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# **BARRIERS TO LAST PLANNER SYSTEM IMPLEMENTATION: A SYSTEMATIC REVIEW OF THE LITERATURE**

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## **SUMMARY**

Last Planner System (LPS) has proven to be an effective tool that brings better results in construction projects. However, its implementation faces several barriers that limit wider adoption and the benefits it offers. Currently, there is a research gap on a compilation of these barriers present in the academic literature, making it difficult to develop effective strategies to address them. Therefore, the objective of the article is to identify and analyze the barriers that hinder the implementation of the LPS. This study carried out a review of the academic literature using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology where 67 research articles were included and analyzed. The barriers found were divided into 4 categories that include: organizational and management barriers (51.34%), technical and knowledge barriers (22.22%), cultural and social barriers (13.41%) and external and contextual barriers (13.03%). The document expands the existing knowledge on the barriers in the implementation of the LPS by providing a basis for future research and concludes that the barriers that prevail from the perspective of academic literature are organizational and management, and provides suggestions aimed at reducing the barriers encountered when implementing LPS.

## **KEYWORDS**

LPS; Last planner; PRISMA; Lean Construction; Review.

## **INTRODUCTION**

The construction industry, despite its great economic importance globally (Sarmiento-Rojas et al., 2020), faces productivity problems compared to other industries (Barbosa et al., 2017), which is due to various industry problems such as inadequate planning in work (Gomez & Morales, 2016), fragmentation of the supply chain (Schöttle et al., 2014), among others. In this context, the Last Planner System (LPS) has emerged as a methodology to improve the planning and execution of activities at the construction site, by increasing workflow reliability and therefore reducing waste (Ballard & Tommelein, 2016).

The Last Planner System aims to enhance productivity and reliability in weekly work plans, viewing production as a workflow process designed to create value for customers (Ballard, 2000). This system has been shown to provide significant improvements in productivity (Howell & Ballard, 1997), more reliable planning (Hamzeh, 2009), and meeting established deadlines (Ballard, 2000). Its implementation has been successful in several countries such as Peru (Rosas et al., 2011), Chile (Alarcón et al., 2002), USA (Howell & Ballard, 1997), Mexico (Priyadarshana et al., 2023), among others.

Despite the benefits found, on many occasions barriers have been encountered that limit its implementation. For example, Alarcón & Seguel (2002) identify resistance to change as one of the main barriers. Hamzeh (2009) mentions the lack of leadership and commitment from top management, and Johansen & Glimmerveen (2016) point out the lack of adequate training as another critical barrier.

The literature does not find a study that compiles the barriers encountered in implementing this methodology. For these reasons, the present study focuses on conducting a literature review of the barriers to implementing LPS with the goal of serving as a compilation and classification of the barriers present in the literature over the past 10 years. This information will then serve academics and industry practitioners to develop LPS implementation strategies.

## **THE LAST PLANNER SYSTEM ®**

The adoption of the LPS in construction has been widely studied as an effective tool for improving planning and reducing waste (Howell & Ballard, 1997). However, a review of the literature identifies various barriers that hinder its effective adoption in construction projects (Hamzeh, 2011). One of the inherent barriers to implementing new processes, such as LPS, in any organizational environment, is resistance to change (Hamzeh, 2009). The transition from traditional methods to Lean and LPS not only requires changes in processes and tools but also a significant cultural shift within the organization (Koskenvesa & Koskela, 2005). Koskela & Ballard (2006) point out that in many construction organizations, a risk-averse and change-resistant culture prevails, which can hinder the implementation of innovative methodologies like LPS and induce a preference for traditional working methods. This resistance often stems from a lack of knowledge and uncertainty about its effectiveness (Alarcon & Seguel, 2002). Johansen & Glimmerveen (2016) found that lack of knowledge is another critical barrier, as a successful LPS implementation requires a deep understanding of its principles and techniques. Without proper training, work teams may not use the system effectively,

leading to suboptimal results and frustration among participants. Another identified barrier is the incompatibility with traditional planning systems, which fail to address the iterative and collaborative nature required by the LPS, creating friction and resistance to change (Alarcón et al., 2002). Additionally, Hamzeh (2009) highlights that the commitment and support of organizational leaders are essential for the successful implementation of LPS. Without this support, it is difficult to motivate employees to adopt new practices and secure the necessary resources for training and implementation. Furthermore, the lack of adequate resources such as time, personnel, and technological tools can hinder the effective implementation of LPS (Alarcón et al., 2002). Finally, construction projects often operate under time and budget constraints, which can make it difficult to allocate the necessary resources for training and adopting new methodologies (Chan & Kumaraswamy, 1997).

