CHALMERS
UNIVERSITY OF TECHNOLOGY

Figure 1 Cover Picture

Productivity Follow-Up in The Swedish Construction Industry

An Investigation of Implementation and Influencing Factors

Master's thesis in Design and Construction Project Management

Amar Taja

Rozhgar Hama Amin

DEPARTMENT OF ARCHITECTURE AND CIVIL ENGINEERING

DIVISION OF CONSTRUCTION MANAGEMENT

CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2025
www.chalmers.se

MASTER'S THESIS ACEX30 2025

Productivity Follow-Up in The Swedish Construction Industry
An Investigation of Implementation and Influencing Factors

Amar Taja

Rozhgar Hama Amin

CHALMERS
UNIVERSITY OF TECHNOLOGY

Department of Architecture and Civil Engineering

Division of Design and Construction Project Management

CHALMERS OF TECHNOLOGY

Gothenburg, Sweden 2025

Productivity Follow-up in the Swedish Construction Industry

An Investigation in Implementation and Influencing Factors

Master's Thesis in the Master's Program Design and Construction Project Management.

Amar Taja
Rozhgar Hama Amin

Master's Thesis ACEX30
Department of Architecture and Civil Engineering
Division of Design and Construction Project Management
Chalmers University of Technology, 2025.
SE-412 96 Gothenburg, Sweden.
Telephone + 46 (0)31-772 1000

Cover:
The cover picture on the main page represents the fragmented status of the Swedish construction industry and was created by the help of ChatGPT. Prompt for creating the picture "Imagine fragmented institution in the construction industry inspired by Picasso's Blue Period", (*ChatGPT*, n.d).

Göteborg, Sweden 2025

Productivity Follow-up in the Swedish Construction Industry
An Investigation in Implementation and Influencing Factors

Amar Taja
Rozhgar Hama Amin

Department of Architecture and Civil Engineering
Chalmers University of Technology

Abstract

Despite its economic significance, the Swedish construction sector faces persistent productivity stagnation, exacerbated by inadequate follow-up mechanisms that fail to translate technological advancements into measurable efficiency gains. This thesis addresses this gap by investigating how productivity follow-up is currently implemented in Swedish construction projects and identifying the systemic, cultural, and contractual barriers that hinder its effectiveness. We examine the interplay between digital tools, organizational structures, and industry norms to uncover why productivity tracking remains fragmented and underutilized. Combining a systematic literature review with qualitative data from 15 interviews with industry professionals and analysis of 27,000 reclamation cases, we apply grounded theory to map the challenges and opportunities in productivity follow-up.

Key results reveal three critical findings: (1) productivity tracking relies heavily on ad hoc methods like Excel, with advanced tools such as BIM and Earned Value Management (EVM) siloed or inconsistently applied; (2) cultural resistance to formalized processes, rooted in Sweden's lagom ethos, perpetuates improvisation over structured follow-up; and (3) contractual misalignment and weak accountability mechanisms undermine incentives for continuous improvement. These findings contradict assumptions that digital adoption alone can resolve productivity gaps, highlighting the need for integrated systems and cultural shifts. While focused on medium-to-large Swedish firms, the study's insights may inform similar contexts in Nordic construction.

Theoretically, this study redefines productivity follow-up as a sociotechnical challenge, bridging literature on digital transformation with institutional barriers. Our study contributes to the practice with an original, empirically grounded framework that explains how organizational culture, contractual structure, and digital infrastructure jointly influence follow-up effectiveness. Practically, it provides construction firms with targeted recommendations to standardize productivity metrics, align performance incentives within contracts, and integrate AI-enabled tools into daily routines. By contextualizing Sweden's productivity paradox, this work advances strategies to transform follow-up from a procedural formality into a strategic lever for industry-wide improvement.

Keywords: *Swedish Construction, Productivity Follow-Up, Digital Tools, Performance Management, Organizational Learning*

Uppföljning av Produktivitet i den Svenska Byggbranschen

En Undersökning av Implementering och Påverkande Faktorer

Amar Taja
Rozhgar Hama Amin

Institutionen för Arkitektur och Samhällsbyggnad
Chalmers Tekniska Högskola

Sammanfattning

Trots sin ekonomiska betydelse lider den svenska byggsektorn av en långvarig stagnation i produktivitet, förvärrad av bristfälliga uppföljningsmekanismer som misslyckas med att omvandla teknologiska framsteg till mätbara effektivitetsvinster. Denna avhandling behandlar denna klyfta genom att undersöka hur produktivitetsuppföljning för närvarande genomförs i svenska byggprojekt samt identifiera de systemiska, kulturella och avtalsmässiga hinder som begränsar dess effektivitet. Vi analyserar samspelet mellan digitala verktyg, organisatoriska strukturer och branschpraxis för att förstå varför produktivitetsuppföljning förblir fragmenterad och underutnyttjad.

Genom en systematisk litteraturöversikt i kombination med kvalitativ data från 15 intervjuer med yrkesverksamma i branschen samt analys av 27 000 reklamationsärenden, tillämpar vi grundad teori för att kartlägga utmaningar och möjligheter inom produktivitetsuppföljning. Tre centrala resultat framträder: (1) produktivitetsuppföljning bygger till stor del på ad hoc-metoder som Excel, medan avancerade verktyg såsom BIM och Earned Value Management (EVM) används isolerat eller inkonsekvent; (2) kulturellt motstånd mot formaliserade processer, rotat i Sveriges lagom-ideal, upprätthåller improvisation framför strukturerad uppföljning; och (3) avtalsmässig obalans och svaga ansvarsmekanismer undergräver incitament för kontinuerlig förbättring. Dessa resultat motsäger antagandet att digitalt införande ensamt kan lösa produktivitetsproblemen, och betonar behovet av integrerade system och kulturella förändringar. Även om studien fokuserar på medelstora till stora svenska företag, kan insikterna vara relevanta även för liknande sammanhang i nordisk byggindustri. Teoretiskt omdefinierar denna studie produktivitetsuppföljning som en socioteknisk utmaning, där den överbryggar litteratur om digital transformation med institutionella hinder.Den bidrar med ett originellt, empiriskt förankrat ramverk som förklarar hur organisationskultur, avtalsstruktur och digital infrastruktur tillsammans påverkar uppföljningens effektivitet. Praktiskt erbjuder den byggföretag konkreta rekommendationer för att standardisera produktivitetsmått, anpassa prestationsincitament i avtal, och integrera AI-baserade verktyg i det dagliga arbetet. Genom att kontextualisera Sveriges produktivitetsparadox, bidrar detta arbete med strategier för att omvandla uppföljning från en formell rutin till ett strategiskt verktyg för branschövergripande förbättring.

Nyckelord: *Svensk Byggindustri, Produktivitetsuppföljning, Digitala Verktyg, Prestationsstyrning, Organisatoriskt Lärande*

Acknowledgements

First and foremost, we would like to express our deepest gratitude to our families for their unwavering support, patience, and encouragement throughout the course of this thesis and our entire academic journey.

We would also like to sincerely thank our academic supervisor at Chalmers University of Technology, Dr. Dimosthenis Kifokeris, for his insightful guidance, constructive feedback, and continuous support. His expertise and critical perspectives were invaluable in shaping the direction and depth of this research.

Our heartfelt appreciation goes as well to Isabelle Mac Kellie, our industry supervisor, for her thoughtful mentorship and practical insights, which helped bridge academic research with real-world practice.

We are grateful to the case company for making this collaboration possible and for granting us access to key professionals whose experience and openness enriched our study immensely.

Lastly, we would like to thank all the interviewees who generously shared their time, knowledge, and perspectives. Their contributions provided the core foundation for the empirical findings of this thesis and were instrumental in bringing this work to life.

Gothenburg, June 2025

Amar Taja

Rozhgar Hama Amin

Table of Content

Table of Figures

List of Tables

1 Introduction

Sweden’s construction industry is building more than ever, but not necessarily better. Despite accounting for roughly 11% of national GDP and employing over 350,000 people (European Construction Sector Observatory, 2021), the sector continues to underperform in terms of productivity growth. Over the last two decades, investment in digital tools and sustainability frameworks has surged, yet efficiency gains have remained elusive. A recent sector-wide review noted that, compared to leading EU counterparts, Sweden has seen some of the flattest productivity trajectories in infrastructure delivery (Nilsson et al., 2024). This tension, between a technologically advanced ecosystem and underwhelming project performance, underscores a deeper question: why are gains in construction not translating into measurable improvement?

Part of the answer lies in how performance is managed. While productivity is often invoked as a strategic goal, the practical routines that support its measurement and follow-up remain underdeveloped. In a nationwide study of 430 Swedish construction projects, Koch et al. (2020) found that nearly 68% of firms did not apply structured protocols for productivity tracking beyond budget and time control. Follow-up, when it occurs, is typically disconnected from daily project rhythms, seen as retrospective compliance rather than proactive learning. This absence is not due to lack of tools. Building Information Modelling (BIM), Earned Value Management (EVM), and Lean planning frameworks are widely available. What is missing is the integration of these tools into a cohesive system that supports real-time insight, collaborative adaptation, and transparent accountability (Kifokeris & Koch, 2023).

What makes this gap particularly pressing is that it appears systemic. Contractual models, such as Sweden’s standard AB 04/ABT 06 forms, prioritize risk allocation and legal clarity but often lack mechanisms to incentivize continuous performance monitoring (Eriksson & Westerberg, 2011). Organizational structures tend to assign productivity tracking to isolated roles, typically cost controllers or planners, without embedding it into team-level routines. As a result, the data collected is often underutilized, and the potential for insight-driven decision-making is lost in translation. Furthermore, fragmented subcontracting practices and unclear data ownership compound this problem, especially on large-scale public projects where coordination is already complex (Regona et al., 2022).

This thesis takes these challenges as a point of departure. It asks not just whether Swedish construction projects track productivity, but how that follow-up is implemented, operationalized, and interpreted by those on the ground. It aims to reveal the organizational and cultural logics behind current follow-up routines, highlighting how they are shaped by contracts, digital infrastructure, and institutional norms. In doing so, it builds on and extends prior work that has documented the existence of inefficiencies (e.g., Josephson & Saukkoriipi, 2007), by focusing instead on the structures or absences that enable them to persist. The main research question that guides this investigation is:

How is productivity follow-up currently implemented in Swedish construction projects, and what factors influence its effectiveness?

To answer this, the study engages four sub-questions:

1. What methods and tools are used for tracking productivity on construction sites in Sweden?
2. What challenges do project teams face when conducting productivity follow-up?
3. To what extent are digital tools and real-time data analytics being adopted to support productivity follow-up in Swedish projects?
4. How do organizational structures and roles (e.g., planners, cost controllers, subcontractors) influence productivity tracking?

The scope is delimited to large-scale projects undertaken by a leading construction firm operating in Sweden and the broader Scandinavian. The exclusion of small-to-medium subcontractors and firms outside the selected organization reflects methodological choices aimed at securing deep access, role diversity, and coherent data environments. The focus is placed on the execution phase of the project lifecycle, where productivity practices are most operationalized yet remain least systematically embedded or reflected upon.

In addressing these questions, this thesis contributes the first empirically grounded framework for understanding how productivity follow-up functions or fails to function as a system of organizational learning in Swedish construction. While prior research has examined project performance broadly or focused on technology adoption in isolation, few studies have explored the intersection of digital systems, contractual norms, and professional roles through the lens of follow-up practices. By doing so, the thesis offers both theoretical and practical insights into what it would take to transform productivity tracking from a procedural afterthought into a strategic enabler of performance improvement.

2 Literature Review

2.1 Introduction: The Importance of Productivity Follow-Up in the Swedish Construction Sector

Productivity has long been a central concern in Sweden's construction industry. Defined as the ratio of output to input, where inputs may include labor, time, cost, equipment, and other resources (Lee et al., 2022). Construction plays a major role in the Swedish economy, contributing tens of billions of euros annually and employing hundreds of thousands of people (European Construction Sector Observatory [ECSO], 2021). Yet, despite its size and significance, the sector has consistently lagged behind others in terms of productivity growth, with inefficiencies continuing to challenge both practitioners and policymakers (Landin & Öberg, 2014; Nilsson et al., 2024).

A landmark Swedish study by Josephson and Saukkoriipi (2007) estimated that 30–35% of total project costs were attributed to work that added no value to the final product. This striking figure has become a powerful symbol of the need for change. This striking figure has become a powerful symbol of the need for change. Since then, researchers and industry voices alike have emphasized the importance of systematic productivity follow-up, ongoing efforts to track, measure, and analyse performance throughout project lifecycles. For example, Koch et al. (2020) documented persistent inefficiencies in Swedish construction and called for more structured productivity tracking, while Shehata and El-Gohary (2011) underscored the value of productivity improvement initiatives in construction more broadly. Without such methods, stakeholders are left to navigate uncertainty, often resulting in poor planning, misaligned expectations, and suboptimal decisions (Landin & Öberg, 2014). In response, calls have grown louder for more robust monitoring frameworks that can help reduce waste and increase the overall effectiveness of project delivery (Josephson & Saukkoriipi, 2007; Nilsson et al., 2024).

2.2 Overview of the Swedish Construction Industry: Key Trends and Developments

Between 2015 and 2019, Sweden's construction sector experienced robust growth, with production volume increasing by approximately 18%, driven largely by rising housing demand in urban areas and significant infrastructure investments (European Construction Sector Observatory, 2021). This expansion was strengthened by national initiatives aimed at expanding housing supply and executing large-scale transport and infrastructure plans. However, in 2020, the COVID-19 pandemic triggered a temporary slowdown, delaying ongoing projects and modestly reducing output (European Construction Sector Observatory, 2021). Following this period, the industry demonstrated resilience, aided by deferred investments and public sector stimulus targeting infrastructure development (European Construction Sector Observatory, 2021).

Swedish Construction Industry Overview (2015–2024)

Table 1Construction Economical Overview

Economic Indicator	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
GDP Growth (%)	4.1	2.3	2.4	2.0	1.2	-2.8	3.9	3.5	-0.1	0.9
Construction Sector GDP (SEK Billion)	3,689.7	3,830.6	3,980.1	4,139.8	4,289.5	4,168.4	4,321.5	4,482.0	4,401.2	4,520.0*
Number of Enterprises	175,785	179,333	183,450	186,200	187,100	187,694	188,900	189,700	190,300	190,800*
Production Volume Index (2015=100)	100.0	104.9	111.0	118.3	117.9	116.7	119.1	120.5	119.3	121.0*
Total Turnover (EUR Billion)	98.2	109.8	126.2	141.7	138.8	146.3	152.7	158.9	156.2	161.5*
Gross Operating Rate (%)	16.2	16.0	15.8	15.6	15.7	15.8	15.4	15.2	14.9	15.1*

Table Source: *European Construction Sector Observatory. (2021), Statistics Sweden (2023), Eurostat (2024), and the Swedish Construction Federation (2024).*

Despite the detailed tracking of earlier developments, there is a conspicuous lack of peer-reviewed academic data on the sector's performance beyond 2022. Sources for 2021 to 2024 primarily include non-peer-reviewed government and industry reports, such as those from Statistics Sweden (2023), Eurostat (2024), and the Swedish Construction Federation (2024). These provide the most current sector insights but lack academic validation. Methodological differences between these sources, such as variations in turnover currency conversions and gross operating rate calculations, may affect time-series comparability. Additionally, 2024 data marked with an asterisk (*) are forecasts. This data void may not necessarily stem from poor performance but instead from entrenched structural issues within the Nordic construction industries, including Sweden. Studies from the closely related Norwegian context, where market, regulatory, and environmental conditions often parallel those of Sweden, highlight sector-wide constraints such as fragmented documentation practices, a lack of incentives for rigorous reporting, and insufficient stakeholder coordination (Fufa et al., 2023). These observations align with challenges identified within the Swedish construction industry itself, where slow adoption of digital technologies, low prioritization of circularity, and an absence of coordinated strategies for reuse and transparency in the building process have impeded progress (Gerhardsson et al., 2020). Thus, while Fufa et al.'s research is geographically situated in Norway, its conclusions offer valuable insights that reinforce documented structural issues present in Sweden's construction sector.

2.3 Several key trends marked this period in Sweden

2.3.1 Labour Market Dynamics

Between 2015 and 2025, the labour market dynamics in Sweden's construction industry have been significantly influenced by digitalization trends, particularly the adoption of Building Information Modelling (BIM), and by systemic industry incentives. The implementation of BIM has contributed to efficiency and standardization across construction workflows. However, it has also introduced new demands for workforce upskilling and organizational coordination. Hooper (2015) examines Sweden's national BIM standardization efforts, highlighting how they aim to align project processes and actors across the industry. While the study primarily focuses on technical and procedural coordination, these changes imply a growing need for professionals with digital competencies and the capacity to operate in increasingly standardized and collaborative environments. Complementing this, Gharaibeh et al. (2022) identify specific implementation barriers in the Swedish wood construction sector, such as a lack of demand from clients, limited internal company readiness, and insufficient software integration capabilities, all of which influence labour market readiness and productivity outcomes.

Beyond digitalization, persistent structural issues related to incentive misalignment continue to affect the effectiveness of Sweden's construction labour market. Samuelson and Stehn (2023) highlight how the fragmented, project-based nature of the industry, combined with conflicting goals among stakeholders, creates inefficiencies in resource allocation and hinders the recruitment and retention of skilled labour. These dynamics reinforce a critical relationship between technological transformation, labour market capacity, and incentive structures in shaping productivity in the Swedish construction sector.

2.3.2 Rising Costs and Stagnant Productivity

Despite notable growth in construction output, production costs in the sector increased at a rate outpacing many other industries during this period (Nilsson et al., 2024). This trend raised concerns among both policymakers and industry stakeholders, particularly as the anticipated productivity improvements failed to materialize. Swedish public reports emphasized that investments in construction often substantial in both public and private sectors, were not yielding proportional gains in efficiency or cost-effectiveness (SOU 2015:105). Essentially, while more was being built, the cost per unit of output continued to rise, suggesting that the sector was not effectively translating investment into productivity growth. A big part of the problem comes down to how construction projects are run. Many still follow a fragmented approach, and digital tools, while helpful, aren't used in a steady or thoughtful way. Samuelson and Stehn (2023) point out that teams often work apart from each other, with little communication or coordination. Furthermore, Shehu et al. (2025) explain that tools meant to track and improve production aren't being used to their full potential. Subsequently, in many cases, the systems don't work well together, and there aren't clear rules for how to use them.

2.3.3 Market Structure and Competition

The Swedish construction market has historically been characterized by a high degree of concentration, with a few dominant domestic contractors controlling a significant share of large-scale projects. This market structure has been noted to influence both competition and innovation within the sector. For instance, the dominance of a few large firms tends to reduce competitive pressures and can hinder the adoption of new technologies and practices (Landin & Öberg, 2014). These firms often operate through extensive supply chains comprising networks of subcontractors, frequently selected based on long-standing relationships rather than open competition. Such dominance in the market structure, combined with established procurement and production traditions, has been linked to slow innovation and limited productivity growth (Josephson & Saukkoriipi, 2005).

However, while seminal studies such as Josephson and Saukkoriipi (2005) and Landin and Öberg (2014) laid the groundwork for understanding how traditional organizational structures and the dominance of large firms have hindered innovation in Sweden's construction industry, more recent research shows that these challenges are still very much present. A 2023 study by Blackwell, Holgersen, and Wallstam points out that limited competition in the residential construction sector, largely due to market concentration, has made it harder to improve housing affordability and efficiency. That resonates with the claims of Landin & Öberg (2014) talking about the dominance of established firms has been associated with a reluctance to adopt innovative practices, thereby stifling sector-wide advancement. Similarly, Bondemark et al. (2024) highlight how rigid procurement systems and deeply rooted hierarchies in transport infrastructure projects continue to hold back innovation and slow down development. That in turn, strengthening the claim of Josephson & Saukkoriipi (2005) about continued persistence of traditional processes and hierarchical organizational structures within Swedish construction that contributes to inefficiencies, task duplication, and resistance to continuous improvement

In contrast, certain market segments, particularly residential development in urban areas and infrastructure projects tied to European Union funding have seen the entry of foreign construction firms and smaller, more agile domestic entrants. This trend has introduced recent technologies, project management strategies, and cost structures that differ from those employed by the incumbent giants (European Construction Sector Observatory, 2021). These new players exert competitive pressure on traditional firms, incentivizing them to adapt by modernizing workflows, adopting digital tools, and exploring more collaborative contracting models.

