

GOVERNING STOCHASTIC SERVICE DEMANDS IN LEAN CONSTRUCTION: A HYBRID LPS-SCRUM MODEL

João P. P. Vieira¹, Raquel H. Reck², Bernardo M. B. S. Etges³, Mayara C. Sousa⁴, & Wesley O. Costa⁵

ABSTRACT

Lean Construction planning systems, such as the Last Planner System (LPS), are effective in stabilizing production flows but face limitations when applied to service-oriented contexts characterized by high variability and stochastic demand. This paper addresses this gap by proposing and evaluating a Lean–Agile governance model that integrates adaptive prioritization mechanisms from Scrum with commitment-based execution mechanisms from the LPS. Using a Design Science Research approach, a governance artefact was developed and implemented in the technical assistance function of a residential construction company. The model structures governance across three layers: demand discovery, value-based prioritization, and execution commitment. Results from a 70-week longitudinal evaluation indicate reductions in service lead time, improved backlog stability, and increased transparency in decision-making. The study contributes to Lean Construction research by demonstrating how commitment-based planning systems can be extended to stochastic service environments through context-sensitive governance design.

KEYWORDS

Lean construction, Last Planner System, agile project management, Scrum, governance.

INTRODUCTION

Lean Construction has been widely adopted as a production philosophy aimed at increasing value, reducing waste, and improving reliability in construction systems (Koskela, 2000; Ballard, 2000). Central to this approach is the Last Planner System (LPS), which structures planning and control around commitments made by those responsible for execution, protecting production from variability and improving plan reliability (Ballard, 1994). Its effectiveness has been demonstrated in environments with stable and predictable workflows, such as housing and infrastructure projects.

However, service-oriented activities—particularly post-construction technical assistance—exhibit fundamentally different dynamics. These are driven by stochastic, customer-initiated

¹ M.Sc. Eng., Lean Consultant at Climb Consulting Group, Porto Alegre, Brazil, joao@climbgroup.com.br, orcid.org/0000-0003-0292-2570

² PhD and Lean Consultant at Climb Consulting Group, Porto Alegre, RS, Brazil, +55 51 998711561, raquel@climbgroup.com.br, orcid.org/0000-0003-1928-3461

³ PhD Candidate, M.Sc. Eng., Founding-Partner at Climb Consulting Group, Federal University of Rio Grande do Sul, Porto Alegre, Brazil, bernardo@climbgroup.com.br, orcid.org/0000-0002-3037-5597

⁴ Planning Coordinator at Wanderley Constructions, Campina Grande, Brazil orcid.org/0009-0006-6666-7790

⁵ Production Engineer at Wanderley Constructions, Campina Grande, Brazil orcid.org/0009-0001-6350-0593

demands with high variability in scope, urgency, and resource requirements. In such contexts, assumptions of predictable sequences and stable production rates are challenged, leading to backlog growth, long lead times, and reduced customer satisfaction, even in organizations adopting Lean principles.

This limitation points to the need for a broader perspective beyond planning tools. In this study, governance is understood as the set of structures and decision-making mechanisms that regulate how work is selected, prioritized, and committed. The core limitation of traditional approaches lies not only in execution logic, but in the lack of mechanisms to regulate demand inflow under uncertainty.

The literature has increasingly explored Agile methods to address variability (Owen et al., 2006). Scrum, in particular, emphasizes adaptability and value-based prioritization, making it suitable for volatile environments (Sutherland, 2019). However, when applied in isolation, Agile lacks the commitment mechanisms required for reliable execution in construction settings.

Recent studies have explored Lean–Agile integration (Hamerski et al., 2019; Power et al., 2023; Power & Sinnott, 2025), but these primarily focus on production-oriented contexts. The application of such approaches to service operations remains underexplored.

This study addresses this gap by framing Lean–Agile integration as a governance design problem. In stochastic service environments, neither commitment-based planning nor adaptive prioritization is sufficient alone. Effective performance depends on a governance structure that integrates dynamic prioritization with stable execution commitments. Accordingly, this study proposes and evaluates a hybrid governance model combining LPS and Scrum. It addresses the following research question: How can commitment-based planning and dynamic prioritization be combined to govern stochastic service demands in Lean Construction?

