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Proposed Implementation of Lean Construction in Project Management Procedures in the Preparation of Project Work Plans (A Case Study of PT ICC TBK.)

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ABSTRACT

This study examines the integration of Lean Construction principles into the Project Work Plan (RKP) procedures of PT ICC to address persistent inefficiencies despite the use of a PMBOK-based project management framework. Using a mixed-methods approach that combines process mapping, in-depth interviews, expert judgment, and quantitative analysis through the Relative Importance Index (RII), this study identifies key sources of waste, including waiting, overproduction, excess inventory, and non-utilized talent. The findings indicate that integrating Lean Construction tools—particularly the Last Planner System (RII = 0.93), early cross-functional collaboration (RII = 0.90), and pull planning (RII = 0.83)—is projected to improve project time efficiency by approximately 20% and reduce material waste by more than 10%, based on expert judgment and empirical benchmarks from prior studies. These results represent predictive improvements at the procedural planning level, rather than post-implementation performance measurements. This study demonstrates that embedding Lean Construction principles at the procedural planning level transforms the RKP from a static administrative document into a proactive control tool for waste reduction and project efficiency improvement.

KEYWORDS *Lean Construction, Project Management, PMBOK, Waste Reduction, Efficiency Improvement, PT ICC*

INTRODUCTION

The Government of Indonesia prioritizes national development through strategic initiatives focused on natural resource downstreaming and strengthening food and energy security, the success of which relies heavily on large-scale infrastructure development (Cabinet, 2024). In parallel, the construction industry is increasingly directed toward sustainability-oriented projects, including renewable energy infrastructure, transmission and storage systems, green buildings, and energy and mining developments (Wibowo et al., 2024). These shifts place growing pressure on construction organizations to deliver projects more efficiently under evolving technical and regulatory demands.

Despite these strategic priorities, Indonesia's construction market is projected to experience stagnation, with an estimated annual growth rate of only 0.9% during the 2025–2030 period (Bigwanto et al., 2024; Gazali et al., 2025; Putra & Machfudiyanto, 2024; Villacreses et al., 2025). This slowdown is largely driven by reductions in government infrastructure spending, which remains the dominant source of construction demand, accounting for approximately 76–77% of the total market. As a result, state-owned construction enterprises (BUMN Karya) face increasing pressure to improve internal efficiency, particularly in project planning and execution, in order to remain competitive amid constrained fiscal conditions (Business Indonesia, 2025; Market Research Indonesia, 2025).

Previous studies have demonstrated that Lean-based project management approaches, including buffer time calculation and Critical Chain Project Management (CCPM), can

significantly enhance project performance by improving time efficiency by up to 20% and reducing costs by approximately 25% (Sahrupi et al., 2021; Leach, 2021). Other empirical findings indicate that project delays are commonly caused by material delivery issues, adverse weather, and equipment failures, with steel structure procurement representing one of the highest delay risks (Febianti et al., 2023). From a theoretical perspective, Koskela and Howell (2002) argue that traditional project management paradigms are increasingly inadequate, calling for a shift toward planning-as-organizing and production-oriented thinking to address the complexity of modern construction projects.

Within this broader industry context, PT ICC—one of Indonesia's major state-owned construction enterprises—continues to experience persistent project inefficiencies. Internal project verification results for April 2025 indicate that a significant portion of projects within Infrastructure Division 2 suffered from schedule delays and cost overruns. Supporting evidence from prior case studies shows substantial waste arising from delayed material payments, labor discipline issues, and excessive inventory, including procurement waste amounting to 12.27% of contract value and precast inventory waste exceeding 10% (Rahdewa, 2024). These findings suggest that inefficiencies are not merely operational incidents, but reflect deeper weaknesses in planning practices (Suranata et al., 2025; Wresniwira et al., 2025; Zohrehvandi et al., 2023).

At the organizational level, project planning at PT ICC is governed by the formal procedure ICC-PPP-PM-01.01 Project Management Procedure Rev. 02, which produces the Project Work Plan (RKP) as the primary planning document guiding project execution. While the RKP structure is comprehensive and aligned with the Project Management Body of Knowledge (PMBOK), it has not been fully optimized as an effective control mechanism. In practice, the RKP tends to function as an administrative compliance document rather than a proactive planning tool for waste elimination and workflow optimization.

Although Lean Construction has been widely studied and applied as an execution-level improvement approach, its integration at the procedural and planning level remains limited, particularly within standardized project management systems of large construction organizations. This study addresses this gap by examining how Lean Construction principles can be embedded directly into the RKP preparation procedure at PT ICC. Rather than proposing new Lean tools, the novelty of this research lies in repositioning Lean Construction as a planning-level and procedural intervention, aimed at preventing waste from the earliest stages of project planning. By focusing on procedural integration rather than post-implementation outcomes, this study contributes a new perspective to Lean Construction research in the Indonesian construction context. infrastructure projects.

METHOD

The research design adopts a problem-solving framework aimed at integrating Lean Construction principles into the Project Work Plan (RKP) preparation procedure, with the Project Management Body of Knowledge (PMBOK) serving as the primary reference for process classification and analysis. The study began by systematically mapping the ICC-PPP-PM-01.01 Project Management Procedure into PMBOK Process Groups and Knowledge Areas to identify structural gaps and planning-related inefficiencies. This mapping provided the basis

for identifying Knowledge Areas most affected by waste and for formulating a focused gap analysis at the procedural planning level.

A mixed-method approach was employed to ensure analytical depth and methodological rigor. Primary data were collected using purposive sampling, targeting experts with substantial experience and direct involvement in construction project planning and management. The expert selection criteria included: (1) a minimum of ten years of professional experience in large-scale infrastructure projects; (2) active roles in project planning, cost control, engineering, or commercial functions; and (3) familiarity with Lean Construction concepts or improvement initiatives. The selected participants consisted of senior project managers, commercial managers, and subject matter experts from PT ICC, as well as external practitioners with experience in Lean-based project environments.