Despite these developments, challenges remain. The entry barriers for new firms, particularly administrative complexity, access to skilled labour, and regional procurement biases continue to favour established players. Moreover, even with increased participation from foreign firms, market fragmentation and inconsistent innovation adoption rates may limit the overall impact on sector-wide productivity (European Construction Sector Observatory, 2021). Therefore, the Swedish construction market remains structurally conservative, external pressures from new entrants are beginning to reshape competitive dynamics. This shift may not yet be fully transformative, but it signals the early stages of a potentially broader reconfiguration of the sector's productivity landscape (European Construction Sector Observatory, 2021; Josephson & Saukkoriipi, 2005).

2.3.4 Increased Complexity and Regulations

The Swedish construction industry underwent a marked transformation, characterized by increased complexity in both building and infrastructure projects. This was largely driven by the growing demand for energy efficiency, enhanced safety standards, and improved user functionality. These evolving expectations led to the adoption of advanced design methodologies such as Building Information Modelling (BIM) and required greater coordination across stakeholders to manage technical and regulatory requirements effectively.

The push for more sustainable and high-performance buildings introduced new layers of complexity in design integration, material selection, and planning processes. This shift, while beneficial in terms of environmental performance and societal outcomes, has complicated traditional methods for assessing productivity. As Landin and Öberg (2014) point out, standard productivity metrics often fail to account for these evolving parameters. Their study underscores the need for updated evaluative frameworks that reflect the multifaceted nature of modern construction projects, which now incorporate regulatory compliance, sustainability targets, and digitalization.

In response to persistent delays and administrative bottlenecks, Sweden introduced amendments to its Planning and Building Act (PBA), with the intention of streamlining planning approvals and cutting red tape (European Construction Sector Observatory [ECSO], 2021); further changes are set to take effect on July 1, 2025, introducing a new framework for building regulations (Boverket, 2024). However, the intended benefits of these reforms were not always fully realized. While designed to facilitate faster development, the legislative changes sometimes resulted in additional administrative requirements that inadvertently increased the overall regulatory burden. Ulfvarson Östlund (2008) pointed out a paradox that still feels relevant today: that new legislation, even when meant to simplify things, can overcomplicate processes if it isn't grounded in practical realities. Recent research backs this up. For example, Núñez Varela et al. (2022) explored how digitalization has affected Sweden's urban planning process. They found that, despite good intentions, reforms often struggle due to fragmented governance and poor coordination between stakeholders, issues that end up creating more confusion than clarity. Similarly, von Malmborg et al. (2023) investigated Sweden's climate declarations for buildings that was introduced on January 1, 2022, under the Act on Climate Declarations for New Buildings (2021:787). They discovered that the new rules, while environmentally motivated, brought with them hidden costs and complex data requirements that have made implementation harder than expected.

2.3.5 Digitalization and Innovation Efforts

Digitalization and Innovation Efforts There was a growing emphasis on digital tools, industrialized building techniques, and "Lean" construction practices in Sweden as means to improve productivity. By the late 2010s, Sweden had implemented several initiatives to integrate digital technologies in construction, such as the adoption of BIM and digital project management systems (European Construction Sector Observatory, 2021). Building Information Modelling (BIM), for example, became more widespread, and some firms adopted digital project management systems. Industry and government formed programs such as "Smart Built Environment" to support construction innovation. However, adoption was uneven, a study on ICT use found many practitioners felt "it's fine, just as it is", indicating a cultural resistance to change (Jacobsson & Linderoth, 2012). Furthermore, Sweden's construction sector has encountered persistent challenges that support the claim of uneven adoption. Núñez Varela et al. (2022) highlight that while digitalization has the potential to streamline urban planning and enhance stakeholder coordination, institutional fragmentation and unclear responsibilities often hinder its effective use. Additionally, the construction industry is generally risk-averse and slow to embrace new technologies, as evidenced by widespread cultural and organizational inertia (Chen et al., 2022). Their systematic review found that although tools like BIM offer significant productivity benefits, their integration is frequently impeded by a lack of technical skills, insufficient training, and resistance from practitioners comfortable with traditional methods.

2.4 Methods for Productivity Follow-Up in Construction

Tracking productivity in construction is inherently challenging due to the sector's complexity and variability. In the Swedish construction industry, this difficulty is further compounded by the absence of standardized measurement methods, which hampers the ability to identify inefficiencies and areas for improvement (Landin & Öberg, 2014). Landin and Öberg emphasize that without consistent metrics, stakeholders struggle to forecast project costs and benefits accurately, leading to inefficiencies across project life cycles. Their research highlights the need for measurement tools that are adapted to contemporary construction processes, rather than outdated practices. In response to these challenges, both scholars and practitioners have explored a range of productivity follow-up methods. These include the use of expert panels, scenario analysis, and the development of models aimed at quantifying efficiency in specific building types, such as office buildings and multifamily housing (Landin & Öberg, 2014).

Each of these approaches offers unique insights but also comes with limitations depending on context and application. Despite these efforts, the Swedish construction sector continues to grapple with implementing widely accepted methods, underscoring the importance of ongoing research and industry collaboration (Landin & Öberg, 2014). Nonetheless, companies and scholars have employed several key methods for productivity follow-up.

Key Methods for Productivity Follow-Up:

2.4.1 Labour Productivity Metrics

In the context of construction management, labour productivity is a critical performance metric, typically quantified as output such as square meters constructed or the monetary value of work completed per labour hour. This measure serves as a fundamental indicator of project efficiency and effectiveness. According to Park (2006), labour productivity is affected by a variety of factors, which can be systematically categorized into internal and external domains. Internal factors relate to elements such as construction methods, site layout, and the quality of supervision, while external factors encompass environmental conditions including weather and regulatory constraints. Park's conceptual framework facilitates structured estimation of productivity levels and offers a basis for identifying and addressing issues that hinder performance.

Shehata and El-Gohary (2011) also stress the significance of identifying and managing the key determinants of construction labour productivity. Based on findings from a structured survey, they highlight factors such as the skill level of the workforce, crew coordination, material and tool availability, and communication efficiency as central to productivity outcomes. Their work ranks these variables by importance, emphasizing the need for proactive management to mitigate productivity challenges. Regular monitoring and analysis of labour productivity not only provide insights into current performance but also support the diagnosis of underlying issues by linking observed trends to their contributing factors.

2.4.2 Cost Productivity and Earned Value Management (EVM)

Proaño-Narváez et al. (2022) present Earned Value Management (EVM) as a quantitative project control method that integrates scope, schedule, and cost to assess performance, with relevance in construction project environments. Through empirical case studies of construction projects in Cuenca, Ecuador, the authors demonstrate how EVM facilitates early detection of cost and schedule deviations, allowing for more accurate forecasting and improved decision-making related to project productivity. The study emphasizes that EVM enhances cost control by providing objective performance metrics tied to actual progress.

In contrast, Eriksson and Westerberg (2011), while not addressing EVM directly, focus on how cooperative procurement procedures contribute to improved project outcomes. Their conceptual framework suggests that collaborative planning and early contractor involvement can support more reliable performance baselines. Such baselines are foundational to the successful application of performance measurement tools, including EVM, as they provide accurate references against which project performance can be measured.

2.4.3 Work Sampling and Time Studies in Construction

Josephson and Saukkoriipi (2005) conducted a comprehensive investigation into waste within construction projects, employing direct observation methods to categorize workers' activities. Their study revealed that a significant portion of workers' time was allocated to non-value-adding activities. Specifically, they found that only 17.5% of the observed time was spent on direct, value-adding work, while 45.4% was dedicated to preparatory tasks, and 33.4% constituted pure waste, including waiting and unnecessary material handling. The study's methodology involved detailed work sampling across four Swedish construction projects, combining observations with interviews, group discussions, and project documentation analysis. This multifaceted approach allowed for a nuanced understanding of time allocation on construction sites. The authors emphasized that such time-and-motion studies are instrumental in identifying inefficiencies and have informed Lean construction practices by highlighting areas where processes can be streamlined.

2.4.4 Key Performance Indicators (KPIs) and Benchmarking

Key Performance Indicators (KPIs) are widely used to assess construction project performance across cost, schedule, quality, and client satisfaction metrics. These indicators form the backbone of performance evaluation frameworks and support continuous improvement within project delivery systems. Kunkcu et al. (2022) conducted a comprehensive review of KPI use in construction project management literature, identifying cost, time, quality, client satisfaction, and communication as the most critical indicators. Benchmarking, in parallel, allows construction organizations to compare performance against industry standards or best practices, facilitating organizational learning and efficiency. Costa et al. (2006) analysed international benchmarking programs and reported that such initiatives in countries like the UK, USA, and Brazil contributed significantly to performance gains through structured learning. Additionally, Ofori-Kuragu (2025) proposed a conceptual framework to support benchmarking efforts tailored to the unique characteristics of the construction industry, emphasizing the importance of contextual factors. While peer-reviewed frameworks offer theoretical rigor, practical applications are often documented in national industry studies. For example, Koch et al. (2020) performed a large-scale analysis of 430 Swedish construction projects, using cost per square meter as a benchmark. This study provided valuable empirical insights into factors affecting productivity, such as project type, contract form, and region, thus offering important context for productivity assessment in Scandinavian construction.

2.4.5 Lean Construction Tools (Last Planner System)

The Last Planner System (LPS) is recognized as a central tool within lean construction practices, aiming to improve planning reliability and production control. Schimanski et al. (2020) provide a comprehensive review of the LPS and highlight its role in facilitating short-term planning and enhancing coordination among project participants. Through mechanisms like lookahead planning and weekly work plans, the LPS allows teams to make reliable task commitments, and its performance is typically measured using the Percent Plan Complete (PPC) metric. According to Schimanski et al. (2020), PPC serves as a quantitative indicator of planning reliability, with low PPC values often signalling process instability and the presence of constraints that obstruct workflow.

Koch et al. (2020) observe that Swedish contractors implementing lean construction practices, including the Last Planner System, utilize PPC as part of their continuous production monitoring. Their study of 430 Swedish construction projects reveals that while lean principles and follow-up tools such as LPS are theoretically acknowledged, their practical implementation varies significantly. In particular, Koch et al. (2020) note that challenges in cultural adaptation and workforce training have limited the consistent application of LPS-based planning and feedback mechanisms. Further study by Kifokeris and Koch (2023) highlight that tools like the Last Planner System can only lead to meaningful productivity gains when they are not just occasionally used but fully embedded into the everyday routines of an organization backed by ongoing training and strong managerial support.

2.4.6 Digital Monitoring and BIM-based Tracking

The integration of digital technologies such as Building Information Modelling (BIM), sensors, and tracking software is increasingly influencing how construction productivity is monitored. Jacobsson and Linderoth (2012) investigated the perceptions of information and communication technologies (ICT) in Swedish construction firms and found that while digital tools are available and have the potential to improve transparency and control, they are often perceived as sufficient "as is," leading to a lack of proactive technological development. This attitude has hindered more dynamic uses of ICT for real-time productivity tracking and improvement.

Barbosa et al. (2017) identify technologies such as 4D BIM, laser scanning, and drones as emerging tools with strong potential to enhance productivity measurement by enabling accurate visualization and comparison of planned versus actual progress. Yet, the industry-wide uptake of these tools remains limited, primarily due to challenges in integration and user familiarity. Similarly, Landin and Öberg (2014), in a survey of Swedish construction practices, found that while data collection capabilities have improved, most firms still lack centralized systems that synthesize productivity information into actionable feedback. This limits the ability to conduct comprehensive, real-time productivity follow-up.

Koch et al. (2020) report on Swedish projects experimenting with sensor-based monitoring of equipment usage and production cycles. Although promising, these initiatives remain in the pilot phase and have not been widely adopted across the sector. The literature consistently emphasizes that realizing the benefits of digital monitoring depends not only on technological advancement but also on developing a culture that values data-driven decision-making (Jacobsson & Linderoth, 2012; Landin & Öberg, 2014; Koch et al., 2020).

2.5 Impact Of Productivity Follow-Up on Efficiency and Project Success

Does actively monitoring productivity actually lead to better project outcomes? The consensus in the literature is that yes – projects that rigorously follow up on productivity tend to achieve higher efficiency and are more likely to meet their goals. By measuring and managing productivity, project teams can identify problems early, implement improvements, and ultimately save time and cost (Shehata & El-Gohary, 2011; Gunduz & Abu-Hijleh, 2020). Several studies illustrate the positive impact of productivity follow-up on project performance:

2.5.1 Improved Efficiency and Cost Savings

When productivity is tracked, inefficiencies become visible and can be addressed, leading to more efficient use of resources. For example, Fox et al. (2010) investigated how the application of constructability reviews during the design and construction phases contributes to improved project efficiency. Their study found that early-stage constructability assessments help prevent design conflicts and enhance coordination among stakeholders, resulting in shorter project durations and reduced costs. They concluded that integrating constructability principles into project planning facilitates proactive management and more efficient resource utilization. Similarly, Josephson and Saukkoriipi (2005) analysed waste within Swedish construction projects and identified that approximately thirty percent of project resources are lost due to avoidable inefficiencies such as waiting, rework, and miscommunication. They argued that if these losses were systematically tracked and addressed through structured follow-up procedures, projects could significantly reduce costs and improve schedule adherence without compromising quality outcomes.

In a complementary study, Gunduz and Abu-Hijleh (2020) assessed labour productivity drivers and emphasized the financial significance of even modest productivity improvements. Their findings show that small increases in labour efficiency can lead to substantial cost savings because a large portion of construction project expenditure is tied to labour and equipment use. These three studies collectively reinforce the importance of productivity monitoring and follow-up to achieve measurable improvements in cost performance and operational efficiency in construction.

2.5.2 Enhanced Ability to Meet Schedule and Quality Goals

Effective productivity monitoring plays a critical role in improving both schedule adherence and quality outcomes in the Swedish construction industry. Forsberg and Saukkoriipi (2007) emphasize that systematic measurement of waste and productivity, particularly when aligned with lean thinking principles, provides a foundation for identifying inefficiencies that commonly disrupt timelines and compromise quality. Their research demonstrates that proactive identification of wasteful practices through continuous follow-up enables project teams to implement corrective actions earlier, leading to more reliable scheduling and higher-quality deliverables.

Building on this, Borg and Song (2013) highlight the importance of accounting for quality changes in productivity assessments. Focusing on Swedish housing construction between 1990 and 2010, they argue that traditional productivity metrics tend to overlook quality improvements, leading to underestimation of actual performance. Their findings suggest that when quality is incorporated into productivity evaluations, stakeholders are better equipped to make informed decisions regarding schedule planning and quality management. This reinforces the value of follow-up practices that go beyond quantitative output and also capture qualitative progress.

Further evidence is provided by Nilsson et al. (2024), who compare total factor productivity in Sweden’s construction sector with broader European benchmarks. Their analysis points to a relative lag in Swedish productivity performance, which they partly attribute to the absence of structured and comprehensive productivity follow-up mechanisms. They argue that systematic monitoring is essential for enhancing operational efficiency and ensuring that projects stay on schedule while achieving their intended quality objectives.

In parallel, Jacobsen et al. (2023) present an advanced method for monitoring labour productivity using kinematic data and deep learning. Although not focused exclusively on Sweden, their work offers practical insights into how real-time digital monitoring can improve responsiveness to on-site deviations. The authors demonstrate that such technologies allow for more precise intervention and progress tracking, both of which support timely delivery and consistent quality standards.

2.5.3 Contribution to Project Success Factors

Building upon the relationship between productivity follow-up and schedule and quality performance, a growing body of literature affirms its integral role in broader project success dimensions, particularly cost control, stakeholder satisfaction, and operational efficiency. Gunduz and Abu-Hijleh (2020) assert that labour productivity is a foundational contributor to the success of construction operations, as it directly influences resource efficiency and cost performance. Through a comprehensive analysis of labour productivity drivers using importance rating and risk mapping, they demonstrate that projects which actively monitor and manage labour performance tend to achieve superior outcomes across multiple performance metrics.

Similarly, Shehata and El-Gohary (2011) stress the importance of project managers’ knowledge of productivity influencers factors that either impede or enhance the efficiency of site operations. Their study highlights that project leaders who are well-versed in these dynamics and incorporate them into day-to-day decision-making are better positioned to implement corrective measures in a timely manner, thus maintaining alignment with project goals and client expectations.

In the Swedish construction sector, Landin and Öberg (2014) provide evidence that the absence of standardized productivity measurement systems has historically hindered the industry's ability to forecast performance reliably. They argue that aligning productivity tracking methods with current industry practices is essential not only for evaluating cost and time-related risks but also for enhancing transparency and predictability in project delivery. Their findings suggest that embedding productivity follow-up within project management systems reinforces accountability structures and supports improved stakeholder engagement.

2.5.4 Continuous Improvement and Learning

The role of productivity follow-up in supporting continuous improvement and organizational learning has been increasingly emphasized in recent construction literature. Landin and Öberg (2014) argue that standardized measurement systems are essential not only for enhancing productivity and efficiency, but also for enabling reflective learning processes. When project teams can systematically compare planned versus actual outcomes, they are better equipped to identify inefficiencies and develop informed strategies for improvement. This, according to the authors, creates a foundation for organizational learning over time.

Expanding on this idea, Koch et al. (2020) observe that in the Swedish construction context, daily and weekly productivity monitoring routines are being used not just for performance control, but also as part of a learning cycle. Their study illustrates how project teams that engage in regular follow-up discussions use productivity data to revise work methods and refine execution strategies. This ongoing feedback process helps to institutionalize knowledge gained from experience, thereby supporting continuous improvement across project phases.

The application of internal benchmarking as a learning tool is further supported by Barbosa et al. (2017), who document how major contractors such as NCC and Skanska use cross-project performance reviews to identify best practices and replicate success. These organizations systematically compare productivity outcomes across multiple projects, leading to the adoption of refined scheduling and logistics approaches in future work. Such practices demonstrate how structured data analysis and post-project learning contribute to incremental but sustained performance gains at the organizational level.

However, the literature also cautions that learning does not occur automatically from measurement alone. Gunduz and Abu-Hijleh (2020) emphasize that productivity data only fosters improvement when it is actively used to guide decision-making. Their research shows that organizations must not only identify high-risk productivity drivers but also implement targeted actions in response. Without this follow-through, the potential for learning and process refinement remains unrealized.

2.6 Challenges and Barriers to Effective Productivity Tracking

Implementing productivity follow-up in construction projects presents several challenges, particularly within the Swedish context. The literature identifies industry practices, contractual frameworks, resource constraints, and cultural factors as key barriers to effective productivity tracking.

Key Barriers Include:

2.6.1 Conservative Contracting Practices and Incentive Misalignment

Traditional contracting models in Sweden, particularly fixed-price frameworks such as AB 04 and ABT 06 tend to focus on budget and time compliance rather than performance or innovation. Eriksson and Westerberg (2011) argue that these contracts seldom incorporate productivity incentives and often discourage collaboration, reinforcing a risk-averse and cost-control mindset. While more progressive models like pain/gain share or early-completion bonuses exist, they remain underutilized in the Swedish context, limiting their potential impact on productivity enhancement.

This lack of incentive alignment weakens motivation across the project chain to pursue productivity-focused improvements. Without contract structures that explicitly reward performance beyond compliance, actors are less inclined to engage in transparent follow-up or continuous improvement processes. (Eriksson & Westerberg, 2011).

Additionally, several recent studies further underline structural contractual weaknesses that limit productivity improvements:

First, the absence of precise and enforceable quality clauses in Swedish standard contracts undermines consistent performance standards. Asadi et al. (2023) argue that vague definitions of defects and quality result in increased rework and disputes, diverting focus from proactive productivity strategies. Contracts that fail to incorporate measurable quality indicators miss an opportunity to incentivize first-time-right execution and continuous improvement.

Second, when comparing partnering models, Sweden lags behind neighbouring Finland in implementing alliance-based contracts. Kadefors et al. (2024) observe that Finnish alliance contracting marked by integrated governance, shared risks, and joint decision-making fosters innovation and productivity. In contrast, Sweden's continued reliance on AB-forms hinders collaborative practices, with limited diffusion of partnering models that could align project stakeholders around shared productivity goals.