Using a Design Science Research (DSR) approach, a governance artefact was developed and applied to the technical assistance sector of a residential construction company. The study contributes by: (1) introducing a governance artefact to regulate stochastic service inflow; (2) operationalizing Lean–Agile integration through separation between prioritization and commitments; and (3) providing longitudinal evidence from a 70-week case study.

LAST PLANNER SYSTEM: COMMITMENT-BASED PLANNING

Lean Construction conceptualizes production as a flow of value generation constrained by variability and uncertainty (Koskela, 2000). Within this paradigm, the Last Planner System (LPS) represents a central mechanism for planning and control, shifting the focus from activity-based scheduling to commitment-based planning (Ballard, 1994; Ballard, 2000). The system structures planning across hierarchical horizons—long-, medium-, and short-term—progressively transforming what should be done into what can and will be done through the systematic identification and removal of constraints.

A key strength of the LPS lies in its ability to enhance the reliability of commitments, supported by metrics such as Percent Plan Complete (PPC). By engaging those responsible for execution, the system stabilizes workflows and protects production against variability. Empirical evidence consistently demonstrates improvements in coordination, predictability, and workflow stability, particularly in environments characterized by repetitive and relatively predictable production processes.

However, these strengths are closely tied to an implicit assumption: a minimum level of stability in demand, task definition, and sequencing. In contexts where demand is externally triggered, highly variable, and difficult to forecast, such as service-oriented processes, this assumption is challenged. Under these conditions, planning horizons tend to collapse, constraints are continuously reintroduced, and the ability to make reliable commitments is compromised. This suggests that while LPS is effective in stabilizing execution, it offers limited mechanisms to regulate uncertain demand inflow.

AGILE AND SCRUM AS DYNAMIC PRIORITIZATION SYSTEMS

Agile methodologies emerged as a response to the limitations of plan-driven approaches in environments characterized by uncertainty, change, and rapid feedback (Highsmith, 2001; Beck et al., 2001). Among these, Scrum has become one of the most widely adopted frameworks, emphasizing iterative development, adaptability, and continuous value delivery (Schwaber & Sutherland, 2020). Central to Scrum is the concept of a prioritized backlog, which dynamically orders work based on value, urgency, and stakeholder needs (Sutherland & Sutherland, 2019).

The primary strength of Scrum lies in its capacity to manage uncertainty through dynamic prioritization. Rather than attempting to stabilize the system upfront, Scrum embraces variability, enabling continuous reordering of work and incremental delivery (Schwaber, 2004; Rigby et al., 2016). This makes it particularly suitable for environments where demand is volatile and customer-driven, including service operations (Owen et al., 2006; Highsmith, 2009).

However, when applied to construction contexts, Scrum presents limitations. Construction systems require coordination across multiple actors, interdependent tasks, and shared resources, where reliability of execution is critical. In such environments, the absence of explicit commitment mechanisms may lead to fragmented workflows and reduced predictability (Koskela & Howell, 2002; Ballard, 2000). Thus, while Agile approaches are effective in regulating what should be done next, they provide limited support for ensuring what will be reliably executed. Figure 1 presents an example of the governance meeting routine adopted in the case study, demonstrating how Scrum-inspired dynamic prioritization was embedded within a commitment-based control structure to address the limitations discussed above.



Figure 1: Weekly governance routine using the LPS-Scrum model.

TOWARDS A GOVERNANCE PERSPECTIVE ON LEAN-AGILE INTEGRATION

The complementary nature of Lean and Agile approaches has motivated increasing efforts toward their integration in construction. Lean emphasizes stability, flow, and reliable commitments, while Agile emphasizes adaptability, responsiveness, and value-based prioritization. Previous studies have explored this integration in different contexts. Owen et al. (2006) highlighted the potential of Agile methods in construction while noting their limitations in execution phases. Hamerski et al. (2019) demonstrated the benefits of combining Lean and Agile in multi-project environments. Power, Sinnott, and Lynch (2023) showed that Scrum can complement LPS, improving planning performance, while Power and Sinnott (2025) proposed the Hybrid Agile Lean (HAL) framework integrating Scrum, LPS, and Takt planning.

Despite these advances, existing approaches predominantly focus on production-oriented systems, where workflows can be structured and stabilized. In contrast, service operations—

particularly post-construction technical assistance—are characterized by stochastic demand inflow, where requests are customer-driven, episodic, and highly variable. From a service operations perspective, such environments are defined by the simultaneous presence of variability in arrival rates, service times, and customer expectations, requiring mechanisms for both demand regulation and execution control.