## **METHODOLOGY**

The present research conducted a literature review on the barriers to implement Last Planner System using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). This methodology is currently being used by several authors, for example, Yuming et al. (2024) examined the impacts of construction robotics in civil engineering in the last decade, focusing on productivity, efficiency and safety improvements. Also, PRISMA has been used in studies associated with lean construction (Besser et al., 2017; Souza et al., 2021) such as the work of Abanto et al. (2024) where with PRISMA seeks to explore the scope of AI techniques in lean construction methodology and how they can revolutionize project management.

For the literature review, a search for publications related to Last Planner System barriers was conducted in the following databases: Scopus, IGLC and the Web of Science. This because Scopus is one of the databases with a wide domain in research on the subject of construction compared to other databases (Galaz et al., 2021); IGLC is a database that covers multiple researches on lean construction worldwide (Daniel et al., 2015); and Web of Science because it is one of the most recognized international multidisciplinary references (De Filippo, 2013).

In the first phase of identification of the PRISMA methodology, the search was carried out using 5 key words that were "last planner system", "last planner", "barriers", "challenges" and "challenge" and were combined for each database as shown below. For the SCOPUS database, they were I and II (I: "barriers" AND "last planner"; II: "challenges" AND "last planner"); for the Web of Science database they were III and IV (III: "barriers" AND "last planner"; IV: "challenges" AND "last planner") and for the IGLC database, they were V to VIII (V: "barriers" AND "last planner"; VI: "challenges" AND "last planner"; VII: "barriers" AND "last planner system"; VIII: "challenge" AND "last planner system"). Likewise, 218 results were obtained based on all the keywords and 9 articles belonging to snowball were added because: during the keyword search, documents related to the topic were found in other main sources of varied research. This left a total of 227 initial articles in the review. For the next phase of eligibility, after having the combinations of articles found from I to VIII, 69 duplicate publications were eliminated from the reviewed articles and relevant articles were filtered for evaluation by reading the title and abstract. A total of 48 articles were excluded by reviewing the title

and abstracts, the articles were excluded because they were considered to be far from the topic in question or mentioning another context that is not related to LPS barriers. A total of 110 articles remained, which, in the next phase of exclusion, were filtered again through a complete reading, thus excluding 43 articles that did not fulfill the criteria to be considered in this study: they did not mention any example of last planner barrier in the content of the paper, leaving a total of 67 articles that were considered for this research.