Expert judgment was collected through a two-stage process. First, semi-structured interviews were conducted to explore planning-stage challenges, sources of waste, and perceptions of Lean Construction relevance within formal project management procedures. These qualitative insights were used to identify candidate Lean principles and tools applicable to the RKP framework. Second, a structured questionnaire was administered to assess the relative importance of selected Lean Construction tools and principles using the Relative Importance Index (RII). Spearman correlation analysis was subsequently applied to examine the consistency of expert perceptions and stakeholder alignment. The outcomes of this expert judgment process directly informed the prioritization of Lean tools and guided their integration into specific stages of the RKP preparation process.

Secondary data were obtained from official company procedures, historical RKP documents, internal project reports, and relevant academic literature to provide contextual and comparative support. Data analysis combined qualitative and quantitative techniques. Qualitative analysis involved process mapping and content analysis to examine the existing RKP workflow and identify non-value-added activities, while quantitative analysis using descriptive statistics, RII, and correlation analysis supported the prioritization and validation of Lean-based interventions. The final synthesis triangulated findings from both analyses to develop evidence-based recommendations for refining PT ICC's project management procedures through the integration of Lean Construction principles at the planning and procedural level.

RESULTS AND DISCUSSION

Analysis

This part of the analysis focuses on answering the first research question, namely why the current RKP procedure is not optimal in becoming a control tool for efficient project implementation? This analysis aims to diagnose the current condition (As-Is), identify gaps between practices at PT ICC and the ideal Lean Construction framework, and validate the root causes of the previously hypothesized problems. In accordance with the research design, the analysis was carried out with a mixed-method approach, combining qualitative data from process mapping and in-depth interviews with quantitative data from expert perception surveys. The findings in this sub-chapter will build a strong evidence-based foundation for the business solutions to be proposed in section 4.2.

Mapping of the "As-Is" Process of the RKP Preparation Procedure

The first step in the analysis is to understand the workflow of the preparation of the Project Work Plan (RKP) currently in force at PT ICC in accordance with the procedure document ICC-PPP-PM-01.01 Rev. 02. This "As-Is" process mapping aims to visualize the formal stages, the parties involved, as well as the main inputs and outputs in each step. This process is then mapped into the PMBOK framework to identify structural alignments and determine where each activity is within the project management lifecycle.

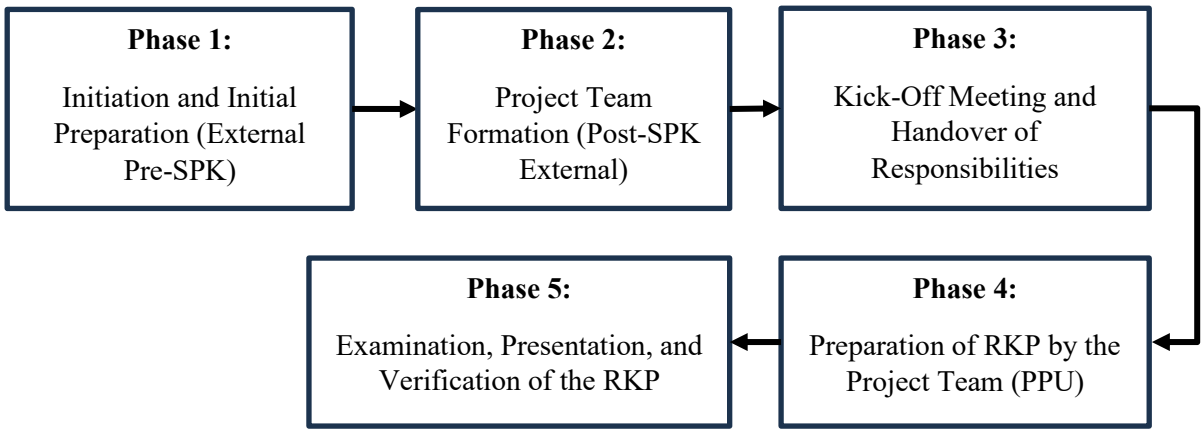

Figure IV.1 Flow Diagram of the RKP Preparation Process

Based on the analysis of the procedure documents, the flow of the RKP preparation process can be seen in the attachment Appendices 1 It is broken down into 5 (five) main phases as follows:

a. Phase 1: Initiation and Initial Preparation (External Pre-SPK)
   1) Tender Winning Information Received: PjPU Management (Person in Charge of Business Management) received information that ICC won the tender or will be appointed as the project implementer.
   2) Formation of a Project Preparation Team (TPP): The PjPU Leadership appoints a Project Preparation Team (TPP) within 3 working days to evaluate tender documents and RABT (Tender Cost Budget Plan).
   3) Handover of Documents to TPP: The Tender Team submits all project documents to TPP.
   4) Evaluation by TPP: TPP conducts a detailed evaluation of the scope, construction methods, procurement strategies, and risks identified in the tender.
   5) Presentation of Evaluation Results: TPP presented the results of its evaluation and recommendations to PjPU management.

b. Phase 2: Formation of the Project Team (Post-SPK External)
   1) External SPK Accepted: The PjPU Leader receives an official Work Order (SPK) from the Service User.
   2) Project Category Designation: Projects are categorized as Mega, Large, Medium, or Small based on contract value and monthly production targets.
   3) Formation of a Project Team (PPU): Based on the project category, the PPU (Business Management Implementer) organization is formed and determined within 5 working days after the effective date.

4) Issuance of Internal SPK: The Leader of the PjPU issues an Internal SPK to the Chairman of the PPU as an official order to start work.

c. Phase 3: Kick-Off Meeting and Handover of Responsibilities
   1) Holding Kick-Off Meeting: TPP held a kick-off meeting to submit all documents, evaluation results, and recommendations to the newly formed PPU team.
   2) Preparation of Minutes of Events: The results of the meeting are outlined in the minutes which are the initial reference for PPU in compiling the RKP. The TPP's task was declared complete.

d. Phase 4: Preparation of RKP by the Project Team (PPU)
   1) Preparation of Work Breakdown Structure (WBS) and Cost Plan: PPU prepares a detailed WBS and Project Implementation Cost Budget Plan (RABP).
   2) Preparation of Revenue Plan: PPU prepares an income plan based on the value of the contract.
   3) Preparation of 12 Chapters of the RKP: PPU prepares a draft of the RKP which consists of 12 chapters, covering all aspects ranging from General Explanation (Chapter 1), Engineering Plan (Chapter 3), Time Plan (Chapter 4), Quality Plan (Chapter 5), to Contract Plan (Chapter 12).

e. Phase 5: Examination, Presentation, and Ratification of the RKP
   1) Inspection by PjPU: Draft RKP is inspected by related functions at the PjPU level (Operations, Project Control, Finance, QHSE, etc.).
   2) Cross-Functional Presentation: RKP is presented at the PjPU level by inviting corporate functions (PjFK) such as Risk Management, SCM, and Legal to get input.
   3) Final Ratification of RKP: The final RKP is ratified by the authorized officials in accordance with the project category. The deadline for RKP ratification is a maximum of 2 months for Mega/Large projects and 1 month for Medium/Small projects after the project starts.
   4) Release Budget in SAP: Once the RKP is passed, the budget is officially released in the ERP system (SAP) to allow for the start of procurement transactions and the actual cost recording.

