

Article

Barriers to Adopting Advanced Work Packaging (AWP) in Construction

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Abstract: This study presents a systematic literature review (SLR) of the Advanced Work Packaging (AWP) methodology, focusing on identifying barriers to its adoption. The review encompasses an analysis of 287 documents from 2013 to 2023, including conference articles, doctoral theses, journal articles, master theses, reports, and organizational documents. Following a rigorous selection process, 59 of these documents were identified as pertinent to the investigation. This research employs a dual approach. First, a scientometric analysis to map the collaborative networks of authors and the co-occurrence of keywords, providing a comprehensive picture of the research landscape in AWP. Second, the study delves into the main barriers hindering the adoption of AWP, as revealed through the SLR of the selected documents. The findings offer an overlay network visualization of coauthorship and a network visualization of keyword co-occurrence. The study culminates in a detailed identification of primary AWP barriers, suggestions for future research directions, and potential lines of inquiry within the field. This work contributes to the existing body of knowledge by offering a novel perspective on the challenges associated with AWP implementation and provides a foundation for future scholarly endeavors in this domain.

Keywords: advanced work packaging (AWP); systematic literature review (SLR); construction; research networks; adoption barriers



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1. Introduction

The construction industry serves as a cornerstone of the socioeconomic development of nations, playing a significant role in wealth and well-being generation across countries. With its contribution to the Gross Domestic Product (GDP) ranging between 3% and 9%, the industry's economic impact is undeniably substantial [1–3]. Despite its critical importance, the construction sector has historically exhibited insufficient progress in productivity, especially when compared to other industrial sectors. Over the past two decades, the annual average growth rate of labor productivity in construction has barely reached 1%, a figure significantly lower than the 2.8% growth rate for the global economy and 3.6% for the manufacturing industry [4,5]. This stagnation underscores a pressing need for innovative approaches to project management within the construction industry.

Advanced work packaging (AWP) is a methodology that has the potential to optimize execution and enhance predictability in project management. AWP represents a paradigm shift, promising to revolutionize project management and execution through automated information extraction for improved constraint management, thereby facilitating more efficient identification and modeling of constraints [6]. Its capabilities underscore the method's

potential to address the construction industry's productivity woes effectively [7]. AWP aligns project planning and execution from initiation through closing, organizing projects into manageable packages that facilitate better planning, coordination, and execution [8,9]. This approach has generated quantifiable improvements, including up to a 10% reduction in total installation costs, a 25% enhancement in labor productivity, and significant safety and quality standards advancements [10,11].

However, despite the promising advantages of AWP, its seamless integration into the broader project-management framework faces significant barriers. These challenges not only impede AWP's adoption but also highlight the gap between theoretical understanding and practical application within the industry [12]. A comprehensive exploration of these barriers remains a critical need, underscoring the potential benefits of such an endeavor. By identifying and analyzing the obstacles to AWP adoption, valuable insights can be gleaned regarding the challenges construction-industry professionals encounter when implementing this innovative methodology.

This study aims to bridge this knowledge gap through a systematic literature review (SLR), intending to identify the expected barriers to adopting AWP in the construction sector. Employing the "Preferred Reporting Items for SLR and Meta-Analyses" (PRISMA) guidelines, this SLR seeks not only to elucidate these barriers but also to offer a clear and methodologically sound exploration of the existing literature [7,13]. The significance of this study lies in its contribution to the construction-management discipline's body of knowledge, offering both practical implications for industry stakeholders and a foundation for policy development aimed at facilitating AWP adoption. By fostering a deeper understanding of AWP's barriers, the construction industry can develop strategies to overcome these challenges, thereby driving innovation and progress within the sector.

2. Research Methodology

This study rigorously investigates the adoption barriers of the AWP methodology within project management through a structured three-stage approach, adhering to established SLR practices. The methodology unfolds as follows (as shown in Figure 1).

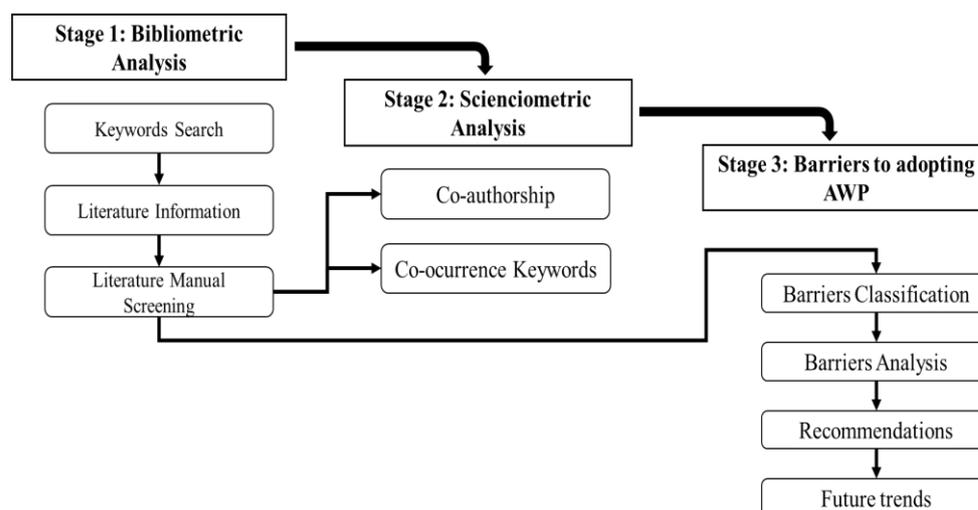


Figure 1. The research methodology of the study. Source: own elaboration.