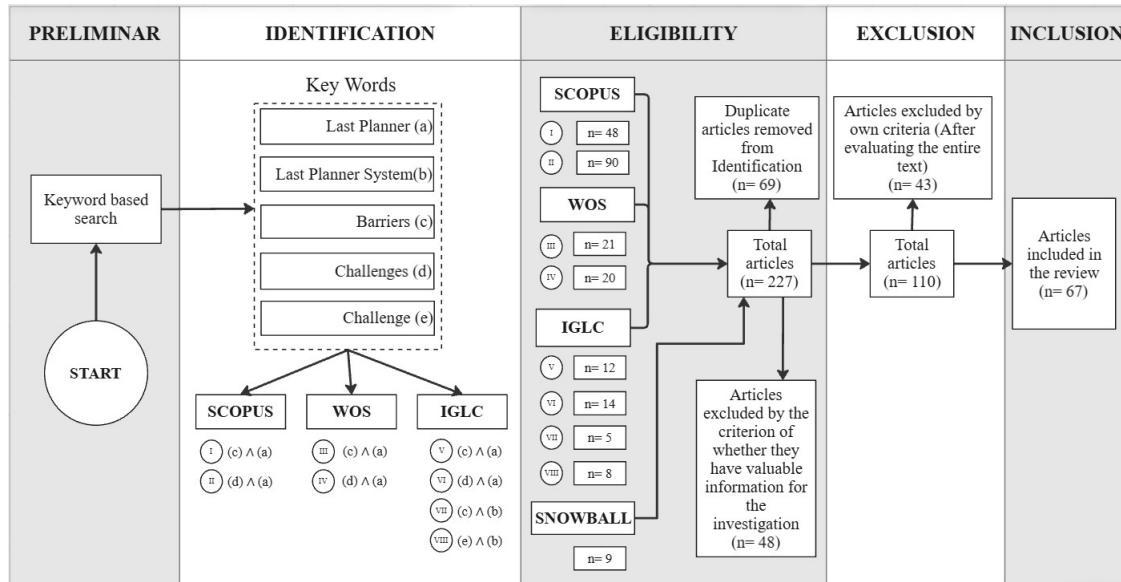


Figure 1. PRISMA flow diagram for the systematic review

## RESULTS AND DISCUSSIONS

### CLASSIFICATION OF LPS BARRIERS IN THE LITERATURE

In this section, the results obtained from the literature review on barriers to LPS implementation are presented. The barriers have been classified into four main categories: organizational and management barriers, technical and knowledge barriers, cultural and social barriers, and external and contextual barriers. The categorization was based on the nature of the barriers and their origin, which helps to identify specific areas within the organization and the project environment that need attention and improvement. The categorized review barriers are shown in Table 1, and the frequencies with which these barriers have been cited in Table 2.

The four main categories identified are subdivided into specific subgroups designated as A1, A2, A3, A4, A4, B5, B6, C7, C8, D9 and D10. Based on the literature review of 67 papers numbered 1 to 67, we detail which studies have cited barriers associated with each of these subgroups.

**Table 1.** LPS barriers from the academic literature

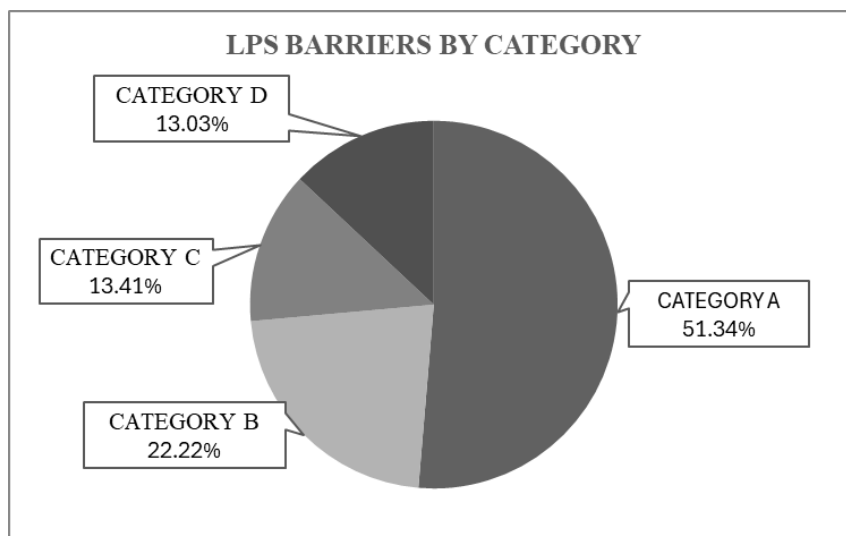
Categories	Code	LPS Barriers	Reference
<b>Organizational and management barriers</b>	A1	Resistance to change	1,4,5,6,8,12,15,16,17,20,21,22,23,24,25,26,28,29,30,32,33,35,36,39,47,50,51,58,59,62,66
	A2	Lack of leadership, commitment and involvement of stakeholders	1,4,5,6,7,10,11,13,15,16,17,18,20,21,22,23,24,25,29,30,32,33,34,35,36,37,39,42,43,48,49,50,54,55,56,57,58,59,61,63
	A3	Coordination, collaboration and communication problems	1,3,4,6,11,12,13,14,15,16,17,20,21,22,23,24,25,28,29,30,32,33,34,35,37,39,46,47,49,51,53,54,56,59,60,61,63,65,66
	A4	Planning and control problems	8,13,17,20,21,22,25,26,29,30,32,33,35,37,38,48,55,57,58,59,60,61,62,66
<b>Technical and knowledge barriers</b>	B5	Lack of training	2,4,5,6,9,12,14,16,17,18,20,21,22,25,26,28,29,30,31,32,34,35,36,37,39,42,46,47,48,50,51,54,55,56,58,61,67
	B6	Inadequate use and interpretation of LPS tools.	19,22,23,32,33,38,39,42,43,46,47,49,55,56,57,58,61,62,63,65,67
<b>Cultural and social barriers</b>	C7	Lack of Lean culture	1,5,6,8,10,15,16,21,22,23,25,29,30,32,33,34,35,37,42,43,58,61,62,65
	C8	Organizational and attitudinal problems	7,16,17,22,29,37,54,61,63,65,67
<b>External and contextual barriers</b>	D9	Contractual and legal problems	2,4,10,13,14,15,16,17,21,25,30,34,35,37,46,47,48,49,57,60
	D10	Lack of Resources and Tools for LPS Implementation	3,17,25,28,33,40,43,47,51,54,55,58,64,67