Third, contractual rigidity is a key reason for low productivity in the Swedish construction industry. Outdated contract structures do not support the use of digital technologies such as AI, which are essential for improving efficiency. Regona et al. (2022) show that unclear responsibilities, poor data sharing, and fragmented workflows, often reinforced by legacy contracts make it difficult to adopt AI across construction phases. Abioye et al. (2021) explain that vague contract terms on liability and data rights reduce trust in digital systems and slow down their adoption. Chen et al. (2025) similarly emphasize that rigid procurement frameworks and low contractual adaptability are major obstacles to the integration of AI in infrastructure projects, ultimately hindering productivity gains.

2.6.2 Retention and Security Bonds: Financial withholds vs. Incentives

The literature highlights those traditional contractual mechanisms, such as retention and financial withholds, can undermine collaborative project environments and fail to stimulate productivity improvements. Kadefors (2004) emphasizes that contractual practices focused on control and risk transfer, including mechanisms like retention, often generate adversarial dynamics between clients and contractors. This focus on compliance rather than cooperation can inhibit trust and reduce the willingness of contractors to engage proactively in performance improvement activities. Instead of promoting excellence, such arrangements tend to reinforce minimum acceptable standards and defensive behaviours (Kadefors, 2004).

Meng and Gallagher (2012) similarly argue that punitive financial mechanisms do not serve as effective incentives for enhanced project outcomes. Their research finds that projects with incentive-based payment systems, such as performance bonuses or gain-sharing models achieve better cost, time, and quality performance than those relying solely on penalties or retentions. The authors advocate for a shift from adversarial, control-based mechanisms toward incentive structures that align the objectives of all stakeholders, suggesting that positive reinforcement is more conducive to contractor motivation and overall project productivity (Meng & Gallagher, 2012).

2.6.3 Skilled Labor Shortages and Training Gaps

Even when contract structures and incentive models are improved, other systemic barriers can limit the effectiveness of productivity follow-up. Chief among these is the shortage of skilled labor and the persistent gap in vocational training. Skilled labour shortages and inadequate training are consistently identified in the literature as major barriers to productivity in construction. Gunduz et al. (2020) identify labour skill level as one of the most critical productivity drivers in construction projects. They note that the lack of experienced workers and inconsistent training result in reduced efficiency and increased variability in performance, which undermines productivity tracking and improvement efforts.

Loosemore and Andonakis (2007) reinforce this by highlighting the challenges small and medium-sized contractors face in implementing occupational health and safety reforms due to limited training resources and skill development opportunities. Their findings suggest that systemic underinvestment in workforce training contributes not only to safety risks but also to performance inefficiencies, particularly when less experienced workers are rapidly integrated into projects to fill labour gaps.

Complementing these findings, the European Construction Sector Observatory (2021) reports a persistent misalignment between vocational education and the evolving demands of the construction industry across Europe. This mismatch contributes to the under-preparedness of the labour force, limiting their effectiveness on-site and hindering efforts to improve productivity through performance follow-up.

2.6.4 Cultural and Organizational Barriers

While workforce-related challenges such as skill shortages and training gaps directly affect on-site productivity, broader cultural and organizational conditions within construction projects also play a critical role. Cultural and organizational conditions in the Swedish construction industry contribute to difficulties in improving productivity. Landin and Öberg (2014) point out that fragmentation among project participants is a key issue, particularly when subcontractors and suppliers are not fully included in collaborative approaches such as partnering. Their exclusion limits the value of shared knowledge and weakens the potential for collective productivity efforts.

In addition to structural fragmentation, relational issues further complicate cooperation. Kadefors (2004) explains that low levels of trust between stakeholders in construction projects tend to produce adversarial interactions. These dynamics inhibit collaboration and reduce the likelihood that productivity-related initiatives will be openly supported. Trust is therefore presented as a necessary condition for effective joint improvement.

Furthermore, in examining the organizational behaviours that influence project performance, it is essential to consider the role of national culture. A widely cited framework in this context is Hofstede's cultural dimensions theory (Hofstede, 2001), which offers insight into how shared societal values shape workplace behaviours and attitudes toward authority, structure, and uncertainty. According to Hofstede's model, Sweden is characterized by low power distance, low uncertainty avoidance, and strong individualism (Hofstede, 2001; Minkov & Hofstede, 2011).

In environments marked by uncertainty and complexity, organizations often move away from highly structured systems and instead adopt more improvised, relational approaches. Hällgren et al. (2018) highlight how project practitioners in Nordic contexts often normalize deviation and uncertainty through informal coordination practices rather than relying on strict procedural discipline. Building on this, De Waard and Kalkman (2022) demonstrate that as project conditions become more urgent and ambiguous, formal procedures are frequently replaced by improvisation and collaborative coordination.

Although Hofstede's framework has been widely applied to studies of cross-cultural leadership, compliance, and coordination (Minkov & Hofstede, 2011), it has rarely been used to examine productivity and methodological challenges specific to the Nordic construction sector. Understanding how these cultural predispositions influence organizational practices provides a useful lens for interpreting recurring issues.

2.6.5 Data Collection and Measurement Difficulties

In addition to cultural and organizational challenges, technical difficulties related to how productivity is measured and interpreted also pose significant obstacles to effective follow-up in construction projects. Measurement challenges are a recurring theme in the literature on construction productivity. Landin and Öberg (2014) observe that the Swedish construction sector lacks standardized methods for productivity measurement, resulting in uncertainty among practitioners regarding which metrics to apply and how to interpret them. This ambiguity contributes to inconsistent measurement practices, which in turn weakens efforts to evaluate and enhance productivity across projects. Their study further emphasizes that construction projects are highly variable, which complicates the development of reliable and comparable productivity indicators.

At a more granular level, Rathnayake et al. (2024) identify that conventional productivity measurement methods often fail to capture activity-level inefficiencies, such as interruptions in workflow and the movement of labour, equipment, and materials. These overlooked factors can have significant effects on performance yet remain invisible in traditional assessments. To address this, the authors propose a framework that disaggregates productivity into its efficiency and effectiveness components, allowing for more detailed and meaningful analysis of productivity losses in construction environments.

2.7 Best Practices in Productivity Follow-Up: Insights from Scandinavian and Global Experiences

Despite the challenges, many organizations and projects have found innovative ways to successfully track and improve productivity. The literature offers a range of best practices, proven or promising approaches – drawn from experiences in Sweden, its Scandinavian neighbours, and the broader global construction industry. These best practices serve as examples of how the barriers discussed can be overcome and how productivity follow-up can be embedded into project execution for better outcomes.

Key Best Practices Include:

2.7.1 Lean Construction Implementation

In Sweden, the implementation of lean construction (LC) has evolved into a flexible and context-sensitive practice, shaped by both organizational needs and broader industry dynamics. Rather than being adopted as a single, uniform framework, LC is often applied in selective and pragmatic ways. Companies tend to integrate specific tools or principles that align best with their project demands and internal capacities (Kifokeris & Koch, 2023). large-scale national study by Kifokeris and Koch (2023) provides valuable insight into how this selective adoption plays out in practice. Their findings identified four common variants of LC currently in use across Swedish construction: IT-supported design processes, production-focused methods, planning strategies emphasizing tools like the Last Planner System (LPS), and supply chain and logistics models built on strong supplier partnerships. These variants reflect a clear emphasis on improving technical processes such as streamlining workflow, minimizing waste, and increasing customer value.

Beyond adoption patterns, significant challenges continue to impede wider and more consistent LC implementation. According to Moradi and Sormunen (2023), key barriers include a general lack of awareness, resistance to change at both individual and organizational levels, and limited commitment from top leadership. These obstacles, while observed globally, remain particularly relevant within the Swedish context. On the flip side, several factors have been found to enable successful LC uptake, such as fostering a culture oriented toward lean thinking, strong managerial support, collaborative project environments, and the structured use of lean tools like LPS (Moradi & Sormunen, 2023).

Looking further back, earlier research by Kifokeris and Koch (2020) helps to contextualize these findings. Their review of Swedish LC practices over the past decade highlights a dominant focus on production efficiency and strategic alignment, while other critical areas, like planning, design integration, stakeholder partnering, and supply chain collaboration have received comparatively less attention. Interestingly, much of the research and practical interest has concentrated on industrialized construction, despite its relatively modest share of the overall market. This suggests that certain aspects of LC have been prioritized, perhaps at the expense of a more holistic or balanced approach (Kifokeris & Koch, 2020).

2.7.2 Prefabrication and Industrialized Construction

Kamali and Hewage (2016) conducted a comprehensive review of modular building systems and emphasized the environmental and operational advantages of prefabrication in the built environment. They found that prefabricated construction, carried out in controlled factory conditions, allows for improved process optimization, reduced material waste, and greater precision in execution. These benefits collectively contribute to superior life-cycle performance when compared to traditional site-built construction, especially in terms of environmental sustainability and time efficiency.

Complementing this, Lessing, Stehn, and Ekholm (2015) examined the evolution of industrialized housebuilding within the Swedish construction sector, where prefabrication has become a key strategic approach to overcoming inefficiencies. Their research positioned industrialized construction not only as a technical innovation but as a process-oriented transformation aimed at increasing predictability, reducing on-site variability, and improving productivity. Within the Swedish context, this approach involves tightly integrated design, planning, and production activities, made possible through centralized factory environments.

The Swedish experience, as outlined by the authors, illustrates how systemic implementation of prefabrication can drive industrial renewal in the construction sector and lead to more standardized, higher-quality outputs.

From a regional perspective in North America, Giorgio et al. (2025) explored the application of prefabricated wood light-frame systems in Quebec. Their findings echo the insights observed in the Swedish context, with professionals identifying reduced on-site labour, improved workflow coordination, and faster assembly times as primary motivations for adopting prefabrication. However, their study also pointed out persistent barriers, including logistical constraints and difficulties in aligning prefabricated elements with existing construction processes, which continue to limit broader adoption in Quebec.

Similarly, in the infrastructure sector, Culmo (2011) documented the use of prefabricated elements in bridge construction, further illustrating the effectiveness of industrialized methods. His study demonstrated that off-site fabrication of structural components such as bridge decks and beams significantly shortens on-site construction times, minimizing traffic disruptions and enhancing cost efficiency. Importantly, Culmo emphasized that the success of such projects depends on careful synchronization between production and field operations an insight that mirrors the Swedish model of integrated and streamlined project delivery.

2.7.3 Collaborative Contracting and Partnering Agreements

Collaborative contracting frameworks, particularly those involving partnering and alliancing, have received increasing attention in the construction management literature for their potential to improve project performance through structured and deliberate cooperation among stakeholders. Eriksson and Westerberg (2011) explain that adversarial behaviours often seen in traditional procurement approaches can be reduced through the adoption of cooperative procedures. These include joint risk management, early contractor involvement, performance-based incentives, and transparent communication. When such mechanisms are embedded in procurement strategies, they help align stakeholder interests, foster mutual trust, and diminish opportunistic behaviour. The authors argue that this alignment can produce measurable improvements in cost efficiency, schedule adherence, and overall quality outcomes.

Building on this conceptual framework, Lahdenperä (2012) provides a detailed analysis of the contractual and structural underpinnings of collaborative models. His study focuses on project partnering and project alliancing, which are forms of multi-party agreements that integrate clients, contractors, and designers into a single contractual arrangement. These models emphasize the importance of shared objectives and collective decision-making. A defining feature is the joint setting of performance targets and the shared allocation of financial results, whether gains or losses. According to Lahdenperä, this shared responsibility supports greater transparency and accountability while promoting a unified and team-oriented approach to managing risk and reward throughout the life of the project.

2.7.4 Digital Project Management and BIM-Based Monitoring

Digital project management in the construction industry increasingly relies on Building Information Modelling (BIM) and related technologies to streamline planning and monitoring activities. Barbosa and Costa (2022) emphasize that the integration of 4D BIM with data collected through Unmanned Aerial Vehicles (UAVs) and 360-degree cameras enables real-time visualization of project progress. This approach supports digital construction monitoring by allowing direct comparison between planned and actual site conditions, which facilitates early detection of deviations and timely corrective actions. Their study highlights how such visual and data-rich environments can enhance construction management efficiency by improving accuracy in progress assessments.

Complementing the technological perspective, Jacobsson and Linderoth (2012) examine the organizational implications of adopting digital systems in Swedish construction firms. They argue that the successful use of information and communication technologies (ICT), including BIM-related tools, hinges on how these systems are perceived and integrated by users. Their findings show that digital tools can improve workflow efficiency and decision-making, but their impact is contingent upon organizational readiness and the dismantling of traditional information silos.

In more recent studies, researchers have taken a closer look at how digital technologies are not just changing construction practices but also shaping how teams and organizations work together. El Masry (2025) shows that when big data is used alongside tools like BIM, it can support more sustainable construction by helping companies make smarter, data-driven decisions. However, the study also points out that adopting these tools isn't just about having the right tech, it depends on things like cost, company structure, and how willing people are to embrace change. Bäcklund et al. (2024) add that even when powerful digital tools like BIM and drone-based monitoring are available, many construction firms still struggle to make the shift because of old habits and rigid structures. They emphasize the importance of strong leadership and a clear strategy to help teams adapt.

2.7.5 Standardization and Process Improvement

Improving productivity in the construction sector has been a long-standing challenge, particularly in environments where each project is approached as a unique endeavour. A growing body of literature suggests that shifting from this project-based mindset toward a more process-oriented model can yield substantial gains in efficiency and performance. Landin and Öberg (2014), examining the Swedish construction industry, emphasize that consistent productivity improvements depend on the ability to standardize work practices and institutionalize learning across projects. Their study found that firms focusing on long-term process orientation were better positioned to capture and apply lessons learned, enabling systematic improvements rather than isolated gains.

This argument is echoed in global research that identifies standardization as a foundational driver of productivity growth. Barbosa et al. (2017) highlight that firms achieving the most progress were those that implemented repeatable, standardized processes throughout project delivery stages, from design to execution. By reducing variability and introducing structured routines, these firms were able to more effectively measure performance, scale innovations, and reduce inefficiencies. Standardization, therefore, serves not only as a means of simplification but also as a strategic approach to embed continuous improvement into the fabric of project management.

However, process standardization alone is not sufficient; its success is often contingent upon the collaborative dynamics among project stakeholders. Rahman et al. (2014) found that collaboration, particularly from the perspective of contractors, plays a critical role in supporting standardized processes. Through improved communication, shared goals, and coordinated task execution, collaboration fosters the consistent application of procedures across diverse teams and subcontractors, thereby reinforcing process reliability and predictability.

Digitalization further strengthens this relationship by enabling visibility and control over standardized practices. Zulu et al. (2023) demonstrate that digital tools mediate the link between work practices and productivity by facilitating the monitoring and refinement of standardized procedures. These technologies create feedback loops that allow organizations to track deviations, measure efficiency, and update processes in real time, enhancing the capacity for systematic improvement.

2.8 Policy Implications and Recommendations for Enhancing Productivity in the Swedish Construction Industry

The persistent productivity challenges in construction have prompted responses not only from firms and project teams but also from policymakers and industry bodies. The literature provides several policy implications and recommendations aimed at creating an environment in Sweden where productivity can improve. These suggestions often stem from the findings of studies and best practices discussed earlier.

Key recommendations include:

2.8.1 Promote Collaborative Procurement and Incentive Alignment

Collaborative procurement and incentive alignment have been increasingly recognized as critical factors for improving productivity and innovation in construction projects. Eriksson and Westerberg (2011) argue that traditional procurement models, which often emphasize lowest-cost bidding, tend to undermine project outcomes by limiting opportunities for innovation and reducing overall efficiency. Their conceptual framework suggests that cooperative procurement procedures, such as early contractor involvement, joint specification development, and incentive-based payment structures, foster trust and long-term collaboration, leading to better project performance in terms of time, cost, and quality. Expanding on these findings, Lahdenperä (2012) provides a comparative analysis of collaborative models such as project partnering, alliancing, and Integrated Project Delivery. His study highlights how these approaches support the alignment of stakeholder objectives, improve coordination, and enable more effective risk-sharing, all of which contribute to enhanced project outcomes.

This alignment of interests is further reinforced by Kent and Becerik-Gerber (2010), who show that Integrated Project Delivery promotes transparent communication and collective accountability among project participants. Their empirical findings reveal that such collaborative environments encourage knowledge sharing and joint problem-solving, which are essential for achieving efficiency and innovation. Extending these insights to the public sector context, Eriksson et al. (2019) examine multiple infrastructure projects and demonstrate how public clients can actively shape project performance through the use of relational contracting and performance-based incentives. Their study shows that when clients implement collaborative procurement strategies, contractors are more likely to engage in continuous improvement and invest in innovative solutions.

2.8.2 Invest in Training and Workforce Development

Addressing productivity challenges in the construction sector requires a strong focus on workforce training and development. Shehata and El-Gohary (2011) argue that enhancing labor productivity is contingent upon improving both managerial and technical competencies. Specifically, they emphasize that strengthening project management skills-particularly in planning and monitoring-can significantly influence project outcomes. In parallel, increasing the proficiency of site workers in adopting modern construction techniques, such as lean construction, benchmarking, and reducing variability, is essential for achieving consistent performance gains.

Building on this, the European Construction Sector Observatory (2020) highlights the strategic importance of human capital development in the construction industry, especially in light of increasing technological advancement. It stresses that effective training must not only cover new tools and processes but also be adapted to the needs of a highly diverse workforce. The report identifies multilingual and visual training methods as crucial for reaching international labor groups and ensuring that all workers can engage with productivity-enhancing practices, regardless of language or educational background.

This need for targeted and inclusive upskilling is further underscored by recent findings from the OECD (2024), which reveal that Sweden faces some of the highest rates of qualification mismatches in the European Union. A significant proportion of Swedish workers report lacking the necessary skills to adapt to digital and computer technologies introduced in their workplaces. In response to these structural challenges, the Swedish government has implemented initiatives such as the "transition package," offering financial support for training, and established a public transition organization to assist workers in navigating job changes. These measures reflect a broader policy commitment to strengthening the skills system and mitigating labor shortages through strategic workforce development.

2.8.3 Facilitate Technology Adoption through Standards and Support

Government and industry bodies can accelerate the adoption of productivity-enhancing technology by setting standards and providing support. One proven approach is requiring the use of Building Information Modelling (BIM) on publicly funded projects above a certain size-an approach used by several EU countries to promote digitalization in construction. Sweden could consider similar mandates-or at least strong encouragement-given its established capacity for digital uptake. According to the European Construction Sector Observatory (2021), Sweden has taken notable steps towards digitalization in the sector, including mandating BIM in certain public projects and developing CoClass, a national classification system to support BIM implementation. Additionally, ECSO reports that mandates in other EU countries have been associated with improved systematic project control, although direct links to quantified productivity gains are still under evaluation.

Establishing open standards for data exchange can also support interoperability across software platforms, enabling firms to implement integrated systems more easily. Policymakers can further stimulate innovation by funding pilot programs and offering grants for construction technology initiatives. For example, financial support could target the development and testing of productivity measurement tools-such as sensor-based monitoring-with publicly shared results to foster broader adoption. Sweden's innovation agency, Vinnova, has supported such efforts under the "Smart Built Environment" initiative. One example is the project *Digital Information Flow in Infrastructure Projects*, which aimed to enhance collaboration and transparency by improving data exchange across project phases (Moscati & Engström, 2019). Expanding this type of support, with a targeted focus on productivity tracking tools could deliver system-wide benefits.

Finally, while Jacobsson and Linderoth (2012) focus more broadly on the implementation of information and communication technology (ICT) in Swedish construction firms rather than solely on BIM, their findings remain highly relevant. Their study revealed that successful implementation depends on aligning digital tools with existing work practices and mitigating perceived risks. This reinforces the importance of reducing both the financial and organizational uncertainties associated with new technologies. By introducing standardized requirements and offering financial incentives, government and industry actors can lower adoption barriers and accelerate the uptake of systems that support systematic productivity monitoring and management.

2.8.4 Enhance Data Collection and Benchmarking at Industry Level

Koch et al. (2020) emphasize the importance of systematically collected productivity data in understanding performance variation across construction projects in Sweden. By analysing 430 construction projects, they demonstrate how cost per square meter can serve as a benchmark for comparing project efficiency across building types, contract forms, and geographic regions. Their findings suggest that benchmarking based on consistent and comprehensive data allows for more accurate identification of productivity patterns and informs targeted improvement efforts. The study highlights that large-scale data collection, when methodologically standardized, can provide a foundation for understanding industry-wide productivity levels and guiding strategic decisions.

