Lima, C. M., Fireman, M. C. T., Nascimento, L. H., Etges, B. M. B. S., Antonini, B. G., Bluhm, B. B., Silva, D. P. & Rocha, F. C. O. (2024). Agile ramp-up: a method to reduce premature construction start. In D. B. Costa, F. Drevland, & L. Florez-Perez (Eds.), *Proceedings of the 32nd Annual Conference of the International Group for Lean Construction* (IGLC32) (pp. 478–489). doi.org/10.24928/2024/0212

AGILE RAMP-UP: A METHOD TO REDUCE PREMATURE CONSTRUCTION START

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ABSTRACT

It is understood that one of the main contributing factors to stagnant productivity in the construction sector is the haste of project teams to start construction without a thorough readiness assessment. With the aim of improving the sector's performance, recent research has turned to analyzing the consequences and challenges associated with the premature start of projects, showing a direction in the search for effective solutions to these issues. The purpose of this work was to present the application of an agile ramp-up method developed to mitigate cases of premature construction start in onshore wind projects. The method used in this article was Design Science Research and covers the following phases: awareness of the problem through understanding the concepts involved; artifact suggestion through the development of a diagnosis; development from the choice of appropriate tools for constructing the "Starting Right" method; evaluation through the impact, transparency, and statistical variance analysis in 16 projects, of which 6 applied the method; conclusion through the systematization of the main learnings. The "Starting Right" method significantly improved the performance of projects during the initial phases, with strategic tool use proving essential for effective responses to various scenarios.

KEYWORDS

Agile Ramp-Up, Lean construction, Wind Farm, LPS.

INTRODUCTION

The construction sector faces persistent productivity challenges, often compounded by the premature start of projects without a thorough assessment of construction readiness. This research, initially focused on onshore wind projects, reveals issues that are universally relevant across various types of construction, such as civil infrastructure, commercial buildings, and industrial developments. In this context, investigating the premature start of construction has

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proven critical to understanding how the pressures of deadlines and perceived benefits by stakeholders can compromise the success of a project in any of these areas.

In pursuit of enhancing the performance of the sector, some studies have shifted their research focus towards understanding the premature start of construction projects. (Griego;Leite, 2017; Abotaleb et al., 2019; Radzi et al., 2020; Ibrahim, et al. 2021). In this point, Ibrahim et al. (2021) suggest as a major reason of the stagnant productivity in the sector is that project teams often rush into construction without adequately assessing construction readiness.

Determining the right time to start construction is pointed out by Griego; Leite (2017) as one of the most important planning decisions on a major capital project. According to the same authors, this decision in many times is influenced by the fact of at least one stakeholder perceives a benefit from an early start construction, as result, project teams face pressure to begin construction, whether or not they are ready. The consequences of this decision could negatively impact a project outcome through frequent interruptions, rework, litigations, claims, disputes, out-of-sequence work, delays (Griego; Leite, 2017; Aboutaleb et al., 2019; Ibrahim et al., 2021).

This new line of research is led by the Construction Industry Institute (CII), which present two key terms: (i) premature construction start; (ii) construction readiness. The premature construction start is defined as "a decision, by at least one party, to start construction with at least one risk that exceeds an acceptable tolerance to a party, and which can result in an interruption to construction" (Griego; Leite, 2017). While construction readiness is defined as "a series of activities and procedures that should be completed or substantially completed prior to construction to productively start and sustain construction operations" (Ibrahim, et al. 2021). Despite the different definitions, it is implicit that the main purpose of both terms is to bring more clarity to the importance of avoiding interruptions right from the beginning of the projects.

It is possible to identify in the literature some research that has already addressed similar topics, but without the specific focus on the start of projects. For example, Koskela (2004) introduce the term making-do as a situation where the activity is started even without all prerequisites available. The relevance of the line of research led by CII is that when an organization experiences an interruption in the start, project teams react by spending additional capital on increased labor and speedier engineering documentation delivery in order to get the project back on track (Griego; Leite, 2017). In this point, the studies of Griego; Leite (2017) identified drivers, lead indicators and impact of premature construction start while Ibrahim et al. (2021) propose a model to assess the construction readiness. But even though advances have been observed in the respective research, there are still alternatives of methods that help companies reduce the cases of premature construction start.

