma and Six Sigma philosophies, organizations can improve their goals in a range of sectors such as the office, service, and manufacturing operations, from the automotive industry to the local pizza delivery business.