In a different context, Uhlhorn et al. (2024) discuss how the adoption of digital technologies in environmental assessment practice in Austria and Germany has supported the structuring and accessibility of large volumes of information. They show that integrating advanced digital tools enables more effective information management and enhances the transparency of complex processes. Their findings point to the potential value of digital infrastructure in supporting institutional data collection and knowledge sharing. Although focused on environmental assessment, the study's insights are applicable to construction, where digital tools could similarly facilitate standardized data gathering and benchmarking initiatives.

2.8.5 Addressing Structural Issues: Competition and Regulation

Some policy recommendations are more structural. For instance, the government could continue efforts to increase competition in the construction sector, as more competition can drive firms to find productivity improvements to stay competitive. This could involve easing entry for foreign firms or supporting smaller domestic firms to grow and challenge the big players, under the idea that a more dynamic market incentivizes efficiency (European Construction Sector Observatory, 2021). Additionally, while ensuring high standards, policymakers should review and streamline regulatory processes (permits, inspections) that, if overly slow or complex, can hamper project productivity through delays. Sweden has made some regulatory tweaks (e.g., the Planning and Building Act amendments to simplify certain planning steps – European Construction Sector Observatory, 2021), but continued attention is warranted so that external bureaucratic factors don’t stifle on-site productivity gains.

2.8.6 Encourage a Culture of Continuous Improvement

Landin and Öberg (2014) emphasize the critical importance of fostering a culture of continuous improvement within the Swedish construction sector. Their study identifies several conditions necessary for such a cultural shift, starting with the development and implementation of appropriate methods and tools to measure productivity and efficiency. The authors argue that without systematic measurement, stakeholders lack the necessary information to make informed decisions or identify areas requiring improvement. This absence of clarity can create uncertainty and hinder efforts to drive productivity forward. Furthermore, Landin and Öberg highlight the importance of open communication and shared responsibility among key actors in the construction process, including clients, contractors, and consultants. Through this collaboration, organizations can create a feedback loop that supports learning and continuous development.

In more recent studies, Larsson and Larsson (2020) underscore that sustainable project management relies heavily on inter-organizational collaboration and shared objectives among stakeholders. Their research demonstrates that an inclusive and communicative work environment encourages adaptive learning and ongoing improvement. Rather than solely depending on formal measurement tools, their findings suggest that trust-based relationships and transparent communication enable continuous feedback loops, which are crucial for iterative development and mutual learning across project teams.

Expanding on this perspective, Engebø et al. (2020) highlight the significance of collaborative project delivery methods, such as Integrated Project Delivery (IPD) and Alliancing, in promoting continuous improvement. These methods institutionalize mechanisms for joint decision-making, risk-sharing, and collective goal alignment, which inherently foster a culture receptive to change and innovation. Through a scoping review of collaborative frameworks, the authors find that such models not only enhance project efficiency but also create an environment in which iterative learning and reflective practices become routine. These models reduce adversarial relationships and siloed thinking, both of which are barriers to sustained improvement.

2.9 Expert Opinions and Predictions on the Future of Productivity Tracking

Looking ahead, experts in the construction field offer varied perspectives on how productivity tracking might evolve and what the future holds for efforts to improve efficiency. In Sweden and globally, there is optimism that new technologies and approaches will make productivity follow-up easier and more impactful, but there are also notes of caution about potential pitfalls.

Key predictions and opinions include:

2.9.1 Increased Digitalization and Real-Time Analytics

The integration of digital technologies in the construction industry has introduced new possibilities for monitoring productivity and improving project outcomes through real-time analytics. A notable example of this shift is provided by Mechtcherine et al. (2019), who present the CONPrint3D concept-an on-site, monolithic 3D printing method that reflects the increasing use of automation and sensor-driven control systems. Their study demonstrates how digital construction methods can produce continuous data streams during execution, enabling more immediate feedback loops and adaptive process control on the jobsite.

While such innovations signal a technical breakthrough, their successful integration into daily construction operations is far from automatic. As Linderoth (2017) explains, the adoption of digital tools is shaped not only by their functional capabilities but also by how organizational actors make sense of them within institutional and practical contexts. This sensemaking process influences whether tools intended for real-time insights are genuinely leveraged to support decision-making or remain underutilized despite their potential.

This concern is echoed in the findings of Jacobsson and Linderoth (2012), who identify a pattern of passive engagement with digital technologies among construction professionals. Many users perceive existing ICT systems as sufficient and are reluctant to explore more advanced solutions, thereby limiting the industry's progression toward fully data-informed practices. Such resistance can significantly undermine the transformative potential of real-time analytics, especially when digital literacy or perceived relevance is low.

Despite these organizational barriers, Whyte (2019) offers a more optimistic view by showing how digital information flows are reshaping project delivery models. She emphasizes that when project teams are embedded in data-rich environments, they gain enhanced visibility into ongoing operations, which supports predictive management and reduces uncertainty. This perspective illustrates the broader strategic implications of digitalization: beyond its technical applications, real-time analytics can reconfigure how construction projects are conceived, coordinated, and controlled.

2.9.2 Greater Emphasis on Early Planning and Design for Productivity

A growing body of research underscores the importance of embedding productivity considerations at the earliest stages of construction projects. Fox et al. (2001) provide a foundational perspective, demonstrating that the adoption of a “design for manufacture” (DfM) approach during planning and design enables more efficient project delivery. By addressing construction constraints and assembly methods upfront, their study shows that the need for complex on-site problem-solving is significantly reduced, thereby promoting smoother execution and faster project completion.

Building on this rationale, Lu et al. (2020) further emphasize that productivity gains in construction are closely tied to early integration of Design for Manufacture and Assembly (DfMA) strategies. Their analysis reveals that methods such as modularization, standardization, and design simplification are most effective when embedded during the initial design phase. These early decisions lead to streamlined on-site processes and reduced construction time, whereas delayed implementation diminishes their potential impact. The authors argue that the full benefits of DfMA can only be realized when design is approached with productivity as a central objective from the outset.

Adding another dimension to this discussion, Gao et al. (2018) highlight the detrimental effects of fragmented project phases and reinforce the value of early collaboration between designers and constructors. Their findings show that aligning design intentions with construction goals at the beginning of the project not only improves constructability but also enhances overall productivity. This approach is particularly effective in projects involving standardized or repetitive building types, such as housing, where lessons learned can be readily transferred to future projects.

2.9.3 Holistic Performance Metrics: Beyond Traditional Productivity

The construction industry's traditional focus on labor and cost efficiency has long shaped how productivity is measured. However, this narrow view is increasingly being challenged by the complexity of modern projects and the growing demand for sustainable outcomes. Fulford and Standing (2014) argue that these conventional metrics fail to capture the broader dynamics required for delivering value in today's construction environment. Their study highlights how fragmented communication and isolated roles within project teams limit overall performance. They propose that productivity should be understood within a more holistic framework-one that emphasizes collaboration, integration, and systems thinking across all phases of a project.

Building on this perspective, Felicioni et al. (2023) provide evidence that the industry is already moving toward more comprehensive evaluation frameworks. Through their review of building rating systems, they reveal a clear trend toward incorporating sustainability and resilience as integral aspects of project performance. These systems assess not only environmental impacts such as carbon emissions and energy use but also the adaptability and long-term viability of buildings. Their findings suggest that these broader criteria are becoming essential components of how success is defined in construction.

2.9.4 Cultural Change: From Compliance to Continuous Improvement

Digital transformation (DT) in the construction industry is increasingly recognized as a catalyst for significant organizational changes. Samuelson and Stehn (2023) emphasize that DT requires modifications in organizational structures and processes, highlighting the necessity for companies to adapt to new digital tools and workflows to enhance efficiency and value creation. Their proposed framework underscores the importance of strategic responses and structural changes to facilitate DT.

In the context of Sweden's precast concrete sector, Shehu et al. (2025) explore the adoption of digital tracking technologies, identifying systemic barriers such as high investment costs, fragmented infrastructure, limited knowledge, and cultural resistance. Their study suggests that overcoming these challenges is essential for the successful implementation of digital tools, which can lead to improved operational efficiency and alignment with circular economic objectives.

2.9.5 Potential Game-Changers: Automation and Robotics

Barbosa et al. (2017) identify automation and robotics as pivotal opportunities for reversing the longstanding productivity stagnation in the construction industry. Technologies such as robotic bricklayers, 3D-printed structures, and autonomous machinery are highlighted as solutions capable of delivering transformative gains. Unlike traditional, incremental improvements in labor efficiency, these innovations promise significant leaps in productivity by streamlining processes, reducing manual labor, and accelerating project timelines. This potential is particularly relevant in high-cost labor markets like Sweden, where the financial incentive to automate is especially strong.

While full-scale automation is not yet prevalent across the sector, Barbosa et al. (2017) note that several construction tasks are already being automated, signalling a shift that could redefine how productivity is monitored and optimized. In this emerging context, the role of productivity follow-up may move away from tracking human performance and instead focus on the operational metrics of machines-such as uptime, production output, and integration with human-operated systems. This shift represents a broader rethinking of construction workflows, where technology and human oversight are increasingly interdependent.

However, realizing the full benefits of automation requires more than just adopting new tools-it demands a cultural and organizational readiness to embrace change. Jacobsson and Linderoth (2012), in their study of Swedish construction companies' attitudes toward information and communication technologies (ICT), highlight a generally conservative mindset and limited enthusiasm for technological disruption. While their research does not address robotics specifically, it underscores a critical barrier: even when advanced tools are available, their impact depends heavily on how they are received and utilized by industry professionals.

2.10 Opposing Viewpoints and Debates

While there is broad agreement that improving productivity in construction is desirable, the literature also presents opposing viewpoints and debates on several aspects of productivity follow-up. It is important to critically examine these, as they highlight uncertainties and potential downsides that need to be managed.

2.10.1 The Measurement Debate: Are We Measuring It Right?

The construction industry has long faced criticism for its seemingly stagnant productivity, especially when compared to sectors like manufacturing. However, recent scholarly work challenges the accuracy and fairness of this narrative by questioning the validity of the productivity metrics themselves. At the heart of this debate lies a growing recognition that conventional measurement tools may not adequately capture the complexities and realities of construction work.

Fulford and Standing (2014) argue that traditional productivity metrics are poorly aligned with the construction sector's inherently project-based and highly variable nature. Unlike manufacturing, which benefits from standardized processes and consistent outputs, construction projects are characterized by unique conditions, varying scales, and site-specific challenges. These factors make the application of uniform performance indicators problematic, often leading to misleading evaluations of productivity. Fulford and Standing emphasize the need for more context-sensitive tools and collaborative practices that better reflect the fragmented and customized nature of construction operations.

Supporting this concern, Nilsson et al. (2019) provide empirical evidence from road maintenance projects, where productivity was assessed using cost per square meter within public procurement contracts. Their findings demonstrate that conventional metrics can obscure significant project-level nuances, such as procurement strategies and organizational inefficiencies. This case study highlights the broader limitations of applying generalized productivity measures across a sector where project characteristics differ substantially, even within sub-domains like infrastructure.

Further complicating the picture, Yi and Chan (2014) conducted a systematic review of labor productivity research in the construction field, revealing substantial inconsistency in how productivity is defined and measured. Their analysis suggests that perceived productivity declines may be more reflective of data fragmentation and methodological flaws than actual inefficiencies. According to their findings, the lack of standardized frameworks and comparable data undermines the reliability of existing productivity assessments, reinforcing the argument that current measures fail to present an accurate depiction of performance in construction.

While these critiques highlight the shortcomings of current measurement practices, Barbosa et al. (2017) take a more cautious stance. Acknowledging the imperfections in existing data, they argue that the persistent and well-documented productivity gap between construction and other sectors cannot be dismissed outright. Even if the metrics are flawed, the consistency of the trend across time and regions points to structural inefficiencies that warrant serious attention.

Their position suggests that rather than abandoning current metrics entirely, the industry should work towards refining them to better align with construction's unique conditions.

2.10.2 Focus on Productivity vs. Focus on Value and Quality

In the construction industry, the pursuit of productivity is often treated as a primary objective. However, Ghodrati et al. (2022) caution that strategies aimed solely at boosting output can lead to unintended and counterproductive consequences. Their study reveals that when productivity is prioritized through acceleration of work processes, it often results in excessive productivity pressure (PP) on labourers. This pressure encourages risk-taking behaviours that compromise safety and increase the likelihood of defects, ultimately necessitating costly rework. Such outcomes undermine both the actual efficiency of construction processes, and the overall value delivered to clients, suggesting that a narrow focus on speed may be detrimental rather than beneficial.

To address these challenges, a more balanced and human-cantered approach to productivity has been proposed within the Lean construction framework. Ljungblom and Lennerfors (2021) emphasize the Lean principle of "Respect for People" as a vital counterweight to overemphasis on output metrics. They argue that recognizing and valuing workers' craftsmanship fosters an environment of trust, collaboration, and continuous improvement. Rather than pushing for productivity in isolation, this perspective encourages conditions that support sustainable performance and high-quality outcomes. By embedding respect into organizational culture, projects are more likely to achieve lasting value beyond immediate production targets.

2.10.3 Efficacy of Lean Construction: Mixed Evidence

Lean construction is frequently promoted as a best practice for improving efficiency, reducing waste, and enhancing project outcomes. However, a closer examination of the literature reveals that its effectiveness in real-world construction environments is far from universally demonstrated. Instead, studies highlight a pattern of inconsistent results, with some implementations yielding limited benefits or even proving counterproductive.

For instance, Kifokeris and Koch (2020), in their review of lean practices in Sweden over the past decade, found that although tools like the Last Planner System have been widely adopted, they are often applied superficially. Rather than driving substantial process improvements, these tools were sometimes used as formalities, checklists were completed, and meetings were held, but without meaningful engagement or impact on productivity. This points to a disconnect between the adoption of lean methods and their intended outcomes, often stemming from a lack of comprehensive understanding or commitment.

Adding a more critical dimension to the discussion, Green (1999) questions the very suitability of lean for construction. Although their research was done in 1999, He argues that lean's origins in manufacturing make it a poor fit for the fragmented, one-off nature of construction projects. Green warns that in some cases, the adoption of lean may serve more as a rhetorical device than a practical solution, masking deeper problems rather than addressing them. His critique highlights the ideological risks of adopting

This issue of implementation is later echoed in the work of Höök and Stehn (2008), who investigated lean principles within the context of industrialized housing production. Their findings emphasize that lean is not merely a set of tools, but a management philosophy that requires deep cultural change. Without this foundational shift, they argue, efforts to apply lean tend to remain at the surface level, leading to minimal or no improvements. Like Kifokeris and Koch, they suggest that without internalizing the principles behind lean, organizations are unlikely to realize its promised benefits.

Further reinforcing these concerns, Azizi and Taghavi (2023) identify organizational barriers and cultural misalignment as key reasons why lean initiatives often fall short. Their literature study points out that lean cannot succeed as a stand-alone set of practices; instead, it must be fully integrated into the wider organizational framework and supported by sustained leadership and strategic alignment. When lean is introduced without such systemic support, its potential impact is significantly diminished.

2.10.4 Transparency, Data Sharing Concerns and AI

Transparency in data sharing continues to pose significant challenges to productivity improvement within the construction industry. One core issue lies in the lack of standardized measurement approaches, which obstructs meaningful performance comparisons across firms and regions. As noted by Kapelko, Horta, Camanho, and Oude Lansink (2015), variations in input-specific productivity metrics hinder consistent industry-wide assessments, thereby limiting opportunities for benchmarking and targeted improvement. This limitation is compounded by organizational reluctance to share performance data. Dave and Koskela (2009) highlight that companies often fear misinterpretation of shared data, especially when contextual nuances are ignored, which may expose them to reputational risks or competitive disadvantages.

In addition to these concerns, technical fragmentation across digital systems presents another obstacle to transparency. Zhang et al. (2013) emphasize that the absence of standardized digital infrastructures hampers effective data exchange and automated processes, which are essential for collaborative productivity management. Furthermore, the perception of data as proprietary knowledge further restricts openness. According to Love, Matthews et al. (2014), many firms consider productivity-related information a strategic asset, making them hesitant to disclose internal practices or performance outcomes.

2.10.5 Is Productivity Improvement the Key Priority?

The role of productivity improvement in the construction sector has become a focal point of debate, particularly as stakeholders seek to identify the most effective levers for transformation. Two key sources-SOU 2012:39 and Barbosa et al. (2017)-offer critical insights from both Swedish and international perspectives, helping to frame this question within a broader industry context.

From a Swedish standpoint, SOU 2012:39 emphasizes that while on-site productivity is important, it is not the sole or even primary factor behind high construction costs. The report highlights that market conditions-such as limited competition (oligopoly), escalating land prices, and regulatory complexity-are substantial contributors to inefficiency in the sector. As a result, productivity measures alone are unlikely to yield significant cost savings unless these structural issues are also addressed. This suggests that in the Swedish context, treating productivity as the top priority may overlook more fundamental problems embedded in the market and governance systems (Statens offentliga utredningar, 2012).

In contrast, Barbosa et al. (2017) present a more global and systems-oriented argument in favour of prioritizing productivity. They identify construction as one of the world's least productive sectors and argue that addressing this gap is essential for unlocking broader improvements. Their research underscores the importance of enhancing labor efficiency, digitizing processes, and improving project coordination. Crucially, they position productivity not as a competing goal to innovation or reform, but as a foundational step that enables them.

In this view, productivity is a catalyst for transformation, without which other reforms may underperform or stall (Barbosa et al., 2017).

Bringing these perspectives together, it becomes clear that productivity improvement can indeed be a key priority-but only when approached with contextual awareness. While Barbosa et al. (2017) make a compelling case that productivity is essential to driving global industry transformation, SOU 2012:39 reminds us that productivity gains must be integrated with structural reforms to have lasting impact, particularly in markets like Sweden. Thus, productivity should not be pursued in isolation but rather aligned with efforts to address deeper systemic barriers.

2.11 Artificial Intelligence in Scandinavian Construction: A Critical Review of Productivity, Trust, and Governance

The rise of AI and data-driven tools in construction is reshaping how project stakeholders share information, establish trust, and exercise control over processes (Lidelöw et al., 2023). Nowhere is this more evident than in Scandinavia's construction sector, where a strong emphasis on transparency and collaboration is met with evolving concerns about data sharing and digital governance (Hummel et al., 2021). Key themes include the pivotal role of clients in driving digital adoption, the challenges of data security and legal frameworks, and the importance of return on investment (Bang & Olsson, 2022).

2.11.1 Clients as Drivers of Digital Adoption

The adoption of Artificial Intelligence (AI) technologies in the Architecture, Engineering, and Construction (AEC) industry is increasingly shaped by the influence of demand-side actors, particularly clients. Scholarly research highlights that while AI adoption is often approached from a technological or organizational lens, the role of clients as external drivers is gaining prominence in the literature.

Regona et al. (2022), in a comprehensive PRISMA-based review, identify fragmented project structures and inconsistent data practices as key obstacles to AI integration in construction. Although their analysis does not directly isolate clients as a singular factor, they emphasize the importance of cohesive stakeholder engagement in mitigating these challenges. The authors suggest that clients, especially public sector clients, have a unique capacity to mandate better data governance and to specify AI-supported deliverables, thus establishing foundational conditions for effective AI implementation. This implies that client organizations can catalyze

AI adoption by demanding systematic data acquisition, integration, and transparency from project participants (Regona et al., 2022).

Similarly, Bang and Olsson (2022) conduct a systematic scoping review of AI applications in construction projects, revealing that the current research landscape remains largely focused on technological applications and algorithmic performance. However, they explicitly call for more empirical studies into stakeholder influence, particularly the role of clients in shaping AI uptake. The authors note that client expectations and procurement practices can significantly influence which AI technologies are prioritized, suggesting that project owners who integrate AI-related goals into tendering criteria or performance benchmarks may effectively steer innovation adoption at the project level (Bang & Olsson, 2022). sometimes create tension with contractors who perceive these technologies as instruments of surveillance or rigid control (Melin et al., 2023). Thus, while clients in Scandinavia are instrumental in shaping digital trajectories, their influence is double-edged. They can drive innovation but may also inadvertently undermine trust if AI systems are imposed without sufficient stakeholder engagement.