In Lean construction, which highlights collaboration among teams to minimize waste and maximize value for stakeholders (LCI), the Last Planner System (LPS) stands out as a method that aligns closely with these goals. The main idea behind LPS is to establish a reliable and stable workflow through the preparation process (Ballard; Howell, 1998). Another aspect related to the Last Planner System tool is that it allows a global view of the project through three levels of planning: short, medium, and long-term (VIEIRA; BORGE; BARROS NETO, 2020). In this sense, the preparation process works to ensure that all prerequisites are available when the task is initiated, thus avoiding interruptions and lack of productivity. But, although this is the ideal to be pursued, in practice, some studies have shown that due the complexity of construction, unexpected contexts emerge that require adaptive decision-making, and the go/no-go decision to start an activity need to be applied (Pikas et al., 2012). These natural manifestations of resilience by team to respond an unexpected event require the appropriate support from the organization to create conditions to encouraging the diversity of perspectives when making decision, design slack, monitoring gaps between prescription and practice, or even anticipating and monitoring of small changes (Saurin; Sanches, 2014). Yet, although the benefits related to the application of the LPS, it is not exclusive to the construction start phase, requiring adaptations to its peculiarities.

In other industries, the Ramp-up phases presents similarities with the construction start phase, since the interruptions and the uncertainty are a common theme. The Ramp-up begins when the process is scale up from zero and ends at the stable production of full-volume (Christensen; Rymaszewska, 2016). This phase also encompasses the cases of manufacturing "start-ups" of new production lines or new factories, where the production output increase gradually (Glock; Grosse, 2015). Recently, a new way of managing the Ramp-up phase has emerged. This includes agile principles as an asset to combat the growth volatile and uncertainty of business environment (Kremsmayr et al., 2016; Mamaghani; Medini, 2021). According to DeVor et al (1997), agile manufacturing is described as the ability of a company to adapt and thrive amidst constant changes, including those in markets, technologies, and business relationships.

Historically, production management can be viewed from different perspectives, with the traditional approach linked to conversion, prioritizing aspects related to the transformation of inputs into the final product (COELHO, 2003). One important criterion of lean management is achieving the customer's needs. By entering lean management into the construction industry to reduce wastes in each process. Many innovative techniques developed by different individuals can be used for lean production, lean construction or agile methods in such a way that identifies wastes and tries to eliminate or minimize their impact (RASHID, HERAVI, 2012).

Therefore, understanding the complete production flow and identifying value-adding activities is crucial. One of the primary objectives of Lean Construction is the reduction of non-value-adding activities, further optimizing the production process.

The present study seeks to present the results of the application of an agile ramp-up method developed to mitigate cases of premature construction start in onshore wind projects. The methodology was developed based on 6 case studies.

AGILE RAMP-UP

Managing Ramp-up phase is a challenging task, due the complexity related to high uncertainty, resource availability, lack of process maturity and the involvement of several stakeholders from different backgrounds (Heraud et al., 2023). Another characteristic with negative impact is that the ramp-up process is normally designed based only on experiences from an existing production line (Mueller et el. 2020).

Recently several studies have presented agility as one of the main drivers of ramp-up management (Kremsmayr et al., 2016; Bergs et al., 2021; Mamaghani; Medini, 2021; Heuraud et al., 2023; Kadkhoda-Ahmadi et al.,2023). These studies highlight that the agile principles enable the companies to respond quickly to changes and to support continuous development and quality improvement during ramp-up phase.