The research commences with a bibliometric analysis to systematically sift through the extensive corpus of the AWP literature. According to the PRISMA guidelines, this covers three main phases to identify the pool of references to be included in the final analysis. As shown in Figure 2, these phases are the identification of the search sources and inclusion and exclusion criteria, screening of the results, and making the decision to identify the eligible studies. Commencing with the "Identification" phase, a total of 283 records were ascertained through comprehensive searches in esteemed databases such as Google Scholar,

Scopus, Web of Science, and the American Society of Civil Engineers. In parallel, four additional records were sourced from other unspecified avenues, rendering an aggregate of 287 initial records. In the “Screening” phase, duplicates were meticulously eradicated, resulting in a curated set of 212 records. Of this ensemble, 105 records were shortlisted after a rigorous screening, while 107 were dismissed, though the specific reasons for such exclusions remain unstated in the flowchart. In the “Eligibility” phase, the 105 shortlisted records underwent a thorough examination of their full texts. Forty-six articles were discarded based on explicit criteria: they referenced AWP superficially or AWP was named merely to acknowledge its existence. Conclusively, the “Included” phase signifies the culmination of this rigorous selection process, with 59 studies deemed suitable for a qualitative synthesis. These selected studies presumably shed valuable light on the research’s focal themes, including the barriers’ relationships, AWP application, and theoretical aspects of AWP.

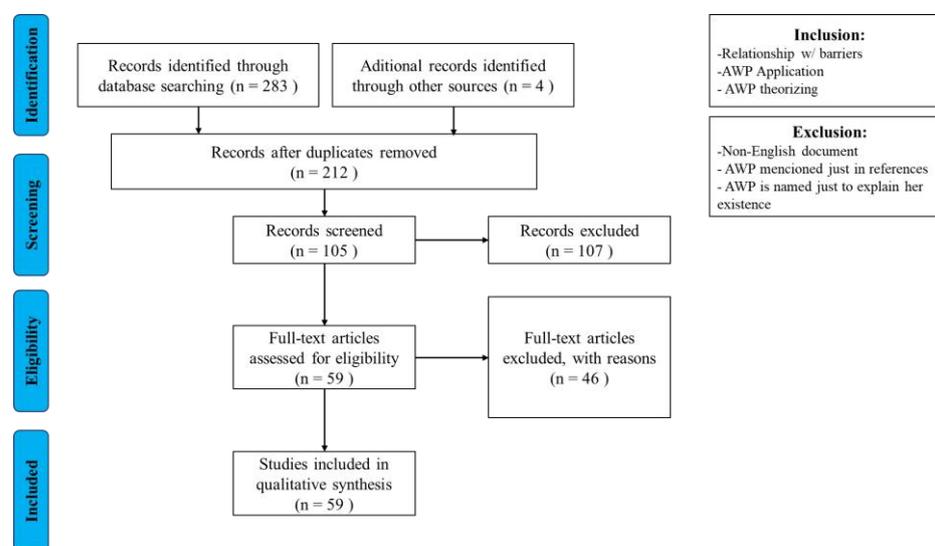


Figure 2. Identification of the eligible resources to be included in the review. Source: own elaboration.

Subsequently, a scientometric analysis is undertaken to dissect and visualize the academic discourse surrounding AWP. This stage focuses on mapping out the coauthorship and keyword co-occurrence networks, illuminating the collaborative and thematic landscape. The analysis reveals influential authors, seminal works, and the evolution of research themes over time, corresponding to the screening phase, where studies are assessed based on inclusion and exclusion criteria determined beforehand. This step is crucial for filtering the literature to those studies most pertinent to the review’s objectives, ensuring that the analysis is both focused and relevant [14].

The final stage delves into the classification and in-depth analysis of barriers to AWP adoption, as discerned from the literature. Manual screening of the literature information refines the selection, isolating critical texts that address AWP implementation challenges. Insights from this analysis lead to synthesizing comprehensive recommendations for overcoming these barriers and highlighting future research trends.

3. Results and Analysis

3.1. Bibliometric Analysis and Literature Characteristics

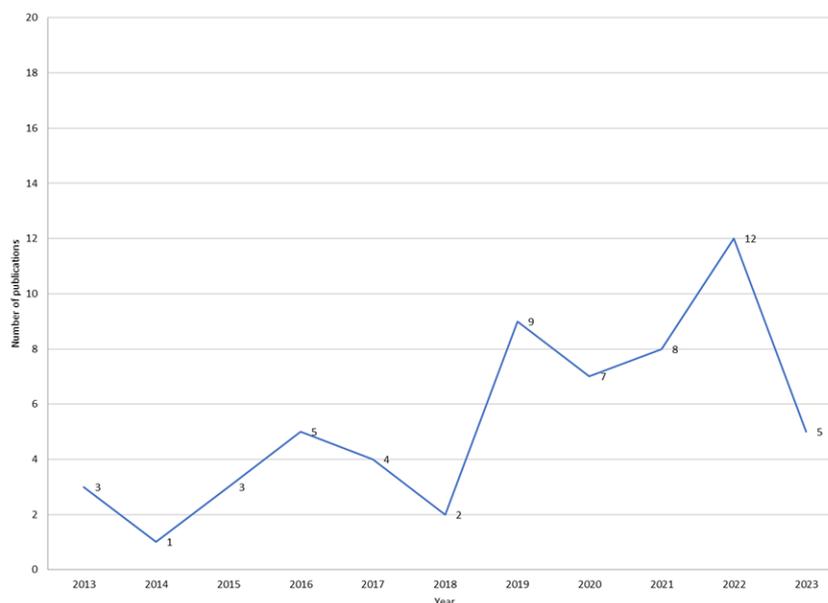
The bibliometric analysis phase resulted in 59 eligible studies. Table 1 shows the classification of the found studies. The table shows that theses (master’s and doctoral) emerge as the most prevalent type, with 23 entries representing 38.98% of the total publications. Journal articles and conference articles also feature significantly, accounting for 25.42% and 23.73%, respectively. The contributions of reports and organizational documents constitute 11.86% of the overall list of references.

