

A Systematic Review of Digital Leadership and Lean Six Sigma Approaches in Higher Education

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Abstract. This research aims to examine how digital leadership contributes to the performance of study programs in higher education thru the integration of Lean Six Sigma as an operational mechanism. The method used is a Systematic Literature Review (SLR) utilizing the Scopus, Web of Science, and Google Scholar databases. Articles published between 2015 and 2024 were selected based on established inclusion and exclusion criteria, resulting in 42 reputable articles for further analysis. The study results indicate that digital leadership plays a role in improving study program performance thru data-driven decision-making, process efficiency, and continuous improvement practices. Lean Six Sigma serves as a structured framework that operationalizes digital leadership in quality and performance improvement at the study program level. The contribution of this research lies in presenting an integrative conceptual perspective that connects digital leadership and Lean Six Sigma within the context of higher education management.

Keywords: Digital Leadership; Lean Six Sigma Approach; Higher Education.

1 Introduction

Digital transformation has become a strategic priority in higher education, driven by increasing demands for efficiency, accountability, transparency, and the quality of academic services [1-3]. Higher education institutions are no longer expected merely to adopt digital technologies as supporting tools, but are required to systematically integrate them into governance structures, decision-making processes, organizational coordination, and performance improvement. This transformation is influenced by the growing complexity and competitiveness of the higher education landscape, where institutions must respond more rapidly and accurately to the needs of students, academic staff, administrative personnel, and other stakeholders. In this context, digital transformation is not solely a technological issue, but also an organizational and managerial challenge that requires strong leadership capabilities.

Leadership plays a critical role in aligning digital transformation initiatives with institutional goals. In particular, digital leadership has emerged as a key concept in understanding how leaders can effectively guide organizations in the digital era. Digital leadership refers to the ability of leaders to leverage digital technologies and data to support decision-making, enhance coordination, foster innovation, and improve organizational performance [4-6]. This concept

goes beyond technical competence, encompassing strategic vision, adaptability, change management capabilities, and the ability to build a digitally oriented organizational culture. Therefore, digital leadership is considered essential for enabling higher education institutions to transition from traditional management approaches toward more agile, data-driven, and responsive governance systems.

Previous studies have demonstrated that digital leadership contributes positively to organizational effectiveness, innovation, and service quality in higher education [7-8]. Leaders who possess strong digital orientation tend to facilitate data-driven decision-making, encourage the adoption of emerging technologies, and create environments that support continuous improvement. Moreover, digital leadership has been associated with enhanced organizational adaptability in response to external changes, such as technological advancements, policy shifts, labor market demands, and increasing expectations for higher education quality. As a result, digital leadership is increasingly recognized as a critical factor in strengthening institutional competitiveness and sustainability.

Despite its importance, existing literature predominantly conceptualizes digital leadership as an individual competency or leadership style rather than as a structured managerial mechanism. Consequently, the implementation of digital leadership in higher education often remains fragmented and lacks measurable impact on operational performance. Many institutions have invested in digital platforms, information systems, and data dashboards; however, these initiatives do not always translate into improved process efficiency, service quality, or performance at the program level. This indicates that digital leadership, while necessary, is not sufficient on its own to ensure meaningful organizational transformation. Without a clear operational framework, digital leadership may remain at the level of strategic vision without producing tangible outcomes.

In this regard, Lean Six Sigma (LSS) offers a relevant and complementary approach. Lean Six Sigma is a data-driven management methodology that focuses on process efficiency, waste reduction, quality control, and continuous improvement [9-12]. It integrates Lean principles, which emphasize the elimination of non-value-added activities, with Six Sigma techniques, which aim to reduce process variation and defects through statistical analysis. LSS has been widely applied across various sectors as a structured approach for improving operational performance and ensuring consistency in service delivery.

Within the context of higher education, Lean Six Sigma has shown considerable potential in improving administrative processes, enhancing academic services, and strengthening quality assurance systems [13-15]. Applications of LSS in higher education include streamlining student administrative procedures, reducing delays in academic processes, improving service delivery efficiency, and supporting accreditation and quality assurance frameworks. Through its systematic and data-oriented approach, LSS enables institutions to identify process inefficiencies, analyze root causes, and implement sustainable improvements. Therefore, Lean Six Sigma is not only applicable to industrial settings but also highly relevant for addressing the complexity of processes within higher education institutions.

