

LEAN OPTIMIZATION'S ROLE IN DRIVING EFFECTIVE DIGITAL TRANSFORMATION IN PROJECT-BASED ORGANIZATIONS

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Abstract. This paper examines the critical role of Lean optimization in successful digital transformation for project-based organizations. Adopting digital technologies often brings challenges like inefficiencies, waste, and misaligned goals. Lean principles – reducing waste, continuous improvement, and value creation – offer an effective framework to address these issues. Integrating lean methods with automation, AI, and data analytics enhances efficiency, decision-making, and sustainable growth. The paper presents an overview of such integrations, supported by case studies and industry examples. In doing so, it highlights the importance of aligning technological adoption with business objectives and process optimization. By applying Lean thinking to digital transformation efforts, organizations can not only streamline operations but also foster innovation and adaptability in increasingly dynamic market environments. This synthesis of Lean and digital strategies provides a roadmap for navigating the complexities of modern project management while maximizing long-term value and performance. The conclusion emphasizes that this synergy also mitigates common digital transformation challenges, ensuring better alignment between technology investments and strategic objectives.

Keywords: digital transformation; lean; process optimization; project-based organizations

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1. Introduction

Digital transformation becomes the new norm while companies seek to stay competitive in the market. It presents unique challenges for the project organizations operating through structured initiatives with specific objectives and timelines. More often than not while the digital integration happens this very process brings inefficiency complexities such as increased waste and misalignment between technological implementations and organizational goals. Despite significant investments in digital tools and platforms, many organizations find it challenging to use the potential of these technologies fully as there are hidden process issues.

Lean methodology is a way of thinking that was there even before the authors quoted in this paper suggested we call this way of thinking Lean. It is as groundbreaking as it is common sense. The idea for it to be put in words mainly is to be widely used and implemented in all types of companies but it should also be widely known in society. Idealistically and realistically speaking, eliminating waste is the main thing humanity should do, so that it survives. Constant change is the prerequisite to not only achieving better results and saving time company-wise. If more people changed their perception of how to do certain things better, the better people would be. In a way if the words Lean and Agile are put together, the association could be made with the healthy lifestyle, no food wasted and better trained people that constantly adapt to the environment by improving themselves. Overall, Lean also refers to the way people live.

In brief, this strategic methodology is dedicated to boosting efficiency and eliminating waste in processes. Lean, which was derived from the Toyota Production System concepts, focuses on delivering customers the highest value with the least amount of resources by continuously refining workflows. Several of the main principles of the methodology are customer value identification, value stream mapping, ensuring there is a smooth flow, implementation of the pull system and the constant strive for perfection. By emphasizing waste reduction and continuous improvement, lean principles align closely with the objectives of digital transformation.

The process optimization is critical for each organization as it directly impacts the results and the competitiveness of the respective organization. Streamlining its operations, processes and eliminating inefficiencies found, results in reduction of cost, productivity increase and better quality of the end product. Thus, this would meet customers' expectations in a more efficient way, in addition to all other results. Internally, the optimized process essentially leads to a faster response to market changes, shorter production cycle and more efficient way to utilize the available resources. Many organizations are embracing Lean methodology, so that they can achieve the significant benefits of process optimization. Lean optimization plays a pivotal role in the digital transformation of project-based organizations and is essential for aligning technological advancements with efficient processes and maximizing value creation.

Furthermore, numerous issues could arise and hinder the success of transformation initiatives, for e.g. inconsistent practices and a lack of standardized procedures and their implementation. "Digital technologies have significantly impacted all sectors including business, society, industry, and technology. Leading to enhanced operations, experiences, and improved efficiency. It also creates new risks." (El-Khatib et al., 2023). Even if they make substantial investments and plan as detailed as possible, many organizations stumble on the gap between transformation efforts and successful outcomes. Quite often than not the mismatch is due to

inefficiencies in change management, insufficient stakeholder engagement, difficulties in adapting to new operational models. One practical way to improve process efficiency, align technological implementation with business goals is to foster a culture of continuous improvement and implement Lean methodology optimizations.

2. Theoretical Framework

Several of the main principles of the Lean methodology and process optimization that drive efficiency and effectiveness in modern organizations are presented in this paper. Understanding what value means from the customer's perspective is crucial for optimizing processes in project-based organizations. This ensures that resources are allocated effectively, enhances project outcomes and eliminates non-value-added activities without contribution to customer satisfaction. "The first principle of Lean is to define value from the standpoint of the end customer by product" (Womack et al., 1990). And a few years later James P. Womack and Daniel T. Jones add, "The only way to compete is to deliver exactly what the customer wants and to do it better, faster, and cheaper" (Womack et al., 1996). Aligning all processes and activities in the company is essential for them to meet customers expectations. In other words the theory states that every step in the process should contribute directly to providing high-quality outcomes that satisfy customer needs.