Of the 5 phases above, the focus is on the 4th (fourth) phase which discusses the preparation of the RKP by the Project Team (PPU). In understanding the workflow of preparing the Project Work Plan (RKP) that is currently in force at PT ICC in accordance with the procedure document ICC-PPP-PM-01.01 Rev. 02. The mapping of this "As-Is" process aims to dissect the structure of the RKP itself which consists of 12 chapters as the main output of the planning phase (can be seen in Appendices 2). Each chapter in the RKP will be mapped into the Project Management Body of Knowledge (PMBOK) framework to identify structural alignment and understand how each planning component is managed.

The RKP document, as the main guideline for project implementation, consists of 12 chapters, each of which covers crucial managerial and technical aspects. The mapping of each chapter of the CPR into the PMBOK Knowledge Areas shows that PT ICC's procedures have fundamentally adopted a comprehensive project management framework. The following table details those mappings:

Table IV 1 Mapping of RKP Chapters to PMBOK

Chapter RKP (As Per Procedure ICC-PPP-PM-01.01)	Main Focus of the Chapter	Mapping to the PMBOK Knowledge Area (Knowledge Area)	Mapping Justification (Linkage with PMBOK)
Chapter 1: General Explanation & Scope of Work	Define the name, location, objectives, and work boundaries of the project, and identify the stakeholders.	• Project Integration Management • Project Scope Management	This chapter consolidates the initial information of the project and defines the work limitations in detail, which are the core activities of Scope Management and Integration Management.
Chapter 2: Organization, HC, Project Administration and Junior High School	Detail the project organizational structure, manning schedule, and security management system plan.	• Project Resource Management	The focus of this chapter is on planning the project team structure, human capital allocation, and management, which is part of Resource Management.
Chapter 3: Engineering Planning & Operation	Arrange the layout, construction method, technical specifications, and schedule of engineering activities.	• Project Scope Management • Project Quality Management	This chapter details the technical specifications and implementation methods for producing project deliverables. It is the process of defining the product scope and quality standards that must be met.
Chapter 4: Planning & Time Control	Compile the project Master Schedule, network planning diagram, and S curve (S-Curve) as a schedule reference.	• Project Schedule Management	The main content of this chapter is the preparation of the master schedule of the project (Master Schedule) and the S curve, which is the main output of the Schedule Management process.
Chapter 5: Quality Planning & Control	Setting quality targets, quality plans, and inspection and testing programs.	• Project Quality Management	This chapter explicitly sets quality goals, quality plans, and inspection and testing procedures to ensure products are up to standard.
Chapter 6: HSE Planning & Operation, 5R	Formulate HSE Plan documents, Occupational Safety and Health (K3) programs, and 5R implementation plans.	• Project Quality Management • Project Risk Management	Safety, Health and Environment (HSE) planning is part of the overall fulfillment of quality standards and the identification of project risks.
Chapter 7: Planning & Controlling Construction Direct Cost Budgets	Details the Cost Budget Plan (RAB) per WBS and per resource, including maintenance cost reserves.	• Project Cost Management	This chapter focuses on the process of estimating and aggregating costs for hands-on work in the field, which is at the core of Cost Management.

Chapter RKP (As Per Procedure ICC-PPP-PM-01.01)	Main Focus of the Chapter	Mapping to the PMBOK Knowledge Area (Knowledge Area)	Mapping Justification (Linkage with PMBOK)
Chapter 8: Risk Analysis & Control	Identify the risk context, analyze stakeholders, and compile a Project Risk Register.	• Project Risk Management	Specifically, this chapter is dedicated to the process of identifying, analyzing, and planning responses to project risks.
Chapter 9: Planning & Control of Construction Funds and Indirect Costs	Prepare cash flow plans, indirect cost control, and receivables collection programs.	• Project Cost Management	This chapter discusses cash flow planning and indirect cost management, which are important components of Cost Management.
Chapter 10: Procurement Planning & Handling	Formulate a plan for the procurement of goods and services, spending patterns, and acquisition price efficiency strategies.	• Project Procurement Management	The focus of this chapter is on planning the procurement of goods and services from external parties, including vendor selection and purchasing strategies.
Chapter 11: Communication Planning & Handling	Manage the flow of information and distribution of project reports, both internal and external.	• Project Communications Management	This chapter regulates how project information will be distributed to all stakeholders, in accordance with the essence of Communications Management.
Chapter 12: Contract Administration Plans & Controls	Conduct a review of tender and contract documents, as well as plan change and claims management.	• Project Procurement Management • Project Risk Management	This chapter discusses the management of contracts with third parties (vendors/subcontractors) and the risks inherent in them.

With a fairly complex justification, this mapping further strengthens the conclusion that the structure of the 12 RKP Chapters is very comprehensive and in line with the PMBOK framework. Each Knowledge Area that is essential in the planning phase has its own chapter within the RKP, demonstrating a strong procedural foundation at PT ICC. It also sharpens the critical question of research: If the planning framework is so complete and logical, why is inefficiency and waste still occurring so significantly in the field?

The initial conclusion of this validated mapping is that the problem faced by PT ICC does not lie in the absence of planning components, but in the quality and philosophy behind the preparation of each component. Current procedures focus more on fulfilling administrative completeness, but do not have a proactive mechanism to identify and eliminate waste in the first place. This philosophical gap will be the focus of the next analysis.

