

Implementation of Daily Takt in Construction: A Case Study of a Norwegian Residential Project

Malin Furuli Munkvold¹, Ola Lædre², and Frode Drevland³

Abstract

Question: What happens in the execution of a residential project when daily takt is introduced, and what specific experiences can be drawn to improve future projects?

Purpose: This paper examines the implementation of daily takt time in a residential construction project, focusing on how the takt plan was developed and executed. It explores the changes and challenges encountered when transitioning from weekly to daily takt and identifies lessons learned that can improve future use of takt planning.

Research Method: Case study

Findings: Daily takt introduced challenges such as reduced flexibility, complex coordination, and logistical issues. Key difficulties in the case project included poor planning, inaccurate workload estimates, insufficient subcontractor capacity, problems with digital tools, and limited space. However, with careful planning, subcontractor involvement, logistics alignment, and enhanced management support, daily takt can increase construction efficiency.

Limitations: The study's generalizability is constrained by contextual factors, subjective data sources, market conditions, and the limited scope of existing research on the topic.

Implications: While daily takt can significantly improve workflow and efficiency in construction projects, it requires meticulous planning, robust subcontractor involvement, and enhanced management support.

Value for practitioners: By presenting lessons learned, the paper serves as a guide for practitioners considering short takt times, helping them to anticipate challenges, refine planning processes, and enhance overall project execution.

Keywords: lean construction, daily takt, takt planning, case study

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1 M.Sc. Graduate, Norwegian University of Science and Technology (NTNU), Trondheim, Norway, malinmunkvold@gmail.com

2 Professor, NTNU, Trondheim, Norway, ola.ladre@ntnu.no, orcid.org/0000-0003-4604-8299

3 Associate Professor, NTNU, Trondheim, Norway, frode.drevland@ntnu.no, orcid.org/0000-0002-4596-1564



Introduction

Takt time planning, an approach originating from manufacturing, has gained traction in construction for its potential to reduce project duration and improve efficiency (Haghsheno et al. 2016; Frandson, Berghede, and Tommelein 2013). The approach involves dividing work into manageable chunks and aligning tasks to a set beat or ‘takt’ (Frandson and Tommelein 2014). A common way to illustrate takt planning is through the metaphor of a train (Andreassen and Drevland 2023; Haghsheno et al. 2016). In this metaphor, a train consists of multiple wagons, each representing a trade such as electrical, HVAC, or carpentry. In a construction project, the building is divided into work zones. The train progresses through the building, stopping at each zone in a predetermined rhythm, known as the takt. In construction, the most common practice is for the wagons to remain in each zone for a week before moving on to the next (Binninger et al. 2018). This cycle repeats until all wagons have visited every zone.

Reducing the work zone size enables the shortening of the overall takt timeline (Binninger et al., 2018; Jabbari, Tommelein, and Kaminsky, 2020). This shortening can potentially reduce production times and project costs greatly. However, it introduces new challenges caused by the logistics and the frequency of work zone handovers.

Despite its potential benefits, research on the practical effects of reducing takt time remains limited. Although some examples exist of short takt times being applied (e.g., Binninger et al. 2018; Apgar and Smith 2023; Keskiniva, Saari, and Junnonen 2021; Rieki et al. 2023), the literature on this subject remains sparse. This gap underscores the need for further research to better understand how shorter takt times impact the practical execution of construction projects.

Takt planning has proven beneficial in residential construction projects, as it ensures steady and predictable progress (Haghsheno et al., 2016). Each floor or residential unit typically has an identical layout, and takt planning allows each trade to complete its work on one floor or unit before the train moves on, without waiting for others to finish their tasks. Takt planning enhances workflow by minimising waiting times and resource conflicts, two common challenges in traditional construction projects.

Norway is among the leading countries globally in adopting lean construction practices (Engebø et al. 2017; Lohne et al. 2021). Norwegian contractors have been at the forefront of implementing takt production, with its earliest documented use back in 2013 (Vatne and Drevland 2016), and several studies have examined its application (Haarr and Drevland 2016; Vatne and Drevland 2016; Andersen and Fyhn 2019; Gardarsson, Lædre, and Svalestuen 2019; Haugen, Lædre, and Aslesen 2020; Dahlberg and Drevland 2021). One major Norwegian contractor has been a trailblazer in adopting takt production as its standard approach to production planning and control across its projects. However, their experience, like that of the Norwegian industry more generally, has almost exclusively involved weekly takt; sub-weekly takt times have not yet been documented in research. This paper, therefore, examines the contractor’s second residential project using daily takt, addressing the following three research questions:

RQ1: What changes in execution occur when shifting from weekly to daily takt?



RQ2: What challenges arose during the implementation of daily takt?

RQ3: What lessons can be drawn for improving future projects?

Literature Review

Before conducting the case study, a structured literature review on short takt times was conducted and published separately (Munkvold and Drevland, 2024). The review was based on systematic searches in Scopus and IGLC.net using the keywords “takt” and “construction.” After removing duplicates and irrelevant articles, 13 relevant studies addressing the use of short takt time were included. Thematic analysis, following Robson (2002), was used to identify seven key themes. Overall, the literature on short takt times is sparse. Most identified studies focused on projects that used short takts (defined here as two days or less), primarily during the finishing stages of repetitive builds such as residential or hotel projects. Reported takt durations ranged from 25 minutes to 2 days, with 1-day takt being the most common. Most studies originated from Finland, with additional contributions from Norway, Germany, and the USA. The themes discussed below reflect recurring patterns in both the reported challenges and strategies used to manage short takt projects.

Among these recurring patterns, maturity is frequently cited as a key factor in successfully implementing short takt. Finnish studies often use the term explicitly to describe organizations with advanced takt capabilities (Lehtovaara et al., 2021; Tetik et al., 2019; Kujansuu et al., 2020; Lehtovaara et al., 2020), whereas other studies point to maturity-related issues without explicitly using the term ‘maturity’ (Binninger et al. 2018; Lehtovaara et al. 2019). Projects with lower maturity levels often encounter difficulties, including poor planning, weak coordination, and logistical challenges. Lehtovaara et al. (2021) outline three maturity levels ranging from basic takt planning to integrated practices involving social coordination. Tetik et al. (2019) compare maturity between construction and shipbuilding, highlighting more advanced takt practices in the latter. While definitions of maturity vary, most sources agree that experience and system integration are critical to takt success.

In parallel with maturity, detailed planning is identified as a prerequisite for effective takt execution. Several studies emphasize the importance of early-phase activities, including takt training, preparatory workshops, and the coordination of design and logistics (Riekkii et al., 2023; Lehtovaara et al., 2019; Apgar & Smith, 2023). Insufficient planning is commonly linked to poor flow and reactive problem-solving. Tetik et al. (2019) emphasize that an early definition of project scope impacts procurement and delivery planning. Similarly, Lehtovaara et al. (2020) argue that integrating takt logic during design improves collaboration and mitigates execution issues. However, researchers also warn that tight schedules and minimal buffers can increase sensitivity to disruptions (Lehtovaara et al. 2021).