Table 1. Publications Classification. Source: Own elaboration.

Type	Number	References	Total Percentage (%)
Theses	23	[8,15–36]	38.98%
Journal article	15	[6,17,37–49]	25.42%
Conference article	14	[9,10,12,50–59]	23.73%
Reports	7	[60–65]	11.86%

The inclusion of various types of publications, despite the relatively low number of journal articles specifically about AWP, stems from the necessity to thoroughly investigate the barriers to adopting this method. This approach aims to fully benefit from AWP's potential by providing a more comprehensive understanding of the challenges and opportunities it presents. The diverse nature of the sources ensures a robust and precise understanding of AWP's theoretical and practical impediments, thereby enriching the academic discourse with a multifaceted perspective on AWP adoption challenges.

Figure 3 illustrates the temporal distribution of the 59 studies included in the dataset, which have been systematically compiled using the PRISMA method. The timeline commences in 2013, with a solitary publication, and exhibits a fluctuating yet generally upward trajectory in the number of publications per year. Notable peaks were observed in 2017, with 9 publications, and a more pronounced peak in 2021, with 12 publications, indicating heightened research activity in those years. The graph shows a dip in the following year, 2022, with a decrease to eight publications, followed by a more significant decline to five publications in 2023. This visual representation of data provides a clear historical perspective on the scholarly attention given to the AWP method over the past decade, highlighting periods of intensive research and publication.

**Figure 3.** Historical trend of publications (period 2013–2023). Source: own elaboration.

3.2. Scientiometric Analysis—Coauthor Cooccurrence Analysis

In the enhanced coauthorship network in Figure 4 visualization provided by VOSviewer[®] (1.6.16), the temporal dimension is introduced, offering a nuanced understanding of academic collaborations over time. Nodes are color coded based on their temporal designation, ranging from 2018 to 2022. This color gradient provides insights into the progression and evolution of collaborative efforts. For instance, nodes shaded in lighter tones indicate more recent academic contributions, whereas those in darker shades reference earlier years.

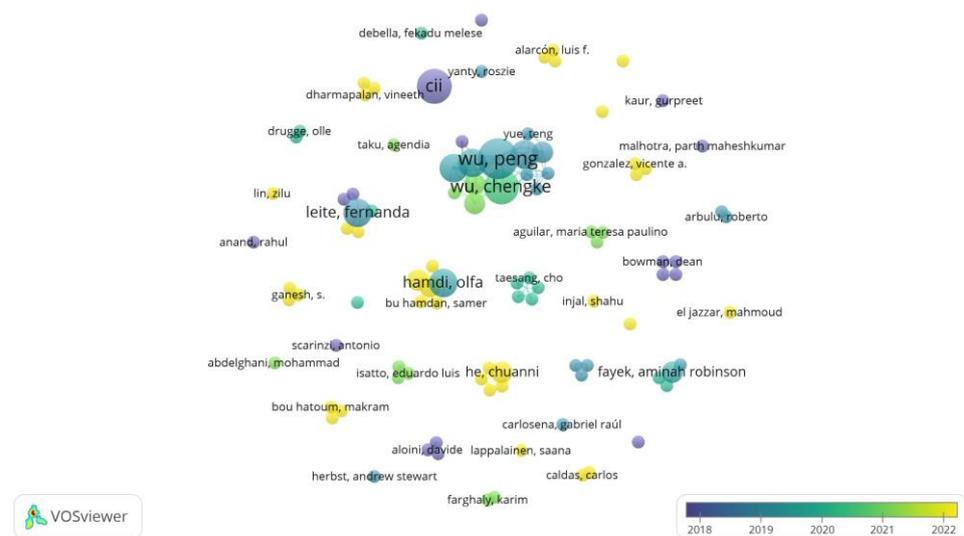


Figure 4. Overlay network visualization of coauthorship. Source: own elaboration.

The central node, “Wu, Peng”, retains its prominence, indicating a sustained contribution and potentially a leading role in this academic network over the observed period. Surrounding nodes manifest various shades, suggesting that some authors have been consistent contributors throughout the years, while others might have emerged more recently or faded in their collaborative intensity.

Moreover, the chronological gradient also offers the ability to discern patterns of collaborative evolution. Some clusters, when observed, may indicate thematic shifts or emerging areas of interest over the years. Such temporal network visualizations are crucial for understanding the dynamics of academic fields, shedding light on trends, emergent leaders, and shifts in collaborative patterns.

3.3. Scientiometric Analysis—Keyword Cooccurrence Analysis

The visualization in Figure 5 presents an intricate interplay of key concepts within the realm of construction management, with AWP positioned at the core. This central placement insinuates its pivotal role in the field. In the latest depiction, a timeline spanning from 2017 to 2022 has been integrated, offering temporal insights. Directly tethered to AWP are the notions of “lean construction” and “best practice”, insinuating a sustained and potentially burgeoning association between these terms throughout the specified time frame.