2.11.2 Data Security, Sovereignty, and Legal Barriers

As AI-driven data sharing becomes more prevalent, concerns about security, data sovereignty, and legal liabilities have come to the forefront. The construction industry has traditionally been cautious about sharing project data, and recent studies confirm that fear of data misuse and regulatory hurdles are significant barriers to digital transformation. In a survey of construction supply chains, Singh et al. (2023) found that cybersecurity threats and privacy issues rank among the top impediments to AI adoption, including risks such as hacking, data breaches, and privacy intrusion. Companies worry that increasing transparency through cloud-based AI systems could expose sensitive project information or personal data, potentially conflicting with strict European data protection laws. In Scandinavia, where regulations like the EU General Data Protection Regulation (GDPR) are strongly enforced, firms are especially mindful of data sovereignty, that is, ensuring that project data (such as building models or sensor outputs) remains under authorized control and within jurisdictional boundaries. Legal scholars note that uncertainties over who owns and controls digital construction data can slow down collaboration. For instance, BIM-enabled projects blur traditional lines of intellectual property and responsibility, raising questions such as: Who is liable if an AI algorithm in design software produces a flawed recommendation? Who “owns” a shared 3D model, or the big data generated on a smart construction site? Without clear answers, stakeholders may be reluctant to fully trust and use these shared digital resources. Another critical barrier involves the contractual and legal frameworks needed to govern AI and BIM use. Conventional construction contracts did not envision data-centric collaboration and adapting them has proven complex.

A comprehensive legal review by Fan et al. (2018) highlights several challenges, including the need to redefine roles and standards of care when BIM and digital tools are used across multiple organizations. The study found that new contract clauses are often required to address data quality assurance and compliance, such as assigning responsibility for auditing and validating AI-generated outputs. In Scandinavia, public clients have begun to include data-sharing requirements and liability clauses in procurement contracts, but navigating these new legal waters requires caution. Researchers emphasize that trust is pivotal: stakeholders must trust that shared data will be secure and not opportunistically used against their interests, and they need confidence that legal agreements will protect them if something goes wrong. Lack of trust among project participants, whether it concerns data security or fear of blame, can thus undermine data-sharing efforts. Indeed, studies of digital innovation barriers frequently cite low trust and poor data governance as reasons firms hold back from full transparency (Singh et al., 2023; Fan et al., 2018). Overall, ensuring robust data security and clear legal frameworks is essential in Scandinavia's highly collaborative construction culture. By addressing these issues, through cybersecurity measures, data agreements, and updated laws, the industry can alleviate fears, thereby strengthening trust in AI tools and allowing stakeholders to relinquish some control to automated systems without feeling vulnerable.

In the Scandinavian context, particularly Sweden, the legal challenges associated with BIM adoption are further complicated by the lack of standardized contractual frameworks that address the nuances of digital collaboration. A study by Ussing et al. (2016) highlights that in Denmark, existing laws are individualistic, whereas BIM promotes a collectivistic approach, leading to disputes over areas of responsibility, risks, and ownership of digital information. Similarly, in Sweden, the absence of clear legal definitions regarding the status of BIM models in contracts has been identified as a significant barrier to full adoption (Ussing, Svidt, & Wandahl, 2016). These challenges underscore the need for legal reforms and the development of standardized guidelines to facilitate the integration of BIM and AI technologies in the construction industry across Scandinavia.

Moreover, the concept of data sovereignty is particularly pertinent in the Scandinavian construction industry, where there is a strong emphasis on maintaining control over data within national jurisdictions. Hummel et al. (2021) conducted a comprehensive review of data sovereignty, highlighting the importance of meaningful control, ownership, and the articulation of data claims by various agents, ranging from individuals to countries. Their study underscores the challenges posed by new data-driven technologies, which, while offering significant benefits, also confront stakeholders with difficulties in retaining control over their data. This is especially relevant in the context of AI and BIM, where data is often stored and processed across borders, raising concerns about compliance with local data protection regulations and the potential for data misuse. Addressing these concerns requires the development of robust legal frameworks and data governance strategies that ensure data remains under authorized control and within jurisdictional boundaries, thereby fostering trust among stakeholders in the construction industry.

2.11.3 Return on Investment and Measurable Impact

The willingness of construction firms to embrace AI and transparent data-sharing depends on the demonstrated value. In an industry known for thin profit margins, any new technology is scrutinized for its return on investment. A common concern in recent research is that many digital innovations have unproven or hard-to-measure productivity impacts, which can erode stakeholder trust in their long-term worth. Singh et al. (2023) identify "unclear profits and advantages" as one of the top five factors hindering AI adoption in construction. In other words, if contractors and clients cannot clearly see how an AI application will improve schedule performance, reduce costs, or otherwise pay off, they are reluctant to cede control to automated processes. This echoes the findings of Lidelöw et al. (2023), who reported a notable gap between the expected benefits of BIM/digital tools often cited in literature and the realized benefits observed by Nordic companies in practice. Many Scandinavian firms have invested in BIM and project management AI with the hope of radical efficiency gains or lifecycle savings. However, interviews indicate that most realized benefits have been incremental, e.g. smoother coordination on a given project - rather than the sweeping productivity transformations often promised (Lidelöw et al., 2023). When benefits do not clearly materialize, it can undermine trust in both the technology and in the advocates (often management or clients) who pushed for its adoption.

To build confidence, researchers stress the importance of measuring and communicating the impacts of AI in construction. Case studies and reviews have started to document tangible improvements from digital tools: for instance, reductions in rework, improved on-site logistics, or faster decision-making cycles. Chowdhury et al. (2019) argue that providing evidence of such gains is crucial to "convince clients and contractors to invest in digital technologies" and thereby accelerate uptake (p. 583). In their review of digital productivity tools, they note that a clear business case, where upfront costs are justified by quantifiable returns like labor savings or fewer delays - greatly enhances stakeholders' willingness to adopt new systems (Chowdhury et al., 2019). In Scandinavia, some large contractors have begun developing key performance indicators (KPIs) to track digital tools' impact on project outcomes, reflecting a shift toward data-driven evaluation of innovation. This effort ties back into the theme of transparency: organizations not only need transparency in sharing project data, but also transparency in results - showing everyone involved how AI is contributing to productivity and project success. When the ROI is evident and distributed (for example, if both the client and contractors see gains), trust in AI-driven processes increases, and stakeholders are more comfortable relinquishing traditional control in Favor of data-guided decision making.

2.12 Conclusion

The literature unequivocally establishes that productivity follow-up is both conceptually endorsed and empirically underleveraged in Sweden's construction sector (Josephson & Saukkoriipi, 2007; Koch et al., 2020; Nilsson et al., 2024). While the availability of tools such as BIM, EVM, and the Last Planner System is well documented (Schimanski et al., 2020; Barbosa et al., 2017), their integration into routine project execution remains fragmented and culturally constrained (Jacobsson & Linderoth, 2012; Kifokeris & Koch, 2023). This disconnect is compounded by entrenched contractual models (Eriksson & Westerberg, 2011), limited incentive structures (Meng & Gallagher, 2012), and underdeveloped data ecosystems (Landin & Öberg, 2014).

Crucially, the field is divided on the adequacy of existing metrics and the cultural readiness for data-centric reform. While Fulford and Standing (2014) and Yi and Chan (2014) critique conventional productivity indicators as misaligned with the project-based and variable nature of construction, Barbosa et al. (2017) argue that the persistent lag observed across regions suggests deeper structural inefficiencies rather than simple measurement flaws. This unresolved tension, situated between perceived stagnation and contested methodologies, signals an urgent need for empirically grounded and context-sensitive frameworks. Additionally, emerging debates on artificial intelligence, trust, and data governance (Lidelöw et al., 2023; Hummel et al., 2021; Regona et al., 2022) make it clear that digitalization will not lead to substantial change unless it is accompanied by parallel adaptation in legal, organizational, and cultural systems.

This thesis responds directly to the structural gaps identified by Landin and Öberg (2014) and the integration challenges highlighted by Koch et al. (2020). It offers the first empirically grounded analysis of how productivity follow-up is practiced on the ground in large-scale Swedish construction projects. In doing so, it answers the call by Bang and Olsson (2022) for stakeholder-cantered investigations and builds on Jacobsson and Linderoth's (2012) critique of passive digital tool adoption. It emphasizes the organizational and interpretive practices that determine how follow-up processes take shape. Future research should prioritize longitudinal ethnographies of productivity routines (as proposed by De Waard & Kalkman, 2022), comparative assessments of contractual innovation (Kadefors et al., 2024), and governance models for artificial intelligence in monitoring systems (Fan et al., 2018). Advancing the field will require more than refining metrics. The real challenge lies in transforming how performance measurement is embedded within construction cultures and decision-making structures. The future of productivity improvement depends not only on better tools, but also on making those tools meaningful in everyday project life.

3 Methodology

3.1 Research Strategy

In this study, we followed a qualitative, inductive research strategy grounded in a constructivist-interpretivist paradigm to explore productivity factors within the Scandinavian construction industry. Our aim was to generate rich, context-specific insights by engaging directly with the experiences and perspectives of construction professionals. We used methodological triangulation to strengthen our findings, combining content analysis, thematic analysis, and grounded theory. Our data sources included academic literature, industry reports, and in-depth interviews, which gave us a well-rounded understanding of how productivity is perceived and managed in the field. To complement these insights, we also conducted a descriptive analysis of a Customer Relationship Management (CRM) dataset. Using Power BI, we identified recurring trends and practical challenges that added another dimension to our understanding. As we moved through the analysis, we applied grounded theory techniques such as constant comparison, theoretical sampling, and memo writing, which helped us develop a conceptual framework rooted in real-world experience. Surveys were deliberately excluded from the research design due to concerns about response bias, methodological inconsistency, and practical constraints typical in short-term academic studies. These limitations are discussed in detail in the following section. Throughout the process, we prioritized ethical research practices, including informed consent, anonymity, and strict confidentiality.

3.2 Justification for Methodology

In this study, we explored productivity factors within the Swedish and broader Scandinavian construction industry using a qualitative research approach grounded in a constructivist-interpretivist paradigm. This perspective assumes that reality is socially constructed and best understood through the meanings individuals assign to their experiences (Creswell, 2014). It aligns with our aim to understand how construction professionals perceive and influence productivity within a complex and evolving industry context. Given the exploratory nature of our research and the need to capture rich, context-specific insights, we adopted a qualitative, inductive research design. This allowed us to engage deeply with participants' experiences and interpret the meanings they attributed to productivity in their work environments (Merriam & Tisdell, 2016). To enhance the credibility, depth, and rigor of our findings, we applied methodological triangulation, which involves combining multiple qualitative methods to examine the same phenomenon (Carter et al., 2014; Flick, 2018; Patton, 2015). This approach helped us view the issue of productivity from different analytical angles and validate emerging insights across methods.

Furthermore, Surveys were deliberately excluded from this thesis due to methodological limitations that reduce their effectiveness in short-term academic research. First, surveys are prone to social desirability bias, where respondents may tailor their answers to appear favourable rather than truthful, especially on sensitive topics (Krumpal, 2013; Tourangeau & Yan, 2007). This undermines the reliability of self-reported data. Additionally, the mode of survey delivery can influence responses, with variations between online, telephone, and in-person formats complicating data interpretation (Kreuter et al., 2008). Time constraints typical of master's-level research also limit the ability to address non-response bias, which arises when certain demographic groups are underrepresented due to lower participation rates (Choi & Pak, 2005). These limitations are particularly critical in short-term studies where rigorous data validation, follow-up, and instrument testing may not be feasible. Consequently, surveys were deemed unsuitable for meeting the reliability and validity standards required in this research.

We began by conducting content analysis on selected academic literature, industry reports, and a set of initial interview transcripts. This helped us identify recurring terminology, core concepts, and prevalent discourse patterns related to productivity in construction. These findings informed the development of our interview guide and highlighted initial areas of inquiry. Next, we employed thematic analysis to examine the full set of interview data. This step enabled us to identify key themes surrounding productivity challenges, enabling factors, and industry-specific dynamics. By systematically coding and organizing participants' narratives, we gained a clearer understanding of how construction professionals conceptualize and respond to productivity issues in their daily practice.

To support our primarily qualitative approach, we also drew on a descriptive analysis of CRM data, which included around 27,000 recorded reclamation cases. Using Power BI, we explored the dataset to identify trends and recurring issues that could shed light on productivity challenges. This supplementary analysis added another layer to our understanding and helped us triangulate our findings by connecting real-world operational data with insights from our interviews and literature review. While the core of our strategy remained inductive and qualitative, this integration of quantitative data served to enrich and validate our interpretations (Creswell, 2014).

In the later stages of analysis, we incorporated grounded theory procedures to support the development of a data-driven conceptual framework (Charmaz, 2014). We engaged in theoretical sampling, iterative coding, constant comparison, memo writing, and pursued theoretical saturation to ensure that the emergent theory was grounded in participants' lived realities. This process concluded in the development of a framework that is further elaborated in the discussion chapter, where we link our findings to existing literature and practical applications.

3.3 Data Sources

3.3.1 Literature Review

We carried out a systematic literature review to support the research, with a particular focus on Scandinavian and broader European contexts. To make sure the review reflected the realities of the Swedish construction industry, we selectively included international studies that offered relevant conceptual or methodological insights that could apply to local practices. Our search was conducted using well-established academic databases, such as Scopus, Web of Science, and Google Scholar, as well as official repositories from government and institutional sources. Our primary aim was to include peer-reviewed journal articles published in recognized and high-quality academic outlets. We focused on studies that dealt directly with productivity follow-up in the construction industry. This included research on performance tracking systems, productivity measurement methods, and the use of digital tools for monitoring project outcomes. In some cases, we also considered literature that wasn't explicitly about productivity but still contributed to useful perspectives. For example, we included studies on digital transformation, artificial intelligence in construction, and modern project management approaches when they helped us better understand methods or concepts related to productivity tracking.

We paid particular attention to studies from Sweden and other European countries to highlight region-specific practices, regulations, and trends. In addition to academic sources, we included publications from national governments and the European Union when they provided reliable and policy-relevant information. A small number of reports from consulting firms like McKinsey & Company were also used, but only when their data-supported findings complemented academic research and provided meaningful insights into construction productivity.

There was one exception to our focus on peer-reviewed literature. In a specific part of the review, where we examined short-term trends in construction productivity over a defined period, we found very few peer-reviewed academic sources. To fill that gap, we included a limited selection of grey literature, mainly industry reports and market analyses. These were used only to give context about recent developments and were not relied on to support theoretical arguments or methodological decisions.

To maintain the overall quality of the review, we applied clear exclusion criteria. We left out non-peer-reviewed content like blogs, opinion pieces, and marketing material that lacked academic or institutional credibility. We also excluded unpublished work, pre-prints, including theses and masters'/PhD dissertations, to keep the review focused on rigorously vetted research. Studies that weren't related to construction or had no clear connection to productivity or project performance were not considered. Finally, we only included literature written in English or Swedish, and only if the full text was available and the methodology was clearly described.

3.3.2 Interview Data

Semi-structured interviews were conducted with professionals from a leading company in the Swedish and Scandinavian construction sector. Participants represented a broad range of roles and departments, including:

- Specialist Lead Planners
- Site Managers
- Cost Control Specialists
- Project Steering Specialists
- Aftermarket Specialists
- Site Supervisors
- HR specialists
- IT and Drone Manager Specialists
- Contracts Lead Specialists
- Lead Logistics Specialists.
- Project Managers.
- Project Development Managers.

All participant names and company-specific identifiers have been anonymized to maintain confidentiality. Respondents are referred to by role titles only.

Although the interviews followed a semi-structured format, the questions and topics were tailored to each participant's professional role, background, and area of expertise. This customization ensured that the insights gathered were both contextually relevant and rich in detail, allowing us to elicit the most meaningful data based on each individual's knowledge and responsibilities.

Despite this tailoring, a core set of approximately four standardized questions was consistently included in all interviews. These questions focused on productivity follow-up challenges, with the aim of enabling comparative analysis across roles. This approach facilitated the identification of recurring themes and systemic issues, which informed the synthesis and interpretation presented in the analysis and results sections.

Additionally, interviewees frequently offered referrals to colleagues better positioned to answer questions outside their domain, further enhancing the depth and accuracy of the data collected. This collaborative and dynamic interview process contributed to a more comprehensive understanding of productivity follow-up practices across the organization.

3.3.3 Data Set from CRM

Alongside the qualitative data we collected through interviews and observations, we also made use of a secondary quantitative data source: customer relationship management (CRM) data provided by the aftermarket department. This dataset included around 27,000 recorded cases related to different aspects of reclamation. We decided to include it to add another layer to our understanding. We mainly used the CRM data for descriptive analysis. With the help of Power BI, we explored the dataset to look for recurring themes, frequent challenges, and trends connected to productivity and service-related activities. Although we didn't carry out any statistical testing, the patterns we found in this data added valuable context to our qualitative findings and helped strengthen the overall analysis.

3.4 Analytical Framework

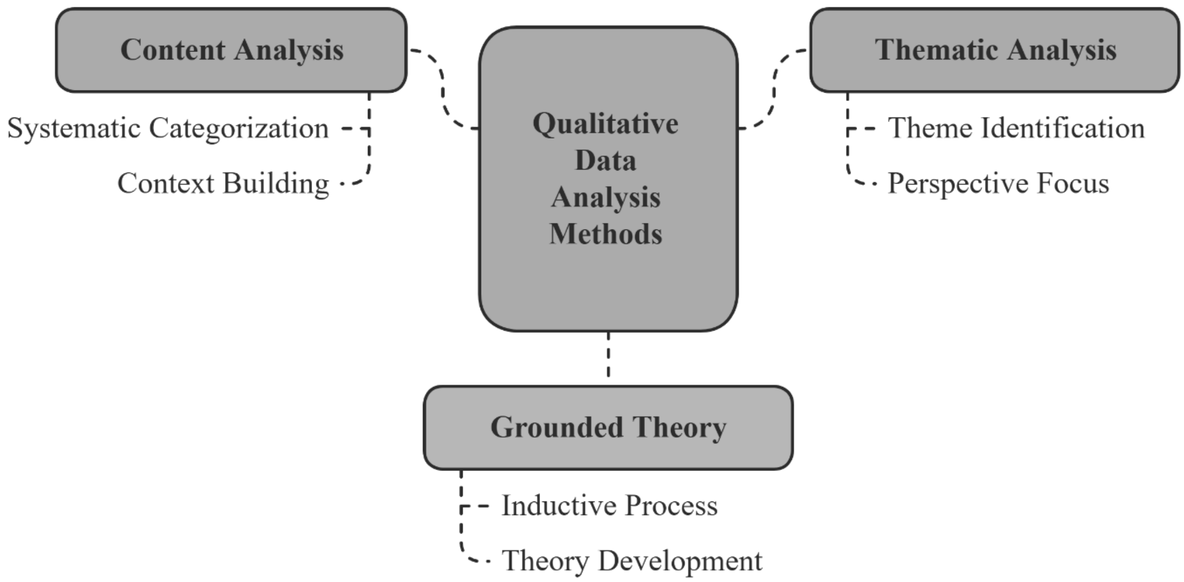

Figure 2 Analytical Framework

3.4.1 Content Analysis of Literature and Interview Data

We began our analysis with a qualitative content review of selected academic literature, industry reports, and a set of early interview transcripts. This phase was guided by Krippendorff's (2018) understanding of content analysis as a way to draw meaningful and consistent insights from texts by considering their broader context. Using this approach, we were able to identify recurring terms, patterns in language, and clusters of ideas related to productivity.

Following Schreier's (2012) model, we developed a coding frame that combined both inductive and deductive elements. Some categories emerged naturally from the data, while others were informed by themes found in existing literature. The coding process itself was iterative: we broke the texts into smaller, meaningful segments and assigned codes based on their underlying ideas. As we worked through the data, we regularly refined our categories to better capture the nuances we observed. Throughout, we made a conscious effort to maintain transparency and shared understanding in our coding decisions, to ensure consistency and strengthen the trustworthiness of our findings.

3.4.2 Thematic Analysis of Interview Data

After completing the content analysis, we moved on to a thematic analysis of the full set of interview transcripts, using the six-phase approach outlined by Braun and Clarke (2006). We started by immersing ourselves in the data, reading each transcript multiple times to become thoroughly familiar with the content. Next, we carried out a line-by-line initial coding process, where we noted down elements of the data that seemed particularly relevant to our research focus. These initial codes were then grouped into potential themes based on shared ideas and connections we noticed across the interviews.

We carefully reviewed and refined these themes to make sure they were internally consistent and truly reflected the data. Once we were confident in their clarity and coherence, we gave each theme a clear name and definition that tied back to our research aims. In the final step, we brought everything together into a structured narrative that directly responded to our key research questions.