Given this sensitivity to disruptions, rigorous daily monitoring and control are considered essential for managing the tight rhythms of short takt projects (Fransson and Tommelein, 2014; Gardarsson et al., 2019; Lehtovaara et al., 2021). Daily coordination meetings play a crucial role in identifying deviations and maintaining shared situational awareness (Riekkii et al., 2023; Kujansuu et al., 2019). With little room for delay, fast decision-making and real-

time adjustments are necessary. Studies also highlight that short takt times increase the workload for supervisors and technical managers, especially during start-up phases (Lehtovaara et al. 2021). Consequently, the need for stable coordination routines is repeatedly emphasized (Lehtovaara et al. 2019; Keskiniva et al. 2021).

To support these tight coordination routines, visual tools and mock-ups are often utilised during implementation. Digital solutions such as 3D models or visual scheduling tools improve coordination and transparency by aligning work zones, timing, and trades (Lehtovaara et al. 2021; Riekki et al. 2023). Physical tools—such as printed takt plans and floor markings—support local coordination and help communicate production expectations, which is seen as especially important when working with limited buffers. Furthermore, mock-ups are highlighted as useful tools for validating these takt plans and standardizing work methods. In a hotel case study, Riekki et al. (2023) describe how a full-scale mock-up helped identify and correct issues before rollout. While they caution that delayed mock-up completion can limit their value, mock-ups appear to enhance both takt planning and execution when used early and systematically.

Alongside on-site coordination, logistics management represents another recurring operational challenge in short takt projects. Material deliveries must be tightly synchronized with the takt plan to avoid delays and congestion (Riekki et al. 2023). Effective strategies include utilizing off-site storage for large components and implementing just-in-time deliveries to minimize on-site inventory. Studies note that logistics is often underprioritized in low-maturity projects, leading to material bottlenecks and increased coordination pressure during execution (Lehtovaara et al. 2019; Kujansuu et al. 2020).

Finally, underpinning all of these execution strategies is the need for appropriate collaboration and contracting. Strong collaboration between designers, contractors, and suppliers is a critical enabler of short takt execution (Apgar, Smith, and Copenhaver 2022; Riekki et al. 2023). Several studies suggest that lean-friendly contract structures can foster openness, enhance information flow, and promote joint problem-solving (Lehtovaara et al., 2019; Kujansuu et al., 2020). Conversely, traditional contracts and adversarial relationships are reported to hinder coordination and adaptability, especially under the time pressure imposed by short takt durations.

Summary and Point of Departure

The existing literature on short takt time identifies a range of critical factors for successful implementation, including organisational maturity, detailed planning, close production monitoring, logistics integration, and collaborative contract structures. Most documented cases focus on high-maturity projects, often with strong logistics systems and standardised, repetitive work. However, few studies examine the implementation of takt times shorter than the typical weekly cycle in projects where such preconditions are only partially in place. In the literature, these *short takts* range from about 25 minutes to 2 days; however, in this paper, we use the term only as a collective label for such sub-weekly cadences. Our case project employed a 1-day takt, and the empirical findings presented here

are limited to that cadence. By focusing on this implementation in a residential project with moderate maturity, limited logistics integration, and variable subcontractor readiness, the paper provides an understanding of the practical constraints and transitional challenges associated with daily takt.

Method

A case study involves an in-depth examination of a specific instance, aiming to reduce complexity and gain deeper insights (Yin 2014). The method is well-suited for capturing a realistic depiction and understanding of individuals' interactions (Jacobsen, 2015). A case study explores how individuals respond within a given context. In this study, *'context'* refers to the implementation of daily takt in the case project, while *'individuals'* refers to the project participants.

Yin (2014) emphasises the importance of using multiple sources of evidence. Here, the data were collected through semi-structured interviews, supplemented by participant observations and document studies.

Participant Observations

The first author conducted unstructured participant observation during a nine-week summer internship at the case project. This included active involvement in daily operations, participation in meetings, and informal site observations. The purpose of this unstructured approach was to gain a contextual and experiential understanding of the case-specific takt planning practice, without imposing predefined categories or observation protocols. While no systematic field notes were collected for formal analysis, the observations were instrumental in shaping the interview guide and ensuring the interviews' relevance and depth. Key insights from these observations are reflected implicitly in the interview findings and the overall interpretation of the case.

Document study

Yin (2014) highlights that the primary purpose of using documents in case studies is to corroborate and enhance evidence from other sources. In this study, documents such as reports, emails, notes, and IT tools were reviewed during participant observations. The documents provided background information and context that reinforced the analysis. Additionally, the main contractor's approach to planning and execution was examined. These documents were crucial for understanding the preparations required for the first takt meeting.

Interviews

Interviews served as the primary data collection method. Insights from the literature review were used to develop the interview guide. A semi-structured format ensured key themes were covered while allowing participants to discuss topics they deemed important.

Interviewees were selected using a three-step process recommended by Jacobsen (2015). First, relevant candidates were identified: all subcontractors involved in the daily takt



plan for phase 1 (10 trades) and relevant personnel from the main contractor Consto (13 individuals). Second, inclusion criteria prioritised those involved in takt planning and daily coordination—namely, subcontractor foremen or project managers, and site managers or project directors from the main contractor. Subcontractors with minimal involvement and workers without planning responsibilities were excluded. Third, from this pool of 22 individuals, 10 were selected for interview based on practical availability, role centrality, and expected contribution to the research questions. Snowball sampling was also used, and interviews continued until information saturation was reached.

Table 1: Overview of Informants

Actor	Informant role
Electrical Subcontractor	Project Manager
Interior Carpentry Subcontractor	Site Foreman
Plumbing Subcontractor	Site Foreman Project Manager
Ventilation Subcontractor	Project Manager
Painter Subcontractor	Project Manager
Main Contractor	Project Director Site Manager 1 Site Manager 2 Planning Facilitator

Eight interviews were conducted in person at the construction site, and two via Microsoft Teams. Interviews were held privately to ensure confidentiality. The participants were informed about the study’s purpose, the confidentiality of their responses, and the research’s independence from the main contractor. Each interview lasted 30 to 60 minutes and was recorded. Key points for the analysis were noted right after the interviews.

The audio recordings were transcribed using transcription software and then reviewed against the original recordings. The interview findings were organised in key themes derived from the literature review and project observations. Colour coding was used to differentiate between planning, execution, informant themes, and comparisons with weekly takt. This structured organisation supported the analysis of the results, and transcripts were revisited when a deeper understanding was needed.

Limitations

The participant observations and interviews were conducted several months after the initial takt plan was developed, making it difficult to capture detailed insights into the early planning process. This time lag may have led to the loss of critical information, as

participants' recollections could have faded. Earlier interviews or direct involvement during the planning phase would likely have yielded more accurate data.

While providing valuable insights, the first author's involvement in the project may have influenced the study's findings. Despite efforts to remain neutral, their presence and interactions could have shaped both the observations and interviews. This potential bias may have affected how participants expressed themselves and how data were interpreted.