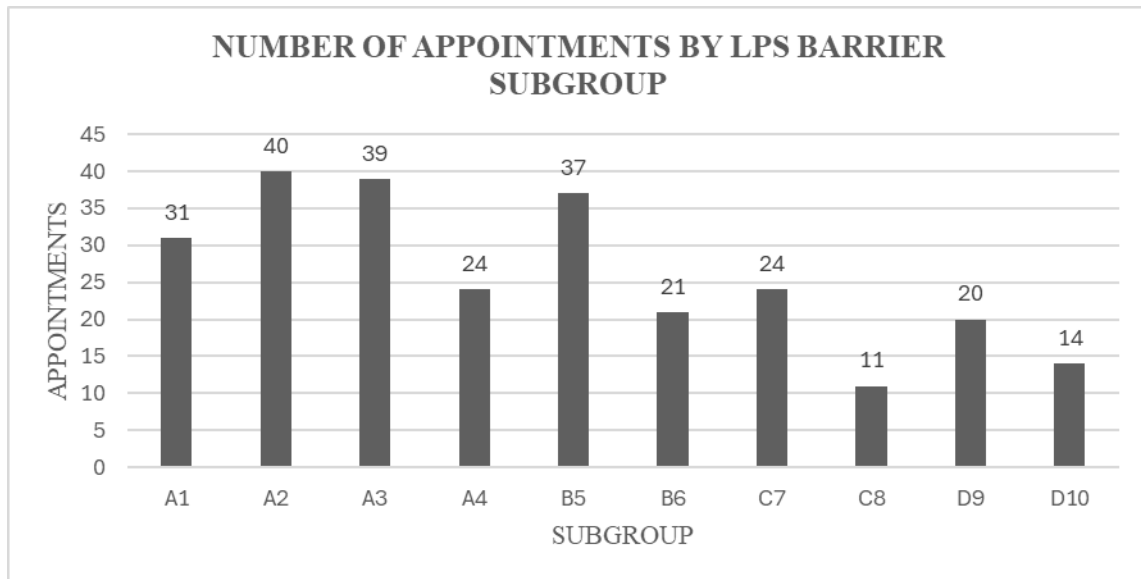
1. (Srikanth et al., 2023), 2. (Samudio et al., 2011), 3. (Vignesh, 2017), 4. (Kovvuri et al., 2016), 5. (Salvatierra et al., 2015), 6. (Hamzeh et al., 2016), 7. (Alsehaimi et al., 2014), 8. (Ahiakwo et al., n.d.), 9. (Tayeh et al., 2018), 10. (Alsehaimi et al., 2014), 11. (Skinnerland & Yndesdal, 2014), 12. (Liu et al., 2020), 13. (Fuemana et al., 2013), 14. (Mota et al., 2019), 15. (Hunt et al., 2018), 16. (Kassab et al., 2020), 17. (Lindhard et al., 2015), 18. (Bygballe et al., 2022), 19. (Zaeriet et al., 2017), 20. (Amado, 2022), 21. (Abusaleem, 2020), 22. (Utomo Dwi Hatmoko et al., 2018), 23. (Aboseif & Khallaf, 2020), 24. (Skinnerland & Yndesdal, 2014), 25. (Porwal et al., 2010), 26. (Hua & Schwartz, 2021), 27. (Priyadarshana et al., 2023), 28. (Agrawal et al., 2024), 29. (Wandahl, 2014), 30. (Hamzeh, 2011), 31. (El-Sabek & McCabe, 2018), 32. (Ryan et al., 2019), 33. (Warid & Hamani, 2003), 34. (Limenih et al., 2022), 35. (Venkatesh et al., 2021), 36. (Patel, 2011), 37. (Ha Duy Khanh et al., 2016), 38. (Perez & Ghosh, 2018), 39. (Tezel et al., 2018), 40. (Sundararajan & Madhavi, 2023), 41. (Elfving, 2022), 42. (Balkhy et al., 2021), 43. (Enshassi et al., 2021), 44. (Ahiakwo et al., 2013), 45. (Brady et al., 2011), 46. (El-Sabek & McCabe, 2018), 47. (Mäki et al., 2002), 48. (Fernandez-Solis et al., 2013), 49. (Aslam et al., 2020), 50. (Patel, 2011), 51. (Boton et al., 2021), 52. (Aslam et al., 2020), 53. (HyunJeongChoo et al., 2001), 54. (Johansen & Porter, 2021), 55. (Cerveró et al., 2013), 56. (Brady et al., 2011), 57. (Fuemana et al., 2013), 58. (Hamzeh, 2011), 59. (Howell & Ballard, 1997), 60. (Ballard et al., 1994), 61. (Small et al., 2020), 62. (Hamzeh, 2009), 63. (Friblick et al., 2009), 64. (Kalsaas & Skaar, 2009), 65. (Asleen et al., 2008), 66. (Sergio & Conte, 1998), 67. (Alarconet et al., 2002).