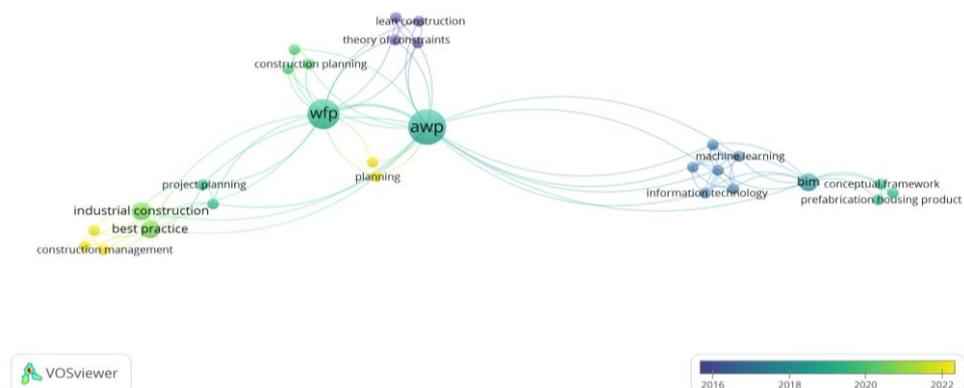


Figure 5. Network visualization of co-occurrence keywords. Source: own elaboration.

Upon scrutiny of the timeline, one discerns that the affiliated concepts have undergone evolution or amassed prominence during these years. The exact temporal correlation for

each term remains unspecified, yet the inclusion of the timeline intimates significant shifts and trends in construction management across these years.

To the right, “constraint management” and “constraints modeling” maintain their presence. Their juxtaposition with the timeline might hint at their increasing significance or the dynamic shifts they have encountered in recent years.

3.4. Main AWP Barriers from the Literature Review

This comprehensive analysis of barriers to the implementation of AWP reveals a multifaceted landscape of challenges, categorized into distinct yet interconnected domains (as shown in Table 2). The category of “Technical and Management Challenges” encompasses barriers such as the complexity of constraint management, the lack of comprehensive knowledge bases, and the manual identification and modeling of constraints. In the realm of “Organizational Resistance and Cultural Change”, the focus shifts to barriers related to change resistance, the conservative nature of the industry, and workforce retention. The “Integration of Methodologies and Tools” highlights the challenges associated with adjusting existing operational logic, integrating WorkFace Planning, and the adoption of BIM/AWP. “Training and Professional Development” addresses the need for continuous education and updates for stakeholders throughout all project phases. The “Planning and Coordination Aspects” centers on the coordination of massive material, information, and resource flows and the complexity of managing multiple disciplines in confined spaces. The “Perceptions and Practical Effectiveness” category delves into the barriers identified by Lean Construction practitioners and concerns regarding AWP’s practical efficacy. “Research Limitations and Empirical Evidence” encompasses the lack of quantitative evidence supporting reported benefits and the challenges in generalizing results. Finally, “Communication and Knowledge Management Aspects” includes barriers such as trust deficits, inadequate knowledge management, poor communication, and the need for cultural and technological change.

Table 2. Categorization of barriers identified from the literature. Source: own elaboration.

Definition	Keywords	References
Technical and Management Challenges	Includes complexities in constraint management, lack of comprehensive knowledge bases, and manual identification and modeling of constraints.	[6,37,42]
Organizational Resistance and Cultural Change	Encompasses barriers related to resistance to change, the conservative nature of the industry, and workforce retention.	[8,9,15,23,29]
Integration of Methodologies and Tools	Combines challenges associated with the need to adjust existing operational logic, integration with WorkFace Planning, and the adoption of BIM/AWP.	[29,35,37,58]
Training and Professional Development	Relates to barriers such as the need for ongoing education and updates for stakeholders in all project phases.	[27,51]
Planning and Coordination Aspects	Focuses on challenges like coordinating massive flows of materials, information, and resources, and managing multiple disciplines in confined spaces.	[28,39,60]
Perceptions and Practical Effectiveness	Contains barriers identified by critiques from Lean Construction practitioners and concerns about the practical effectiveness of AWP.	[49,58]
Research Limitations and Empirical Evidence	Includes the lack of quantitative evidence to support reported benefits and limitations in generalizing results.	[12,31,40]
Communication and Knowledge-Management Aspects	Encompasses barriers such as deficits in trust, inadequate knowledge management, poor communication, and the need for cultural and technological change.	[15,26]

3.4.1. Technical and Management Challenges

The category of “Technical and Management Challenges” encompasses a spectrum of barriers that impede the seamless implementation of AWP. A critical barrier within this domain is the complexity of constraint management in project environments, particularly in scenarios such as bridge rehabilitation, where manual oversight remains prevalent [6,42]. Additionally, the integration of comprehensive knowledge bases into AWP processes presents a significant challenge, as indicated by the repeated identification and modeling of constraints, which are often performed manually and underscore a lack of automation in the integration of information into project knowledge bases [6,42].

These challenges are further exacerbated by a pervasive reliance on manual management, which not only hampers efficiency but also serves as a testament to incomplete knowledge bases that are crucial for informed decision making [42]. The intricate management of these constraints, coupled with an overarching need for robust knowledge bases, underscores the necessity for a shift towards more sophisticated and automated systems that can enhance the efficacy of AWP adoption [42].

Furthermore, the sector is witness to an inherent complexity in the AWP process itself, necessitating extensive resources and organizational change implications [9]. This is not a stand-alone barrier but rather a multifaceted issue that interacts with the need to adjust existing operational logic schemes and manage work package definitions, as articulated by [37]. Such adjustments require not only a change in operational procedures but also a shift in mindset, which can be particularly challenging in established project management frameworks [9,42].