Although the researcher conducted regular site visits, these observations were not used as formal data because of the researcher's limited experience with takt production. While helpful for contextual understanding and interview preparation, the observations were not systematically documented or coded. This reduces the opportunity for triangulation between interview findings and field-based interpretations.

Finally, the limited number of interview participants poses a constraint. A broader sample could have improved the representativeness of the findings. However, the use of predefined questions grounded in the literature helps ensure consistency and enhances the reliability of the data collection.

Case Description

The case project was a residential development in a city in northern Norway. It featured 189 apartments with additional storage and commercial spaces across seven blocks. Construction started in early 2022 and was split into two phases. This paper studies the first phase, which contained the blocks I, J, K, and L to the left in Figure 1.



Figure 1: Rendering of the case project (illustration used with permission)

The case project was the second project in which the main contractor used daily takt, but the first in which they used it from the start of construction. The daily takt schedule was only applied to the interior work of the standard apartments. Common areas such as galleries, storage rooms, and commercial spaces were excluded due to their unique layouts, non-repetitive tasks, and more variable work sequencing. These areas were planned and managed

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using a traditional weekly schedule developed by the site management team. Coordination between the takt-planned and non-takt areas was maintained through regular site meetings and overall schedule alignment to prevent conflicts and ensure smooth integration of all project components. A separate, weekly schedule was developed for the penthouse apartments since they were larger, had unique floor plans, and had different bathrooms.

The standard apartments are marked on Figures 2 and 3. Two apartments were defined as one work zone. Each trade had one day to work in a zone before handover to the next trade the following morning. Similar floor plans and standard apartment sizes allowed repetitive zoning.



Figure 2: The orange, green, and blue areas show zones with daily scheduling.

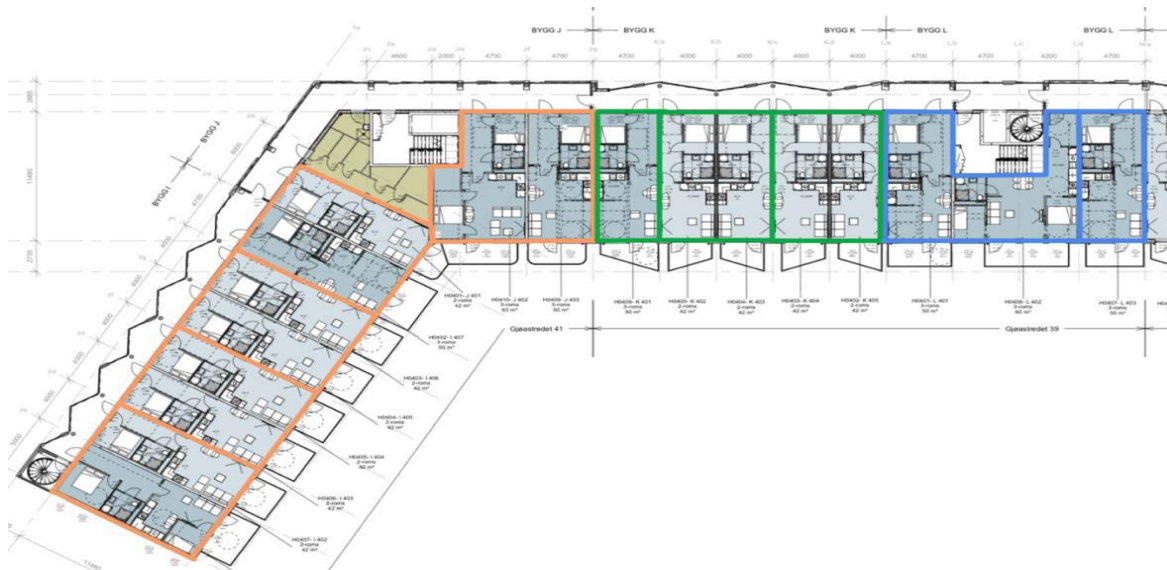


Figure 3: Takt areas on the 4th floor, phase 1.

Each colour in Figure 2 represents a separate train. The first train followed the route through blocks I and J (orange), the second through block K (green), and the last through block L (blue). The same schedule was implemented through all the blocks, with only minor adjustments along the way.

The numbers and dotted line provide a visual representation of the trains' movement through the blocks. The number 1 indicates that the train started in that zone and proceeded in the direction indicated by the arrow. When the arrow stops, it indicates that the train continued on the floor below (at the next number, 2 in this case) and then along the arrow direction.

All apartments (except some penthouses) had prefabricated bathrooms. The bathrooms were delivered ready at the construction site and were already in place when the daily takt started. Table 2 provides an overview of the blocks, number of floors, number of apartments, and total floor area.

Table 2: Number of standard apartments per block.

Block	I	J	K	L
Number of floors	6	8	7	10
Number of standard apartments	35	16	30	31
Floor area per unit	42-63 m ²	42-63 m ²	42-63 m ²	50-60 m ²
Penthouse apartments	0	3	0	2

The expectation was that as workers became more familiar with the tasks as the project advanced, their efficiency would improve.

Project organization

The main contractor employed their own skilled workers, particularly in concrete and carpentry, but subcontracted tradespeople constituted the majority of the workforce. Initially, the project employed one construction manager (CM1) focusing on external production. Later, a second manager (CM2) was added for internal production. CM1 and CM2 collaborated closely, particularly in coordinating trades and overseeing the construction schedule. Regular meetings ensured smooth project progress, with CM2 also playing a key role in schedule management and trade coordination.

The choice of using daily takt

The decision to use daily takt was made by the main contractor based on experience from a prior project, in which daily takt reduced overall construction time compared to weekly takt. One motivation was to reduce the inefficiencies observed in weekly takt, where trades sometimes finished their work early in the week, leaving zones idle for several days. A

project manager noted that “you get to close the gaps you have in a weekly takt... apartments would sit empty for days.”

Additionally, the project faced tight deadlines due to earlier delays in the structural system, necessitating a compressed interior work schedule. Daily takt was seen as a viable strategy to regain lost time. Project-specific factors also supported this choice: the standard apartments had highly repetitive layouts, small floor areas, and a consistent sequence of trades. These conditions allowed for repetitive work cycles, which the contractor believed would enable crews to increase efficiency over time through learning and routine.

While a formal takt time optimization analysis was not performed, the decision reflected an experience-based balance between urgency, repetition, and zone size..

Takt planning

A total of six subcontractors participated actively in the takt planning process. These trades were directly involved in the interior fit-out and were included because their work was central to the takt-regulated production flow.

The first version of the takt schedule was prepared by CM2, the site manager responsible for interior production. This initial draft was based on lessons learned from a previous project using daily takt and included a proposed zoning layout (two apartments per zone) and a tentative wagon sequence. Elements from a prior one-day takt plan were reused to provide a practical starting point for collaborative discussion.

Approximately two months before the first planning meeting, invitations were sent to the selected subcontractors along with the draft takt schedule, zoning proposals, a reference plan from the previous project, and specific preparation tasks. These tasks included:

- Defining their planned work operations
- Estimating durations for each operation
- Specifying required crew sizes
- Identifying dependencies on other trades

The first takt planning meeting was held as a full-day workshop in January 2023. All participants were familiar with takt principles from previous experience with weekly takt, although only a few had prior experience with daily takt. The meeting began with a presentation of the main contractor’s planning and execution methodology. Participants then collaborated to develop the takt plan, following the seven-step procedure outlined in the contractor’s internal guide.