Waste Identification and Mapping in the PMBOK Knowledge Area

In this sub-chapter, the analysis is focused on identifying the manifestations of the four main waste categories that have been established within the study limits. Empirical evidence

from interviews and analysis of secondary documents will be presented, then each waste will be mapped directly into the most affected PMBOK Knowledge Area in the Planning Process Group. This mapping aims to show specifically where procedural weaknesses lie in the preparation of the RKP.

Table IV 2 Waste Mapping in the PMBOK Knowledge Area in the RKP Planning Process

Category Waste	Empirical Evidence of the ICC Project	The Root of the Problem in the RKP Process	Mapping in the PMBOK Knowledge Area
1. Waiting	• Project teams often stop work due to waiting for revision image approval which can take weeks. • Material payments with a cash before delivery system cause delays in delivery when project cash flow is tight.	• The RKP procedure lacks a clear communication and escalation flow for approval. • Financial planning and procurement are not well integrated.	• Project Schedule Management (causing delays) • Project Communications Management (ineffective flow of information) • Project Procurement Management (non-aligned payment strategy)
2. Non-Utilized Talent	• The field team (implementers) had a lot of input for more efficient working methods, but were never formally involved when the RKP was drafted. We only accept the finished RKP.	• There is no formal mechanism in the RKP procedure to gather input from the production team at the initial planning stage.	• Project Resource Management (untapped team potential) • Project Scope Management (suboptimal work methods)
3. Overproduction	• The precast division produced piles based on the initial estimates in the RKP, but later there were design changes. As a result, the finished pole is not used.	• Material production planning begins before the design baseline is 100% approved and locked in the RKP.	• Project Scope Management (weak design change control) • Project Cost Management (incurring wasted material costs) • Project Schedule Management (disrupting the order of work)
4. Inventory (Excess Inventory)	• The precast stock was piling up in the stockyard until we had to rent a new land, because the installation schedule at RKP was pushed back due to problems in the field.	• Procurement schedule planning and implementation schedule are out of sync. • RKP has not implemented a pull system for materials.	• Project Procurement Management (non-adaptive logistics planning) • Project Cost Management (arising from rental and dual handling costs)

From the mapping above, it can be seen that the waste that occurs is not an isolated incident, but a symptom of systemic weakness in the planning process. For example, Waste of Waiting directly shows a problem with Schedule and Communications Management.

Meanwhile, Waste of Overproduction and Inventory highlights the weak integration between Scope, Cost, and Procurement Management in the RKP.

This analysis confirms that although the CRR procedure structurally covers all Knowledge Areas, the interaction and workflow between those areas is not yet efficient and has not focused on the elimination of waste. This is a strong justification for integrating Lean tools that can improve coordination and value flow between the planning process.

Analysis of Expert Perceptions of Lean Construction Implementation

After identifying waste and mapping it into PMBOK's Knowledge Areas, the next step is to analyze experts' perceptions regarding the relevance, priorities, and challenges of Lean Construction implementation at PT ICC. This analysis is based on data collected through in-depth interviews and structured questionnaires given to six respondents, consisting of PT ICC's internal practitioners and external experts. Quantitative methods, such as the Relative Importance Index (RII) and Spearman Correlation Analysis, are used to give objective weight to qualitative findings.

1) Lean Construction Familiarity and Relevance Level

From the results of the interviews, it was found that the level of familiarity with the concept of Lean Construction varies, but there is a strong consensus on its relevance. Respondents with experience in recent projects that have formally adopted Lean, such as the IKN project, showed a deep understanding. A Project Commercial Manager, for example, gave a score of "10 out of 10" for the importance of Lean implementation, stating, "I think 10, Mas, is very important. Because this is one of our tools. How do we implement this, I should be sure that the project will definitely end up on time, on budget".

This view was supported by other respondents, including Project Managers and SMEs, who stated that the Lean approach is "very relevant, Mas, to the current state of the company" and "for collaboration and elimination it is already very suitable". Experts emphasize that Lean is not just a set of tools for the construction phase, but a management philosophy that must be embedded in every process, from the tender stage to planning. As explained by an external expert from IAMKRI, "Lean Construction is a delivery system... He can start from bidding, he can start from design".

2) Priority of Lean Tools and Principles (Relative Importance Index - RII) Analysis

To determine which Lean tools and principles are the most priority to integrate into the CRR procedure, ranking data from respondents was processed using the Relative Importance Index (RII). The results of the analysis show clear priorities, with a focus on aspects of collaborative planning and workflow control.

Table IV 3 Priority Ranking of Implementation of Lean Tools/Principles in the RKP

Peringkat	Lean Construction Tools/Principles	The value of RII	Category
1	Last Planner System (LPS)	0.93	Very important
2	Cross-functional collaboration from the beginning	0.90	Very important
3	Pull Planning	0.83	Very important
4	Focus on Value Stream Mapping	0.70	Important
4	A3 Thinking / Dashboard Monitoring	0.70	Important
5	Target Value Delivery (TVD)	0.57	Quite Important

Analysis of RII on Table IV 3 Priority Ranking of Implementation of Lean Tools/Principles in the RKP indicates that the Last Planner System (LPS) ranks highest. This is particularly relevant to the findings in sub-chapter 4.1.2, where lack of field team involvement (Non-Utilized Talent) and scheduling misalignment are at the root of the main problem. LPS, with its pull planning principle involving direct implementers, is considered the most effective solution. A Project Manager emphasized, "The more it comes here, the more involved, especially with the current concepts that must be lean, must involve many production teams".

In practical terms, the integration of the Last Planner System (LPS) into the RKP framework can be positioned within the scheduling and short-term planning components of project execution. Rather than relying solely on a top-down master schedule, LPS enables the development of look-ahead plans and weekly work plans that are based on actual field readiness. By ensuring that activities are only committed when constraints related to design approval, material availability, and work area readiness have been resolved, LPS directly addresses the identified waste of waiting and improves workflow reliability.

Similarly, Pull Planning can be incorporated during the preparation of the master schedule within the RKP by involving cross-functional stakeholders—such as engineering, procurement, and construction teams—in collaboratively defining milestone sequences. This approach shifts planning logic from target-driven scheduling to demand-driven coordination, thereby reducing overproduction and excess inventory caused by premature procurement or delayed design finalization.