Kremsmayr et al. (2016) allowed an advancement on the application of agility principles in ramp-up management. According to them, the agile ramp-ups could be characterized according four criteria (Figure 1):

- Proactive task prescheduling – Considers the principle of proactive through the application of possible scenarios as well as their effects on a Ramp-up phase. It also presents the concerns with mitigate risk and achieve time advantages.
- Acceleration of upscaling phase – The acceleration principle is achieved with transparent decision-making process and simplification of the major Ramp-up processes. The main idea is to remove unnecessary process steps and interion loops and organize efficiently the experience gained from previous ramp-ups.

- Flexible capacity adjustment – Involves the ability to undertake flexible capacity adjustment even shortly before starting or during Ramp-up activities. It highlights the necessity to determine and monitoring certain performance levels.
- Rapid response to change – Here there is a focus on the reduction of recovery time, since the system need to be able to quickly respond to unexpected disruptions and recovery to the initial schedule as soon as possible. Here the importance of an structured help chain in organization is implicit.

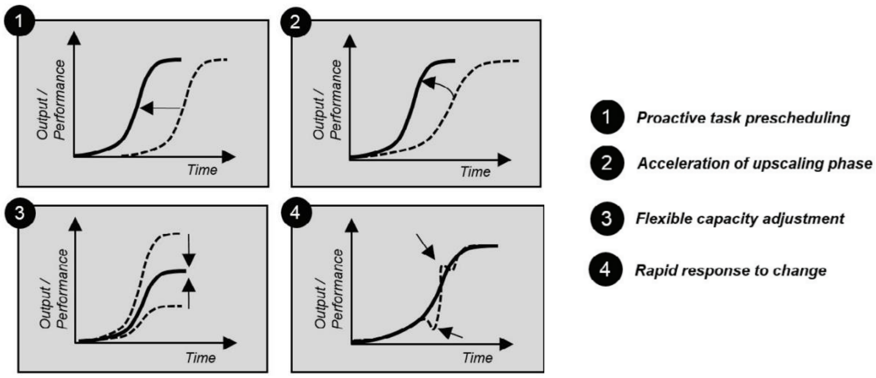

Figure 1: Four Criteria to Agile Ramp-up according Kremsmayr et al. (2016)

METHOD

For the development of the present study, the Design Science Research (DSR) methodology was employed. As highlighted by Bax (2014), the focus of DSR lies in the creation, investigation, validation, and evaluation of new artifacts, including constructs, frameworks, models, methods, and instances of information systems. The artifact developed in this article can be understood as a method for the accelerated initiation of wind farm projects, termed "Starting Right".

The aim of DSR is to create outputs that serve human purposes, and the critical point is to design a system that will address new challenges Kasanen et al. (1993) and create new perspectives for the current time (Lukka, 2003). DSR seeks to devise solution concepts, name artifacts, solve classes of problems (Van Aken, 2004; Holmstrom et al.2009), and, at the same time, provide a theoretical contribution to the field of knowledge (Kasanen et al., 1993).

The "Starting Right" methodology was developed based on the Agile Ramp Up structures used in the work of Kremsmayr et al., (2016), where these authors devised an artifact aimed at a hybrid industry of high-quality powder metallurgy. With this in mind, the "Starting Right" method, aimed at accelerating wind farm projects, utilized the Lean construction management philosophy, as well as tools such as the Last Planner System (LPS), visual management (Control Tower), risk matrix, and mobilization control spreadsheets. For this study, the LPS was integrated with key planning instruments: the Line of Balance for long-term planning, Six-week ahead planning for medium-term objectives, and Check Out meetings for short-term progress monitoring.

In this context, DSR played a crucial role in the design of this artifact, guiding its development through the steps outlined in Figure 02.