However, the implementation of Lean Six Sigma in higher education is often conducted as a technical initiative that is disconnected from leadership practices. In many cases, LSS is applied in the form of short-term projects or isolated quality improvement efforts, without being integrated into the broader strategic direction of the institution. As a result, improvements

achieved through LSS may lack sustainability and fail to produce long-term organizational impact. At the same time, digital leadership initiatives that are not supported by structured operational mechanisms risk remaining conceptual and symbolic, rather than transformative.

This situation highlights a critical gap in the literature. Existing studies on digital leadership and Lean Six Sigma in higher education tend to develop along separate lines. On one hand, digital leadership is examined as a strategic capability for navigating digital transformation. On the other hand, Lean Six Sigma is studied as a technical approach for improving process efficiency and quality. However, there is limited research that integrates these two perspectives into a unified framework, particularly at the study program level. This gap suggests the need for a more comprehensive understanding of how digital leadership can be operationalized through structured quality management approaches.

The study program level represents a crucial unit of analysis in higher education, as it serves as the point where institutional policies, academic leadership, and operational processes converge. At this level, leaders are directly involved in managing academic activities, coordinating faculty members, ensuring service quality, and achieving performance targets. Therefore, improving study program performance requires not only strategic leadership but also effective operational mechanisms that can translate strategic vision into measurable actions.

In this context, Lean Six Sigma can be positioned as an operational bridge that enables the practical implementation of digital leadership. While digital leadership provides strategic direction and promotes the use of data and technology, Lean Six Sigma offers a systematic methodology for executing improvements through structured processes such as Define, Measure, Analyze, Improve, and Control (DMAIC). The integration of these two approaches has the potential to enhance organizational performance by combining strategic leadership with data driven process improvement.

Based on the above considerations, this study aims to systematically examine how digital leadership contributes to the performance of study programs in higher education and how Lean Six Sigma can operationalize this contribution. Specifically, the study seeks to answer the following research question: how can digital leadership in higher education be operationalized through Lean Six Sigma to improve efficiency, service quality, and study program performance?

This study contributes to the literature by providing an integrative perspective that connects digital leadership and Lean Six Sigma within a single conceptual framework. It extends the understanding of digital leadership beyond individual competencies toward a more operationally grounded construct, while also repositioning Lean Six Sigma as a strategic mechanism rather than merely a technical tool. By integrating these perspectives, the study offers a more comprehensive approach to improving performance in higher education institutions, particularly at the study program level.

2 Methods

This study adopts a Systematic Literature Review (SLR) approach to systematically examine the relationship between digital leadership, Lean Six Sigma (LSS), and study program performance in higher education. The SLR method is employed to ensure that the identification,

evaluation, and synthesis of existing studies are conducted in a transparent, structured, and replicable manner, thereby strengthening the scientific rigor of the findings.

The review process follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [16], which consist of four main stages: identification, screening, eligibility, and inclusion. This framework ensures that the literature selection process is systematic and aligned with the research objectives.

2.1 Literature Search Strategy

The literature search was conducted using three major academic databases: Scopus, Web of Science (WoS), and Google Scholar, selected due to their comprehensive coverage of high-quality international publications in the fields of educational leadership, higher education management, and quality management. The search strategy employed combinations of keywords and Boolean operators (AND/OR), applied to titles, abstracts, and keywords of the articles. The primary keywords included digital leadership, Lean Six Sigma, higher education, study program performance, and academic leadership. Additional related terms such as quality improvement, continuous improvement, and process efficiency were also incorporated to broaden the search scope. The search was limited to articles published between 2015 and 2024 to ensure relevance to recent developments in digital transformation and quality management in higher education.

2.2 Inclusion and Exclusion Criteria

To ensure the relevance and quality of the selected studies, clear inclusion and exclusion criteria were established.

The inclusion criteria were as follows: (1) peer-reviewed journal articles, (2) published in English, (3) focused on the higher education context, and (4) addressing digital leadership and/or Lean Six Sigma with implications for organizational or academic performance. The exclusion criteria included: (1) conference proceedings, books, book chapters, theses, and dissertations, (2) studies focused exclusively on industrial or non-educational contexts, and (3) publications lacking sufficient methodological or analytical information. These criteria ensured that only high-quality and relevant studies were included in the review.