The takt plan was developed on a physical wallboard in the project site office (Figure 4). The process adhered to the “Seven Steps of Takt Planning” defined by the main contractor’s standardized approach:

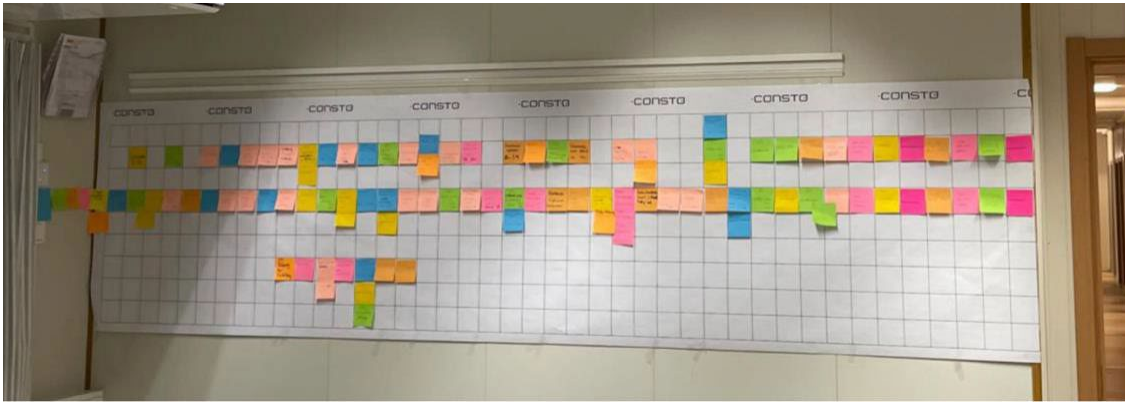


Figure 4: The wallboard used for the takt planning

1. **Establish Takt Zones:** Floor plans are used to divide the building into zones, known as takt areas, where different trades will perform their work.
2. **Determine Work Sequence (wagons):** Each participant describes their tasks in each takt area on Post-it notes and sorts them sequentially.
3. **Form Train:** The tasks from all trades are organised in a train. This train with wagons represents the overall sequence of the trades in each takt area.
4. **Calculate Workload:** After forming the train, each participant calculates the time needed for their tasks/wagons.
5. **Determine Train Length:** The total length of each train is agreed upon collectively. Each wagon gets one or more takt periods.
6. **Check/Adjust Takt Zones:** A joint quality assurance of the size and scope of the takt zones.
7. **Develop Construction Strategy and Finalise Takt Plan:** The final takt plan and train structure are decided.

A previously used one-day takt plan from another project was displayed on a screen during the session to guide the process and show how tasks and sequences had been defined. Several follow-up meetings were held to refine the plan until a final version was agreed upon.

Before execution began, CM2 added control wagons to the trains. These wagons represented time allocated to the general contractor for inspection and correction of any deficiencies before zone handover.

Takt execution

Morning check and preparation

The work at the construction site began at 7 a.m. The workers used the first hour to check the zones' completeness and readiness for handover. Workers prepared tools and materials according to lists and drawings, collecting smaller items from the ground-floor warehouse and larger items from external warehouses. Discrepancies, such as incomplete zones, were discussed with the foreman before the daily 8 a.m. morning meeting.

Morning meeting

The daily morning meetings at the construction site with foremen were normally chaired by CM2. The morning meetings consisted of two sessions, namely the Daily Huddle and the Follow-up Production Plan. Both sessions lasted from 5 to 15 minutes each. The Daily Huddle covered HSE, tidiness, progress, deliveries, and rigging. CM2 encouraged open discussion to address challenges, questions, and comments, and these were noted on a whiteboard. During the Follow-up Production Plan, the digital takt plan was reviewed via StreamBIM. This session focused on daily zone starts, any delays, and registered HSE nonconformities. CM2 went around the site after the morning meeting to monitor progress and address production queries. The daily morning meetings were beneficial for controlling progress and facilitating coordination.

Digital tools

StreamBIM, a digital tool linked to Building Information Modelling (BIM), was utilised throughout the project to provide features such as 3D modelling, access to floor plans, checklists, document management, deviation registration, real-time quantity calculations, and an updatable schedule. It enabled unified access to the same 3D model and project data for everyone, from architects to skilled workers. The subcontractors were able to add specific checklists and drawings. StreamBIM was primarily used by the subcontractors' foremen, as some workers experienced limited access.






Figure 5 shows a screenshot of the takt plan in StreamBIM, where each wagon in the train is colour-coded and numbered according to its trade. Electrical work is red and number 1. Interior carpentry work is orange with both numbers 2 and 4. Plumbing is blue and number 3. The succeeding control wagon is grey, and so on. A wagon can cover several days. The orange carpentry wagon number 4 covers, for example, five days since it involves floor system installation, floor shavings, and the setup of partition walls. In contrast, the red wagon with electrical work completes its task in one day.



Figure 5: Screenshot of the takt plan in StreamBIM.

In StreamBIM, each wagon was marked with two dots at its start and end to indicate its work status. The left dot turned from grey to green when the trade group commenced work in the zone. The right dot turned green when the wagon was ready for handover. Red dots indicated delays, signifying either unstarted (the dot to the left) or incomplete work relative to the takt plan (the dot to the right). The foremen typically managed status updates. Table 2 illustrates the possible status indicators for a wagon in StreamBIM.

Table 3: Status of a wagon in StreamBIM with associated description.

Nr.	Wagon status	Description
1		The trade has not taken over the wagon. Work has not begun.
2		The trade has taken over the wagon on time. The work is ongoing. Work is in line with the takt plan.
3		The trade has taken over the zone. Work is completed and in line with the takt plan.
4		The subject has taken over the wagon. Work is not completed within the takt plan.
5		The trade has not taken over the wagon in time. Work is not completed within the takt plan.

Each apartment featured a QR code that granted instant access to its specific zone in StreamBIM's 3D model, working drawings, and related information. This facilitated efficient uploads of drawings, status checks, and deviation reporting.

Plan adjustments

Several adjustments were necessary during the takt plan execution:

- **Buffer Wagon Addition:** Two specific wagons that were frequently delayed due to dependencies received an extra day to ensure the timely completion of tasks.
- **Takt Zone Shift:** At the beginning of construction, a misplaced bathroom cabin prompted the initial train to start in a subsequent zone that was ready to avoid delays.
- **Post-Summer Adjustments:** After the summer vacation, a general shortfall in subcontractor staffing and delayed returns of foreign workers due to misaligned flight schedules necessitated takt plan modifications.
- **Delayed Start for Blocks K and L:** The initiation of the takt plan in blocks K and L was deferred due to the preceding blocks being delayed.

Logistics and storage

Space constraints in the case project made logistics particularly challenging. A narrow access road to the construction site was shared with residents in a newly completed neighbouring building. The ground-floor commercial space was also handed over before the apartments were finished. This caused even more traffic around the construction site.