This highlights a persistent gap in the literature: while Lean effectively governs execution stability and Agile effectively governs demand prioritization, there is limited understanding of how to govern the interface between demand inflow and execution commitments in stochastic service systems.

RESEARCH METHOD

RESEARCH STRATEGY: DESIGN SCIENCE RESEARCH

This study adopts Design Science Research (DSR) as its overarching research strategy. DSR is particularly suitable for addressing complex, practice-driven problems where existing theories and methods are insufficient to fully explain or resolve observed challenges (Lukka, 2003; Dresch et al., 2015). In Lean Construction, DSR enables the systematic development and evaluation of artifacts that bridge theoretical constructs and practical application (Koskela, 2008).

The research problem—governing stochastic service demands in Lean Construction—presents high variability, limited predictability, and strong interaction between organizational and operational factors. Existing approaches, such as the Last Planner System (LPS) and Scrum, provide partial solutions but remain insufficient when applied independently. Therefore, the study aims not only to solve a practical problem but also to generate generalizable knowledge regarding governance design for service operations in construction.

ARTIFACT DEFINITION

The primary artifact is a hybrid governance model structured into three interrelated layers:

1. Demand discovery and classification
2. Value-based prioritization
3. Commitment-based execution

Scrum and the Last Planner System are not treated as standalone methods, but rather as mechanisms embedded within specific governance layers. The artifact conceptualizes governance as the deliberate separation between demand sensing, decision-making, and execution commitments. Scrum and LPS are embedded as complementary mechanisms within different layers: Scrum supports adaptive prioritization, while LPS supports reliable execution.

ARTIFACT DEVELOPMENT

The artifact was developed iteratively following DSR principles. An initial diagnosis identified a mismatch between stochastic demand characteristics and existing planning practices. Based on this, the model was designed by mapping observed problems to Lean and Agile theoretical constructs.

Alternative design logics were considered during development. A purely Lean-based approach—extending LPS to service operations—was deemed insufficient due to its limited capacity to regulate demand inflow. Conversely, a purely Agile-based approach—centered on backlog prioritization—was considered inadequate to ensure reliable execution in a multi-actor construction environment. These limitations motivated the adoption of a layered governance structure integrating both perspectives.

The final artifact was operationalized through the definition of roles, decision rules, information flows, and planning routines across the three layers. Importantly, the model did not

seek to eliminate variability but rather understand and manage it upstream, preventing its propagation into execution commitments.

IMPLEMENTATION CONTEXT

The artifact was implemented in the technical assistance sector of a residential construction company in Brazil. This context is characterized by stochastic, customer-driven demand with high variability in scope and urgency.

Prior to implementation, the sector exhibited high backlog accumulation, long and variable lead times, and limited transparency regarding prioritization decisions. The implementation spanned a 70-week period, allowing observation across different demand cycles. The model was introduced incrementally, enabling adaptation while maintaining its structural integrity.

EVALUATION CRITERIA AND METRICS

The evaluation of the artifact focused on its ability to improve the governance of stochastic service demands, rather than on isolated performance gains. Accordingly, a multi-dimensional set of quantitative and qualitative metrics was adopted to capture different aspects of governance performance. Table 1 summarizes the evaluation criteria, including the selected metrics, their rationale in terms of governance dimensions, and the logic used to interpret observed changes.

Table 1: Governance-oriented evaluation framework for stochastic service systems.

Metric	Governance Dimension	Evaluation Logic
Lead time	System responsiveness to demand	Reduction indicates improved flow and responsiveness
Backlog size	Demand regulation effectiveness	Stabilization indicates improved control of demand inflow
Backlog aging	Flow efficiency and prioritization	Reduction indicates improved handling of pending work
Throughput	Execution capacity and flow stability	Increased consistency indicates improved flow reliability
Planning reliability (e.g., PPC)	Stability of execution commitments	Increased consistency indicates more reliable commitments
Behavioral observations	Transparency and coordination practices	Changes in decision-making indicate improved governance dynamics

Baseline data were collected prior to implementation, and performance was monitored continuously throughout the evaluation period. This longitudinal approach enabled comparison of system behavior before and after the introduction of the governance model. The effectiveness of the artifact was assessed based on directional improvements across these metrics and their consistency over time, rather than on fixed performance thresholds. These interpretations are based on observed trends in a real-world setting and are therefore understood as indicative of systemic behavioral changes rather than statistically isolated effects.