2.3 Study Selection Process

The study selection process followed the PRISMA flow. The initial identification stage yielded 126 articles from the selected databases. After removing duplicate records, 98 articles remained. The screening stage, based on titles and abstracts, resulted in 64 articles deemed relevant to the research focus. Subsequently, a full-text review was conducted to assess eligibility based on the inclusion and exclusion criteria. This process led to the selection of 42 articles for final analysis. This multi-stage selection process ensured that the included studies directly contributed to understanding the relationship between digital leadership, Lean Six Sigma, and study program performance in higher education.

2.4 Data Analysis Technique

Data were analyzed using thematic synthesis [17] to identify key patterns, concepts, and relationships emerging from the literature. This approach enables the integration of findings

from studies with diverse research designs, including qualitative, quantitative, and conceptual studies. The analysis proceeded through several stages. First, initial coding was conducted to extract key findings from each selected study. Second, similar codes were grouped into broader categories. Third, these categories were synthesized into overarching themes that represent the relationships between digital leadership, Lean Six Sigma, and study program performance.

The analysis focused on four main dimensions: (1) characteristics and dimensions of digital leadership in higher education, (2) the role of Lean Six Sigma as a quality management and continuous improvement approach, (3) operational mechanisms linking digital leadership to performance improvement, and (4) implications of integrating digital leadership and Lean Six Sigma for study program management.

The results of this thematic synthesis form the basis for the findings and discussion sections, emphasizing conceptual interpretation and relational insights rather than purely descriptive reporting.

3 Results and Discussion

3.1 Synthesis of Publication Trends and Research Structure

The synthesis of the 42 selected studies reveals a significant increase in research on digital leadership and Lean Six Sigma in higher education after 2018, reflecting the acceleration of digital transformation and the growing demand for data-driven governance [18]. The literature is dominated by conceptual studies, case studies, and survey-based research, while empirical studies integrating both constructs remain limited [19].

A clear structural pattern emerges from the analysis. The literature develops along two parallel streams: (1) digital leadership as a strategic capability enabling transformation, and (2) Lean Six Sigma as a technical approach for process improvement. However, convergence between these streams is still weak. Only a small proportion of studies explicitly connect leadership and process improvement within a unified framework. This fragmentation indicates a critical research gap and justifies the need for integrative analysis.

3.2 Structured Synthesis of Reviewed Studies

To ensure transparency and analytical rigor, the reviewed studies were systematically synthesized based on methodological approach, thematic focus, and the extent to which digital leadership and Lean Six Sigma are integrated.

Table 1 presents representative studies that reflect the dominant patterns identified in the literature. While only key studies are displayed, all 42 articles were included in the thematic synthesis.

Table 1. Structured Synthesis of Key Studies on Digital Leadership and Lean Six Sigma

Authors	Year	Method	Focus	Key Findings	DL–LSS Integration
Ahlquist [1]	2018	Conceptual	Digital leadership	Enhances participation and engagement through digital platforms	No

Ehlers [4]	2020	Conceptual	Digital leadership	Critical for successful digital transformation in higher education	No
Promsri [7]	2020	Conceptual	Digital leadership	Integrates vision, technology, and innovation management	No
Antonopoulou et al. [5]	2020	Survey	Digital leadership	Supports data-driven decision-making and adaptive leadership	No
Pettersson [33]	2021	Conceptual	Digital leadership	Provides a framework for digital leadership in education	No
Bond[2]	2020	Review	Digital transformation	Leadership is key to digital strategy implementation	No
Cudney et al [10]	2020	SLR	Lean Six Sigma	Improves efficiency and service quality in higher education	Partial
Antony [9]	2014	Conceptual	Lean Six Sigma	Enhances organizational performance through process control	No
Nadeau [14]	2017	Review	Lean Six Sigma	Requires leadership support for sustainability	Partial
Svensson et al. [15]	2015	Case Study	Lean Six Sigma	Leadership commitment determines LSS success	Partial
Hess & Benjamin [12]	2015	Case Study	Lean Six Sigma	Improves administrative efficiency in universities	No
Arcidiacono & Pieroni [34]	2018	Conceptual	LSS 4.0	Integrates digital technologies into LSS frameworks	Yes
Sony, M., & Naik, S [30]	2020	Review	Lean + Industry 4.0	Technology enhances Lean effectiveness	Partial
Tortorella, Guilherme Luz, et al [31]	2020	Empirical	Lean + digital	Digital tools strengthen process improvement outcomes	Partial
Li, Weizi, et al [32]	2016	Empirical	E-leadership	Aligns digital strategy with organizational performance	No

3.3 Thematic Synthesis

The analysis of the reviewed studies produces four interrelated themes that explain the relationship between digital leadership, Lean Six Sigma, and study program performance.