3.4.2. Organizational Resistance and Cultural Change

Under the category “Organizational Resistance and Cultural Change”, the implementation of AWP confronts significant barriers rooted in the human and cultural dimensions of organizational environments. The resistance to change emerges as a recurring theme, reflecting a deep-seated inertia within the corporate culture that is resistant to new methodologies, not only AWP but also many other practices and philosophies, such as lean construction, digital transformation, and others [7,23,66–71]. This resistance is often coupled with concerns about disclosing trade secrets, which can inhibit the sharing of information necessary for effective AWP implementation [23].

The nature of the construction industry itself, characterized by its conservative disposition, further complicates the adoption of AWP. This sector’s proclivity for maintaining traditional practices challenges the integration of innovative project-management approaches [7,15]. Moreover, the retention of a skilled workforce becomes a formidable challenge in an industry where transient employment is common, which can disrupt continuity and the knowledge retention critical for AWP’s success [23].

Organizational change implications are pronounced when implementing AWP, as it demands not only procedural adjustments but also an overarching transformation in organizational structures and mindsets [9]. The need for a strong change-management component is vital, given the new integration and project management practices introduced by AWP [29]. Additionally, the barriers extend to conflicting interests among stakeholders and incompatibilities with certain contractual scenarios, which underscore the complexity of managing change within diverse organizational frameworks [8].

These organizational and cultural impediments necessitate a strategic approach to change management, where the focus is on facilitating the transition through education, leadership, and a re-evaluation of corporate values to embrace the benefits of AWP [8,23,29].

3.4.3. Integration of Methodologies and Tools

The category “Integration of Methodologies and Tools” underscores the multifaceted barriers encountered in harmonizing AWP with existing project management tools and methodologies. A key obstacle is the necessity to recalibrate operational logic schemes to accommodate AWP, which often involves a redefinition of work-package structures and

processes [37]. This recalibration necessitates a thoughtful reexamination and restructuring of current practices, which can be a strenuous process for organizations accustomed to established procedures.

Furthermore, the integration of AWP with other methodologies, such as Lean Construction (LC), is met with criticism from practitioners who highlight deficiencies such as the lack of attention to buffers and practical effectiveness [58]. These criticisms point to the need for a more nuanced approach that addresses the specific workflows and cultural elements inherent in different methodologies.

The challenge extends to the adaptation of the Last Planner System[®] (LPS) to integrate seamlessly with WorkFace Planning, a component of AWP. The available literature on this integration is limited, indicating a gap in research and guidance [35]. This paucity in the literature not only impedes theoretical understanding but also practical application, making it difficult for practitioners to adopt AWP confidently.

This suggests a pressing need for a concerted effort to develop integrative tools and methodologies that are flexible, adaptable, and responsive to the nuances of AWP. Such development should be informed by both empirical research and practical experiences to ensure that the integration of AWP into existing project-management frameworks is both seamless and effective [29,35,37,58].

3.4.4. Training and Professional Development

The “Training and Professional Development” dimension is a critical component in the successful implementation of AWP, as it addresses the educational and skill-related barriers present in the industry. A prevalent challenge is the necessity for ongoing training and updates for stakeholders across all project phases to effectively implement AWP and related methodologies [51]. This requirement underscores the continuous nature of professional development that is needed to keep pace with evolving project management practices.

Malhorta [27] identifies the underutilization of Construction Industry Institute (CII) Best Practices in sectors such as Upstream, Midstream, and Mining (UMM), attributing this to an incomplete understanding of these practices among professionals. This gap in knowledge presents a barrier to adopting AWP, as these best practices form the foundational knowledge required for its application.

Furthermore, the adoption of Building Information Modeling (BIM) in conjunction with AWP necessitates a significant shift in organizational culture and technology, with an acute need for change catalysts and champions to drive the implementation. The transition to BIM/AWP is not merely a technical upgrade but also a cultural transformation that demands a strategic approach to training and development [6,30,38,42].

The lack of familiarity with AWP among contractors amplifies the need for targeted strategies to introduce AWP methodologies [46]. The development of such strategies would facilitate a more profound understanding of AWP and its benefits, promoting its broader acceptance and application. Furthermore, the establishment of ongoing educational programs, mentorship initiatives, and leadership endorsement are vital to fostering an environment conducive to learning and adaptation, enabling the effective deployment of AWP [27,46,51].

3.4.5. Planning and Coordination Aspects

Within the realm of “Planning and Coordination Aspects”, the adoption of AWP is often hindered by the complexities of orchestrating the myriad elements of construction projects. [60] Articulating the challenge of coordinating massive flows of materials, information, and resources to construction sites is a critical endeavor for the successful application of AWP. This coordination demands meticulous planning and an agile response to the dynamic nature of construction environments.

The issue of aligning engineering informational deliverables with the needs of construction planners is particularly pronounced, especially concerning 3D-pipe models, where

a disconnect can significantly affect project execution [39]. This gap suggests a broader issue of alignment between various project stages and the respective stakeholders involved.

Rebai et al. [10] notes the intricate task of managing multiple disciplines within confined spaces, emphasizing the necessity to deconstruct work areas both horizontally and vertically to ensure efficient workflow. This approach requires not only careful planning but also a sophisticated understanding of space utilization concerning project timelines.