Figure 6: Access road (dark blue) to the construction site and construction activity on the neighboring plot (orange). (Drone image used with permission from Vegard Stien.)

Storage space was available both indoors and outdoors. Indoors, unfinished storage units on the first floor were used to store materials needed for weekly operations. Larger materials, such as concrete elements for balconies and railings, were stored outdoors. The case project had to relinquish part of its already limited outdoor storage space when construction of a new hotel began on an adjacent plot.

Results

The results section outlines the key findings from the case study. The first two subsections address the research questions: “What changes occur in project execution when shifting from weekly takt to daily takt?” and “What challenges were encountered during the implementation of daily takt?” The third subsection presents suggested improvements identified by informants during the interviews. These findings lay the groundwork for the discussion section, where the third research question, “What lessons can be learned to enhance future projects?” is analyzed and answered.

Execution Changes from Weekly to Daily Takt

This section outlines the changes experienced by the project participants when transitioning from weekly takt to daily takt. All project participants had varying prior experience with weekly takt—some had only worked on a few projects, while others had been involved in such projects since 2015.

Potential for Improved Workflow and Discipline

The shift from weekly to daily takt brought a significant change in work structure. Weekly takt allows workers more freedom to structure their week, while daily takt requires stricter adherence to a schedule, promoting a smoother and more continuous workflow.

In contrast to earlier weekly-takt jobs, interviewees noted that the one-day takt almost eliminated the multi-day idle gaps between trades. Apartments were “seldom empty for more than half a shift,” according to both site managers, because each crew had to clear the zone for the next trade the following morning. One participant noted:

“With weekly takt, you get more leeway, which can lead to postponing work and a frantic rush at the end of the week.”

Another participant highlighted that daily takt demands greater self-discipline, pushing workers to maintain a consistent pace to keep up with the takt time:

“People need to be stricter with themselves when working this way. Most feel the pressure to finish because someone else will be entering the zone the next day.”

Reduced Flexibility and Response Time

While daily takt promotes a smoother workflow, it simultaneously limits the ability to adjust during the project. Daily takt leaves less room for changes compared to the more flexible weekly takt. The shift to daily takt reduced flexibility in managing time and adapting to unforeseen events.

With weekly takt, workers have more control over their pace and can adjust as needed. If a delay occurs mid-week or an unexpected event disrupts the work, they can extend their work hours for the rest of the week or even use the weekend to catch up. Although this approach may lead to varying workflow, it provides greater flexibility to recover from delays without impacting overall project progress. As one informant noted:

“With weekly takt, it’s easier to recover if you fall behind because you can work harder later in the week and catch up before it’s over. But with daily takt, if you fall behind, it’s tough to make up for lost time. There’s no slack.”

Daily takt requires issues to be addressed immediately to avoid impacting subsequent tasks or trades. In practice, workers have only the same day to recover lost time. This rigidity

makes the schedule more vulnerable to disruptions, as even minor delays can significantly affect progress. Quick responses are essential to prevent small issues from escalating into larger problems for the project. As multiple informants commented:

“When things go wrong with daily takt, they go wrong in a big way. There’s not much room to catch up.”

And:

“It’s easier to adjust with weekly takt. Typically, you have five weekdays for each takt cycle. In construction, if you don’t finish by Friday, you can use Saturday to catch up.”

Increased Material Handling and Higher Demands for Organizing

The transition from weekly to daily takt significantly increases the frequency of material handling on the construction site. While weekly takt involves just one handover per week, daily takt requires five. Daily takt is leading to a substantial rise in material pickups and handling. After each handover of a zone, the trades must transport the necessary materials and equipment from the ground floor to the work zone. The traffic between zones increases, and the service elevator is used more frequently. One informant highlighted this shift:

“There’s a big difference. With daily takt, you pick up materials five times as often. In weekly takt, you gather what you need once a week for a larger area, like a corridor with adjacent apartments. But here, the zones are smaller—just two apartments each.”

The smaller zones limit storage space for equipment and materials, placing greater demands on organisation and efficient use of space. One informant noted that the daily routine of bringing up materials and taking out waste was simpler and more manageable for this project:

“In a project like this, with only narrow walkways for access, weekly takt would be chaotic. With daily takt, it’s much easier—you just bring what you need for the day, then take down the waste when you’re done.”

According to the informants, equipment and materials were often stored outside designated zones, particularly in the walkways, which served as the only access to the zones. There were instances where leftover materials, equipment, or waste were left behind even after work in the zones was completed and the team had moved on. The limited space in the walkways and the lack of proper cleanup became a recurring issue discussed in morning meetings and during safety inspections.

Increased Need for Supervision

The shift from weekly to daily takt significantly increased the supervisory responsibilities of the foremen. In addition to their practical trade work, they were now more involved in

monitoring progress, attending morning meetings, and updating StreamBIM. This shift meant that the foremen spent more time on coordination and less on hands-on tasks.

Several informants highlighted the new dynamics in the foremen's role under daily takt. One described the role as becoming more focused on oversight and facilitation:

"I don't get much production done myself. My job is basically to run around, keep an eye on things, play a bit of a babysitter for the workers, make sure they're doing what they should, and update the computer systems."

Others emphasised the increased need for continuous supervision:

"With daily takt, I'm out there more often, constantly checking that we're on track. I don't like falling behind. With weekly takt, I might leave things until the end."

And:

"With weekly takt, you don't need daily follow-up. I save a lot of time and don't have to go through the entire building every day. Twice a week is enough."

Increased Staffing Requirements

The shift to daily takt compressed the production schedule but increased the need for staffing. Both the takt plan and interviews revealed that daily takt required more personnel because individual trades had to manage multiple zones simultaneously.

One informant observed the difference in staffing needs between the two takt times. With weekly takt, a team of five workers was sufficient for a single zone. However, daily takt demanded a significant increase in crew size, with eight to nine people needed to maintain the pace due to the need to spread the workforce across multiple zones. This increased staffing requirement made some participants sceptical of daily takt:

"It requires more staffing... That's why I'm a bit against daily takt. I need sufficient staffing, and since I manage multiple projects, I have to calculate the staffing needs for each one carefully."

Larger Material Buffer

Some subcontractors maintained a larger material buffer than in previous projects. The increased production pace made them more vulnerable if materials were not delivered on time. The agreement was that no more materials than for a week's production should be stored. However, one informant explained that they had to store materials for a longer period to mitigate risks:

"We have about three weeks' worth of stock... we had to do that to protect ourselves. If a truck got delayed, it wouldn't have mattered"

because we could still keep up with the takt. If we fall behind, we can issue a notice about what happened, but we still need to catch up.”

Having a larger material buffer helped reduce uncertainty related to delays or delivery issues. If a delivery was late, they could maintain the production pace by using materials from the buffer.

Challenges Faced During the Implementation of Daily Takt

This section highlights the challenges encountered during the project’s execution. External factors like weather, sick leave, and other unforeseen events are excluded from this analysis.