It is acknowledged that the absence of a controlled experimental design limits causal attribution. However, the longitudinal nature of the study and the alignment between observed changes and the artifact's intended mechanisms provide a robust basis for analytical generalization.

RESULTS

PRE-IMPLEMENTATION: BASELINE PERFORMANCE

Prior to the implementation of the governance model, service requests were managed without explicit separation between demand capture, prioritization, and execution commitment. Requests were processed on a first-come, first-served basis, with limited transparency regarding prioritization criteria.

Baseline performance data indicate:

- Average lead time: 34 days (recent period);
- Average lead time with historical backlog: 71 days;
- Presence of aging backlog and unresolved requests;
- Significant temporal variability in demand volume, with peak periods generating congestion;

These data describe a system with limited capacity to regulate demand inflow and high accumulation of pending requests.

IMPLEMENTATION OF THE GOVERNANCE MODEL

Following implementation, requests were structured across three governance layers: demand discovery, prioritization and readiness, and execution commitment. Demand processing included classification, prioritization, and controlled release into execution planning.

The system introduced:

- Explicit screening of non-procedent requests
- Separation between ready backlog and committed work
- Weekly planning based on constraint-free and prioritized tasks

PROPOSED GOVERNANCE ARTEFACT

This section presents the governance artefact developed through the Design Science Research process to manage stochastic service demands in construction. The artefact structures the technical assistance function as a commitment-based planning system supported by adaptive demand regulation, integrating principles from the Last Planner System (LPS) and Scrum.

The model organizes service requests across three interconnected governance layers—Demand Discovery, Prioritization and Readiness, and Execution Commitment—each supported by explicit status categories and performance metrics. This structure enables transparency, adaptive decision-making, and reliability in environments characterized by high demand variability.

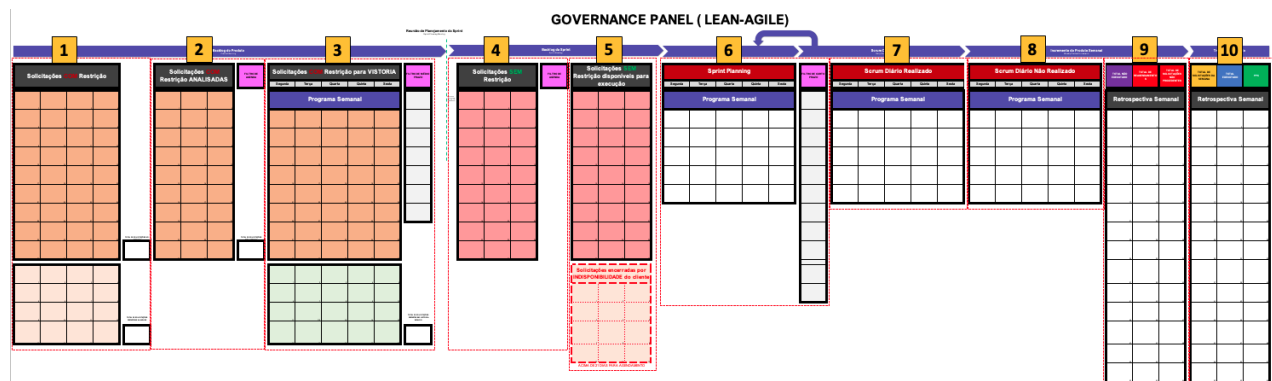


Figure 2: Governance panel (Lean-Agile)

DEMAND DISCOVERY AND INITIAL SCREENING LAYER

The first governance layer is responsible for capturing, validating, and filtering incoming service requests, regulating the inflow of work into the system. In this layer, customer requests are registered through digital platforms (e.g., Facilitat and Mobus) and subjected to an initial technical assessment based on warranty criteria and contractual documentation.

This layer includes the following artefact states:

1. Requests opened by customers in the service platform;
2. Requests initially assessed as technically admissible based on the owner's manual and handover documentation;
3. Short-term scheduling for inspection and scope definition.

Requests deemed non-procedural are explicitly removed from the system and recorded as non-procedent requests, preventing unnecessary load on downstream planning activities. By formalizing this screening process, the artefact introduces an explicit demand qualification mechanism, which is typically absent in traditional LPS applications.