Furthermore, the barriers to AWP adoption are compounded by the complexity of breaking down and sequencing work into packages that align with the project's schedule and resource allocation. It involves a detailed understanding of the project deliverables and the engineering work sequence, which can be significantly different when AWP is applied [28,72].

The planning and coordination aspects of AWP, as highlighted by these studies, call for an integrated approach to project management that facilitates seamless communication and collaboration across all project phases and disciplines [10,28,39,57].

3.4.6. Perceptions and Practical Effectiveness

The "Perceptions and Practical Effectiveness" category delves into the evaluative aspects of AWP concerning its reception and real-world application. Ganesh et al. [58] details the scrutiny from Lean Construction practitioners who question AWP's practical effectiveness, highlighting a perceived deficiency in addressing workflow buffers. This critique points to a misalignment between the theoretical constructs of AWP and the tangible outcomes experienced on the ground.

In addition, [49] discusses the challenges of inadequate coordination between project teams and construction personnel. The restructuring of work to accommodate AWP can be mitigated with a proactive stance between engineering and construction planning, yet this requires a practical approach to collaboration that may not be inherent in current practices.

These insights reveal a critical need for a reassessment of how AWP is perceived and applied within the construction industry. It is imperative to bridge the gap between the method's theoretical benefits and the actual results achieved in practice. Such alignment would not only enhance the credibility of AWP but also ensure its methodologies are effectively leveraged to improve project outcomes [35,49,58].

3.4.7. Research Limitations and Empirical Evidence

The "Research Limitations and Empirical Evidence" segment addresses the critical concerns related to the scope and substantiation of research within the AWP field. Halala and Fayek [40] underscores the scarcity of quantitative evidence to substantiate the reported benefits of AWP, signifying a gap between anecdotal success stories and empirical data. This lack of robust evidence impairs the ability to validate AWP's efficacy and may deter organizations from adopting the methodology.

Injal [31] draws attention to the limitations in generalizing results from specific case studies, such as those conducted within Citec, pointing to a potential over-reliance on limited data sets that do not reflect the broader industry. This limitation is compounded by a focus on initial project stages and a restriction to engineering work, which may not capture the full spectrum of AWP's applicability.

Farghaly and Soman [12] highlights a similar concern, pointing out the absence of a clear relationship in the literature between information management and AWP. This ambiguity hinders the development of a comprehensive understanding and the establishment of best practices that are grounded in solid research.

These limitations suggest a pressing need for more rigorous and expansive research that encompasses diverse project types and stages. Such research should seek to provide a robust empirical foundation for AWP, enabling a clear demonstration of its benefits and a more thorough understanding of its application across the construction industry [12,31,40,57].

3.4.8. Communication and Knowledge-Management Aspects

In the domain of “Communication and Knowledge Management Aspects”, the implementation of AWP is frequently impeded by barriers related to the dissemination and utilization of knowledge within organizations. Abdelghani [15] highlights a collection of such barriers, including the conservative nature of the construction industry, resistance to adopting new technology and management principles, and the pervading issues of trust, inadequate knowledge management, and poor communication. These challenges are often a reflection of deeper cultural and structural issues within organizations, where established norms and practices may inadvertently stifle the flow of information and knowledge sharing necessary for AWP [15]. The industry’s conservative approach frequently leads to a reluctance to share trade secrets or to adopt new technologies, further exacerbating the problem.

Lorys [26] also identifies variability in productivity factors across different projects and the difficulty in reporting consistent construction progress as additional barriers. This inconsistency can lead to skepticism towards new methodologies like AWP and reluctance from clients to embrace new construction strategies.

The issues surrounding communication and knowledge management necessitate a strategic approach that prioritizes the development of trust, the establishment of effective communication channels, and the implementation of robust knowledge-management systems. Such strategies are crucial for the successful adoption of AWP, ensuring that knowledge is not only available but also effectively disseminated and utilized across all levels of an organization [15,26,57].

4. Discussion

In addressing the “Technical and Management Challenges” associated with AWP, the complexity of constraint management, the lack of comprehensive knowledge bases, and the manual identification and modeling of constraints, as identified by [37,42], represent significant hurdles. These challenges highlight the need for more automated and integrated systems within AWP. The current reliance on manual processes for constraint identification and modeling points to an opportunity for the development of more sophisticated technological solutions. The integration of artificial intelligence and machine learning could streamline these processes, enhancing efficiency and accuracy. Future research should focus on the development and implementation of such technologies, aiming to reduce the manual burden and increase the reliability of constraint management within AWP. Furthermore, the gap in comprehensive knowledge bases calls for an extensive compilation and analysis of project data. This data-driven approach could lead to the development of more effective management strategies and best practices in AWP. The establishment of centralized knowledge repositories, accessible to AWP practitioners, would facilitate knowledge sharing and collaboration, thereby improving overall project outcomes. Lastly, future trends should also focus on addressing the challenges presented by the dynamic nature of project environments. This requires adaptive management strategies that can respond to changing constraints and project conditions in real time. The development of flexible and scalable management tools that can accommodate these changes will be crucial for the successful implementation of AWP in a variety of project contexts.

In the context of “Organizational Resistance and Cultural Change” related to AWP, it is imperative to address the deeply rooted barriers that impede its adoption. As [9,15,23] have identified, resistance to change and the conservative nature of the industry are significant obstacles. These challenges underscore the need for future strategies that are not only technically sound but also sensitive to the human and cultural aspects of organizational dynamics. One of the primary areas for future research is the development of comprehensive change-management strategies. These strategies should be tailored to address the specific needs and concerns of various stakeholders within the construction industry. The focus should be on fostering a culture of openness and adaptability, where change is not merely accepted but embraced as a path to improvement and innovation.