Same authors also present their view on waste elimination: "Lean focuses on eliminating waste, or any activity that does not add value to the end customer." (Womack et al., 1990). Identifying and removing waste in project processes helps streamline workflows and reduce costs. Lean principles help in pinpointing and eradicating non-value-added activities that impede project progress. "The greatest waste in the world comes from needless, ill-directed, and ineffective motions." (Gilbreth, 1911).

As Taiichi Ohno, a key figure in Lean methodology, said, "The most dangerous kind of waste is the waste we do not recognize" (Ohno, 1988). Various types of waste could be named: overproduction, waiting times, unnecessary transportation, excess inventory, over-processing, defects, and unused talent. There are many tools to pinpoint inefficiencies and streamline workflows in Lean methodology particularly those are Value stream mapping and 5S tools. Project managers can streamline workflows and enhance efficiency by applying lean principles that identify and remove waste. The Kanban board is quite the practical tool that helps visualize workflow and manage work-in-progress. "Kanban is a scheduling system that helps to control and manage the flow of work through the use of visual signals." (Ohno, 1988). By adequately visualizing the flow, it improves efficiency by balancing demand with production capacity and ensuring timely task completion.

There are several steps that could be recommended to be followed after implementing Kanban to manage workflow and visualize work-in-progress. Next

step could be enhancing project efficiency to address any underlying issues that may arise. This is where root cause analysis commences as it helps identify and resolve the fundamental problems affecting project performance. By combining the visual management of Kanban with the thorough examination of root causes, organizations can achieve a more comprehensive approach to process optimization and continuous improvement. “Lean emphasizes identifying and addressing the root causes of problems rather than merely treating symptoms.” (Liker, 2004). Such a proactive approach not only improves immediate project outcomes but also builds a foundation for ongoing process refinement and long-term success.

One of the most important ideas of Lean is the constant meaningful change/improvement. Continuous improvement (but moreover systematic), or Kaizen, revolves around the consistent evaluation and enhancement of processes and practices. “A philosophy for better business . . . and a better life” (A philosophy for better business, 2024). As Masaaki Imai, a leading advocate of Kaizen, observed, “Kaizen means ongoing improvement involving everyone, without large capital investments” (Imai, 1986). The principle involves regular review cycles, feedback collection, and implementing iterative changes to boost quality and efficiency. It encourages team members at all levels to contribute ideas for improvement and to make small, manageable changes over time. By promoting adaptability and innovation, continuous improvement ensures that processes remain efficient and aligned with evolving customer needs.

There could be many different digital transformation projects - integrating artificial intelligence (AI), automations, data analytics that would fundamentally alter project management practices. For example, AI enhances decision-making by providing predictive insights and sophisticated analytics. It also helps project managers anticipate challenges and refine strategies. As noted by Westerman, Bonnet, and McAfee, “Digital transformation is the use of technology to radically improve performance or reach of enterprises.” (Westerman et al., 2014). Automation addresses repetitive tasks, reduces manual errors, and speeds up workflows. Real-time information gathering, using AI and summarizing is leveraged to guide strategic choices, enhancing accuracy and improving project outcomes. This technological shift enables organizations to operate more efficiently and precisely, contributing to successful project completions.

Moreover, digital transformation projects bring sometimes unforeseen results within the teams and significantly improves collaboration and communication. Cloud-based platforms and digital tools facilitate real-time information sharing and coordination, irrespective of team members' locations. According to Westerman, Bonnet, and McAfee, “Digital transformation involves the integration of digital technology into all areas of business, fundamentally changing how you operate and deliver value to customers” (Westerman et al., 2014). This connectivity fosters transparency and ensures alignment with project goals. Centralized data

repositories provided by digital tools enhance progress tracking and performance measurement.

Optimizing project processes is essential for ensuring both efficiency and adaptability. As Womack and Jones state, “The essence of Lean is to maximize customer value while minimizing waste.” (Womack et al., 2003). Process improvement methodologies, such as Lean optimization, focus on minimizing waste and enhancing productivity through refined project activities. This approach accelerates project timelines and improves cost management, ultimately contributing to more successful outcomes.

Adaptability is another vital aspect of project process optimization. Projects often face shifting requirements, unexpected challenges, scope creep, and evolving stakeholder needs. As Deming states with some irony “It is not necessary to change. Survival is not mandatory.” (Deming, 1986). Continuously improving processes builds flexibility into workflows, enabling teams to quickly adjust to new conditions. When the mindset has shifted to the continuous improvement culture, this helps ensure that teams regularly review and enhance their processes and incorporate innovative solutions. The proactive nature of Lean not only boosts project performance but also strengthens resilience and adaptability, helping organizations navigate market demands effectively.