Theme 1: Digital Leadership as a Strategic but Insufficient Driver

Digital leadership is consistently identified as a key enabler of transformation in higher education. It enhances data-driven decision-making, organizational coordination, and adaptability [20].

However, the synthesis reveals that digital leadership alone does not automatically improve operational performance. In many cases, its impact remains at the strategic or policy level, without significantly influencing process efficiency or service quality. This indicates that leadership must be supported by structured operational mechanisms to produce measurable outcomes.

Theme 2: Lean Six Sigma as an Effective but Isolated Mechanism

Lean Six Sigma is widely recognized as an effective approach for improving efficiency, reducing waste, and enhancing service quality in higher education [21].

Its application spans academic administration, student services, and quality assurance systems. The structured DMAIC cycle enables systematic identification and resolution of process inefficiencies.

However, LSS is often implemented as a technical or project-based tool rather than as part of a broader managerial system. Without integration with leadership practices, its impact tends to be localized and short-term.

Theme 3: Lean Six Sigma as an Operational Bridge

A key synthesis finding is that Lean Six Sigma functions as an operational bridge that connects digital leadership with performance outcomes.

Digital leadership provides strategic direction and promotes the use of data and technology, while Lean Six Sigma translates these elements into measurable actions through process mapping, root-cause analysis, and continuous improvement cycles.

This integration explains how leadership vision can be transformed into tangible and sustainable improvements, addressing a major gap in previous literature.

Theme 4: Study Program Level as a Critical Implementation Context

The strongest impact of integration occurs at the study program level, where strategic decisions intersect with operational processes.

At this level, leaders directly manage academic activities, coordinate faculty, and ensure service quality. Therefore, improvements driven by the integration of digital leadership and Lean Six Sigma become more visible and measurable.

This finding highlights the importance of the meso-level context in bridging institutional strategy and operational execution.

3.4 Integrated Synthesis Model

The synthesis demonstrates a clear relational structure. Digital leadership acts as a strategic driver that enables data-driven governance and technological adoption, while Lean Six Sigma serves as an operational mechanism that ensures systematic process improvement.

The interaction between these two elements leads to improved efficiency, enhanced service quality, and stronger study program performance. Conversely, the absence of integration results in fragmented transformation efforts, where leadership remains conceptual and process improvement remains isolated.

3.5 Discussion

The findings of this study provide a critical extension of existing literature by demonstrating that digital leadership alone is insufficient to generate measurable improvements in study program performance unless it is supported by structured operational mechanisms. While

previous studies have emphasized digital leadership as a strategic capability, this review shows that its effectiveness is contingent upon the presence of systematic process management approaches.

From a theoretical perspective, these findings align with the dynamic capabilities framework, which emphasizes the integration of sensing, seizing, and transforming capabilities to achieve sustainable organizational performance [22]. Digital leadership can be interpreted as a sensing and seizing capability, enabling institutions to recognize technological opportunities and respond strategically. However, without a transforming mechanism that operationalizes these strategic intentions into concrete actions, the impact remains limited. In this context, Lean Six Sigma serves as the transforming capability that converts strategic vision into measurable process improvements.

This interpretation addresses a key limitation in prior research, where digital leadership has often been conceptualized as an individual-level competency rather than an organizational capability embedded in structured processes. The present findings suggest that leadership effectiveness should not be evaluated solely based on vision or technological adoption, but also on the ability to institutionalize improvement mechanisms that ensure consistent execution.

Furthermore, the role of Lean Six Sigma identified in this study reinforces the principles of continuous improvement theory, particularly those proposed by Deming [23] and Juran [24]. Lean Six Sigma operationalizes continuous improvement through structured methodologies such as DMAIC, enabling organizations to systematically identify inefficiencies, analyze root causes, and implement sustainable solutions. This process-oriented approach ensures that improvements are not incidental but embedded within organizational routines.

The findings also highlight that Lean Six Sigma, when implemented without leadership alignment, tends to function as a technical tool rather than a strategic mechanism. This supports previous arguments that quality management initiatives require strong leadership commitment to achieve long-term impact [25]. Without such alignment, LSS initiatives remain fragmented, project-based, and limited in scope. Therefore, the integration of digital leadership and Lean Six Sigma is not merely complementary but mutually reinforcing.