Furthermore, future trends should include the cultivation of leadership that is committed to change. Leaders play a crucial role in setting the tone for organizational culture and can be instrumental in driving the adoption of new methodologies like AWP. Training programs and leadership-development initiatives that emphasize the value of innovation and adaptability in project management could be highly beneficial. Another area of interest is the exploration of ways to enhance workforce retention. This involves not just improving job satisfaction and career-development opportunities but also embedding a sense of ownership and involvement in the organizational change process. Engaging employees in the implementation of AWP can lead to a more cohesive and committed workforce. Lastly, future research should investigate methods to overcome the industry's conservative nature. This could involve case studies and pilot projects that demonstrate the tangible benefits of AWP, thereby building a stronger case for its broader adoption. Collaborative efforts between academia and industry could play a significant role in this regard, facilitating a more evidence-based approach to change.

The discussion around "Integration of Methodologies and Tools" in AWP highlights a significant area for future research and development. As identified by [29,35,37], challenges include the need to adjust existing operational logic and integrate WorkFace Planning with BIM/AWP. These complexities underscore the necessity for developing more cohesive and interoperable methodologies and tools that can seamlessly integrate into existing project-management frameworks. Future research should focus on the creation and refinement of tools that facilitate the integration of AWP with other established methodologies like Lean Construction and BIM. This involves not just technological innovation but also an understanding of how these methodologies can complement each other to enhance overall project efficiency and effectiveness. Developing platforms or software that can bridge the gap between different methodologies will be crucial. Another key area for future trends is the standardization of practices and procedures in AWP integration. Standardization can provide a consistent framework for implementation, reducing confusion and enhancing compatibility across various projects and teams. Research into best practices and the development of industry-wide standards could greatly aid in this process. Additionally, there is a need to explore the organizational implications of integrating new methodologies and tools. This includes understanding the impact on team dynamics, communication flows, and decision-making processes. Future research should also aim to provide insights into how organizations can best adapt to these new tools and methodologies, ensuring a smooth transition and effective adoption.

In the realm of "Training and Professional Development" for AWP, significant attention is required to address the educational and skill-related barriers in the industry. The need for ongoing education and updates for stakeholders throughout all project phases is paramount. This requirement signifies a trend towards continuous learning and professional development as critical components of successful AWP implementation [51]. Future research should explore the development of comprehensive training programs tailored to AWP. These programs must cater to varying levels of expertise and cover all aspects of AWP, from basic principles to advanced techniques. This involves not only technical training but also an emphasis on the strategic and managerial aspects of AWP to ensure a holistic understanding of its application in project management. Another critical area is the integration of AWP training into higher-education curriculums and professional-development courses. Collaborations between academic institutions and industry bodies could facilitate this integration, ensuring that emerging professionals are equipped with the knowledge and skills required for AWP. Research into the most effective teaching methodologies and technologies to deliver this training will be vital. Moreover, future trends should focus on the development of online learning platforms and resources. The use of digital technology in training can provide more flexible and accessible learning opportunities, catering to a wider audience and facilitating continuous learning. Additionally, the establishment of certification programs for AWP could play a significant role in professional development. These certifications would not only provide recognition of expertise but also set a

standard for skills and knowledge in the field, promoting consistency and excellence in AWP practices.

The “Planning and Coordination Aspects” of AWP present a complex landscape where future research and development are critically needed. As identified by [28,39], challenges such as coordinating massive flows of materials, information, and resources, as well as managing multiple disciplines in confined spaces, are paramount. These issues highlight the necessity for advanced planning and coordination mechanisms in AWP. Future research should focus on developing innovative tools and methodologies to enhance the planning and coordination aspects of AWP. This includes leveraging digital technologies such as BIM, Digital Twins, and Geographic Information Systems (GIS) to facilitate more accurate and efficient planning processes. The integration of these technologies can provide a more holistic view of project dynamics, enabling better decision making and resource allocation. Another key area for future trends is the exploration of collaborative platforms that enable seamless communication and coordination among various project stakeholders. These platforms should be designed to support the multifaceted nature of construction projects, allowing for real-time updates and adjustments to project plans as conditions change. Furthermore, there is a need for research into adaptive planning techniques that can accommodate the uncertainties and complexities inherent in construction projects. This involves developing flexible planning models that can respond to unforeseen challenges and changes in project scope or timelines. Lastly, future trends should also consider the human element in planning and coordination. This includes investigating how team dynamics, leadership styles, and communication strategies impact the effectiveness of project planning and coordination. Developing training and guidelines to enhance these soft skills will be crucial for the successful implementation of AWP.

The exploration of “Perceptions and Practical Effectiveness” in the realm of AWP is essential to understanding its real-world impact and acceptance. As highlighted by [49,58], critiques from and concerns about the practical effectiveness of AWP underscore the need for a more comprehensive evaluation of AWP’s implementation and outcomes. Future research should delve into the comparative analysis of AWP with other project-management methodologies, such as Lean Construction. This involves assessing the relative strengths and weaknesses of each approach and identifying best practices that can be leveraged for enhanced project management. Such studies could provide empirical evidence to support the advantages or highlight areas for improvement in AWP. Additionally, it is crucial to investigate the factors that influence the perceptions of AWP among practitioners. Understanding these factors can inform strategies to improve the acceptance and adoption of AWP. Research should explore how organizational culture, previous experiences with project-management methodologies, and the perceived complexity of AWP influence its reception among construction professionals. Exploring the actual effectiveness of AWP in diverse project environments is another area for future trends. This includes studying the impact of AWP on project outcomes, such as time, cost, and quality, in various types of construction projects. Such empirical studies can provide valuable insights into the practical benefits and limitations of AWP, guiding future enhancements. Moreover, future research should consider developing and disseminating case studies and success stories of AWP implementation. These case studies can serve as educational tools and best-practice models, demonstrating the practical effectiveness of AWP in real-world settings.