Thematic coding was done manually to keep us closely connected to the data. This hands-on process encouraged a more reflective approach and helped us better understand the nuances in participants' responses (Schreier, 2012). We also made a point to constantly compare findings across different roles and cases, which helped ensure consistency in our analysis and gave us confidence in the themes that emerged.

3.4.3 Grounded Theory Procedures

To deepen our inductive approach and support the development of a data-driven conceptual framework, we used grounded theory methods following Charmaz's (2014) constructivist model. This included theoretical sampling, which helped us explore emerging ideas more thoroughly by identifying additional participants or sources when needed. We also engaged in memo writing throughout the process, which allowed us to document our interpretations and reflect on how our thinking evolved over time. Moreover, a central part of this approach was the constant comparison technique. We used it to examine patterns across different parts of the data, looking at both similarities and differences. This helped us refine our categories and gain a clearer understanding of what was taking shape in the analysis. We continued this process until we reached theoretical saturation, where new data no longer added meaningful or new insights. As a result, we aimed to co-construct meaning between researcher and participant, staying aligned with our interpretivist perspective. This approach made it possible for us to identify explanatory concepts that were closely tied to the real-world experiences of professionals in the construction industry.

3.4.4 Integration of CRM Dataset

To complement our mainly qualitative analysis, we also carried out a descriptive review of CRM data provided by the aftermarket department. This dataset included around 27,000 recorded cases (see Section 3.2.3). We used Power BI to explore the data and identify common patterns, frequent issues, and trends related to productivity in daily operations.

This CRM data supported our analysis in several ways. First, it allowed us to triangulate our findings by comparing actual operational trends with the themes that came out of our interviews. This helped strengthen the overall credibility of our interpretations (Creswell, 2014). Second, the data provided valuable context by offering real-world examples and measurable trends that either supported or challenged our qualitative insights. Finally, some of the patterns we noticed in the CRM data influenced our theoretical sampling decisions and helped us fine-tune the focus of our ongoing coding and analysis. While we did not use this data for statistical testing, the descriptive analysis added depth to our understanding of the broader operational environment. It also helped increase the practical relevance of the study’s conceptual findings.

3.4.5 Synthesis and Rationale

Bringing together qualitative content analysis (Krippendorff, 2018; Schreier, 2012), thematic analysis (Braun and Clarke, 2006), grounded theory methods (Charmaz, 2014), and a descriptive review of CRM data gave us a well-rounded and adaptable analytical framework. This combination of methods allowed us to look at our data from different angles and helped shape a grounded theoretical model based on real-world insights.

Using this mixed approach helped ensure the credibility of our findings. By engaging in reflexive and transparent coding throughout, we aimed to stay mindful of our own interpretations while staying close to the data. We also tried to be consistent in how we applied each method, which supported the dependability of the overall analysis.

Because our findings are rooted in both what participants shared and what the operational data revealed, we believe they offer a degree of transferability to similar contexts, especially within the Scandinavian construction sector. The use of multiple data sources and the ongoing process of comparing and validating insights helped strengthen the trustworthiness of the study.

Table 2 Content Analysis Table Overview

Productivity Factor	Frequency (across Interviews)	Example Contexts
Resource Constraints	12	Labor shortages for electricians and plumbers; logistical limitations in urban areas
Design Changes	11	Late client-driven modifications; budget not updated with revised drawings
Warranty Claims Management	9	HVAC system defects; water leaks; subcontractors reluctant to return post-handover

Example Table: *(Full table available in the appendix.)*

3.4.6 Field Observations

In addition to reviewing the literature and conducting interviews, we also carried out direct field observations to gain a more grounded and contextual understanding of productivity practices and challenges on active construction sites. We included this step to enrich our understanding of field practices and add depth to our findings, then follow it up with meaningful, informed discussion with our interview professionals. According to Creswell (2014) Observing real-world situations firsthand allows to triangulate across multiple sources and contributed to the overall credibility of analysis. These observations also helped us stay aligned with a grounded theory approach, as they gave us a chance to witness process-level behaviours and spot patterns that may not have come through in interviews alone (Charmaz, 2014).

We conducted three site visits, each with a slightly different focus. During these visits, we paid particular attention to planning routines, scheduling processes, and the kinds of obstacles teams faced during execution. Our goal was not just to confirm the themes that had emerged from our interviews and reading, but also to stay open to noticing unstructured or unexpected aspects, especially around issues like coordination breakdowns, delays, and productivity bottlenecks.

After each visit, we wrote up detailed observational notes. We focused on practical factors that seemed to affect productivity, such as how labor was allocated, how materials were moved and managed, how subcontractors interacted, and how tasks were sequenced on site. Being on-site gave us a clearer picture of how work unfolds and allowed us to see how theoretical ideas play out in practice. By combining interviews, literature, and field observations, we were able to build a more comprehensive and well-rounded view of productivity in the construction sector. This helped us capture not just what people said, but also what we could see happening in real time, which added another layer of insight to our findings.

3.4.7 Ethical Considerations

Anonymization: Removal of personal identifiers from all transcripts and data.

Confidentiality: Secure storage of data and aggregate-only reporting.

Informed Consent: verbal consent obtained from all participants to record the interviews, and all participants were informed how the data from recordings will be used by stating a pre-written statement.

"We would like to inform you that this interview will be recorded solely for the purpose of notetaking. The recording is strictly confidential and will be permanently deleted upon the completion of the data collection phase of the thesis. All personal and organizational identifiers, such as names of interviewees, project titles, or company names, will be removed during the data collection process to ensure anonymity. This information will not be shared with your employer or any third party. Please note that there are no right or wrong answers; we are interested in your personal insights based on your knowledge and experience. Your contribution is highly valued. If at any point you feel uncomfortable or prefer not to answer a question, you are free to skip it. We want to emphasize that your privacy and confidentiality are of the utmost importance to us."

Data Integrity: Triangulation ensured cross-validation of findings.

Use of Language Support Tools & LLM: No artificial intelligence tools were used in the design, execution, or analysis phases of this research. However, AI-based grammar and language editing tools were used to refine the final written text. These tools were applied solely to correct grammatical errors, punctuation, and phrasing inconsistencies that can arise when writing in English as a second language. At no point were AI tools used to generate original content or perform any analytical interpretation of data.

3.5 Limitations

3.5.1 Organizational Scope and Contextual Specificity

The study's empirical focus on a single, leading firm within the Scandinavian construction industry introduces inherent limitations to external validity. While this selection enabled in-depth organizational access and detailed insight into productivity practices, it also confines the generalizability of findings to contexts with similar institutional norms, regulatory frameworks, and corporate structures. This context-specific design supported the study's internal coherence and depth, but it restricts the transferability of results to broader international or multi-firm comparisons. To address this, the research emphasized analytic rather than statistical generalization and developed its conceptual contributions in terms of transferable processes and observed patterns.

3.5.2 Exclusion of Survey-Based Data Collection

Survey methods were intentionally excluded from the research design due to known issues such as response bias, limited reliability in self-reporting on sensitive topics, and feasibility concerns within the study's academic timeframe. While this decision supported the study's focus on depth and interpretive fidelity, it limited the potential to assess attitudinal prevalence or compare findings across a larger professional population. This trade-off was partially mitigated by triangulating themes emerging from qualitative interviews with operational trends observed in CRM data, thereby enhancing the reliability of insights through method convergence.

3.5.3 Temporal Constraints on Data Integration and Saturation

The study was conducted within the limitations of a master's thesis workload of 30 Higher Education Credits (HEC), spanning one academic semester. This restricted the possibility of extending data collection or conducting more longitudinal studies. Furthermore, the methodology incorporated multiple qualitative techniques, including content analysis, thematic analysis, field observations, and grounded theory procedures, the constrained academic timeline limited the extent of follow-up engagement and longitudinal tracking. For example, while theoretical sampling and constant comparison were used, the opportunity for repeated interviews or iterative data collection cycles was constrained. Additionally, the CRM dataset used for supplementary analysis was limited to cases recorded from Q1 2023 up to Q1 2025, excluding potential emergent trends. These limitations were managed by clearly bounding the temporal scope of the study and ensuring that thematic saturation was achieved within the available data.

3.5.4 Analytical Dependence on Manual Coding

All stages of thematic and content analysis were conducted manually to maintain a close, interpretive connection with the qualitative data. While this enhanced reflexive understanding and preserved the constructivist foundation of the research, it also introduced potential risks of subjective bias in coding and theme generation. No computational analysis tools or inter-coder reliability checks were employed, which may affect replicability. These concerns were addressed through iterative coding, detailed memo writing, and the use of constant comparative techniques to ensure conceptual coherence and analytical transparency throughout the process.

Taking into consideration the said limitations, the study’s conclusions should be interpreted as analytically rather than empirically generalisable. Recognising these limitations clarifies the situated nature of the research and strengthens its contribution to theory-building within comparable contexts. Future research may expand on this work by incorporating broader samples, longitudinal designs, or mixed-methods integration to extend its empirical reach

4 Data Analysis and Results

4.1 Introduction to the Chapter

This chapter presents the findings from the empirical investigation into how productivity follow-up is implemented and managed in Swedish construction projects. Drawing from qualitative interviews with professionals at a leading Swedish company in the construction industry, the chapter explores both the current practices and the key factors that influence their effectiveness.

The analysis is structured around the following main research question:

How is productivity follow-up currently implemented in Swedish construction projects, and what factors influence its effectiveness?

To support and deepen this inquiry, four sub-research questions were developed:

1. *What methods and tools are used for tracking productivity on construction sites in Sweden?*
2. *What challenges do project teams face when conducting productivity follow-up?*
3. *To what extent are digital tools and real-time data analytics being adopted to support productivity follow-up in Swedish projects?*
4. *How do organizational structures and roles (e.g., planners, cost controllers, subcontractors) influence productivity tracking?*

To address these questions, a thematic analysis was conducted using qualitative data from fifteen semi-structured interviews. The analysis followed an inductive coding process inspired by grounded theory (Charmaz, 2006) and thematic analysis guidelines (Braun & Clarke, 2006), allowing key patterns and themes to emerge naturally from the data. The inductive nature of the analysis ensured that the themes reflect the participants' perspectives without being constrained by pre-established categories.

Interview participants represented a range of professional roles, including lead planning specialists, cost control experts, project steering specialists, and aftermarket managers. All data were anonymized to protect both individual and organizational identities.

The analysis is presented across five thematic sections, each corresponding to one of the sub-research questions. Each section includes a brief thematic overview, illustrative quotes from participants, and an interpretation that links empirical insights with the broader academic and industry context. A concluding summary highlights the most significant findings, laying the foundation for the discussion in the following chapter.

4.2 Method of Analysis

The empirical data collected for this study was analysed using a thematic analysis approach, which served to uncover recurring patterns, concepts, and meanings within the interview responses. Thematic analysis was chosen for its flexibility and its ability to provide a rich and detailed, yet complex, account of qualitative data (Braun & Clarke, 2006).

The process was grounded in an inductive coding logic inspired by Charmaz's (2014) constructivist grounded theory, which emphasizes the co-construction of meaning between researcher and participant. Rather than applying pre-existing theoretical frameworks, the analysis allowed themes to emerge from the data organically, rooted in the experiences and expressions of the interviewees.

4.2.1 Coding Process

The analysis followed several iterative steps:

1. **Familiarization**: All interviews were transcribed verbatim and read multiple times to build familiarity with the content.
2. **Initial Coding**: Segments of text were manually coded line-by-line to identify significant statements, practices, and perceptions related to productivity follow-up.
3. **Focused Coding**: Initial codes were grouped into broader conceptual categories through constant comparison across transcripts.
4. **Theme Development**: Conceptual categories were further refined into overarching themes and subthemes, aligned with the research questions.
5. **Validation and Revision**: Themes were compared across interviews to ensure consistency and relevance, with several iterative refinements based on recurring patterns.

Manual coding was conducted without the use of computer-assisted qualitative data analysis software (CAQDAS). This decision was intentional to allow closer interaction with the raw data, promoting reflexivity and attention to nuance during the analysis.

4.2.2 Emerging Themes and Subthemes

The coding process led to the identification of four major themes, corresponding to the five sub-research questions. Each theme is composed of one or more subthemes that reflect distinct dimensions of the participants' experiences.

Table 3 Methodological Coding Process

Theme	**Subthemes**	**Illustrative Roles**
1. Methods and Tools for Productivity Tracking	Use of schedules, manual tracking tools, earned value metrics	Lead Planning Specialist, Project Steering Specialist
2. Challenges in Productivity Follow-Up	Lack of standardization, resource limitations, contract ambiguities	Cost Control Specialist, Aftermarket Manager
3. Adoption of Digital Tools and Real-Time Analytics	Current usage (Excel, PowerPoint, PowerProject), future potential (AI, BIM)	Planning Specialist, Steering Specialist
4. Influence of Organizational Roles and Structures	Role specialization, subcontractor coordination, absence of PMO	Planning Specialist, Cost Controller

5. Best Practices and Recommendations for Improvement	Lean approaches, early contractor involvement, standardized close-out planning	All roles

These themes serve as the foundation for the subsequent sections, where empirical findings are presented and analysed in direct relation to each sub-research question.

4.3 SRQ1-Methods and Tools for Productivity Tracking

This section addresses Sub-Research Question 1: What methods and tools are used for tracking productivity on construction sites in Sweden?

The findings reveal a combination of traditional manual methods and evolving digital tools employed by project teams to monitor productivity. Despite some advancements, the lack of standardized processes remains a major theme across participants' responses.

4.3.1 Traditional Tools and Manual Practices

Several interviewees indicated that productivity tracking in construction projects still heavily relies on manual and traditional tools. Lead planning and project steering specialists reported widespread use of Excel spreadsheets as the primary means of documenting completed quantities against planned activities. Weekly updates provided by site managers typically form the foundation of these reports. While Excel is often praised for its flexibility and ease of use, it lacks automation and integration with broader project management systems. In parallel, PowerPoint presentations are commonly utilized to visualize progress for senior management through milestone comparisons and simplified Gantt charts. These tools help create digestible overviews of project status, enabling senior stakeholders to quickly interpret key performance trends without delving into complex scheduling software.

This persistent reliance on conventional tools such as Excel and PowerPoint mirrors broader industry trends. The construction sector has historically favoured simple, adaptable tools over integrated digital platforms due to their low implementation barriers and familiarity among practitioners (Koch & Lundholm, 2018). However, this dependence often results in a superficial form of productivity tracking, where data is collected and reported but not systematically analysed or used for real-time decision-making (Landin & Öberg, 2014). In such cases, tracking becomes a procedural task rather than a dynamic management function, leading to missed opportunities for optimization.

While these tools can still serve useful communicative purposes particularly in facilitating stakeholder alignment (Shibeika & Harty, 2023) they are insufficient for supporting complex, multi-variable project environments where integration of time, cost, and scope data is essential. Literature increasingly emphasizes the need for transition toward digital platforms that offer real-time, data-driven oversight and predictive analytics (Barbosa et al., 2017). Nonetheless, resistance to change, legacy workflows, and lack of digital fluency remain significant obstacles to widespread adoption in the Swedish construction industry (Jacobsson & Linderoth, 2012). This gap between tool usability and strategic functionality underscores a central challenge in advancing productivity measurement from manual reporting toward integrated performance management.

4.3.2 Specialized Scheduling Software

Lead Specialist Planners highlighted the use of specialized scheduling tools to support planning and progress tracking. They noted that Powerproject is the predominant scheduling software currently in use, valued for its adaptability to construction projects. Similarly, Primavera P6 is also being introduced on larger-scale projects where more sophisticated scheduling and resource management are required. They explained, for instance, in a recent infrastructure project, Primavera P6 facilitated complex resource allocation and timeline adjustments, demonstrating its utility in managing intricate project dynamics. However, the use of such software often remains confined to the planning department rather than being fully integrated with cost control, procurement, or site management functions. This siloed application limits the potential for these tools to serve as real-time dashboards for productivity follow-up. Interviewees emphasized that while planners rely heavily on software like Powerproject, site teams often fall back on manual updates, Excel sheets, or verbal progress reports. Such disjointed workflows prevent the seamless integration of schedule, cost, and procurement data, resulting in a reactive rather than proactive management approach.

Academic literature supports these observations, indicating that a lack of integration between planning software and other project control functions undermines the effectiveness of digital tools in construction. Landin and Öberg (2014) argue that construction firms in Sweden often adopt digital tools in fragmented ways, leading to information silos and inefficiencies. Even when software is available, it is frequently underutilized due to insufficient standardization, weak cross-departmental collaboration, or organizational resistance to change. Jacobsson and Linderoth (2012) highlight that such resistance often stems from a lack of training, fear of change, and inadequate communication strategies, which impede the adoption of integrated digital solutions. Shibeika and Harty (2015) further emphasize that real productivity gains from digitalization are achieved only when tools are integrated across the project lifecycle and used to support real-time decision-making. This integration requires not only technical interoperability but also aligned processes between planning, procurement, and cost control. Without such integration, productivity follow-up remains disconnected from actual site conditions, and the opportunity to use software as a live dashboard capable of early deviation detection and adaptive planning is lost.

Despite these challenges, there are notable examples of successful integration. For instance, a Swedish construction company implemented an empowered collaborative planning method that combined scheduling, cost control, and procurement functions, resulting in improved efficiency and real-time decision-making capabilities. This approach involved collaborative planning workshops, integration of Building Information Modelling (BIM), and active participation from various stakeholders, leading to enhanced project outcomes (Viklund Tallgren et al., 2015). Such cases illustrate that overcoming organizational resistance and investing in comprehensive training programs can facilitate the effective adoption of integrated digital tools. Therefore, addressing the structural and cultural barriers to integration is essential for leveraging the full potential of specialized scheduling software in enhancing construction productivity.

4.3.3 Integration Challenges of Earned Value Management (EVM) in Construction Projects

Interviews with key personnel at a prominent construction company operating in the Swedish and broader Scandinavian markets reveal that the application of Earned Value Management (EVM) remains largely siloed within the planning function. Multiple planners and specialists consistently described how EVM tools such as the Schedule Performance Index (SPI) and Cost Performance Index (CPI) are not actively integrated with other essential departments like cost control, procurement, and site operations. A Specialist Lead Planner noted that although EVM is theoretically recognized as a standard performance tracking methodology, many practitioners either misunderstand it or implement it only in a limited fashion. Instead, they often rely on informal tools such as Excel-based trackers or PowerPoint dashboards, which lack dynamic, real-time feedback capabilities.

This compartmentalized use of EVM reflects broader challenges rooted in both organizational structure and training. Structurally, the absence of a centralized Project Management Office (PMO) means that project managers are often tasked with both delivering and controlling projects roles that are ideally separated for better oversight. In terms of training, many Swedish construction professionals remain unfamiliar with comprehensive EVM practices, or perceive them as overly complicated, leading to partial or failed implementations. Past negative experiences with EVM tools and resistance to standardized methodologies further compound the problem.

A concrete example illustrating the lack of integration comes from a recent large-scale public infrastructure project undertaken by the case company. During execution, the project scope evolved substantially after the design phase; however, the corresponding budget adjustments were not implemented in time. As a result, several critical path activities such as foundational concrete work and weather-sensitive installations experienced significant delays and cost overruns. These misalignments between planned scope, schedule, and budget demonstrate the consequences of operating without a fully integrated EVM framework.

These findings are consistent with observations in contemporary academic literature. Aramali et al. (2022) highlight the persistent disconnect between academic EVM frameworks and their practical implementation in the construction industry, noting that this gap impairs EVM's potential to serve as a robust project control mechanism. Similarly, Proaño-Narváez et al. (2022) argue that the comprehensive application of EVM integrated with cost control and scheduling is crucial for improving the accuracy of performance measurement and project oversight. Furthermore, Mayo-Alvarez et al. (2022) emphasize that EVM's integration with other project management methodologies can significantly enhance its utility in schedule performance monitoring and proactive control.

4.3.4 Challenges in Standardization of Methods

A consistent theme across all interviews with planning and cost control personnel at the leading construction company in the Swedish and Scandinavian region was the lack of a standardized system for productivity tracking across projects. Planning professionals, such as the Specialist Lead Planner and Project Steering Specialist, emphasized that productivity follow-up is carried out using disparate tools like Excel, PowerPoint, PowerProject, and Primavera. These tools are often tailored to individual preferences rather than guided by a unified organizational approach.