Poor Quality in the Plan

A significant challenge highlighted by multiple informants was the poor quality of the planning. Several trades had to revisit the same zone multiple times due to inadequate planning and a poorly conceived takt plan. Non-optimised wagons and inefficient sequencing led to increased workload for some trades. One informant mentioned that they could have completed their work with fewer visits than the takt plan required. Some wagons were unnecessary, either because tasks could have been combined or because the placement of wagons in the sequence was suboptimal. The unnecessary wagons lead to a loss of oversight:

“When you have to enter an apartment unnecessarily many times, it quickly leads to chaos and a lack of clarity about what’s happening.”

Another informant compared this to a previous project using weekly takt, in which similar work was completed more efficiently because multiple tasks could be performed simultaneously in one zone. However, the informants acknowledged that technical solutions vary by project.

Several informants noted that a lack of detailed planning led to additional work and complications, as certain operations were not adequately considered during the planning phase. This resulted in a suboptimal organisation of the wagon sequence, reducing workflow and increasing workload for several trades. An example was given where drywall was installed over bathroom cabins before ventilation and sprinkler systems were connected. The carpenters had to remove and reinstall the drywall to allow the technical work to be completed.

Inaccurate Workload Assessment Due to Limited Experience

Misjudging the workload and time requirements was another challenge. During the takt planning, each trade was responsible for estimating the time needed for tasks in each wagon. According to the “Seven Steps of Takt Planning” in the main contractor’s planning method, these estimates were based on past experience. The estimation posed challenges for those with less experience. One informant highlighted this issue:

“The challenge is having enough experience to plan in sufficient detail. This has been an issue in this project, where people haven’t finished their work on time because they didn’t plan it well enough.”

This issue was particularly acute for one trade, where the lack of attention to detail during planning led to an underestimation of the time required:

“In our planning, we didn’t account for small rooms, details, and solutions that take time but aren’t reflected in the quantity takeoffs. These details take more time than average production tasks.”

This oversight became evident when they consistently fell behind schedule.

Lack of Capacity and Competence

A further challenge arose due to insufficient labour and expertise in a subcontractor’s team. They had to significantly increase their workforce beyond what was originally planned:

“We probably had about a 50 % increase in staffing compared to our initial plan.”

Inadequate quality assurance of the hired workers’ skills caused difficulties at the start. It was challenging to assess the skills of unfamiliar workers, leading to a trial-and-error period in the early construction phase to assign suitable tasks. Language barriers further complicated and delayed the work process.

This subcontractor had faced similar issues in a previous weekly takt project, where errors by hired workers initially caused delays. However, the weekly takt allowed more time to correct these delays.

Supervision Challenges – Workload for Foremen

The lack of foremen and poor internal structure led to overwork and challenging supervision. One subcontractor, responsible for nine wagons and up to 30 apartments at once, stressed the need for more foremen to oversee the production adequately:

“I’ve run up and down these stairs more than ever in my life... It’s due to poor internal structure. We didn’t have enough foremen to communicate with, and there was too much turnover among those we did have.”

The informant, who was responsible for overseeing workers, had to take on tasks that would normally be distributed among multiple foremen, leading to significant strain:

“Our lesson is that we should have had a better internal structure before taking on a project like this... One person can’t oversee 30 people.”

Timing and Control – Communication and Coordination

One challenge was determining the right time to intervene and adjust the plan to maintain progress and control. Coordination challenges arose because the timing of adjustments was suboptimal. Late adjustments could lead to loss of control and difficulties managing delays, while premature adjustments could disrupt situations that might have resolved themselves. The key was intervening at the right moment to ensure continued progress.

On the job site, one subcontractor frequently fell behind schedule. In morning meetings, they promised to catch up by the end of the day, often for zones that were already supposed to be handed over to the next trade. The general challenge was knowing exactly when to adjust the plan without losing control, while also allowing for necessary flexibility. An informant noted:

“The challenges arise when things start slipping, and we lose progress and control. We might not have the tools or be proactive enough to adjust accordingly. With daily takt, it’s difficult to see these issues early enough – you don’t realise it until it’s too late.”

Poor communication and late adjustments also caused problems for one trade working in the penthouses, which were on a weekly takt schedule. Originally planned to start before the summer break, the schedule had to be adjusted to start after the break. This led to material damage from prolonged exposure and additional costs. An informant pointed to poor communication as the cause:

“They should have come in earlier and said: ‘No, just stop everything in L902, for example. Delay it until after the summer break. Let’s have a new meeting then.’ Someone needs to report that we won’t be ready for the takt start and that we need to postpone.”

Challenges with Digital Tools in Daily Takt

Several StreamBIM users experienced technical issues despite appreciating its functionality. Some found the user interface less intuitive, but the main challenges were functional errors and system instability. Several users had used the tool in previous projects without encountering these issues, and one informant linked the problems to the shift from weekly to daily takt:

“The big difference here is that we’re using daily takt, while other projects used weekly takt. Somehow, the interface isn’t quite there for daily takt.”

The transition to daily takt significantly increased the number of wagons in the plan, requiring the software to handle more data. A common issue was difficulty checking into the correct area in the digital plan because the app would freeze. The informant emphasised the app’s functionality in motivating participants to use it.

Another worker struggled to update the takt plan in StreamBIM, unable to mark a wagon as completed because the app froze, leaving the progress information unchanged. There were also difficulties making adjustments to the wagon sequence, resulting in a mismatch between the plan and the actual work status. These challenges likely resulted from both limitations in the software and insufficient user competence:

“If I understood correctly, it wasn’t easy to make changes in StreamBIM. Once the takt plan was finalised and uploaded, it wasn’t easy to move or adjust the wagons, which should have been possible.”

Logistics and Storage Challenges

Space constraints made it difficult to deliver materials to the site. The access road was narrow with no natural turnaround point, and another construction project by a different contractor was located at the site entrance. When asked if logistics posed a challenge, one informant said:

“Yes, but it’s nothing beyond what we expected. The conditions are tough—it’s very cramped, hard to get trucks in, narrow roads, and another construction site just five meters away. But overall, it has gone pretty well.”

Storage space was also constrained, making it challenging for the subcontractors to adhere to the agreement to store materials and equipment for only one week of production. Materials were often stored longer than agreed. One informant noted that it was unrealistic to operate with only one week’s worth of materials:

“Handling deliveries or storage has been a problem... We can’t manage with just one week’s worth of materials. It’s not feasible.”

When asked if the takt plans accounted for the project’s logistics needs, another informant replied:

“No, not really. The amount produced in takt over a week doesn’t match the storage space we have for that week.”

Adjustments or revisions to the takt plan could lead to even more materials being stored. If buffer wagons were added or the schedule shifted, ordered materials might arrive before they were needed, further straining the already limited storage capacity. Some informants also suggested that deliveries were larger than necessary to ensure early arrival and avoid delays.

Some subcontractors addressed these storage challenges by using local suppliers as intermediaries. Two informants reported managing space issues by storing materials with nearby suppliers. One explained that their suppliers increased stock levels and arranged for

more frequent deliveries. These informants received materials on Fridays that lasted until Wednesday, when they received new deliveries.