By aligning Lean tools with specific project phases, the RKP can evolve from a static planning document into a dynamic coordination platform. During early project stages, Pull Planning facilitates collaborative milestone definition, while in execution phases, LPS supports adaptive control through continuous feedback loops. This phased integration enhances workflow predictability and strengthens coordination across PMBOK Knowledge Areas, particularly Schedule, Procurement, and Resource Management (Ballard, 2016; Ballard, 2023; Liker, 2021; Meshref et al., 2022).

To further clarify the practical implementation logic, the integration of Lean tools within the RKP can be operationalized through a structured planning sequence. During the RKP preparation stage, cross-functional representatives from engineering, procurement, construction, and commercial functions participate in Pull Planning workshops to collaboratively define milestone sequences based on actual field readiness. These milestones are then translated into the master schedule and supported by look-ahead planning to identify potential constraints related to design approvals, material availability, and resource readiness (Aguome et al., 2024; Zhu et al., 2025).

As project execution progresses, the Last Planner System enables the conversion of look-ahead plans into weekly work plans, where commitments are made only for constraint-free activities. Feedback from weekly coordination meetings is used to update planning assumptions, creating a continuous planning loop that improves workflow reliability and reduces waiting, overproduction, and inventory-related waste, while remaining fully embedded within the formal RKP framework (Aguome et al., 2024; Meshref et al., 2022).

3) Identify the Biggest Implementation Challenges

Although the relevance is very high, experts consistently highlight that the biggest challenge in adopting Lean Construction at PT ICC is not technical, but related to people and organizational culture.

a. Change in Mindset and Work Culture: This was the most dominant theme that emerged from all respondents. A Senior Manager stated firmly, "People, Mas. The person, Mas. The mindset of the person, the perception of the person, the culture of the person... If it's a system, we can make it. If it's a procedure, we can make it, Mas. But people's desire to change... That's probably what should be our focus first". This challenge is reinforced by the Project Manager who mentions "work culture... who are still familiar with the hierarchical system, meaning top-down and procedural orders".
b. Commitment and Respect for People: External experts emphasize that Lean implementation requires more than just instruction. "The first biggest challenge is the commitment... Second, there is a need for a learning system... But the most important thing there is our openness to reports and respect for the people". A top-down culture that is difficult to accept differences of view is considered a major obstacle to collaboration that is at the core of Lean.
c. Practical Training Needs: Another challenge is the lack of practical understanding in the field. An SME highlighted the need for education that is not only theoretical, "It does not mean just an introduction to knowing what Lean Construction is, but examples that occur in cases in the field... more about the practice".

Overall, this expert perception analysis provides three key conclusions: (1) Lean Construction is highly relevant and needed by PT ICC; (2) Implementation priorities must start from a collaborative planning system such as the Last Planner System; and (3) Successful implementation will largely depend on the company's ability to manage cultural change and increase its human resource capacity.

Synthesis and Gap Analysis

This sub-chapter summarizes the overall findings from process analysis, waste identification, and expert perceptions to formulate a fundamental gap between the current RKP preparation procedure at PT ICC ("As-Is") and the ideal conditions driven by the Lean Construction ("To-Be") philosophy. This synthesis becomes a logical bridge that connects the diagnosis of the problem with the formulation of business solutions in the next section.

The analysis of the previous sub-chapters yields three key interrelated findings:

1) The Gap Between Structural Completeness and Operational Philosophy

The mapping in sub-chapter 4.1.1 shows that the PT ICC RKP procedure is structurally very comprehensive and in line with the PMBOK framework. However, an in-depth interview revealed that this completeness was more administrative in nature and served as a "deterrent of liability". Existing procedures do not yet have an operational philosophy that proactively encourages efficiency and elimination of waste.

2) Waste as a Symptom of Inefficient Planning

The analysis in sub-chapter 4.1.2 confirms that waste such as waiting, overproduction, and inventory is not a random incident, but rather a systemic symptom of an immature and reactive planning process. Practices such as creating an S-curve before the final Master

schedule are clear evidence of the existence of an illogical process and have the potential to create waste at the execution stage.

3) Consensus Solutions on Collaborative Planning

An analysis of expert perceptions in sub-chapter 4.1.3 shows that there is a strong consensus that Lean Construction is very relevant to address this issue. Tools that focus on collaborative planning, such as the Last Planner System (LPS), occupy the highest priority because they are considered to be able to address the problem of unutilized talent and increase planning realism.

Based on the synthesis of these findings, the main gaps can be formulated as follows:

Core Gaps: PT ICC's RKP preparation procedures currently operate with a push-based paradigm that focuses on administrative compliance, while the solutions needed to address waste demand a shift to a pull-based paradigm that focuses on collaboration and value stream creation.

In more detail, this gap is manifested in several aspects:

a. From Hierarchical to Collaborative: Current procedures tend to be top-down, while Lean demands early involvement from implementers on the ground (bottom-up) to ensure plans can be executed.
b. From Static Documents to Dynamic Tools: The RKP is currently treated as a static reference document, while the Lean approach will transform it into a dynamic and adaptive control tool.
c. From Focus on Output to Focus on Process: Existing procedures are oriented towards the completeness of the 12 chapters of the CRR (output), while Lean focuses on the efficiency of the drafting process to ensure that the output is free of waste.

This gap analysis provides a strong justification that the improvements needed are not the addition of new components to the complete RKP, but the integration of Lean Construction philosophy and tools into the drafting workflow. This will be the basis for the formulation of business solutions in the next section.

Business Solutions

Based on the gap analysis that has been described in section 4.1, it was identified that the root of the inefficiency problem at PT ICC does not lie in the absence of planning components, but in the operational philosophy that has not been proactive in eliminating waste. Therefore, the proposed business solution does not aim to completely overhaul the structure of the RKP that is already aligned with PMBOK, but rather to integrate Lean Construction principles and tools into the existing framework. This approach aims to transform the RKP from just an administrative document into a dynamic, collaborative, and value-stream-oriented planning tool. The following sub-chapters will detail the proposed integration model and provide concrete examples of revisions to the ICC-PPP-PM-01.01 procedure.