To analyze the citation frequency of each barrier in the literature reviewed, the number of references associated with each barrier can be observed. This provides an idea of the importance and prevalence of each barrier in the implementation of LPS throughout the academic literature. Thus, using this indicator, we can measure the frequencies of the subgroups presented in Figure 2.

**Table 2.** Frequencies of LPS barriers

Categories	Subgroup	LPS Barriers	Frequency by subgroup	Frequency by categories
Organizational and management barriers (A)	A1	Resistance to change	31	134
	A2	Lack of leadership, commitment and involvement of stakeholders	40	
	A3	Coordination, collaboration and communication problems	39	
	A4	Planning and control problems	24	
Technical and knowledge barriers (B)	B5	Lack of training	37	58
	B6	Inadequate use and interpretation of LPS tools.	21	
Cultural and social barriers(C)	C7	Lack of Lean culture	24	35
	C8	Cultural and attitudinal problems	11	
External and contextual barriers (D)	D9	Contractual and legal problems	20	34
	D10	Lack of resources and tools for LPS implementation	14	

**Figure 2.** LPS barrier groups based on their frequency per category



**Figure 2.** LPS barrier subgroups based on frequency.

### **MAIN BARRIERS FOUND IN THE LITERATURE ORGANIZATIONAL AND MANAGEMENT BARRIERS:**

The literature review reveals that organizational and management barriers (Group A) predominate in the implementation of the LPS, with a total of 134 mentions, representing 51.34% of the total barriers identified. Within this group, the most recurrent problems include lack of leadership, commitment and involvement of stakeholders (A2), mentioned on 40 occasions (15.33% of the total). Problems in coordination, collaboration and communication (A3) is also significant with 39 mentions (14.94%), followed by resistance to change (A1) with 31 mentions (11.88%) and problems in planning and control (A4) with 24 mentions (9.20%). Studies indicate that organizations face significant internal challenges that hinder effective LPS implementation (Murugaiyan et al., 2022) such as recurring problems such as coordination, collaboration and communication, together with lack of leadership, commitment and stakeholder involvement, underline the urgent need to strengthen the organizational structure (Skinnarland & Yndesdal, 2012). In addition, clear communication among all stakeholders is crucial to mitigate resistance towards the adoption of new systems (Gallego et al., 2020). Committed and actively supported leadership from top management is crucial to overcome organizational and managerial barriers in construction, underlining the importance of a corporate culture that values and supports this type of leadership (Howell & Ballard, 1997).