The presented definitions are not exhaustive but provide essential perspectives on optimizing project management. They offer insights into project efficiency enhancing, digital transformation focusing on advanced technologies and process improvement along with waste elimination. Numerous other frameworks and interpretations also contribute to the understanding of the topic. Due to space constraints, not all of these perspectives can be fully explored in the current paper.

3. Transformation Challenges

With every change and especially with digital transformations, when adopting new methodologies and technologies, significant challenges arise. In addition, when such projects are carried out in project-based organizations, the complex and temporary nature of projects amplifies them. Amongst the common issues are aligning project goals with broader organizational strategies, managing resistance to change, and integrating new processes within existing frameworks.

In project-based settings, particularly during digital transformations, Lean process optimization presents unique challenges. One significant challenge is resistance to change. Team members and stakeholders accustomed to established processes may and most certainly will resist new Lean principles, which demand significant shifts in mindset and practices. It can hinder the adoption of Lean even delaying or derailing transformation efforts.

Integration with the current systems is another significant challenge. Project organizations often utilize various software platforms and technologies, which may

not be designed with Lean principles in mind. Integrating Lean may result in data silos. To overcome this they must ensure that Lean is compatible with their current systems and plan for necessary upgrades or integrations.

Aligning Lean process optimization with specific project objectives can also be difficult as it has unique requirements and constraints. Therefore, it is crucial to tailor Lean practices to the context of each project to achieve the desired outcomes.

Measurement and metrics present another challenge. Establishing appropriate metrics to evaluate the effectiveness of Lean changes, especially in digital contexts, is essential but often difficult. Traditional key performance indicators must be supplemented. Without accurate and relevant metrics, assessing Lean's impact can be challenging.

Project organizations will face difficulties if the teams lack necessary skills and knowledge to apply Lean techniques effectively. Insufficient training can lead to improper application of Lean methods causing confusion or errors. To address this, organizations need to invest in comprehensive training plans and support to build Lean capabilities and ensure that those are being conducted, so that employees can effectively implement Lean practices. Lean must be sustainable and scalable across multiple projects and teams. Without focusing on these aspects, establishing standardized processes and implementing them, fostering a culture of continuous improvement and scaling Lean practices effectively, Lean improvements might be short-lived or limited to individual projects.

Last but not least, adapting Lean processes to meet customer expectations and market conditions can be challenging alone. Failure to adapt can lead to misalignment between project outcomes and customer satisfaction. Incorporating feedback loops and maintaining flexibility are essential for being responsive to customer demands and market trends. But overall addressing all these challenges requires a strategic approach.

4. Methodology and Case Studies Selection

This research employs a qualitative case study design. By focusing on specific case studies, the research aims to uncover nuanced insights into the challenges and successes associated with implementing Lean methodologies in diverse organizational contexts.

For the case studies, the selection criteria focused on identifying organizations that have demonstrated a significant commitment to both Lean process optimization and digital transformation. The leading multinational companies such as Siemens AG, General Electric, and Bosch were chosen due to their extensive project experience and their engagement in integrating Lean methodologies and the new digital technologies. Looking for companies' innovation culture, their successful track record in adopting Lean practices and digital transformation initiatives were the main points on the checklist. The aim was to provide different contexts.

Data for the case studies was gathered through a review of publicly available reports, company publications and other relevant documents. This included also examining annual reports and industry analyses found online. Information was analyzed to identify common patterns, challenges and best practices. This approach allowed for the extraction of meaningful insights into how Lean optimization contributes to successful digital transformation efforts in project-based organizations, despite the absence of direct interviews.

5. Case Studies and Key Inferences

– **Case Study 1:** General Electric (GE), a famous company and renowned for managing complex projects, is the first case study. As a result, they have effectively integrated Lean with digital transformation to address challenges like market volatility and technological advances. By implementing those into their processes, GE team aimed to enhance efficiency and quality.

There Lean involved a Lean Management System (LMS) to foster efficiency and continuous improvement. Key strategies for identifying and eliminating inefficiencies were Value Stream Mapping (VSM) and for standardizing processes: Standard Work Procedures. In GE Aviation, these methods led to a 20% reduction in production time and improved delivery rates. At GE digital transformation featured initiatives like the Industrial Internet of Things (IIoT) (Resnick, 2016) and the Predix Platform for real-time data collection, predictive maintenance and advanced analytics. As per reports, this approach reduced unplanned downtime by 5% and improved equipment lifespan.