Lean Construction Integration Model into the RKP Framework

The proposed integration model is to insert the most relevant Lean Construction tools—based on the results of expert perception analysis (RII)—into the RKP chapters that are in accordance with the PMBOK Knowledge Area. The goal is to change the way each component

of planning is structured: from being push-based and static, to being more pull-based, adaptive, and collaborative. This model does not change the structure of the 12 Chapter CRC, but enriches the substance and processes within it.

Visualizations of this integrated model can be seen in Table IV 4 Lean Tool Integration Model into Related KPR Chapters. This table maps the priority Lean tools (such as Last Planner System and Pull Planning) into the CRR chapters that have been most affected by the waste that have been identified.

Table IV 4 Lean Tool Integration Model into Related KPR Chapters

Bab RKP & (Knowledge Area)	Targeted Waste	Integrated Lean Tools	Integration Justification
Chapter 2: Organization & HC (Resource Management)	Non-Utilized Talent	Cross-functional collaboration from the beginning	Changing the paradigm from rigid team formation to collaborative team formation involving production/field representatives from the beginning of the preparation of the RKP to obtain practical input.
Chapter 4: Schedule Management	Waiting, Overproduction, Inventory	Pull Planning & Last Planner System (LPS)	Replacing the top-down scheduling method with a bottom-up approach. The Master Schedule is enriched by milestones that are pulled from field readiness, not pushed from above. This ensures the schedule is more realistic and executable.
Chapter 10: Procurement Management	Inventory, Waiting	Just-in-Time (JIT) Principles	Change procurement planning from "hold as scheduled" to "hold as needed pull from the field". The material procurement plan should be synchronized with the results of the Pull Planning to minimize inventory buildup.

This model conceptually transforms the CRR from a mere "what to do" document to a dynamic guide on "how to do it efficiently". By integrating these tools, each chapter of the CPR contains not only a plan, but also a built-in mechanism for identifying and eliminating waste. For example, in Chapter 4 (Time Plan), there is now not only an S Curve, but there is also an obligation to attach the results of the Pull Planning Session as the basis for the preparation of the schedule. The implementation of this model will be described in more detail in the proposed procedure revision in the next sub-chapter

Proposed Revision of Procedures ICC-PPP-PM-01.01 (RKP Section)

Referring to the integration model that has been presented, this sub-chapter presents a proposal for concrete revisions to the procedural document ICC-PPP-PM-01.01 Rev. 02, especially in the sections that regulate the preparation of Project Work Plans (RKP). This proposal does not change the structure of the existing 12 RKP chapters, but rather adds and improves certain articles to instill Lean Construction philosophy and tools. Each revision proposal is presented in an "As-Is" (current condition) and "To-Be" (proposed improvement) comparison format, complete with justifications based on the findings of the analysis in section 4.1.

1) Proposed Improvements in CHAPTER 2: Organization, HC, Project Administration and Junior High School

a. Objective: Address the Waste of Non-Utilized Talent by ensuring the involvement of the field team from the start.

b. As-Is Conditions (Implied): Chapter 2 focuses on the formation of organizational structures and the assignment of personnel on a top-down basis after the project has begun.

c. "To-Be" Improvement Proposal:

Additional Articles	The Contents of the Proposed Article	Justification
Article 2.1.3	**Establishment of a Collaborative Planning Team:** "In addition to the formal project organizational structure, the Project Manager is obliged to establish a Cross-Functional Planning Team at the initial stage of the preparation of the RKP. This team should at least involve representatives from the Production/Field function (e.g., Senior Implementer or Site Manager) to provide practical input on work methods and duration estimates."	Based on the findings of the analysis (4.1.2), one of the root problems is the lack of field team involvement in the initial planning. The addition of this article formally requires collaboration from an early age to ensure that the RKP prepared is more realistic and executable.

2) Proposed Improvements to CHAPTER 4: Plans & Time Control

a. Objective: To overcome Waste of Waiting, Overproduction, and Inventory by changing the scheduling approach to be more adaptive and pull-based.

b. As-Is Conditions: Chapter 4 requires the preparation of the Master Schedule and the S Curve, but the practice is often push-based and illogical (the S-Curve is created before the detailed schedule).

c. "To-Be" Improvement Proposal:

Revised / Added Article	The Contents of the Proposed Article	Justification
Article 4.1 (Revised)	**Basic Assumption of Activity Time Schedule:** "The preparation of the Master Schedule in article 4.2.1 should be based on the results of the Pull Planning session which establishes the main milestones based on the most efficient work sequence and the need for inter-activity handovers."	Changing the paradigm from top-down to bottom-up scheduling. Schedules are no longer just driven by the end target, but are pulled from the logic of work in the field. This answers the results of RII (4.1.3) which places Pull Planning as a high priority.
Article 4.2.5 (Additional)	**Implementation of Last Planner System (LPS):** "For weekly and daily schedule control, the project team is required to implement the Last Planner System. Weekly work plans should be prepared based on Lookahead Planning and only include work that has been confirmed to be ready (Constraint-Free). The implementation is monitored through the Daily Huddle Meeting."	LPS is the Lean tool with the highest RII value from expert perception analysis (4.1.3). Its application directly addresses the problem of misalignment between plans and reality, reduces waiting due to unprepared resources, and documents constraints systematically.

3) Proposed Improvements to CHAPTER 10: Procurement Plans & Controls

a. Objective: Overcome Waste of Inventory and Overproduction by synchronizing material procurement with actual field needs.

b. As-Is Conditions: Procurement planning is based on a static master schedule, causing a risk of material build-up if the field schedule changes.

c. "To-Be" Improvement Proposal:

Revised or Added Chapters/Chapters	Contents of the Proposed Article (To-Be)	Justification / Reason for Change
CHAPTER 10 – Procurement Plan & Control Article 10.1 (Revised)	**Procurement Plans for Goods and Services:** "The procurement and delivery schedule for key materials, especially long lead items and fabrication materials (precast), should be synchronized with the Lookahead Planning results schedule from the Last Planner System (refer to Chapter 4). Procurement is carried out on the principle of Just-in-Time to minimize the waiting time for materials at the project site."	This revision creates a direct link between procurement planning and the pull system from the field. This change specifically addresses the precast inventory buildup problem identified at the Kijing Wharf Project by ensuring materials are produced and delivered only when needed.