PRIORITIZATION AND READINESS LAYER

The second layer governs backlog formation, prioritization, and readiness, operating as a buffer between demand discovery and execution commitment. In this layer, requests are assessed in terms of constraints, resource availability, and scheduling feasibility, allowing adaptive prioritization without compromising execution reliability.

This layer includes the following artefact states:

4. Requests without constraints, available for execution and awaiting scheduling confirmation;
5. Requests without constraints, scheduled outside the current week.

The separation between “ready but unscheduled” and “scheduled beyond the current week” allows the organization to maintain visibility over the backlog while preventing premature commitments. This logic mirrors Scrum backlog management principles, while preserving alignment with Lean concepts of flow and waste reduction.

EXECUTION COMMITMENT LAYER

The third governance layer corresponds to commitment-based planning and execution, directly aligned with the short-term planning logic of the Last Planner System. In this layer, only requests that are free of constraints and explicitly committed are included in the weekly work plan.

This layer includes the following artefact states:

6. Requests scheduled for execution in the current week;
7. Requests completed in the current week;
8. Requests not completed in the current week;
9. Execution performance is monitored through explicit outcome categories, including:
 - 9.1 Total not executed: requests planned but not completed;
 - 9.2 Total rescheduled: non-completed requests with a new execution date;
 - 9.3 Total non-procedent requests identified after inspection;
10. Weekly planning reliability is assessed using:
 - 10.1 Total requests planned for the week;
 - 10.2 Total requests completed;

10.3 Percent Plan Complete (PPC), calculated as the ratio between completed and planned requests.

By applying PPC to service execution, the artefact extends the use of commitment-based performance metrics beyond production contexts, while preserving their original intent of learning and continuous improvement.

GOVERNANCE LOGIC OF THE ARTEFACT

Rather than representing a linear process flow, the artefact functions as a governance mechanism that regulates how demands enter the system, how priorities are established, and when execution commitments are made. The explicit separation between prioritization and commitment prevents overloading the production system and enables adaptive responses to demand variability without sacrificing planning reliability.

This governance structure operationalizes Lean–Agile integration by assigning Agile principles to demand regulation and Lean principles to execution control, providing a coherent framework for managing service operations in construction.

PERFORMANCE EVOLUTION AFTER IMPLEMENTATION

Performance indicators were monitored over a 70-week period following implementation. As summarized in Table 2, the results indicate a progressive reduction in average lead time—from an initial range of 34–71 days—alongside stabilization of backlog size, reduction in long-aging requests, and increased consistency in weekly throughput. The figure also highlights that demand variability remained high and that rescheduling, although reduced, persisted over time. These patterns reinforce that the system did not eliminate variability but improved its capacity to manage it without compromising execution reliability.

Table 2: Summary Key Metrics (Pre vs. Post).

Metric	Pre-Implementation	Post-Implementation
Average Lead Time	34–71 days	Decreasing over time
Backlog Size	High and unstable	Stabilized
Backlog Aging	Significant accumulation	Reduced aging
Throughput Consistency	Irregular	More consistent
PPC (Planning Reliability)	Low / not structured	Monitored and improved
Demand Variability	High	Remains high
Rescheduling Rate	Frequent	Reduced but present

These improvements did not occur immediately. Instead, a gradual adaptation process was observed, including periods of temporary instability during early adoption. This temporal pattern suggests that performance gains were associated with the stabilization of governance routines rather than isolated operational changes.

LINKING METRICS TO GOVERNANCE LAYERS

The observed performance changes can be associated with different governance layers. Backlog-related metrics (size and aging) reflect the effectiveness of the prioritization layer in managing demand variability, while execution metrics (e.g., PPC and completion rates) relate to the commitment layer, indicating improvements in planning reliability. Demand filtering metrics (e.g., non-procedent requests) are associated with the screening layer. This alignment provides empirical support for the model’s core proposition: separating prioritization from execution commitments enables more reliable operation under stochastic demand conditions.

RESULTS SUMMARY

Overall, the results indicate changes in system behavior after implementation, particularly in lead time reduction, backlog stabilization, and improved monitoring of execution reliability. Variability in demand persisted, and performance improvements emerged progressively over time.