Suggested improvements

The following suggestions for improvement are based on the informants' reflections and recommendations. Drawing on their first-hand experience with the daily takt implementation, they offered specific proposals to improve similar projects. While not all ideas were universally shared, they highlight perceived shortcomings and practical insights from those directly involved in project execution.

Better Planning

In the case study, informants reported a need for improved planning, especially for wagon sequences and work operations. Several informants mentioned that more detailed planning could have prevented dissatisfaction with the plan.

The informants felt more time could have been spent on methods that would allow project participants to delve deeper into the specific work operations and the specific context in which the work was to take place.

More Buffer Wagons at the Start to Facilitate Learning

One subcontractor struggled to keep pace with the takt, particularly in the early construction phase. Having more time at the beginning to adjust and familiarise with the tasks would have positively impacted the project's progress. The subcontractor became more efficient as the project progressed, having learned which team members worked well together and by assigning the same workers to the same tasks throughout. The repetitions led to learning.

One informant suggested adding more buffer wagons at the start of the project and then gradually reducing them:

“More buffer zones... since the end date for the I-apartments is the same as for the J-apartments, the I-apartments could have had a two- or three-day buffer at the start, because that's where most of the learning happens. Then, we could have adjusted better for the next block.”

More Visual Management Tools

Two informants suggested that having a physical takt plan visible on the construction site or displayed on a TV screen in the break room would have been beneficial. The plan was less visible to those not directly involved in daily meetings, and several workers expressed a desire for it to be accessible outside StreamBIM. The informants highlighted that more communication channels to visualise the work plan would have made it easier to reach more workers. This could have helped ensure that everyone was informed about the daily and weekly tasks and the zones where they should be performed. Overall, they believed this would have improved communication on the site.

Weekly Takt Should Have Been Used

Two informants expressed concerns that the chosen takt time was not optimal for the project, which became apparent during execution. One informant clearly preferred using weekly takt. Another shared this when asked what should have been done differently:

“Yes, give us more time in the daily takt in certain areas... We should have put our foot down and said this won’t work. But we were optimistic, and it turned out it didn’t run as smoothly as we’d hoped. In theory, everything lines up, but in practice, it’s much different. This has been the biggest problem.”

Discussion

The discussion section begins by comparing the findings on research questions 1 and 2 with the existing literature. It then addresses the third research question, “What lessons can be learned to enhance future projects,” by providing an analysis and synthesis of insights from the case study.

What Changes When Going from Weekly to Daily Takt?

The results indicate that transitioning to daily takt time can improve workflow efficiency. The stricter requirement to adhere to a tighter schedule promotes a more continuous and even production flow. Informants noted a marked reduction in instances where work was waiting for workers, i.e., zones standing empty with no active tasks underway. However, daily takt simultaneously imposes stricter discipline and reduces operational flexibility. Any disruptions must be addressed immediately to avoid delays cascading to subsequent trades. While the literature suggests that short takt times can offer greater flexibility and control (Riekki et al., 2023), the case project experiences contrast with this perspective. Workers reported feeling constrained by the rigid schedule, which left them with less autonomy over their daily tasks.

The increased need for frequent material handling and improved space management was another significant impact of the shift to daily takt. Consistent with the literature on logistics management (Riekki et al., 2023; Heinonen & Seppänen, 2016), the smaller work zones and limited storage capacity at the case project site led to cluttered work areas, adversely affecting efficiency. This finding aligns with the literature’s emphasis on the necessity for meticulous logistics planning and coordination in takt production. However, it should be noted that the logistical constraint in the case project likely exacerbated the situation beyond what would typically be experienced when using daily takt.

The foremen on the case project took on expanded supervisory roles, focusing more on oversight and less on technical execution. This shift aligns with findings in the literature indicating that increased managerial resources are necessary to maintain workflow efficiency in projects with short takt times (Lehtovaara et al., 2021). The need for improved collaboration and digital tools to support these changes also corresponds with the literature’s

emphasis on the role of technology and team coordination in managing complex construction processes (Lehtovaara et al., 2019).

Furthermore, the shift to daily takt required increases in staffing and material buffers, consistent with findings from previous studies (Keskiniva et al., 2021; Lehtovaara et al., 2019). Subcontractors had to adapt by assuming greater responsibility for managing materials, labour, and equipment to meet the tighter schedule. This adaptation highlights the literature's point that short takt times necessitate resource management and production oversight to prevent disruptions and maintain project momentum (Binniger et al., 2018; Riekki et al., 2023).

What Challenges Arose During the Implementation of Daily Takt?

The implementation of daily takt revealed several challenges, primarily stemming from poor planning. Informants highlighted suboptimal task sequencing and missed opportunities to combine operations, reflecting planning shortcomings. The literature emphasises the importance of meticulous planning for successful takt implementation (Apgar & Smith, 2023; Lehtovaara et al., 2019). Similar to findings in the literature, the case study underscores the necessity of detailed task breakdowns and early identification of obstacles to streamline the workflow. The difficulties faced in this project reinforce the literature's assertion that effective planning is a critical factor in managing short takt times (Riekki et al., 2023).

One subcontractor struggled to maintain steady progress due to inaccurate workload assessments, lack of competence, and insufficient supervision. These issues were compounded by varying subcontractor experience, which affected their capacity to manage daily takt effectively. This strain was amplified by the project's decision to implement daily takt across multiple apartment lines in parallel. While the rationale for this approach was not explicitly stated, it required trades to operate in several zones simultaneously, which magnified the resourcing challenge and contributed to execution difficulties. This finding aligns with the literature on the importance of evaluating subcontractors' maturity and readiness for takt production (Lehtovaara et al., 2021). The suggestion to assess subcontractors aligns with the literature advocating for choosing partners equipped to meet the demands of daily takt (Lehtovaara et al., 2020). The two informants who preferred weekly takt echo the literature's caution that immature project organisations may struggle with the rigidity of daily takt (Tetik et al., 2019).

Communication issues and delays in plan adjustments were also significant challenges, particularly when subcontractors fell behind schedule. The literature highlights the need for communication and management to maintain workflow consistency (Frandsen & Tommelein, 2014; Riekki et al., 2023). The case study findings, which emphasise the importance of realistic time estimates and transparent communication, are consistent with the literature's recommendation to foster ownership and accountability. This is crucial in preventing the project from becoming derailed by unforeseen complications (Lehtovaara et al., 2019).

While digital tools like StreamBIM were intended to support transparency and coordination by providing shared access to floor plans, checklists, and real-time progress

indicators, several challenges emerged during implementation. Informants reported functional issues, including freezing, inaccurate status updates, and difficulty making plan adjustments. These problems occasionally led to discrepancies between the digital takt plan and on-site progress, limiting the tool's effectiveness for real-time decision-making. It remains unclear whether these issues were primarily caused by software limitations or insufficient user training, though it is likely a combination of both. The findings suggest that the success of digital tools in short takt projects depends not only on technical functionality but also on proper implementation and user competence. Without robust training and disciplined updating routines, digital plans may fail to reflect reality, undermining their intended value as coordination and control tools.