This fragmentation leads to inconsistent data formats, obstructs project-to-project comparability, and ultimately prevents organizational learning.

This perspective was reinforced by the Leading Logistics Specialist, who described the planning environment as historically fragmented, with each project operating in silos. Despite the presence of digital scheduling software, they noted that tools are often selected based on habit or local team dynamics rather than standardized policy. The interviewee highlighted that although there has been a decade-long effort to build a central planning support structure, including departmental representatives and standardized scheduling methodologies, its implementation remains uneven. As a result, productivity data is difficult to consolidate and leverage for broader insights across the organization.

Participants frequently pointed to the absence of a centralized repository for productivity metrics, echoing findings from academic literature. This deficiency hinders cross-project analysis and weakens data integrity, especially when attempting to compare planned versus actual performance. As noted by Elghaish et al. (2019), integrating Earned Value Management (EVM) within a unified digital ecosystem, such as through Building Information Modelling (BIM), can significantly enhance progress tracking by standardizing and automating key performance metrics. However, in the current decentralized context observed at the company, such integration remains aspirational rather than operational.

The interview with the Leading Logistics Specialist also underscored how cultural fragmentation and varying technical competencies exacerbate these challenges. Even within the same organization, differing levels of digital tool adoption and a lack of harmonized methods create inconsistency. The specialist noted that organizational learning is stalled because lessons from one project are often not transferable to others, as processes and data structures differ fundamentally. They stressed that continuous improvement is only possible once standardization is achieved, stating: “You cannot improve what’s not standardized.”

Interview data suggest that advanced methodologies such as EVM are significantly hindered by the absence of a company-wide productivity tracking framework. While Section 5.3.3 explored conceptual and organizational hurdles to EVM adoption, its inconsistent application across projects illustrates how non-standardized practices reduce the reliability of indices like the Schedule Performance Index (SPI) and Cost Performance Index (CPI). Literature supports this view. Vanhoucke (2011) and Zwikael et al. (2000) both argue that EVM becomes truly effective only when embedded within a structured, centralized data system, which enables early detection of cost and schedule deviations.

Currently, the lack of such standardization inhibits planners and cost controllers from performing cross-project benchmarking or integrating productivity insights into future estimates. As stated by the Leading Logistics Specialist, this results in a heavy reliance on individual judgment and informal feedback loops, often leading to duplicated inefficiencies and missed opportunities for systemic improvement. These practitioner insights are consistent with research that warns of the risks posed by fragmented practices, including diminished data reliability and reactive, rather than proactive, planning (Jørgensen & Emmitt, 2008; Hwang & Ng, 2013).

Hence, both empirical interviews and academic research converge on the conclusion that the absence of a centralized, standardized approach to productivity tracking is a significant barrier to operational efficiency, strategic planning, and long-term knowledge retention in the Swedish construction sector.

4.4 SRQ2-Challenges in Conducting Productivity Follow-Up

This section addresses Sub-Research Question 2: What challenges do project teams face when conducting productivity follow-up?

The analysis of the interviews revealed several recurring challenges impacting the effectiveness of productivity tracking. These challenges can be categorized into five main thematic areas: lack of standardization, cultural resistance, resource constraints, contractual ambiguities, and technological limitations.

4.4.1 Cultural Resistance to Structured Methodologies

Several participants emphasized a cultural inclination toward improvisation over structured project control methods. Interviewees from a leading construction company in the Swedish and broader Scandinavian region revealed a recurring theme: schedules and productivity tracking were frequently treated as secondary to immediate delivery pressures. For example, a senior planning expert highlighted that “whiteboard planning” and ad hoc schedule adjustments remain commonly used tools due to their perceived practicality, despite the company’s investment in digital systems. Another project steering specialist noted that site teams often prioritize task execution over standardized productivity tools such as Earned Value Management (EVM) or Lean-based planning systems. This cultural tendency is not isolated but reflects a broader industry norm across Swedish construction that favors operational flexibility over formal control systems. This often results in inconsistent or superficial application of available methodologies, a situation aligned with what Biesenthal et al. (2018) describe in their analysis of megaprojects: successful control practices must align with prevailing institutional norms, and rigid systems that lack contextual sensitivity tend to be rejected or only symbolically implemented.

This resistance is partly rooted in negative past experiences with overly complex control systems. Multiple interviewees pointed out that when structured methods like EVM have been trailed, they were often implemented with excessive granularity and limited user support. This led to user disengagement and scepticism toward structured project management tools. Where Sacks et al. (2017) made the theoretical case for culture and leadership as enablers of Lean-BIM synergy, Maraqa et al. (2021) demonstrated that synergy in practice, showing measurable performance gains only when those enabling conditions were met. Thus, the later study operationalizes and validates the earlier conceptual claims, marking a clear evolution from "what should be done" to "what works in practice". These observations align with Söderlund’s (2014) institutional perspective on Scandinavian construction practices, which he characterizes as “project pragmatism.” This term describes a normalized reliance on improvisational approaches rooted in the region’s historical preference for consensus-driven, decentralized governance structures. This cultural backdrop helps explain why standardized systems are frequently perceived as incompatible with on-the-ground realities, leading to ad hoc workarounds even when formal systems are available.

Further evidence of this pattern is found in Lindhard and Larsen’s (2016) study, which identifies that inefficiencies in construction projects are often due to inconsistent routines and planning misalignments, particularly in large, multi-actor environments. Their findings suggest that even when tools exist to support effective project control, their impact is diminished if they are not embedded into consistent, shared practices across teams. Although some organizations have achieved success with Lean and BIM frameworks, their implementation has typically been highly dependent on strong leadership and careful adaptation to the local context. Sacks et al. (2017) emphasize that without long-term cultural support and internal champions; digital and Lean systems fail to take root. This reinforces the idea that technology alone cannot overcome entrenched habits and institutional resistance.

4.4.2 Resource Constraints and Site-Specific Limitations

Insights from interviewees reflects in the situation of productivity follow-up on construction projects in Sweden, particularly in urban centres like Gothenburg, is significantly affected by practical site constraints and persistent resource limitations. They stressed that a common issue highlighted by planning and project control professionals is the acute shortage of specialized labour, including electricians, HVAC technicians, and mechanical installers. Consequently, they highlighted that this shortage becomes especially pronounced in large-scale or remote projects and further stressed that such scarcity undermines adherence to scheduled activity durations and diminishes the reliability of productivity tracking.

This is prevalent in the interview with the aftermarket specialists, one of the most critical consequences of the skilled labour shortage is poor execution on site, which directly increases the volume of reclamation cases. As stated in the interview, “Everything we do in aftermarket is a consequence of what wasn’t done right in production,” particularly due to execution faults and inconsistent installation quality. This is reflected in the data provided to us by aftermarket specialist database: *Installationer inomhus* (Indoor Installations) account for 10,197 out of 27,000 total reclamation cases, over 37.7%, highlighting the scale of impact from improperly executed technical installations like HVAC, electrical, and plumbing systems. The specialists argue that without qualified tradespeople, adherence to quality standards deteriorates, leading to costly aftermarket interventions that could have been prevented through better upstream execution and workforce planning. Furthermore, this problem extends beyond just the shortage of skilled labor and is explored in greater detail in Section 4.4.3.4, which connects the issue to broader concerns around *Quality and Productivity*. Furthermore, Section 4.5.2, titled *Fragmented Integration: Tools in Isolation*, highlights how disjointed digital systems and siloed workflows further compound the challenges, drawing a holistic picture connecting the shortage of labor to the issues discussed in this section.

While Sweden is part of a highly developed labour market, this challenge is far from unique to the region. Brucker et al. (2021) identify continent-wide labour shortages linked to demographic shifts, declining enrolment in technical education, and increasing system complexity. The literature stresses that these trends affect even advanced economies, aligning with practitioners’ observations from Sweden that qualified labour is increasingly difficult to source and retain, particularly for technically demanding trades.

Furthermore, the effectiveness of productivity tracking is hampered by how project teams respond to these labour gaps. In the absence of centralized systems or standardized tracking frameworks, as detailed under RQ1, interviewees emphasised that many teams adopt informal or improvised methods to adjust schedules and report progress. Although these ad-hoc responses are often necessary to meet short-term deadlines, they compromise data consistency and obscure long-term performance trends.

Importantly, recent insights from human resource specialist's interview in Sweden's construction sector indicate that labour constraints extend beyond tradespeople to include white-collar professionals such as site managers, quality engineers, and supervisory staff. They stressed that even within this segment, the shortage is not merely in numbers but in the availability of experienced personnel, particularly those familiar with complex urban infrastructure projects. Moreover, the interviewee highlighted that while entry-level candidates are more readily available, firms often settle for "workable" hires over ideal fits due to recruitment urgency and geographic limitations, challenges that resonate with the logistical bottlenecks already facing urban projects like those in Gothenburg.

This informal mode of operation reflects a systemic challenge that extends beyond Sweden. Das (2023), studying urban project environments in the Global South, describes how project management practices often evolve into what he terms "anti-planning" behaviours, reactive, fragmented, and driven by necessity rather than formal methodology. Surprisingly, findings from interviews highlighted that these dynamics find resonance in Sweden's highly developed construction sector. Despite its advanced infrastructure and digital capabilities, the Swedish context mirrors some of the improvisational behaviours described by Das, particularly in high-pressure urban projects where logistics are complex and workforce supply is inconsistent. The parallel suggests that contextual pressures, such as site congestion, contractual fragmentation, or regulatory inflexibility, can drive even mature systems toward reactive and informal planning cultures.

An Interview from a construction site in the heart of Gothenburg revealed that this situation is further compounded by logistical constraints in dense urban areas in Sweden. Additionally, the interviewee stressed that rigid site conditions, including limited access, storage space, and transport bottlenecks, exacerbate the impact of labour shortages; Thus, these limitations force teams to continuously revise schedules and workflows, often without integrating changes into a broader data environment. As Hasan et al. (2018) emphasize, poor coordination and inadequate planning remain key global drivers of productivity loss, regardless of project location.

4.4.3 Contractual Ambiguities and Weak Incentives

4.4.3.1 Misaligned Incentive Structures and Their Practical Consequences

The Swedish construction sector, encompassing both public and private actors, has long depended on fixed-price contracts as a primary delivery model. However, Eriksson and Westerberg (2011) argue that these contracts often fail to reward above-minimum performance, discouraging innovation and productivity. These concerns are echoed by the Contracts Specialist, who described early collaborative contract implementations that used a 50/50 cost-sharing structure, where contractors kept 50% of cost savings and bore 50% of any overruns.

According to the Contracts Specialist, this rigid formula led to several unintended consequences. Contractors inflated budgets to protect against risk, trust eroded, and collaborative behaviours were replaced by defensive tactics. He cited a major infrastructure project, the WestLink (Västlänken), as a representative example where this model contributed to early-phase tension and breakdowns in cooperation. While that project later improved after revisions, its initial issues illustrate a broader pattern within Swedish contracting culture.

To correct these misalignments, the Contracts Specialist described how some projects have since adopted a more flexible 80/20 incentive model. This version reimburses contractors for 80% of budget overruns and awards them 20% of cost savings. He emphasized that this format was "significantly more realistic" and led to improved outcomes by preserving the incentive for efficiency while reducing risk exposure. Though still unevenly adopted across Sweden, this shift signals growing sectoral awareness of the need to better balance risk and reward.

4.4.3.2 The Fragility of Collaborative Culture: The Critical Role of Early Engagement

Collaborative contracting models, such as Early Contractor Involvement (ECI), are designed to foster mutual trust through structured cooperation in the project's early planning phase, known as Phase 1. During this stage, stakeholders jointly define the project scope, technical solutions, and budget before entering Phase 2, the construction stage.

However, the Contracts Specialist stressed that collaboration is not automatic. He warned that when clients fail to actively engage during Phase 1, the relationship often deteriorates during execution. This observation aligns with findings by Lahdenperä (2012) and Eriksson and Westerberg (2011), who emphasize the importance of sustained stakeholder involvement.

Again, referencing the WestLink project, the Contracts Specialist noted that its early struggles were not solely contractual but also cultural. Weak client presence in Phase 1 contributed to poor alignment, disputes, and strained collaboration. Only after contractual redesign and increased engagement did performance begin to improve.

In contrast, the Contracts Specialist highlighted a smaller tunnel repair project in Gothenburg that succeeded due to consistent client involvement and jointly developed expectations. He offered this comparison to demonstrate that while project size matters, it is cultural commitment and early-stage alignment that ultimately determine success. This is an insight applicable across Sweden's construction market.

4.4.3.3 Transparency and the Practical Limits of Open Book Accounting

Open book accounting is often championed as a transparency-enhancing feature of collaborative contracts. However, the Contracts Specialist provided a more nuanced view, explaining that its practical application is riddled with limitations. While basic project costs, such as labor and materials, are generally disclosed, contractors frequently withhold supplier discounts or volume rebates due to commercial confidentiality concerns.

To manage this tension, the Contracts Specialist described how some contracts now allow partial transparency by setting a standard markup (typically 8–10%) for indirect costs and profits. This compromise, he noted, adds predictability but can also limit the flexibility and trust that open book models are meant to support. He cautioned that without shared definitions of transparency and accountability; open book practices may "create an illusion of openness rather than true collaboration."

This insight contributes to a broader understanding across the Swedish sector. While transparency is essential, it must be balanced with business integrity and operational realities. In other words, effective open book accounting requires trust, boundaries, and mutual safeguards, a lesson increasingly recognized but not yet consistently implemented.

4.4.3.4 Quality and Productivity: The Overlooked Connection

Both the Contracts Specialist and the Aftermarket Specialists independently highlight a systemic weakness in the contractual enforcement of quality standards, which manifests as recurring and costly reclamations after project handover.

The Contracts Specialist emphasized that construction contracts in Sweden prioritize cost control and deadline adherence, often at the expense of long-term quality. He reported that rework, poor site oversight, and lack of embedded quality metrics contribute significantly to productivity losses. Yet contracts rarely incentivize proactive quality assurance or reward high standards. As he put it:

"Unlike other industries, we tolerate too much waste"

Calling for a fundamental shift in how quality is integrated into project evaluation. This concern is validated by recent data: there have been 27,000 reclamation cases, from Q2-2023, to Q1-2025, with 10,197 (approximately 38%) relating to indoor installations (Installationer inomhus), a highly complex system where execution quality is critical. Other significant categories include interior walls (Invändig vägg) with 4,284 cases, and facades (Fasad) with 3,211 cases. These three categories alone account for over 65% of the total reclamation volume, underscoring the prevalence of quality issues in technically demanding areas.

In direct alignment, the Aftermarket Specialists reveal the downstream consequences of this contractual oversight. They report that most post-handover issues are not due to faulty products but are rooted in execution errors, poor inspection, and inadequate installation standards. These issues, especially in complex systems such as indoor installations, interior walls, and facades, often emerge only after handover, when end-users begin interacting with the systems. By then, accountability is fragmented, and the burden of troubleshooting falls on the aftermarket team.

Critically, the aftermarket team points out that construction contracts frequently lack enforceable quality clauses. This legal and procedural gap allows contractors to deliver just the minimum standard, leading to a *"legal and operational void"* in which responsibility is blurred, and reclamation costs escalate. Their experience confirms that many of these faults are systemic and preventable, had performance expectations and lifecycle quality measures been embedded contractually from the beginning.

The most affected product types also reflect this dynamic. Multi-family residential buildings (Flerbostadshus) alone account for 63.45% of the total cases (17.13K), followed by Hospitals (Sjukhus) with 19.49% and educational buildings (Skolor/Utbildning) at 4.64%, further indicating that issues concentrate in large-scale, complex facilities.

To address this, the Aftermarket Specialists have taken proactive steps to inject their insights upstream. This includes collaborating with vendors, developing installation protocols, and contributing to platforms for quality knowledge sharing. They have even attempted to influence contracts at the project start, by reinforcing quality clauses and drawing from previous fault patterns. However, these efforts remain voluntary, decentralized, and inconsistently adopted, as there is no institutional requirement to integrate aftermarket input into the contracting process. These remarks echo findings by Landin and Öberg (2014), who argue that traditional productivity metrics fail to capture rework and operational excellence. The Contracts Specialist pointed to Finland's alliance contracts as a positive counterexample. They include structured, continuous quality dialogues, shared accountability, and aligned incentives. By embedding quality objectives into the core of contractual relationships, Finnish projects avoid many of the coordination failures observed in Sweden.

Table 4 CRM Data Extract 1

Category	Description	Count / Percentage
Total Reclamation Cases	Overall reported reclamations	27,000 cases
Top Reclamation Case Types	Installationer inomhus (indoor installations)	10,197 cases (37.8%)
	Invändig vägg (interior walls)	4,284 cases (15.9%)
	Fasad (Façade)	3,211 cases (11.9%)
Reclamations by Year	2023(Q2,3,4)	~10,000 cases
	2024	~14,000 cases
	2025(Q1)	~3,000 cases
Reclamations by Product Type	Flerbostadshus (Multi-family housing)	17.13K (63.45%)
	Sjukhus (Hospitals)	5.26K (19.49%)
	Skolor/Utbildning (Schools/Education)	1.25K (4.64%)
	Kontorshus (Office buildings)	0.69K (2.55%)
	Others	Remaining ~10%

4.5 SRQ3-Adoption of Digital Tools and Real-Time Data Analytics

This section addresses Sub-Research Question 3: To what extent are digital tools and real-time data analytics being adopted to support productivity follow-up in Swedish construction projects?

The findings suggest that while awareness of digital tools is increasing among project teams, actual adoption remains limited and fragmented. Several factors, including organizational culture, technical integration challenges, and a cautious approach to innovation, have influenced the pace and extent of digitalization efforts.

4.5.1 Early Digitalization Efforts: Pilots Without Policy

Although traditional manual tracking methods remain prevalent on construction sites in Sweden, particularly Excel and PowerPoint-based updates, there is a measured shift toward digital solutions. Interviews with planning specialists and project steering personnel describe early-phase integration of technologies such as scheduling software linked with 3D models and, prospectively, 4D BIM environments. These innovations aim to enhance progress visibility and synchronize planned versus actual performance. However, interviewees stressed that digital uptake remains inconsistent and experimental rather than institutionalized, with adoption decisions often made at the project level rather than through centralized policy.

This cautious trajectory aligns with literature identifying Sweden's fragmented yet evolving digital construction landscape. Jacobsson and Linderoth (2012) emphasize that while digital tools such as BIM offer efficiency and transparency gains, their impact is limited by cultural inertia and user perceptions that existing systems are “good enough.” Similarly, Barbosa and Costa (2022) show how integrating BIM with 360° cameras and unmanned aerial systems (UAS) enables more objective progress tracking but also note that these innovations face hurdles in implementation due to complexity, training demands, and uncertain ROI. Thus, while early digital steps are being taken, the long-term effectiveness of these technologies depends not only on their technical capacity but also on overcoming the behavioural and institutional resistance that has historically characterized Sweden’s construction sector.

4.5.2 Fragmented Integration: Tools in Isolation

Despite growing awareness of digital tools' benefits, their practical integration across departments remains limited and inconsistent. As interviews revealed, software platforms such as Powerproject, Customer Relationship Management systems (CRM), or Power BI are present in the workflow, but are often used in silos, detached from procurement, cost control, quality assurance, or real-time data sources. The interview analysis shows that this lack of system-wide integration results in duplicated efforts, weak feedback loops, and minimal organizational learning.

While this fragmentation is evident across several departments, the most comprehensive case data provided during the study comes from the aftermarket department’s CRM system also presented in detail in the appendix, which captures post-handover client-reported issues. This dataset reveals over 27,000 reclamation cases over the course of 2 years (April 2023-March 2025), offering a concrete lens into the operational consequences of fragmented digital practices. These issues typically emerge only after systems become operational, underscoring how quality assurance during earlier phases remains disconnected from lived performance outcomes.

Table 5 CRM Data Extract 2

Metric Description	**Value**
Total reclamation cases in CRM dataset	27,000
Reclamation cases tied to indoor technical systems (electrical, ventilation, HVAC)	10,000+
Percentage of reclamation cases from residential projects	63%
Spike in reported cases	2023–2024
Reason for spike	Adoption of new CRM system from April 2023
Sharp decline in reported cases	Early 2025
Reason for decline	Data only received until March 2025 (real-time limit)
Average cases received per day	31

A closer examination of the CRM data supports and quantifies many of the themes identified in qualitative interviews. Over 10,000 cases are tied to indoor technical systems, particularly electrical, ventilation, and heating/cooling systems. As one aftermarket specialist explained, “we do not know how [these systems] will function, until [they are] operational.” This uncertainty post-handover is further compounded by the lack of proactive issue reporting during the production phase. Interviewees noted that production staff are rarely incentivized, or sometimes even equipped, to log and share faults in a way that feeds back into continuous improvement. Even when problems are known, they are often undocumented or siloed, severing the feedback loop.