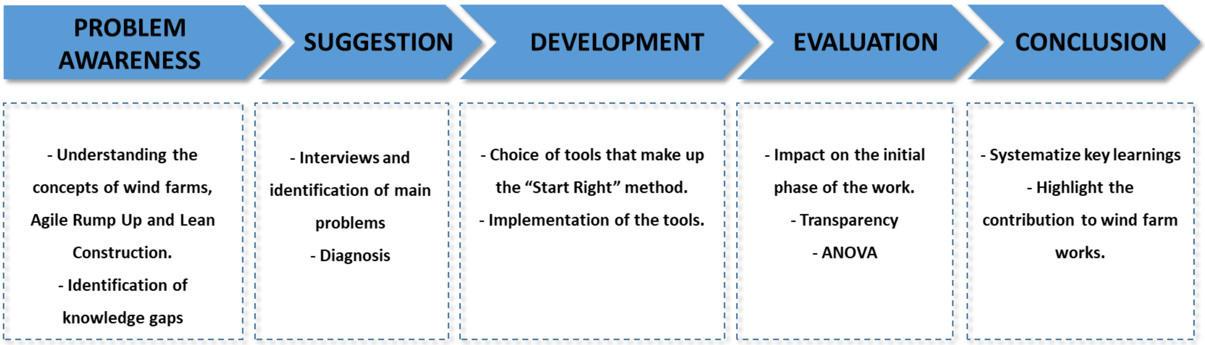

Figure 2: Methodological design

The development and implementation of the "Starting Right" method, as well as its deployment, were carried out by a management consultancy that began in 2020 at a wind farm construction company located in the northeast of Brazil. The Problem Awareness stage involved understanding the construction process of wind farms, studies on Agile Ramp Up, and studies on Lean principles. Furthermore, gaps in knowledge regarding these topics were identified. The selection criteria for the projects analyzed in this article required the project to involve the construction of wind farms, specifically the construction of access roads and concrete foundations (Table 1). Although there were other ongoing projects, such as building constructions and highways, the "Starting Right" method was applied exclusively to wind farm constructions, reflecting the constructor's strategic decision to focus on this sector.

Subsequently, the Artifact Suggestion stage was carried out, in which the consulting firm conducted interviews with the engineers involved in the project "Project 11" (Table 1). The objective was to identify the main obstacles related to efficient management, culminating in the formulation of a diagnosis to be addressed.

Table 1: List of works analyzed

PROJECT	YEAR	TOWERS	METHOD	PROJECT	YEAR	TOWERS	METHOD
Project 01	2015	31	Conventional	**Project 09**	2019	121	Conventional
Project 02	2015	153	Conventional	**Project 10**	2019	49	Conventional
Project 03	2015	47	Conventional	**Project 11**	2020	120	*Start Right*
Project 04	2016	98	Conventional	**Project 12**	2021	76	*Start Right*
Project 05	2017	65	Conventional	**Project 13**	2021	93	*Start Right*
Project 06	2018	230	Conventional	**Project 14**	2021	70	*Start Right*
Project 07	2018	36	Conventional	**Project 15**	2021	123	*Start Right*
Project 08	2019	36	Conventional	**Project 16**	2022	188	*Start Right*

The Development phase involved selecting the most appropriate tools, taking into account the context identified during the diagnosis, followed by their implementation in "Project 11". This development process was subdivided into four parts, which were outlined as the initial guidelines of the "Starting Right" method. It is important to highlight that, after the implementation in "Project 11", this method was extended and applied to subsequent projects.

"STARTING RIGHT" RAMP UP METHOD

The "Starting Right" method encompassed 4 main pillars, which are: (1) Anticipating possible scenarios and mitigating risks as early as possible; (2) simplifying processes using a mobilization checklist; (3) making capacity adjustments before starting or during the initiation of activities; (4) reacting quickly to unexpected events through a structured support chain.

To facilitate the implementation of these guidelines, it was essential to determine the ideal timing for their application and identify the necessary tools for each situation, as described below:

Anticipate possible scenarios and mitigate risks as quickly as possible

Anticipating possible scenarios and mitigating risks are crucial elements for the success of any venture, especially in the field of wind farm construction. To address this challenge, two strategic tools were adopted: the Risk Matrix and Scenario Simulation. The Risk Matrix provides a comprehensive view of the potential challenges and opportunities that may arise throughout the project, allowing for proactive identification and an anticipatory approach. The Scenario Simulation, on the other hand, offered a global view of the project through long-term planning. For this purpose, the Critical Path Method and Line of Balance spreadsheets were used, which provided a clear visualization of milestone dates and resource allocation. Moreover, the combination of Scenario Simulation with the Risk Matrix contributed to better formulation and refinement of analysis at this stage.