Technical difficulties with StreamBIM further complicated matters. Users reported interface issues, malfunctions, and instability, which hindered accurate progress tracking. These problems align with the literature's discussions on the critical role of digital tools in takt production (Lehtovaara et al., 2019; Riekkilä et al., 2023). However, the case study findings highlight the additional challenge of insufficient user training and software limitations, suggesting that advanced tools can fail without proper training and reliable functionality. This nuance expands on the literature's recommendations, indicating that successful integration of digital tools in takt projects requires comprehensive training and technical support.

Finally, logistical challenges were significant due to space constraints on the construction site, resulting in difficulties with material storage and delivery. The narrow access roads and limited storage space resulted in materials being stored longer than planned, disrupting the intended workflow. This finding resonates with the literature's emphasis on the need for a logistics plan that complements the takt plan to manage site constraints effectively (Heinonen & Seppänen, 2016; Riekkilä et al., 2023). The study suggests that better logistics planning could have mitigated these challenges, aligning with the literature's call for a logistics plan in projects with tight schedules and high variability.

These findings are consistent with prior research on takt implementation at lower maturity levels. Lehtovaara et al. (2021) highlight that projects with limited logistics integration, reactive planning practices, and uneven subcontractor engagement often face similar difficulties when using short takt times. While this paper does not attempt a formal maturity assessment, the observed issues suggest that the case project was still in the early stages of developing a fully integrated takt production system.

What Lessons Can Be Learned for Future Project Improvements?

Based on the findings and prior discussions, several key lessons have emerged for future projects utilising short takt times.

Lesson 1: Improved Planning of Task Sequences and Operations

The case study highlighted the need for better planning and coordination of task sequences and operations. Informants reported dissatisfaction with the planning quality,



emphasising the importance of detailed planning, as highlighted in the literature (Apgar & Smith, 2023; Apgar et al., 2022; Lehtovaara et al., 2019; Lehtovaara et al., 2020; Lehtovaara et al., 2021; Riekki et al., 2023; Tetik et al., 2019)

More time could have been spent on detailed planning of the case project, using methods that allow participants to delve into specific tasks and the context in which they are carried out. Building physical mock-ups, as discussed in the literature (Riekki et al. 2023), can provide valuable insights early in the process and minimise later adjustments. Additionally, implementing lookahead planning, which focuses on short-term planning and identifying potential obstacles, can improve coordination, particularly in projects with varying levels of subcontractor experience.

Lesson 2: Strengthening Ownership of the Plan—Involving Subcontractors

This lesson ties into Lesson 1 but focuses on subcontractor involvement. While the case project showed good involvement in takt meetings, subcontractors were less involved in takt time and zone-division decisions. This lack of involvement may have contributed to scepticism about the plan's feasibility and weaker collective ownership. The involvement of subcontractors in decision-making can enhance motivation, ensure the plan reflects a collective effort, and promote adherence to the plan.

Lesson 3: Assessing Subcontractor Maturity and Training Needs

The study found that the subcontractors had varying experiences with takt, which became evident when one struggled to keep pace. The literature often equates experience with maturity, and while maturity models, such as the one suggested by Lehtovaara et al. (2021), exist, their application in early project phases is limited. Using a maturity model to assess subcontractors' ability to adopt takt planning could improve project execution. Early maturity assessments could help tailor training and guidance. Introducing buffer zones early in the project allows trial and error, facilitates learning, and reduces errors in later stages.

Lesson 4: Optimizing Logistics and Material Handling

The case study showed that short takt times increased material handling frequency and required better organisation due to smaller work zones and more frequent handovers. The study emphasises the need to adjust logistics in line with project timelines and changes to work structure. Implementing dynamic, tailored material handling approaches that account for the specific demands of daily takt is recommended. Developing logistics solutions in parallel with takt planning, considering site-specific constraints, could optimise space use and minimise workflow disruptions.

Lesson 5: Enhancing Follow-up Resources and Visual Management

The literature highlights that short takt times increase managers' workload and require more supervision (Keskiniva, Saari, and Junnonen 2021; Lehtovaara et al. 2019; Apgar and Smith 2023). Similarly, the case study found that the foremen spent more time on follow-up and coordination in relation to daily takt. To address this, support for leadership during the

transition to daily takt should be strengthened. This could involve developing foremen's skills in new work methods and ensuring they have adequate resources to manage their expanded responsibilities. Additionally, leveraging digital tools and visual aids can reduce the burden on leaders by simplifying communication across all project levels. In the case project, many workers lacked access to the takt plan in StreamBIM. Visualising the plan in more accessible ways, such as physical displays around the site or screens in common areas, could enhance communication and workflow. It is supported by the literature (Lehtovaara et al. 2019; 2021; Riekkilä et al. 2023) showing that visual aids such as digital tools, boards, symbols, and colours reinforce communication and workflow in construction projects.

Conclusion

This study explored the impact of introducing daily takt on a residential construction project and identified valuable insights to improve future implementations. It addressed key questions on the changes, challenges, and lessons associated with transitioning from weekly to daily takt.

The findings indicate that transitioning to a daily takt can support improved workflow efficiency. The stricter requirement to follow a tighter schedule was reported to contribute to a more continuous and even production flow. Furthermore, there was a noticeable reduction in situations where work was waiting for workers, with fewer instances of zones standing empty. At the same time, the use of daily takt also poses challenges, including reduced flexibility, increased coordination demands, and complex logistics management. Specific issues included insufficient planning quality, inaccurate workload assessments, and varied competence among subcontractors. Complications related to space constraints and a digital tool further impeded project execution.

The implications are clear. Daily takt can increase productivity, but its success hinges on meticulous planning and execution. Effective implementation requires precise coordination, logistical support, and a strong commitment to collaborative planning involving all stakeholders. The study also suggests that the maturity of project participants—particularly subcontractors—plays a significant role in the implementation of daily takt. Low maturity in planning practices, logistics integration, and takt familiarity contributed to several of the difficulties observed in the case.

To enhance future project outcomes, the study recommends comprehensive planning methods, including creating physical mock-ups and employing lookahead planning. Early and active subcontractor involvement in the planning process can foster ownership and ensure alignment with the takt plan. Assessing subcontractor maturity can highlight areas where additional training or support may be needed. Logistics must be integrated with takt planning to manage space and material flow effectively, and digital tools and visualisation techniques can significantly improve communication and coordination during the transition to daily takt.

However, this study's conclusions are limited by its single-case focus, potential biases, and time gaps between initial planning and data collection. These limitations may affect the generalizability of the findings. Future research should explore multiple case studies across

diverse construction projects to gain broader insights into the impact of daily takt. Longitudinal studies tracking projects from inception to completion could offer a deeper understanding of the long-term effects of daily takt. Investigating the relationship between subcontractor maturity and takt planning effectiveness could provide valuable guidance for improving project outcomes in the construction industry.

In summary, while daily takt offers significant potential for enhancing project efficiency, its success depends on strategic planning, stakeholder engagement, and adaptive management. By implementing the lessons learned from this study, future projects can better navigate the complexities of daily takt and realise its full benefits.

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