Another important contribution of this study lies in identifying the study program level as a critical meso-level context for implementing integrated performance improvement. While much of the existing literature focuses on institutional-level strategies, this review demonstrates that the most tangible impact occurs at the level where academic processes are directly managed. This finding extends existing higher education management literature by emphasizing the importance of aligning strategic leadership with operational execution at the program level.

From a performance management perspective, the integration of digital leadership and Lean Six Sigma can also be interpreted through the lens of the Balanced Scorecard framework [26]. Digital leadership contributes to strategic alignment and innovation (learning and growth perspective), while Lean Six Sigma enhances internal processes and operational efficiency (internal process perspective). Together, they influence service quality and stakeholder satisfaction (customer perspective), ultimately leading to improved organizational performance (financial and performance outcomes). This multi-dimensional perspective provides a more comprehensive understanding of how leadership and process management interact to drive performance.

The study also contributes to bridging the gap between strategic and operational perspectives in higher education management. Existing research often treats leadership and process improvement as separate domains. However, the findings of this review demonstrate that sustainable performance improvement requires the integration of both. Digital leadership provides direction, vision, and technological orientation, while Lean Six Sigma ensures execution, consistency, and continuous improvement.

Importantly, this integration shifts the conceptualization of digital leadership from a symbolic or policy-oriented construct to an operationally grounded capability. It emphasizes that leadership effectiveness is not only about initiating change but also about sustaining it through structured mechanisms. This perspective is particularly relevant in the context of higher education, where organizational complexity and bureaucratic structures often hinder the implementation of change initiatives.

Despite these contributions, the findings also reveal limitations in the current body of literature. Empirical studies explicitly examining the integration of digital leadership and Lean Six Sigma remain scarce, particularly at the study program level. Most existing studies focus on either leadership or process improvement in isolation, limiting the ability to fully understand their interaction. This highlights the need for future research to empirically validate the integrative framework proposed in this study across different institutional contexts.

In addition, future studies should explore the role of organizational culture, digital maturity, and technological infrastructure as moderating factors in the relationship between digital leadership, Lean Six Sigma, and performance outcomes. These factors may influence the extent to which integration can be effectively implemented and sustained.

3.6 Practical and Theoretical Implications

From a theoretical perspective, this study contributes an integrative framework linking digital leadership and Lean Six Sigma in higher education management. From a practical perspective, the findings provide guidance for academic leaders in improving study program performance through: data-driven governance, continuous improvement mechanisms, evidence-based decision-making, service quality enhancement. This integration is particularly relevant in the context of accreditation, academic service excellence, and institutional competitiveness.

4. Conclusion

The findings of this study provide a critical extension of existing literature by demonstrating that digital leadership alone is insufficient to generate measurable improvements in study program performance unless it is supported by structured operational mechanisms. While previous studies have emphasized digital leadership as a strategic capability, this review shows that its effectiveness is contingent upon the presence of systematic process management approaches.

From a theoretical perspective, these findings align with the dynamic capabilities framework, which emphasizes the integration of sensing, seizing, and transforming capabilities to achieve sustainable organizational performance [27]. Digital leadership can be interpreted as a sensing and seizing capability, enabling institutions to recognize technological opportunities and

respond strategically. However, without a transforming mechanism that operationalizes these strategic intentions into concrete actions, the impact remains limited. In this context, Lean Six Sigma serves as the transforming capability that converts strategic vision into measurable process improvements.

This interpretation addresses a key limitation in prior research, where digital leadership has often been conceptualized as an individual-level competency rather than an organizational capability embedded in structured processes. The present findings suggest that leadership effectiveness should not be evaluated solely based on vision or technological adoption, but also on the ability to institutionalize improvement mechanisms that ensure consistent execution.

Furthermore, the role of Lean Six Sigma identified in this study reinforces the principles of continuous improvement theory, particularly those proposed by Deming [28] and Juran [29]. Lean Six Sigma operationalizes continuous improvement through structured methodologies such as DMAIC, enabling organizations to systematically identify inefficiencies, analyze root causes, and implement sustainable solutions. This process-oriented approach ensures that improvements are not incidental but embedded within organizational routines.

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In addition, future studies should explore the role of organizational culture, digital maturity, and technological infrastructure as moderating factors in the relationship between digital leadership, Lean Six Sigma, and performance outcomes. These factors may influence the extent to which integration can be effectively implemented and sustained.

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