Integration of lean and digital strategies gave the following results: a 15% increase in productivity and up to a 25% reduction in project timelines. The enhanced resources utilization normally led to cost savings. For instance, in wind turbine manufacturing, lean and digital tools “reduced production costs by 20%” (General Electric Company, 2013) and enhanced efficiency. GE’s experience accentuates the importance of strong leadership and data-driven approach in successfully merging lean into the company. This case study highlights how aligning all can drive significant improvements, incl. mainly on the efficiency side.

– **Case Study 2:** Second one is Robert Bosch GmbH. The global leader in engineering and technology, faced with rapid technological advancements and evolving market demands. They integrated lean principles with digital technologies to boost process efficiency, cut waste, and foster innovation within the company.

Bosch implemented its tailored Bosch Production System (BPS) to standardize processes and eliminate inefficiencies. The 5S Methodology improved workspace organization, while Kaizen Workshops drove continuous, employee-driven improvements. Just-In-Time (JIT) production optimized inventory and scheduling, achieving a 30% reduction in lead times and better quality in automotive electronics. Bosch elevated its digital transformation by adopting Industry 4.0 technologies for

real-time monitoring, developing the Bosch IoT Suite for advanced data analytics, and using AI for predictive maintenance. They also used and implemented Augmented Reality (AR) tools, including smart glasses, enhanced maintenance and training efficiency.

This integration led to improved process transparency. Digital tools amplified lean efforts, while data analytics facilitated more informed decisions. Increased employee engagement through digital platforms also contributed to the ongoing process improvements and innovation. Bosch achieved up to “25% gains” (Bosch Media Service, 2020) in production efficiency, reduced defect rates. Other benefits that they realized were cost savings from optimized resource use, alongside accelerated innovation and the development of new products and services.

– **Case Study 3:** Last but not least, Siemens AG is the third case study. Yet another global technology leader that successfully combined Lean optimization with digital transformation to drive growth across its industrial automation, energy, healthcare and other sectors. By integrating lean principles and digital technologies, Siemens streamlined processes and minimized waste. The company utilized its Siemens Production System (SPS). The 5S Methodology, on the other hand, improved workspace organization. Regular Kaizen events promoted continuous improvement. Just-In-Time (JIT) Production optimized inventory management, resulting in a 25% reduction in production cycle times and enhanced product quality.

In its digital transformation journey, Siemens deployed the Digital Enterprise Suite, leveraging digital twins and real-time analytics to refine production control. IoT platforms and AI were also implemented for predictive maintenance and operational optimization. They played a role in resource management efficiency. The synergy of lean and digital resulted a “25% reduction” (Andrews, 2024) in production cycle times and a 20% increase in overall efficiency. These advancements in process control and predictive maintenance led to substantial cost savings. Another conclusion could be drawn that this positioned Siemens to better meet evolving market demands.

The analysis of the case studies from General Electric (GE), Robert Bosch GmbH, and Siemens AG not only proves that Lean significantly enhances digital projects. Each company demonstrated how those integrations - such as GE's Value Stream Mapping and IIoT, Bosch's Bosch Production System and Industry 4.0, and Siemens' Siemens Production System and Digital Enterprise Suite – led to improved efficiency. Of course, they resulted in notable gains in productivity, quality and cost savings too, underscoring the effectiveness of combining lean with digital.

While previous research often examines the concepts of Lean optimization and digital transformation separately, the case studies provide evidence of how their combined application enhances operational performance. However, the paper is limited by its focus on just three large multinational corporations, which do not fully

represent all project organizations. Future research could expand on these findings by including a bigger range of companies to provide a broader understanding how lean and digital strategies intertwine.

6. Conclusion

As this paper emphasizes enabling Lean while having a digital transformation project within the project organization aligns with better efficiency. It aligns technological advancements with efficient processes to maximize value creation. The presented case studies

General Electric, Robert Bosch GmbH, and Siemens AG report that lean principles blended with digital technologies (real-time analytics, predictive maintenance, and advanced process control) notably leads to efficiency, quality, and cost-effectiveness improvements.

The integration of Lean optimization with digital transformation will continue to progress, as technology evolves. New trends, the increasing use of AI, Internet of Things (IoT) applications, are already refining lean processes and offer deeper operational insights. The adoption of digital twins and advanced simulation tools will further enhance the ability to predict and manage project outcomes. As having a main goal to stay competitive, companies should be focusing on the merge between lean and digital. This way it would result in continuous improvement culture along with making investments in training the employees to use the methodology on a daily basis. The above-mentioned steps would lead to better operational and strategic results.

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