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# A Review on Lean, Six Sigma and Lean Six Sigma in Pharmaceutical Industry

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**ABSTRACT:**
Manufacturing Industry have used LEAN thinking and Six Sigma to lower costs and boost quality and productivity by minimizing variance and faults in manufacturing. Due to the notable achievements in Companies are becoming more interested in manufacturing the pharmaceutical sector, which decided to use LEAN to achieve objectives like a shorter wait time Time to launch the product and lower production, waste, enhance end-user communication, and raise quality standard for testing and production laboratories. In this piece, the fundamentals of LEAN and Six Sigma are discussed, and an application idea was made for their ideas in the pharmaceutical business in conjunction with Compliance with legal requirements is indicated by Good Manufacturing Practice (cGMP) regulations, in For "smarter" work.

**Keywords:** lean, six sigma, pharmaceutical industry

## INTRODUCTION:

Pharmaceutical and medical device manufacturers are increasingly utilizing Lean and Six Sigma principles to improve operational efficiency, quality, and compliance. These methods aim to reduce costs, encourage research and development, and ensure a solid market position. They are focusing on optimizing resources, improving efficiency, reducing waste, and controlling inventory. The FDA and other regulatory bodies are supporting these changes by implementing a risk reduction approach and embedding quality in the manufacturing process from the beginning (quality by design) instead of relying on final laboratory testing (quality by testing). The current developments in the pharmaceutical and medical device industry make it an ideal time to adopt these principles.

**Moving beyond the status quo**

The pharmaceutical industry, despite its focus on quality, has struggled to maintain manufacturing efficiency and productivity compared to other industries due to the high cost and burden of revalidating processes for improvement. Manufacturers, who have consistently maintained strong profit margins, have little economic incentive to introduce change, making them hesitant to change once they confirm compliance.

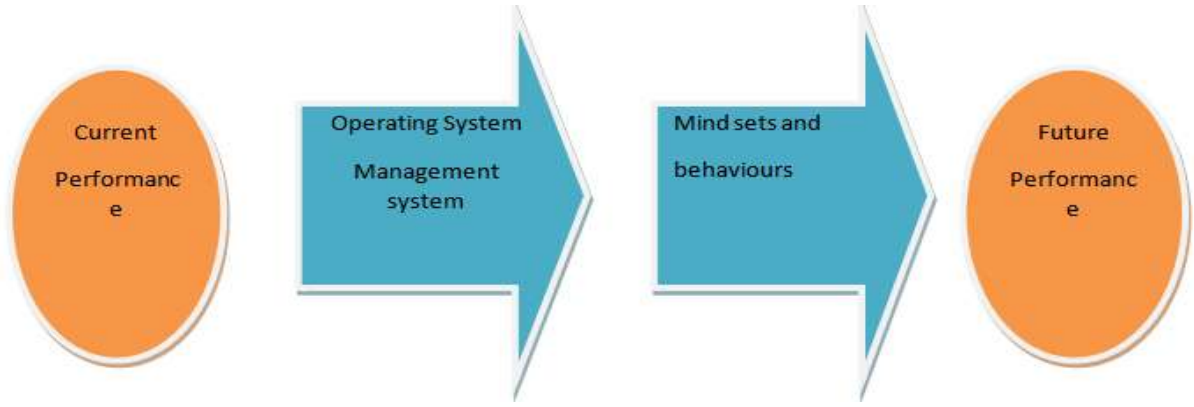


Fig. Changes demanded for successful Lean transformation

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**Ensuring the integrity of data**

Pharmaceutical manufacturers often have IT environments with multiple vendors, which can hinder the exchange of information and prevent a comprehensive view of the enterprise. To achieve end-to-end visibility in a Lean Six Sigma environment, manufacturers must integrate heterogeneous systems and create a single source of trusted information. This ensures complete confidence in the integrity of supply chain, manufacturing, and distribution-related data, eliminating duplication and outdated information, driving informed decision-making, and lowering administrative costs. A single source of information also provides a streamlined audit trail in case of product safety issues raised by regulatory agencies. For instance, if a bad lot of drug compound is released into the market, manufacturers can quickly establish the manufacturing location, equipment used, ingredient source, and distribution locations. A single version of truth is critical in regulated industries, as it eliminates the need to synchronize multiple sources of redundant data and manage various technologies, which increase risk and complexity.