Simplify processes using a mobilization checklist

The simplification of processes in the mobilization stage was crucial for the efficiency of the "Starting Right" methodology, being proactively incorporated through the use of a mobilization checklist spreadsheet. This spreadsheet not only simplifies the management of mobilization but also provides an effective channel to document and track new items that apply to a new project. The records obtained can be used in identifying patterns in the process. Thus, this simplification boosts operational efficiency and contributes to building a solid foundation for future ventures.

Make capacity adjustments before starting or during the start of activities

At this stage, the Carousel of Works control spreadsheet was employed, which facilitated the process of transferring a resource from one project to another. This approach aims to optimize the use of resources, ensuring proper allocation according to the needs of each project, providing greater flexibility and efficiency in the execution of simultaneous or sequential projects. For this purpose, mid-term meetings known as "Six Weeks Look Ahead" were utilized. These meetings were held periodically, occurring weekly or bi-weekly, with the goal of anticipating potential constraints in the planned activities over a six-week period.

React quickly to unexpected events from structured help chain

For effective management of emergency situations, it is essential to promptly address unforeseen events through a structured support chain. For this, Project Schedule Meetings, Check Out, Control Tower, and Management Meetings were utilized. The Project Control meeting involves discussions regarding the approvals and releases of executive projects, as well as analyzing specific aspects of the construction. This meeting takes place before the construction starts. On the other hand, Check Out, Control Tower, and Management Meetings occur at the beginning of the construction. The Check Out meeting provides a dedicated environment where operational teams meet with leadership daily to review critical events, share information, and make decisions, eliminating constraints for the next day. The weekly meeting called Control Tower presents an overview of all the project's information, with the participation of key leadership involved in the project's execution, aiming to present tactical indicators to the management. Concluding the support chain, a strategic meeting is held weekly, summarizing the main indicators and events for the board of directors. These four meetings enable quick and coordinated responses to minimize negative impacts, mitigate risks, and restore operational normality as quickly as possible.

Continuing with the DSR stages, the evaluation of the artifact took into account the Impact of the Starting Right method in the initial phase of the projects and the Transparency of the processes (Figure 02). The analysis of this impact is quantified by two aspects, first by the degree of deviation observed during the contractual progress of 25%, as exemplified in Figure 03, and by the level of challenges faced during implementation, classified as low, medium, and high.

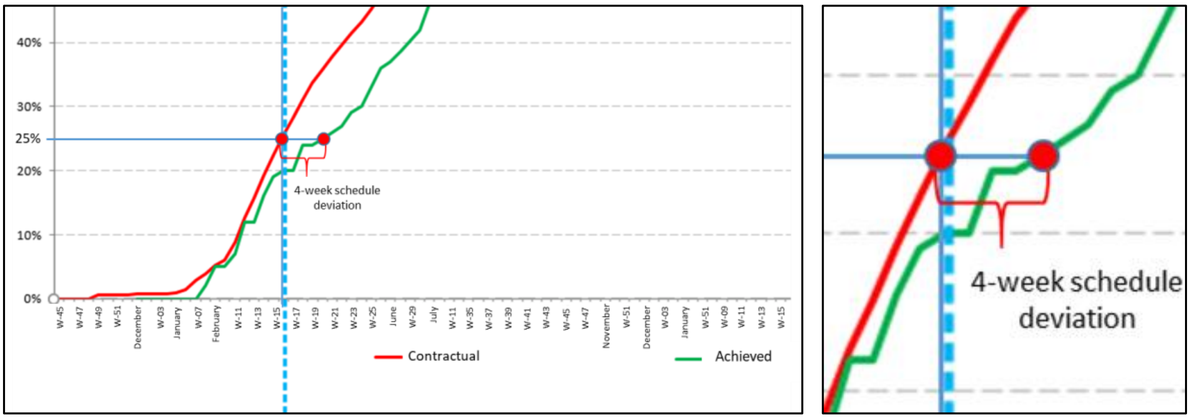

Figure 3: Example of S Curve for Project 7 Monitoring (left) and Zoom in on the 4-week schedule deviation (right)