Implementation Plan and Justification

After formulating a proposal for improving the RKP procedure that integrates Lean Construction principles, the next step is to prepare a realistic and measurable implementation plan. This section aims to answer the third research question: What is the potential impact of the implementation of Lean Construction on time efficiency, cost control, and quality of project implementation at PT ICC? For this reason, an implementation roadmap, positive impact projections, and change management strategies needed to ensure the successful adoption of this new procedure will be presented. The plan is designed to be executed in stages, starting from a pilot project to a full-scale implementation, with clear justification for benefits at every stage.

Phased Implementation Plan (5W+1H)

The implementation of changes in procedures and work philosophy requires a structured approach in order to be well adopted by the organization. This implementation plan is designed using the 5W+1H (What, Who, When, Where, Why, How) framework to ensure every aspect of the transition process is clearly defined.

a. What to Do: The implementation program will consist of four main activities in order:
    1) Socialization and Implementation Team Formation: Introduce the concept and proposed revision of procedures to key management and form a cross-functional team as a change agent.
    2) Training and Capacity Building: Conduct intensive training on the philosophy of Lean Construction and the use of new tools (LPS, Pull Planning) for the project team to be involved.
    3) Pilot Project Implementation: Applying a revised CRR procedure to a selected project to test its effectiveness in a controlled environment.
    4) Evaluation and Improvement of Procedures: Analyze the results of the pilot project, collect lessons learned, and refine draft procedures before they are proposed for widespread adoption in the company.
b. WHO: Implementation responsibility will be divided among the following parties:
    1) Main Sponsor: The Board of Directors who oversees the operations and risk management functions, in charge of providing support and resources.

2) Implementation Team (Change Agent): A cross-functional team consisting of representatives of the QHSE Department (as the owner of the procedure), Infrastructure Division 2 (as the initial user), and the Project Control function.
3) Pilot Project Manager: Fully responsible for the implementation of new procedures in the pilot project.
4) Human Capital (HC) Function: Responsible for designing and organizing Lean Construction training programs.

c. When: The implementation plan is proposed to be implemented within a period of 12 months, with the following schedule details:

Table IV 5 Implementation Plan for the Proposed Lean Integration in the RKP

Period (Month, Year 2026)	Main Activities
January–February 2026	Socialization, team formation, and finalization of training modules.
March 2026	Intensive training for teams that will be involved in the pilot project.
April–October 2026	The implementation of the pilot project with the implementation of new RKP procedures, accompanied by periodic monitoring and evaluation.
November–December 2026	Analysis of the results of the pilot project, collection of lessons learned, and preparation of final recommendations for revision of procedures at the corporate level.

1) Where to Implement: To minimize risk and maximize learning, the initial implementation will be focused on a pilot project selected from the scope of Infrastructure Division 2. The project selection criteria are projects with medium complexity and duration that allow them to be evaluated within the research timeline.
2) Why: This implementation is crucial to address the root cause of inefficiencies that lead to cost overruns and schedule delays at PT ICC. By embedding a Lean philosophy, companies can proactively eliminate waste, improve project predictability, and ultimately strengthen profitability and competitiveness in a challenging market.
3) How to Implement It: Implementation will use a structured change management approach:
    a) Communication: Communicate the urgency and benefits of these changes transparently across the organizational level.
    b) Practical Training: The training is not only theoretical but also includes simulations and case studies relevant to the conditions of PT ICC.
    c) Full Support: The project pilot team will receive intensive mentoring from the implementation team and Lean experts to ensure they do not run alone.
    d) Performance Measurement: The success of a pilot project will be measured with clear metrics, comparing the project's performance to the baseline of previous similar projects.

1. Impact Projection and Benefit Analysis

The implementation of RKP procedures that have been integrated with Lean Construction principles is projected to have a significant positive impact on three main performance areas: time efficiency, cost control, and overall project quality and performance. The analysis of these benefits is predictive, based on empirical evidence from previous studies and the logical justification of the application of the proposed Lean tools.

1) Increased Time Efficiency

Waste of Waiting was identified as one of the major wastes, caused by delays in approvals, technical data, and materials. The proposed implementation of the Last Planner System (LPS) and Pull Planning directly targets the root of this problem.

a. Reduced Lead Time: By involving all relevant parties (including subcontractors and vendors) in the Pull Planning session, the resulting schedule will be much more realistic and executable. LPS ensures that work is only scheduled when all constraints (materials, design, work areas) have been eliminated, thus drastically reducing downtime in the field.
b. Quantitative Projection: Various studies have shown the significant impact of Lean implementation. Sahrupi et al. (2021), for example, found that this approach was able to increase time efficiency by up to 20%. Given the magnitude of the approval delay problem that can reach "two weeks, three weeks", the implementation of LPS has the potential to significantly cut this waiting cycle, speeding up the overall completion of the project.

2) Cost Control Optimization

Waste of Overproduction and Inventory proved to be a source of massive cost overruns on case study projects, with total wastage amounting to 12.27% of the contract value for piles and 10.32% for precast concrete inventory. Proposed improvements to the RKP are designed to mitigate this risk.

a. Elimination of Overproduction: By requiring material production to be carried out only after the design is 100% approved and stable, as emphasized in the correct procedure, the risk of producing the wrong or unused goods can be eliminated.
b. Minimizing Inventory Costs: The application of the Just-in-Time (JIT) principle in Chapter 10 (Procurement Plan) will synchronize the delivery schedule of materials with the actual needs of the field. This will reduce the build-up of materials in the stockyard, thus eliminating unexpected costs such as additional land leases. While there are dilemmas in price hedging strategies, a lean CTR will encourage a better balance between price risk and inventory risk.
c. Rework Cost Reduction: With more mature work methods from the start (involving field team input) and better quality control, the potential for rework that ultimately affects costs can be suppressed.

3) Improved Quality and Overall Project Performance

In addition to the quantitative impact on time and cost, Lean implementation is projected to bring fundamental qualitative improvements.

a. Increased Collaboration and Team Morale: By addressing the Waste of Non-Utilized Talent through the active involvement of the field team in planning, the sense of ownership and commitment to the plan will increase. This is in line with the principle of respect for the people which is the foundation of Lean.
b. More Predictive Workflows: LPS and Pull Planning will create a more stable and predictable workflow. As revealed by a source, this will help the project team to "be able to quickly decide, where are the obstacles, so that we can be on track with our targets".