**Building quality into the manufacturing process**

Process and workflow automation is a significant contribution to a Lean Six Sigma environment in pharmaceutical manufacturing. Integrated IT infrastructures reduce the need for manual checks, which present greater risk and variability, and focus on automated checks that can be easily audited by regulatory agencies. Automation allows manufacturers to enforce electronic signature checkpoints during production batch order processing and notify key personnel of nonconformances, enabling quick reviews and action.

Electronic record keeping is essential for pharmaceutical manufacturers to build quality into the process. Paper records are cumbersome and expensive to circulate for review and approval, especially in a global enterprise. Electronic routing of signature requests allows faster and cheaper product development, manufacturing, and quality assurance turnaround. Electronic records also improve accuracy by providing users with lists of appropriate values and validating data formats before accepting or saving the data into files or tables.

**Enabling rapid analysis and modelling to respond to change**

Pharmaceutical manufacturers have vast amounts of data on processes like office supplies and gas chromatographs, but often struggle to analyze and interpret this information. Advanced analytics can help them run real-time analysis, reduce risk, improve efficiency, and streamline compliance. This data can be used for quality analysis, risk assessments, yield analysis, on-time production tracking, scrap reason analysis, cost comparisons, and comparisons of manufacturing plans and efficiencies between sites. This enables manufacturers to conduct various tasks and improve their manufacturing practices.

**Instituting and controlling businesses processes and standard operating procedures**

Lean Six Sigma is a process that focuses on eliminating variability in processes and materials. IT systems provide the necessary information to support risk-based decisions and enable greater control over variability. Process automation enhances operational efficiencies, allowing manufacturers to enforce business rules for quality tests before reaching customers. This reduces complexity, redundancy, operator error, and waste. Leading IT vendors like Oracle are leveraging Business Process Execution Language (BPEL) to simplify process integration. BPEL allows manufacturers to build a process once and apply it throughout the environment, reducing the cost and complexity of process integration initiatives. This approach is becoming the standard for assembling discrete services into an end-to-end process flow.

**Enabling a real-time demand-driven sales and operations planning process**

Pharmaceutical manufacturers can reduce inventory costs and product expiration risk using a demand-driven model based on Lean Six Sigma principles. However, transitioning from a make-to-stock approach is challenging due to the fragmented Sales and Operations Planning (S&OP) process, which often leads to inaccurate forecasts and misalignment between departmental plans and company objectives. Advanced Strategic Network Optimization (SNO) solutions can help optimize choices and combinations by simulating and optimizing different supply chain configurations and creating dynamic sourcing rules for downstream planning processes. These solutions combine a flexible supply chain modelling

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environment with highly tuned solver algorithms and visualization capabilities.

**Ensuring compliance and security**

Understanding variability sources and estimates is crucial for determining corrective and preventative actions in pharmaceutical manufacturing. This process requires detailed information about the event, nonconformance, batch phase, incident or observation, criticality level, and follow-up. Manual completion is costly and time-consuming, and it also presents opportunities for data omission or incorrect recording. Corrective and Preventive Action (CAPA) solutions manage issues through automated workflows and provide necessary documentation for regulatory compliance. Pharmaceutical manufacturers are recognizing the benefits of Lean Six Sigma practices, but they need greater visibility into their end-to-end operations. This is not easily achieved through paper-based processes or disparate IT systems. Pharmaceutical manufacturers are increasingly using integrated IT infrastructures to execute Lean Six Sigma paradigms, achieving new levels of operational efficiency, quality, and corporate performance.

**Comparison of CGMP and Lean**

GMP has steadily developed into a complicated system of strict regulations and institutionalized medication manufacturing culture to assure the quality, dependability, and safety. The most recent risk-based scientific framework and the analytical process technologies (PAT) projects, created by regulatory agencies to assist Efficiency and innovation in a cGMP environment, propose a new strategy thinking in the twenty-first century.18regulatory authority since 2001 Policies have supported projects created to expand the selection of fresh and inexpensive pharmaceuticals. This novel viewpoint ought to aid the pharmaceutical sector shift to manufacturing innovation help dispel apprehension about lean improvement. These worries won't go away till The makers believe that a successful application of lean in a cGMP There are both environmental and regulatory acceptance and be GMP Perspective

| Area | LEAN | cGMP |
|---|---|---|
| Objectives | Reduce waste<br>Create value | Product effectiveness |
| Focus | Productivity with assured quality | Product development |
| Approach | Quality balanced with productivity | Quality |
| Improvement | Continuous and simultaneous | Regulated and prudent |
| Typical Goals | Reduce cost<br>Improve quality | Follow validated process prevent deviation |
| Typical Tools | Kaizen improvement<br>Error Proofing | Documentation<br>Validation<br>Audits |