DISCUSSIONS

IMPLICATIONS FOR LEAN CONSTRUCTION THEORY

The results reinforce and extend core principles of Lean Construction by highlighting a structural limitation in the application of the Last Planner System (LPS) to service-oriented environments. While Lean theory conceptualizes production as a flow constrained by variability (Koskela, 2000), the findings indicate that, in stochastic service systems, variability cannot be sufficiently reduced at its source.

Instead, effective performance depends on the ability to regulate variability upstream, before it affects execution. This suggests that the effectiveness of commitment-based planning systems such as LPS is contingent on the presence of governance mechanisms that stabilize the inflow of work. Thus, rather than redefining LPS, this study positions it as conditionally effective, depending on how demand is structured prior to commitment-making.

This shifts the theoretical focus from improving planning accuracy to designing governance conditions that enable reliable commitments under uncertainty.

IMPLICATIONS FOR AGILE USE IN CONSTRUCTION

The findings also contribute to the understanding of Agile methods in construction. Prior research has highlighted both the potential and limitations of Agile approaches, particularly Scrum, in environments requiring coordination and execution reliability (Owen et al., 2006).

This study shows that Agile mechanisms generate the greatest value when applied at the governance level, rather than at the execution level. Specifically, Scrum-based practices supported:

- Continuous backlog refinement
- Dynamic prioritization based on value and urgency
- Improved transparency in decision-making

However, when applied directly to execution without structural separation, Agile practices may increase instability by introducing frequent priority changes. This suggests that the role of Agile in construction is not to replace planning systems, but to structure decision-making upstream of execution.

LEAN-AGILE INTEGRATION AS A GOVERNANCE DESIGN PROBLEM

The study reframes Lean–Agile integration as a context-dependent governance design problem, rather than a direct combination of methods. While previous approaches, such as HAL (Power & Sinnott, 2025), focus on integrating methods within production systems, the present findings suggest that, in service environments, decoupling is more effective than operational integration.

By separating prioritization (Agile) from commitment (Lean), the proposed model establishes a stable interface between demand variability and execution reliability. This indicates that the effectiveness of Lean–Agile hybrids depends on:

- The degree of demand controllability;
- The ability to regulate inflow;
- The existence of a structured interface between decision-making and execution.

MANAGERIAL IMPLICATIONS

For practitioners, the findings provide actionable insights for managing service operations in construction:

- Do not push variability into execution: unmanaged demand inflow reduces planning reliability and increases rework;
- Separate prioritization from commitment: only constraint-free and prioritized tasks should enter execution planning;
- Introduce explicit demand screening: filtering non-procedent requests reduces unnecessary system load;
- Use backlog management as a governance tool: not just as a list, but as a mechanism to regulate flow;
- Adopt PPC and Lean metrics in service contexts: but only after stabilizing upstream conditions.

These insights suggest that improving performance in technical assistance is less about better scheduling tools and more about designing how decisions are made before scheduling occurs.

BEHAVIOURAL AND ORGANIZATIONAL IMPLICATIONS

The gradual improvement observed over time indicates that governance changes are not purely technical. Performance gains emerged as participants adapted to new roles, routines, and decision-making structures.

This highlights that:

- Governance is enacted through behavior, not only structure;
- Transparency and shared understanding are critical for system performance;
- Sustained improvement depends on organizational learning over time.

SYNTHESIS

Overall, the findings suggest that planning reliability in stochastic service environments is primarily constrained by upstream governance conditions rather than execution routines alone. By regulating demand inflow and structuring prioritization, organizations can create the conditions under which commitment-based planning systems operate more effectively.

This reinforces the central argument of the study: Lean–Agile integration should be understood as the design of governance structures that balance adaptability and reliability, rather than as a direct combination of methods.

CONTRIBUTIONS AND CONCLUSIONS

THEORICAL CONTRIBUTIONS

This study advances Lean Construction theory in three key ways. First, it extends the applicability of the Last Planner System (LPS) to stochastic, service-oriented environments by showing that its effectiveness depends on upstream governance conditions rather than execution mechanisms alone.

Second, it reframes Lean–Agile integration as a governance design problem, demonstrating that the separation between dynamic prioritization and commitment-based execution enables both adaptability and reliability to coexist.

Third, the research contributes to the discussion on governing variability in construction systems, offering empirical evidence that variability need not be eliminated to improve performance. Instead, it can be absorbed and managed through structured decision-making

layers, reinforcing and extending Koskela's production theory in the context of service operations.