Still pertaining to the Analysis phase, in addition to considering transparency as the ability of the production process (or its components) to facilitate communication with people (Formoso et al., 2002), robust statistical analyses were conducted to assess the effectiveness of the "Starting Right" method. According to Kerzner (2013), the technique of Analysis of Variance (ANOVA) is essential for comparing groups in project management studies. This technique was employed to quantify the schedule deviations during the Ramp-Up phase, comparing the performance of projects that used the conventional method with those that implemented "Starting Right".

In the final stage, the conclusion consisted of systematizing the main learnings, aiming to clearly highlight the method's contribution to wind farm projects.

RESULTS

In this section, we will discuss the results related to the development and evaluation phase of the artifact, presenting a representation of the method's structure, as well as analyses focused on the impact on the initial phases of the projects and the perception of the transparency of the implemented processes.

STRUCTURE OF THE "START RIGHT" METHOD

The "Starting Right" artifact represents an effective approach to the agile initiation of projects in wind farms. As illustrated in Figure 04, tools such as the Risk Matrix, Scenario Simulation, Mobilization Worksheets, LPS, "six weeks look ahead" meeting, Carousel of Works, Project schedule meeting, Check out, Control Tower, and Board meetings should be applied, especially in the initial phases of the project, until it reaches its production stability. It is worth noting that the continued use of these tools (1, 3, and 4) beyond the stability phase is indispensable, as they play fundamental roles in the ongoing management of the project.

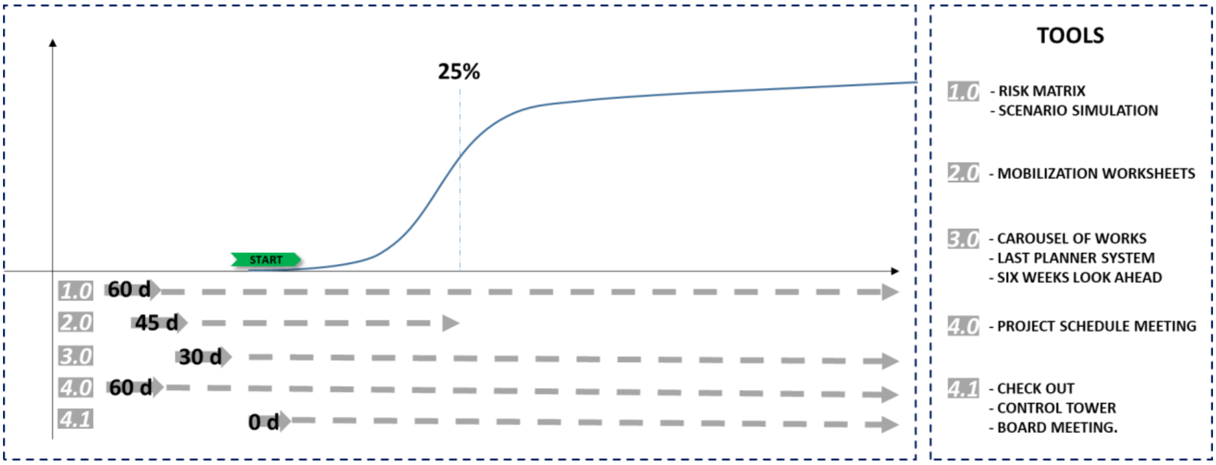

Figure 4: Representation of the Application of the method

Figure 03 also shows that each group of tools is initiated at a specific moment in the development of the project. This cadence is essential to ensure the success of the rapid startup of the venture.