Culture of Continuous Improvement: The integration of Lean into the CPR is not just a one-time fix, but builds a system for continuous learning. Documentation of constraints through the Constraint Log in LPS, for example, will be "our evidence, who knows at the end

of the day that there is a delay process or what... that could be one of our proofs". This will allow the company to learn from each project and systematically reduce waste in the future.

Expert Validation and Change Management Strategy

Proposed improvements to the RKP procedure will not be effective if it is not acceptable and implemented by the organization. Therefore, the final stage of the analysis is to validate the proposed solutions through a Focus Group Discussion (FGD) with PT ICC's in-house expert panel and formulate a change management strategy to address the most significant implementation challenges.

4) Validation Results through Focus Group Discussion (FGD)

The draft proposed revision of the RKP procedure that has been prepared in sub-chapter 4.2.2 is presented to a panel consisting of experts representing various key functions, ranging from strategic, project manager, commercial, to field construction. In general, the response to the proposals has been overwhelmingly positive, with the consensus that the integration of Lean principles into the CRR is a relevant and urgent step.

Some of the key validation points resulting from the FGD are:

a. Feasibility and Relevance of Solutions: The panel of experts agreed that the proposed tools, in particular the Last Planner System (LPS) and Pull Planning, are particularly relevant to address the issue of misalignment between planning and execution. The perspective of the field construction manager specifically supports this proposal, "The idea of involving us (the construction team) from the beginning is mandatory. Otherwise, like yesterday, we boosted precast production, it turned out that the field was not ready" (Syamsud). From a commercial perspective, LPS is also considered profitable because "The Constraint Log that is part of the LPS can be very strong evidence for extension of time claims" (Aliq).
b. Feedback for Improvements: There are constructive feedback to improve implementation. For example, it is recommended that involvement in planning not only stop at the internal level, but also formally involve subcontractors, especially for critical work. "How do we 'force' subcones to follow this system? ... There may need to be a new clause in the contract or special incentives" (Syamsud).
c. Confirmation of Key Challenges: The discussions in the FGD again confirmed the findings of the individual interviews: the biggest challenge was not in the technical aspects of the procedure, but in the change in culture and mindset. A senior Project Manager underlined, "I am worried on the ground. Are our implementers and foremen ready to be actively involved in planning? So far, they have been accustomed to receiving orders. It's a big mindset change" (Robin). This view is reinforced by external experts who state, "Success depends 90% on culture, and only 10% on software or templates" (Aminullah).

5) Change Management Strategy

Based on consistent findings from interviews and FGDs that the main challenge is "people, culture, same system", the success of the implementation of the new RKP procedure is highly dependent on an effective change management strategy. Here is the proposed strategy, which focuses on three key pillars: Commitment, Capacity, and Communication.

a. Pillar 1: Building Commitment

1. Action: Securing sponsorship from top management (Board of Directors) and making it a corporate program. The company's leadership must actively communicate the urgency and importance of these Lean initiatives, linking them directly to the company's profitability and competitiveness targets.
2. Justification: As emphasized in the FGD, "This initiative should be a corporate program, not just a project initiative. There must be a sponsor at the board of directors. There must be a new KPI that measures the level of Lean adoption" (Media). Without visible support from above, any change initiative will be considered a side program and will not be given priority.

b. Pillar 2: Increasing Capacity
   1. Action: Organize a structured and practical training program. This training not only covers Lean theory, but also hands-on simulation of Pull Planning and the use of Constraint Logs in LPS. Training should target all levels, from project managers to field implementers, even subcontractors.
   2. Justification: The need for education that is not only theoretical but also based on "examples that occur in cases in the field" is the main highlight. Human resource capacity building is key to changing mindsets and providing the expertise needed to execute new procedures.

c. Pillar 3: Strengthening Communication and Collaboration
   1. Action: Using a pilot project as the primary communication tool, starting with simple steps that have a big impact. As suggested in the FGD, "For pilot projects, choose projects that are not too big and not too small" (Aliq) and "implement daily huddle meetings every morning. That alone will drastically change the dynamics of communication in the field" (Syamsud). The measurable success of the pilot project should be widely publicized internally within the company to build trust.
   2. Justification: A cultural shift from hierarchical to collaborative requires tangible evidence that this new approach is superior. The pilot project will serve as a "beacon" that proves the feasibility of the concept and inspires other teams to adopt change, while creating an environment where "those differences of viewpoint will improve relationships with others".

By integrating validation from practitioners and formulating a change management strategy that focuses on the human aspect, this proposed improvement of the RKP procedure has a strong foundation not only conceptually, but also practically to be implemented successfully within the PT ICC environment.

A cultural shift from hierarchical to collaborative planning requires tangible evidence that the new approach offers superior value. In this context, pilot projects can serve as a “beacon” to demonstrate the feasibility of Lean-based planning and encourage wider organizational adoption. Such pilots create a learning environment where differences in viewpoints can be constructively managed and translated into improved cross-functional collaboration.

By integrating validation from practitioners and formulating a change management strategy that emphasizes human and behavioral aspects, the proposed improvement of the RKP procedure is not only conceptually sound but also practically feasible within the PT ICC

environment. Strong leadership commitment and incremental adoption are critical to mitigating resistance to change and ensuring sustainable implementation.

CONCLUSION

This study concludes that inefficiencies in PT ICC's Project Work Plan (RKP) preparation arise not from structural flaws but from a reactive, checklist-based operational philosophy that fosters illogical scheduling, execution delays, and persistent waste; integrating Lean Construction principles into the existing RKP framework can transform it into a proactive planning and control tool. Practically, this integration should begin at the planning level by forming cross-functional teams, applying Pull Planning for master schedules, and aligning procurement with field demand, with success hinging on change management, leadership commitment, and pilot implementations to overcome resistance and ensure sustainability. For future research, scholars could conduct longitudinal post-implementation studies at PT ICC or similar firms to empirically validate the projected efficiency gains (e.g., 20% time savings and 10% waste reduction) and assess long-term cultural shifts in adopting Lean practices within PMBOK-aligned environments.

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