PRACTICAL CONTRIBUTIONS

For practitioners, the study provides a clear and actionable governance model for managing service operations under uncertainty.

- The main practical implications are:
- Separate prioritization from execution commitments to protect planning reliability
- Introduce explicit demand screening and prioritization criteria to reduce backlog overload
- Use backlog management as a governance mechanism, not just a control tool
- Stabilize upstream conditions before applying Lean execution practices

The proposed three-layer model can be directly adapted to technical assistance, facilities management, and maintenance operations, offering a structured approach to balancing responsiveness and operational control.

CONCLUSIONS

This study examined how to govern stochastic service demands in Lean Construction environments through the design and evaluation of a hybrid Lean–Agile governance model.

The results indicate that the main challenge in such contexts is not execution planning itself, but the lack of mechanisms to regulate demand before commitments are made. By structuring governance into three layers—demand discovery, prioritization, and execution—the model enabled more stable commitments under conditions of persistent variability.

These findings support a shift in perspective: improving performance in service-oriented construction systems depends less on refining planning techniques and more on designing the decision-making structures that shape what enters the planning system.

LIMITATIONS AND FUTURE RESEARCH

This study is subject to three main limitations. First, it is based on a single case study, which limits external generalization. Second, causal relationships between the artifact and performance improvements cannot be fully isolated. Third, the evaluation focused on operational metrics, without directly measuring customer satisfaction or long-term organizational impacts. Future research should test the model across multiple contexts, compare alternative governance configurations, and further explore how prioritization strategies influence system performance over time.

REFERENCES

- Beck, K. et al. (2001). Manifesto for Agile Software Development.
- Ballard, G. The last planner. Northern California Construction Institute, Monterey, California, 1994.
- Ballard, G., (2000). "The Last Planner System of Production Control." Ph.D. University of Birmingham.
- Dresch, A.; Antunes Júnior, J. A. V; Proença, A. Design Science Research: Método de pesquisa para engenharia de produção. *Gestão e Produção*. v. 20, nº 4, 2013.
- LACERDA, D. P.; Hamerski, D. C., Formoso, C. T., Isatto, E. L. & Cevallos, C. A.. (2019). Combining Lean and Agile Project Management in a Multi-Project Environment: Case Study in a Retail Company. *IGLC27*. <https://doi.org/10.24928/2019/0217>
- Highsmith, J. (2001). Agile Software Development Ecosystems. Addison-Wesley.

- Highsmith, J. (2009). *Agile Project Management: Creating Innovative Products*. Addison-Wesley.
- Koskela, L. *An Exploration towards a Production Theory and its Application to Construction*. 2000. 296 f. Tese (Doutorado) - Technical Research Centre of Finland, VTT Publications, Espoo.
- Koskela, L. & Howell, G.. (2002). *The Theory of Project Management: Explanation to Novel Methods*. IGLC10.
- Koskela, L. *Which Kind of Science Is Construction Management?* (2008). Manchester, UK. *Proceedings...* Manchester, UK: IGLC, 2008.
- Lukka, K. *The Constructive Research Approach*. In: OJALA, L.; HILMOLA, O-P. (org.). *Case study research in logistics*. Turku: Publications of the Turku School of Economics and Business Administration, 2003. p. 83–101.
- Power, W., Sinnott, D. D. & Lynch, D. P. (2022). *Scrum Complementing Last Planner System – a Case Study*. IGLC30
- Power, W. & Sinnott, D. (2025). *Integrating Agile, Scrum, and LPS Principles: the Development of a Hybrid Agile Lean (HAL) Production Planning & Control System*. IGLC33.
- Rigby, D. K., Sutherland, J. & Takeuchi, H. (2016). *Embracing Agile*. Harvard Business Review.
- Schwaber, K. (2004). *Agile Project Management with Scrum*. Microsoft Press.
- Sutherland, J. e Sutherland, J.J (2019) *Scrum: The Art of Doing Twice the Work in Half the Time*. Sextante: Rio de Janeiro.
- Schwaber, K. e Sutherland, J. (2020). *The Scrum guide*. Disponível em: www.scrum.org/resources/scrum-guide
- Owen, R., Koskela, L., Henrich, G. & Codinhoto, R.. (2006). *Is Agile Project Management Applicable to Construction?*. IGLC14.