Wind farm projects often occur in previously uninhabited locations, requiring the construction of accommodations, advanced campsites, and appropriate infrastructure. These constructions are necessary to ensure that the project can be started on schedule.

Details of the cadence for starting the tool groups:

- 60 days before the start of the project, the first group of tools is initiated
- 45 days before the start of the project, the second group of tools is initiated.
- 30 days before the start of the project, the third group of tools is initiated.
- 60 and 0 days before the start of the project, the fourth group of tools is initiated.

ANALYSIS OF THE METHOD'S IMPACT ON THE INITIAL PHASE OF THE PROJECT

Based on the analysis of the 16 projects monitored (Figure 04), it is observed that, in the period preceding the implementation, the occurrence of schedule deviations, resulting in delays in the initial phase of the projects, was more frequent. However, upon examining the period following implementation, it is noticed that the projects began to exhibit a superior performance pattern in their initial phase.

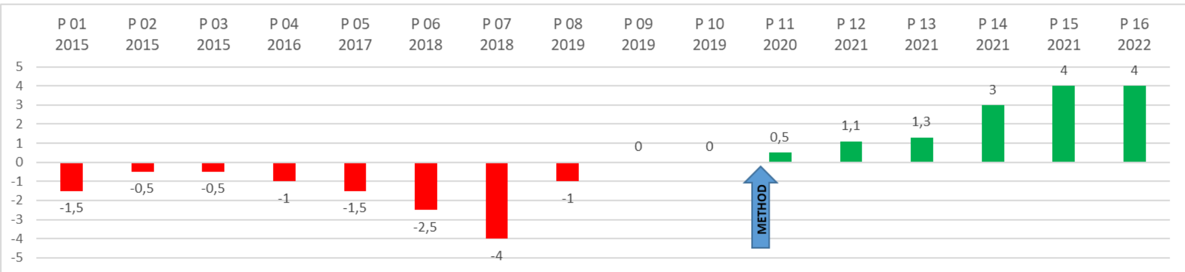

Figure 4: Timeline of the initial Ramp Up of ventures.

Considering this, an advancement in the method's maturity over the time of its application is noted. This progress is evidenced by the increase in the effectiveness of the "Ramp Ups" observed in the projects after the method's implementation (Figure 04). However, it is relevant to highlight the difficulties encountered during the implementation period, as can be seen in the initial performances of projects 11, 12, and 13. Among the difficulties that initially impacted the performance of the projects (Table 02), delays in the application of the tools and the lack of a database stand out.

Table 2: Impacts identified

Impact on Implementation	Level
Delay in applying tools	High
Customer Involvement in the Ramp-up process	High
Database shortage	Average

From this analysis, it was observed that the delay in the implementation of the tools had a significant impact on the adoption process of the new method. This situation arose mainly because the company's standard operational model did not anticipate a 60-day lead time for the start of these follow-ups. As a result, projects 11 and 12 started with only 30 days, compromising the available period for effective responses and identification of constraints, which ended up being identified too late. Despite these setbacks, projects 11 and 12 achieved positive outcomes. However, it is important to highlight that their performance, although satisfactory, did not reach the performance levels observed in projects 14, 15, and 16.

The presence and engagement of the client in the planning process and constraint removal are of vital importance, especially considering that various constraints emerge directly from their participation, such as license releases, project approvals, among other essential items for the construction's progress. In this context, the case of project 13 stands out, which, despite adhering to the 60-day advance preparation recommendation and achieving positive results, failed to replicate the high performance observed in projects 14, 15, and 16. This situation highlights the importance of effective collaboration with the client to overcome challenges and avoid delays, thus ensuring the smoothness and success of the construction process.

Another aspect that had a moderate impact was the lack of a comprehensive database on interferences and risk analyses, leading to a continuous refinement process. As the methodology was perfected over time, a notable improvement in the results of subsequent projects was observed, highlighting the continuous evolution of the method.