The exploration of “Research Limitations and Empirical Evidence” in AWP is crucial for grounding the methodology in solid scientific principles. As pointed out by [12,31,40], a significant gap in the current research is the lack of quantitative evidence to support the reported benefits of AWP and the challenges in generalizing results. Addressing these limitations is vital for the credibility and further development of AWP. Future research should prioritize the collection and analysis of empirical data from a wide range of AWP projects. This involves conducting large-scale, longitudinal studies to gather quantitative data that can validate the benefits and effectiveness of AWP in different project settings. Such data are essential for understanding the true impact of AWP on project outcomes,

including time, cost, and quality. Moreover, there is a need for more diverse case studies that encompass various types of construction projects and geographical locations. This diversity would enable a more comprehensive generalization of results, making the findings more applicable to a broader range of contexts and increasing the global relevance of AWP research. Another area for future trends is the development of standardized metrics and evaluation criteria for assessing AWP performance. Standardized metrics would provide a consistent framework for evaluating the effectiveness of AWP, facilitating comparative analyses across different projects and studies. Furthermore, future research should explore the relationship between AWP and information management, as highlighted by [12]. Investigating this relationship could provide insights into how information-management practices impact the implementation and success of AWP, leading to the development of more integrated and efficient management strategies.

The “Communication and Knowledge Management Aspects” of AWP are pivotal areas that require focused attention for the methodology’s successful implementation. Adelghani and Lorys [15,26] have identified key barriers in this domain, such as trust deficits, inadequate knowledge management, poor communication, and the need for cultural and technological change. Addressing these challenges is essential for enhancing the effectiveness of AWP. Future research should delve into strategies for improving communication within AWP frameworks. This involves exploring how digital tools and platforms can facilitate clearer and more efficient communication among project stakeholders. Research could focus on the development of collaborative tools that not only streamline information sharing but also foster a culture of transparency and trust. Another crucial area for future trends is the development of robust knowledge-management systems tailored to AWP. These systems should be designed to capture, store, and disseminate project knowledge effectively, enabling teams to access and utilize critical information readily. Research should investigate best practices in knowledge management, focusing on how these can be integrated into AWP to enhance decision making and project outcomes. Additionally, understanding the role of organizational culture in the adoption and effectiveness of AWP is vital. Future studies should examine how cultural aspects influence the willingness of organizations to adopt new technologies and methodologies. Research could explore methods for fostering a culture that values continuous learning, innovation, and adaptability, which are crucial for the successful implementation of AWP.

5. Conclusions

In concluding this comprehensive study on the AWP methodology, it is evident that while AWP presents a robust framework for project management, its adoption is encumbered by a range of multifaceted barriers. This SLR, encompassing an analysis of 287 documents and focusing on 59 pertinent studies from 2013 to 2023, has provided a detailed examination of these challenges. Central to this study’s findings are the identified categories of barriers to AWP implementation: technical and management challenges, organizational resistance and cultural change, integration of methodologies and tools, training and professional development, planning and coordination aspects, perceptions and practical effectiveness, research limitations and empirical evidence, and communication and knowledge-management aspects. Each of these categories represents a critical area where concerted efforts are required to overcome the obstacles to AWP adoption.

The study suggests that future research should not only focus on technological advancements but also address the human, cultural, and organizational factors that significantly impact AWP’s successful implementation. The integration of new methodologies and tools, coupled with effective communication strategies and robust knowledge-management systems, will be essential in navigating the challenges identified.

Furthermore, the need for empirical research to substantiate the benefits of AWP and to generalize its applicability across different project types and contexts is paramount. This calls for a more data-driven approach to AWP research, ensuring that the methodology’s efficacy is grounded in solid empirical evidence.

This SLR contributes significantly to the existing body of knowledge on AWP. It offers a novel perspective on the challenges associated with AWP implementation and lays the groundwork for future scholarly endeavors in this domain. The study's findings and recommendations provide a foundation for researchers, practitioners, and industry stakeholders to collaboratively address these challenges, paving the way for more effective and efficient project-management practices in the construction industry.

The current work is not free of limitations. The first limitation is the used methodology, which is the SLR approach. The findings of this study were extracted from the found studies in the literature. No numeric analysis has been conducted to analyze the most serious barriers that may face the adoption of AWP in the construction sector. Therefore, using other methods to collect quantitative or qualitative data (e.g., surveys, interviews, or focus groups) is recommended to answer this important question. Secondly, during the literature survey, the study included various types of publications (i.e., journal articles, conference articles, technical reports, and theses). While this seems very inclusive to cover various views and many ideas about AWP, it does not guarantee the exclusion of non-peer-reviewed results. This is due to the low number of peer-reviewed publications about AWP. This agrees with the above-mentioned barriers concerning the research limitations. Accordingly, the same study can be conducted in the future when more peer-reviewed publications about AWP are available. Lastly, the current study presents various strategies to support the proper adoption of AWP in the construction sector. However, due to the lack of numerical assessment tools, the study does not prioritize any of these strategies, nor does it investigate the expected challenges that may face these strategies. Answering these questions might be an essential need to ensure the successful implementation of AWP.

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