Comparison of the most important attributes of Lean concept and principles of cGMP in pharmaceutical production

**GMP Perspective**

The presence of written processes, such as standard operating procedures (SOPs)21, testing techniques, environmental controls, and training programs, is one of the traits of a cGMP manufacturing environment. There are technical standards and operational processes in this publication. Only after a change control exercise may technical standards like product specifications, validated settings, and production circumstances be altered. The way that people use equipment and the way that product moves are examples of operational procedures. These procedures are founded on custom and experience, and they are subject to change in reaction to deviations or safety concerns. The core of lean pharma is figuring out how to change present operating practices while retaining technical standards to facilitate short-term progress, assuring minimal risk to the product. Attempts are made

## REFERENCES:

[1]. An Introduction to Lean, Deborah Blecker-Shelly and Joel E. Mortensen, Continuing Education Topics & Issues, August 2008

[2]. www.ngpharma.com ,Design for Six Sigma and Lean Six Sigma for the

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 5 Sep-Oct 2023, pp: 774-777 www.ijprajournal.com ISSN: 2249-7781

Pharmaceutical and Medical Industries, Tania Pinilla, Six Sigma Master Black Belt, Motorola University

[3]. www.businessweek.com/technology/content/mar2009, Drug Mergers: Killers for Research, When big pharmaceutical companies merge, like Merck and Schering-Plough or Pfizer and Wyeth, R&D always seems to suffer, Catherine Arnst

[4]. www.pharmafocusasia.com, Pharmaceutical Manufacturers, Embracing Lean Six Sigma, John E. Danese, Dennis Constantinou, Life Sciences

[5]. Lean Manufacturing practice in cGMP environment, Oct 1, 2006, Anne Greene, Dermot O Rourke, Pharmaceutical Technology Europe, Vol 18, Issue 10

[6]. S. Spear and H. K. Bowen, Decoding the DNA of the Toyota Production System (Harvard Business Review, Boston, MA, USA, 1999)

[7]. H. Thomas, Transforming the Pharma Industry: Lean Thinking Applied to the Pharmaceutical Manufacturing, Section 2, World Congress of Chemical Engineering (WCCE7), Glasgow, UK, July 2005

[8]. US Food and Drug Administration (5600 Fishers Lane, Rockville, MD 20857–0001, USA), Pharmaceutical cGMPs for the 21st Century — A Risk-Based Approach, September 2004.

[9]. Benson, R.S. and D.J. MacCabe. "From Good Manufacturing Practice to Good Manufacturing Performance." Pharmaceutical Engineering, July/August 2004.

[10]. "New Prescription for Drug Makers: Update the Plants," The Wall Street Journal, September 3, 2003.

[11]. An Introduction to Lean, Deborah Blecker-Shelly and Joel E. Mortensen, Continuing Education Topics & Issues, August 2008

[12]. www.ngpharma.com, Design for Six Sigma and Lean Six Sigma for the Pharmaceutical and Medical Industries, Tania Pinilla, Six Sigma Master Black Belt, Motorola University

[13]. www.businessweek.com/technology/content/mar2009, Drug Mergers: Killers for Research, When big pharmaceutical companies merge, like Merck and Schering-Plough or Pfizer and Wyeth, R&D always seems to suffer, Catherine Arnst

[14]. www.pharmafocusasia.com, Pharmaceutical Manufacturers, Embracing Lean Six Sigma, John E. Danese, Dennis Constantinou, Life Sciences

[15]. Lean Manufacturing practice in cGMP environment, Oct 1, 2006, Anne Greene, Dermot O Rourke, Pharmaceutical Technology Europe, Vol 18, Issue 10

[16]. S. Spear and H. K. Bowen, Decoding the DNA of the Toyota Production System (Harvard Business Review, Boston, MA, USA, 1999)

[17]. H. Thomas, Transforming the Pharma Industry: Lean Thinking Applied to the Pharmaceutical Manufacturing, Section 2, World Congress of Chemical Engineering (WCCE7), Glasgow, UK, July 2005 [18] US Food and Drug Administration (5600 Fishers Lane, Rockville, MD 20857–0001, USA), Pharmaceutical cGMPs for the 21st Century — A Risk-Based Approach, September 2004