### **TECHNICAL AND KNOWLEDGE BARRIERS**

Technical and knowledge barriers (Group B) represent a significant aspect in the implementation of the LPS, accumulating a total of 58 mentions, equivalent to 22.22% of the total. Within this group, lack of training (B5) stands out as the most frequently cited barrier, with 37 mentions (14.18%), highlighting the critical need for specific educational programs to train personnel in the skills required for effective LPS implementation (Vignesh, 2017; Tayeh et al.,

2018). In addition, inadequate use and interpretation of LPStools (B6) is also notable, with 21 mentions (8.05%), evidencing the complexity and need for better integration and understanding of these tools in the work environment. Although these technical and knowledge barriers are less frequent than organizational barriers, their impact on successful LPS implementation should not be underestimated (Murugaiyan et al., 2022). To overcome these challenges, it is crucial to adopt a structured and systematic approach. This implies the implementation of continuous training programs that strengthen planning skills and the use of digital tools, thus facilitating the accurate visualization and monitoring of project activities (Ballard, 2000).

### **CULTURAL AND SOCIAL BARRIERS:**

Cultural and social barriers (Group C) represent a significant component in the implementation of the LPS, comprising a total of 35 mentions, which constitutes 13.41% of the total. Lack of Lean culture (C7) was the most mentioned barrier, with 24 mentions (9.20%), while cultural and attitudinal problems (C8) totaled 11 mentions (4.21%). Although less frequent, these barriers should not be underestimated (Wandahl, 2014). Entrenched resistance to change, evidenced by the absence of a lean culture and attitudinal problems, underscores the need for continuous and long-term efforts to transform organizational mindsets and attitudes (Vignesh, 2017; Brady et al., 2011). To overcome these cultural barriers and promote successful LPS implementation, it is essential to establish commitment from top management, foster cultural awareness, and facilitate effective communication among team members (Kudrekodlu et al., 2021). In addition, ongoing training and clear communication are critical to mitigate cultural and language differences that may arise during system implementation (Brady et al., 2011).

### **EXTERNAL AND CONTEXTUAL BARRIERS:**

External and contextual barriers (Group D) are the least mentioned, totaling 34 mentions, equivalent to 13.03% of the total. Among these, contractual and legal problems (D9) were mentioned 20 times (7.66%), while lack of resources and tools for LPS implementation (D10) was cited 14 times (5.36%). These barriers emphasize the critical influence of external factors on LPS success (Tayeh et al., 2018). The recurrent presence of contractual and legal issues suggests that existing contractual structures may not be aligned with LPS principles and needs, which can act as a significant barrier to effective implementation (Kassab et al., 2020). Taken together, these external challenges underscore the importance of adopting a holistic approach that not only considers internal aspects of the organization, but also external conditions that can crucially impact LPS adoption (Kassab et al., 2020). To overcome these barriers, it is essential to improve communication and transparency in approval procedures with customers by implementing regular review meetings and the use of digital platforms for document management to streamline processes and reduce waiting times significantly (Porwal et al., 2010).

### **CONCLUSIONS AND RECOMMENDATIONS**

The literature review on LPS reveals several barriers that limit its effective implementation in construction projects. These barriers have been classified into four main categories. Organizational and management barriers are the most prevalent,



accounting for 51.34% of the total mentions in the literature reviewed. Among the most frequently cited barriers are resistance to change, lack of leadership and commitment, and coordination and communication problems. Technical and knowledge barriers, including lack of training and inadequate use of LPS tools, constitute 22.22% of the mentions. Likewise, cultural and social barriers, such as lack of a Lean culture and attitudinal problems, account for 13.41% of mentions. Finally, external and contextual barriers, such as contractual problems and scarcity of resources, also hinder the implementation of LPS, representing another 13.03% of the total mentions found in the literature reviewed.

As a research proposal, the authors recommend classifying the barriers according to the country in which it was found, to identify the countries with knowledge gap of LPS barrier studies. Likewise, it is worth mentioning that the barriers found in the present study do not encompass all the existing barriers but are limited to the barriers reported within the academic literature. Therefore, it is recommended for future research to report based on case studies, barriers that limit the implementation of LPS

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