INFORMATION TRANSPARENCY AND THE VARIANCE ANALYSIS TECHNIQUE

When analyzing the tools implemented in the "Starting Right" method from the aspect of transparency, it is noted that, in general, all of them have the capacity to enhance communication among the involved parties. Particularly noteworthy is the integration observed between groups 3 and 4, as the support network structured by these tools continuously consulted the information surveys developed by tool groups 1 and 2. The discussions and analyses conducted through the support network played a crucial role, allowing the project to react agilely to unexpected events through active communication. However, during the implementation period, significant challenges were faced in attempting to establish a new culture within the company with the new routines. Many employees did not fully understand the proposed changes and, as a result, did not adhere to them as expected. It was essential for the construction engineers to provide regular guidance to their supervisors to ensure the adoption of the new practices until they could apply them independently.

It is important to highlight that, despite the initial positive results presented by the projects, it was essential to maintain the continuous use of the tools for the most part. This aimed to perpetuate transparency among the sectors, ensuring the sustainment of monitoring and control of the venture beyond the initial implementation period. It is worth noting that the tools were reused throughout the project, incorporating new analyses, risk identification, and proposition of solutions.

Moreover, a statistical analysis of variance was also conducted to further elucidate the effectiveness of the 'Starting Right' method. This analysis compared the schedule performances between two distinct groups of projects: those that did not implement the 'Starting Right' method and those that did. The data presented in Table 3 reveal a significant contrast between the groups, with the average of schedule deviations being negative for the group that followed the conventional method, indicating frequent delays, and positive for the group that adopted the 'Starting Right' method, reflecting earlier deliveries compared to the planned schedule.

Table 3: Variance analysis

Group	Average	Variance
Conventional	-1,25	1,51
Start Right	2,32	2,39

Interestingly, greater variance was observed in the projects that used 'Starting Right', particularly due to a substantial leap in performance between projects 11 and 15, where an improvement in schedule deviation from 0.5 to 4 weeks was recorded. This increased variance does not obscure the fact that, as evidenced by Figure 4, projects with the 'Starting Right' method consistently demonstrate superior results, underlining the method’s potential to improve delivery during the Ramp-Up stage.

CONCLUSIONS

The "Start Right" method combines Lean construction principles with agile approaches, aiming to prevent premature project starts and achieve significant improvements in initial performance. Its application demonstrates the importance of strategically using tools for effective responses to various scenarios. The case studies addressed in this work showed that the application of the agile ramp-up methods, yielded positive results. The analysis encompassed 16 ventures, of which 6 adopted the new method. It became evident that determining the appropriate moment to start monitoring the constructions is of fundamental importance, highlighting the relevance of avoiding interruptions from the beginning of the projects.

The development of a database to document interferences and risks proved to be highly beneficial. Such a practice not only facilitated risk management but also significantly contributed to the enhancement and maturity of the method's implementation. However, it is important to note that, despite satisfactory results, the effectiveness of the method may be compromised in the absence of effective collaboration and joint planning with the client. This limitation was particularly evident in project 13, indicating that greater integration and alignment among all involved parties could have elevated the achieved results.

In this context, for the implementation of the Starting Right method, it is recommended to train employees on the presented tools, as well as to respect the appropriate time for the start of each phase. It is important to emphasize that the challenges faced by the construction sector vary according to its constructive characteristics, which can generate variations in the results. Therefore, it is suggested to expand the application of the method to other types of constructions in order to evaluate its performance. Additionally, fostering effective collaboration and joint planning with all stakeholders is essential for enhancing integration and alignment of th implementation. Continual evaluation and adaptation of the method should be carried out to align with the unique challenges and characteristics of each construction sector, accommodating variations in results and ensuring maximum efficacy.

The "Start Right" method combines Lean construction principles with agile approaches, aiming to prevent premature project starts and achieve significant improvements in initial performance. Its application demonstrates the importance of strategically using tools for effective responses to various scenarios.

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