The data also reveals that over 63% of reclamation cases stem from residential projects, particularly multi-family dwellings (“Flerbostadshus”). This aligns with qualitative findings that owner-occupied housing tends to generate more complaints due to heightened user expectations and greater interaction with complex systems. Yet, the fact that such issues are being reported only after handover highlights a systemic failure to integrate field data into upstream planning and design decisions.

The temporal trends in the CRM data show a spike in reported cases during 2023 and 2024, followed by an apparent sharp decline in early 2025. This pattern is because the aftermarket team adopted the new system in April 2023, and the data was extracted in March 2025. At the time of data retrieval, the records only covered up to that point. As of the writing of this thesis, the number of cases is expected to continue rising, with the aftermarket team receiving an average of approximately 31 new cases per day according to the data provided.

Crucially, the interviewee stressed that while the aftermarket team continues to bridge systemic gaps through manuals, internal platforms, and vendor partnerships, these efforts are increasingly constrained. As noted in interviews, budget reductions and decentralization have weakened their ability to conduct proactive investigations or influence upstream decisions. According to the interviewees', previously centralized functions have been distributed across regions without guarantees of consistency or follow-through, further limiting institutional learning.

Academic literature supports these observations. Samuelson and Stehn (2023) assert that without deliberate restructuring of workflows and leadership commitment; digital tools, in our case (CRM systems) often fail to reshape operational practices. Shehu et al. (2025) similarly identify high investment costs and fragmented digital infrastructure as key barriers to digital adoption in Sweden's construction sector, that hints on the deduction of budget mentioned by the aftermarket team. Consequently, as shown in the interview project teams may possess digital tools but underutilize them due to a lack of institutional alignment and managerial alignment.

4.5.3 AI in Construction Productivity: Opportunities and Barriers to Scalable Digital Transformation

One of the piloted projects exemplifying the use of artificial intelligence (AI) in construction productivity tracking was introduced by a leading construction company operating across Sweden and Scandinavia. During an in-depth interview, the company's Drone and IT Services Manager provided a comprehensive walkthrough of the system currently being trailed. This innovative approach represents a significant departure from traditional progress tracking methods, which often rely on subjective human reporting and are susceptible to discrepancies.

Instead, the piloted solution integrates lightweight 360-degree cameras and QR-coded geolocation to enable automated alignment with 4D BIM models. This setup supports real-time verification of progress, anomaly detection, and predictive tracking, offering a more objective and data-driven alternative. As highlighted by the manager, this technological shift enhances accuracy, consistency, and efficiency in productivity monitoring while reducing reliance on manual site inspections or cumbersome laser scanning equipment.

While such initiatives underscore the potential of AI to transform construction practices, their broader adoption remains limited. Despite the promising results seen in select projects, the diffusion of digital tools across the Swedish construction industry is still slow and uneven. This section builds on earlier insights by examining the deeper systemic barriers and organizational misalignments that hinder the scalability of AI-driven solutions and explores how such challenges affect the transformation of trust and control in construction management.

4.5.3.1 AI Transformation vs. Decentralized Practice

According to the interviewees, the introduction of AI into construction workflows significantly redefined how teams operate, reducing the need for repetitive manual labor by automating progress validation and data interpretation. Tasks previously performed by multiple engineers were now handled through a centralized AI system, with teams instead focusing on critical inspection and quality assurance. This shift introduced a “single source of truth” on site, fundamentally changing accountability by ensuring all stakeholders, engineers, suppliers, and clients, made decisions based on shared, factual data.

However, despite these advancements, interviewees consistently described how such innovative efforts often emerge at the project level, with limited efforts to scale or standardize digital practices across organizations. This decentralized project structure hinders institutional learning and results in scattered adoption patterns. These findings align with Dubois and Gadde (2002), who describe the construction industry as a “loosely coupled system,” where fragmented coordination across actors diminishes opportunities for cohesive innovation and long-term productivity gains.

4.5.3.2 Return on Investment and Measurable Impact

Interview findings revealed that the AI solution implemented delivered tangible and quantifiable benefits, reinforcing its value proposition in a high-stakes, cost-sensitive industry like construction. From a study done at their firm, the Drone and IT Manager reported up to

2.3 times productivity gains, a 70% reduction in manual reporting efforts, and notable cost savings attributed to fewer conflicts and dispute resolutions. These improvements translated not only into short-term efficiency but also into long-term value, as the manager emphasized the importance of comprehensive digital records for post-construction maintenance and asset management, this point is well expanded in the section "Clients as Drivers of AI and Digital Adoption". These insights suggest that, when implemented effectively, AI can deliver both operational enhancements and lifecycle benefits, contributing to a compelling return on investment (ROI).

This positive case contrasts with concerns raised in literature, where researchers caution that many AI and digital tool implementations fail to produce clearly measurable outcomes. As Singh et al. (2023) note, unclear profits and advantages are among the top barriers to AI adoption in construction. These disconnects between promised benefits and actualized returns can erode stakeholder trust, particularly in an industry where firms operate with narrow margins and limited tolerance for unproven innovation. Indeed, the scepticism documented by Lidelöw et al. (2023) among Nordic construction companies, who often observed only incremental rather than transformative benefits from digital tools, highlights the challenge of translating theoretical efficiencies into meaningful, on-the-ground impacts.

However, the interview findings provide a counterexample to this trend, suggesting that under the right conditions, such as targeted deployment, organizational support, and integration into workflow, AI tools can surpass the incremental gains often reported. The manager's detailed ROI analysis aligns with recommendations from Chowdhury et al. (2019), who emphasize the importance of clearly communicating quantifiable returns, such as reduced labor hours or fewer project delays, to secure stakeholder buy-in. Furthermore, Chowdhury et al. (2019) highlighted the use of key performance indicators (KPIs), as observed in some Scandinavian firms, echoes the approach described in the interview: a structured, metrics-driven evaluation of the AI solution's impact on productivity and project outcomes.

4.5.3.3 Clients as Drivers of AI and Digital Adoption

One of the most influential forces driving the adoption of digital systems, including AI technologies, has been client demand, as consistently emphasized in the interviews. Clients, having experienced the benefits of verifiable and systematically managed data on completed projects, began actively requesting similar technologies in subsequent tenders. This bottom-up pressure proved to be more decisive than internal policies in overcoming organizational inertia.

Interviewees highlighted that clients increasingly recognize the long-term value of digital tools, not only for improved project delivery but also for lifecycle planning and facility maintenance.

Regona et al. (2022) identify data-related challenges stemming from the fragmented nature of the construction industry, such as inconsistent data standards and siloed project teams, which inhibit the efficient application of AI tools. While their study does not directly connect these issues to client demand, the findings suggest that addressing fragmentation through more coordinated project delivery, often spurred by client expectations, can facilitate AI integration and data interoperability across stakeholders.

Bang and Olsson (2022) find that the construction industry lags others in AI adoption due to several organizational barriers, including resistance to change, lack of strategic alignment, and insufficient digital competencies within firms. They advocate for more empirical, multidisciplinary studies to better understand these drivers and to develop targeted interventions that can foster a culture of innovation and digital readiness.

However, this client-driven model is not without tension. As noted by Liang et al. (2024), AI and robotic systems, such as automated surveillance drones, wearable monitoring devices, and site activity tracking software, when introduced without adequate stakeholder engagement, may be perceived as instruments of surveillance or managerial control. These perceptions can undermine trust among workers and provoke resistance, highlighting the importance of transparent communication and participatory implementation processes.

Nevertheless, both the interview findings and the literature confirm that clients act as crucial enablers of innovation, exerting a pivotal bottom-up influence in shaping the digital transformation of the construction industry.

4.5.3.4 Human-AI Partnership: Trust, Training and Generational Challenge

The interview insights from Drone and IT Manager underscores that successful implementation of the AI system hinges on effective training and onboarding, with engineers typically achieving proficiency within three months through regular support from the technology provider. They stressed further that this structured training fosters a productive human-AI partnership, where automation relieves engineers of repetitive, data-heavy tasks, enabling them to focus on higher-value responsibilities like assessing finish quality during on-site inspections.

However, they mentioned that this shift also exposes a temporal and generational mismatch in change readiness. As they explained further; while younger engineers adapt quickly and embrace AI as a support tool rather than a replacement, resistance often comes from senior project managers. These individuals, who typically hold key decision-making power, may be reluctant to abandon familiar manual processes. This generational hesitation reflects broader industry trends noted by Shibeika and Harty (2015), where digital innovations frequently challenge entrenched practices and the perceived value of new tools remains contested among experienced personnel.

4.5.3.5 Data Security, Sovereignty, and Legal Barriers

Security and compliance emerged as recurring themes during the interview, especially in relation to projects situated in sensitive or high-security environments such as airports and correctional facilities. According to the interviewee, while project data is stored locally in Sweden to comply with data protection regulations, some elements of AI processing still occur in systems located outside of the EU. This raised concerns about data sovereignty and exposure to foreign legal jurisdictions, particularly in terms of who has access to the data and how it is processed and audited.

The interviewee highlighted that such issues could have a direct impact on the company's ability to implement AI-based systems across all project types. The interview stressed that in highly classified environments, even minimal external data processing can represent a significant risk, which sometimes results in restrictions or outright avoidance of AI tool usage in those settings.

These concerns are reflected in the broader literature, where data sovereignty has been identified as a significant consideration in the adoption of AI and cloud-based tools in construction. Hummel et al. (2021), for example, emphasize that data sovereignty involves maintaining meaningful control over where and how data is stored and processed, particularly in cross-border contexts. Similarly, Singh et al. (2023) report that fears around data privacy and cybersecurity risks are frequently cited by construction firms as barriers to digital transformation.

Although the interviewee acknowledged the importance of compliance with the EU's General Data Protection Regulation (GDPR) and national security protocols, they did not indicate that their company has fully implemented specific organizational safeguards to address these data sovereignty concerns. Instead, potential strategies, such as ensuring that all data handling remains within EU borders, were mentioned as possible solutions, though not confirmed as current practice.

The literature underscores that legal and contractual frameworks surrounding the adoption of digital technologies like BIM are still evolving. Ussing et al. (2016) identify several legal uncertainties in Denmark's construction sector related to BIM, including ambiguities in responsibilities and ownership of digital information. Similarly, Fan et al. (2018) highlight challenges in adapting traditional construction contracts to accommodate BIM's collaborative processes and data management requirements. However, the integration of AI technologies introduces additional complexities, particularly concerning data ownership and liability for AI-generated outputs, which are not extensively covered in existing BIM-focused legal studies.

No detailed mention from the interviewee was made of internal legal frameworks, standardized contractual clauses, or dedicated roles for managing data protection in relation to AI systems. As a result, the use of AI technologies is selectively limited and that could be affected by the sensitivity of the project, as a result, the cautious adoption of AI could be a strategy informed by data protection concerns.

4.5.3.6 Misalignment Between Digital Ambitions and Procurement Models

Interviews with Logistics Lead Specialists highlight a persistent disconnect between the digital ambitions of construction projects and the traditional procurement models used to support them. Conventional procurement frameworks often fail to explicitly require or incentivize the use of digital tools such as Building Information Modelling (BIM), collaborative platforms, or integrated data systems. As a result, contracts typically overlook essential elements like real-time data integration, digital traceability, and platform interoperability. This omission discourages subcontractors and other stakeholders from investing in compatible digital technologies, thereby fragmenting project data environments and undermining long-term digital continuity across projects.

Matos and Cruz (2024) reinforce this view, arguing that when procurement processes are not intentionally designed to accommodate or promote digital workflows, they can severely limit the transformative potential of digital tools like BIM. They propose an integrated, BIM-based procurement approach to align digital capabilities with project delivery mechanisms. Landin and Öberg (2014) similarly underscore that structural inefficiencies in Sweden’s construction sector are often rooted in entrenched procurement practices that prioritize immediate cost savings over long-term innovation and systemic improvement.

4.6 SRQ4-Influence of Organizational Structures and Roles on Productivity Tracking

This section addresses Sub-Research Question 4: How do organizational structures and roles (e.g., planners, cost controllers, subcontractors) influence productivity tracking?

The interviews revealed that organizational dynamics, role clarity, and stakeholder coordination significantly impact the quality and consistency of productivity follow-up. Several recurring patterns emerged regarding the influence of internal structures and role definitions on the effectiveness of productivity tracking efforts.

4.6.1 The Growing Role of Dedicated Planning

Several participants emphasized a significant organizational shift from relying on generalist site managers to employing dedicated planning specialists. This trend reflects a growing recognition that sophisticated project scheduling, productivity tracking, and performance optimization require technical expertise rather than being treated as supplementary tasks.

Lead planning specialists observed that professionalized planning roles contribute to more consistent development of baseline schedules and systematic progress tracking methodologies. Despite this positive shift, inconsistencies persist across projects. Particularly on smaller or mid-sized sites, access to specialized planners remains limited, leading to variability in the quality of planning and, consequently, in the effectiveness of productivity monitoring. This disparity was highlighted in both interview responses and scholarly literature. For example, one planning expert noted that while large-scale projects frequently leverage dedicated planners and tools such as PowerProject or Earned Value Management (EVM), smaller projects often rely on site managers or engineers multitasking across planning and operational roles. As a result, these sites frequently adopt ad hoc approaches, including spreadsheets or whiteboard planning, rather than standardized, integrated systems.

This situation aligns with the findings of Dubois and Gadde (2002), who characterize the construction industry as a “loosely coupled system” where fragmentation, particularly prevalent in smaller operations, undermines standardization and innovation. Similarly, Josephson and Saukkoriipi (2007) estimate that up to 35% of project costs may stem from non-value-adding activities, much of which they attribute to inefficient and poorly structured planning processes. Landin and Öberg (2014) also emphasize that the absence of dedicated planning expertise and structured tracking mechanisms hampers the ability of smaller projects to adopt best practices or benefit from recent advancements in planning methodologies. The combined impact of these issues not only perpetuates inefficiencies at the project level but also inhibits the broader construction sector's capacity to achieve systematic and scalable improvements in productivity. To address this, recent industry reports suggest that strategies such as modular construction, integrated project delivery (IPD), and broader digitalization, including the use of Building Information Modelling (BIM), could help bridge the gap in planning capabilities across project sizes. However, the successful adoption of such strategies still hinges on the availability of planning expertise and organizational commitment to professionalized planning roles.

4.6.2 Fragmentation Between Planning, Cost Control, and Execution

A persistent theme across the interviews was the fragmentation of responsibilities among different project functions. Planning, cost control, site management, and subcontractor coordination are often managed separately, with limited integration or shared accountability for productivity outcomes. Cost control specialists described challenges in aligning financial tracking systems with schedule updates, while site managers and planners noted difficulties in coordinating real-time progress reporting. This fragmented structure limits the ability to synthesize productivity data into actionable insights and hinders proactive decision-making. Several participants emphasized that the absence of integrated digital systems across time, cost, and scope domains contributes to discrepancies between planned and actual progress, complicating efforts to identify the root causes of inefficiencies. Weekly updates are typically carried out using isolated Excel sheets or PowerPoint visualizations, which lack real-time connectivity and restrict dynamic assessment of project deviations. These limitations create missed opportunities to respond promptly to issues such as resource constraints, schedule slippage, or design changes.

This observation is reminiscent with academic literature where Dubois and Gadde (2002) mentioned the construction industry as a "loosely coupled system," which described in the previous section "The Growing Role of Dedicated Planning". Shibeika and Harty (2015) similarly highlight the difficulties of integrating digital technologies across the firm-project interface, noting that the diffusion of innovations is often impeded by organizational and structural disconnects. While not focused on performance metrics per se, their work underscores how digital fragmentation can negatively influence project delivery. Landin and

Öberg (2014) emphasize the lack of standardized, organization-wide tools for productivity tracking in Swedish construction, identifying this absence as a barrier to turning operational data into strategic management insights.

4.6.3 Lack of Centralized Project Control Structures

The absence of centralized Project Management Offices (PMOs) within most construction organizations in Sweden was identified as a critical structural barrier to effective project control. In many international contexts, PMOs serve to integrate cost, time, and scope control functions, thereby ensuring objectivity and consistency across projects (Too & Weaver, 2014; Hobbs & Aubry, 2007). These functions help establish standardized processes, enhance strategic alignment, and provide independent oversight of project performance-elements largely missing in the Swedish context. In contrast, interviewees stressed that Swedish project managers often shoulder dual responsibilities: delivering projects and managing project controls. Based on interviews conducted for this study, this conflation of roles was repeatedly identified as a source of conflict of interest, as the same individuals are responsible for both execution and oversight, which can reduce the independence and rigor of productivity monitoring. Moreover, Interview participants frequently emphasized that, in the absence of an independent control function, productivity tracking tends to be deprioritized in favour of immediate project delivery needs, particularly when deadlines are tight. This lack of feedback and learning mechanisms ultimately compromises productivity oversight.

Additionally, research by Josephson and Saukkoriipi (2005) underscores the economic cost of this organizational shortcoming. Their study of Swedish construction projects revealed that inefficiencies, particularly in the form of non-value-adding work such as waiting times, material handling, and unnecessary movements, can exceed 30% of total project costs, highlighting the tangible consequences of inadequate control structures. Without reinforcement from a centralized PMO or incentive-aligned contracts, productivity metrics risk becoming performative rather than actionable, as noted in both the literature and stakeholder interviews. Eriksson and Westerberg (2011) similarly argue that the absence of cooperative procurement and structured follow-up mechanisms undermines strategic contributions to project success.

In summary, interviews show that the lack of centralized project control in Swedish construction fosters structural conflicts, weakens productivity assessment, and results in substantial inefficiencies. Literature consistently affirms that without independent oversight and aligned incentives, project management is less likely to support continuous improvement and strategic performance tracking.

4.6.4 Challenges in Subcontractor Coordination and Accountability

Subcontractor management emerged as another influential factor. Several planners and project steering specialists described difficulties in ensuring subcontractor commitment to productivity follow-up practices. Subcontractors often prioritize their immediate scopes of work over integrated project goals, leading to delays, scheduling conflicts, and inaccurate progress reporting.

Interviewees highlighted that strong relational management, early subcontractor involvement in planning, and clear contractual expectations are necessary to align subcontractor performance with project-level productivity goals. However, such practices are inconsistently applied, often depending on the leadership style of individual project managers.

Early subcontractor involvement, defined as the engagement of key trade partners during the pre-construction or early design phase, enables more accurate scheduling, constructability input, and smoother coordination across interdependent tasks such as HVAC, piping, and electrical work. These benefits are supported by Eriksson and Westerberg (2011), who link cooperative procurement procedures like early contractor involvement (ECI) to improved project performance through enhanced coordination and stakeholder alignment. Further reinforcing this point, Gadde and Dubois (2010) discuss the industry's resistance to institutionalizing collaborative approaches, noting that coordination strategies are often informal and vary significantly between projects. This inconsistency is compounded by variability in leadership: project managers with proactive, integrative leadership styles are more likely to involve subcontractors meaningfully and enforce productivity standards. Others, by contrast, may adopt a more transactional approach, resulting in siloed operations.

The influence of leadership behaviour on the successful implementation of productivity tools and collaborative systems in construction is well-documented. For instance, Olanipekun and Sutrisna (2021) highlight that digital transformation in construction is facilitated by strategic leadership that fosters the adoption of digital technologies across project lifecycles. Their systematic review underscores the necessity of leadership in aligning digital initiatives with organizational goals, thereby enhancing process alignment and on-site performance.

Olanipekun and Sutrisna (2021) findings can be generalized. In essence, aligning subcontractor performance with broader project goals depends not only on structural mechanisms such as planning systems and contracts but also on the project manager's capacity to lead through clarity, coordination, and accountability.

4.6.5 Toward More Integrated and Collaborative Structures

Despite current structural challenges, participants expressed optimism that greater integration is achievable. Proposed measures included establishing dedicated planning and control units within organizations, fostering interdisciplinary collaboration from the earliest project phases, and adopting digital platforms to enable transparent, real-time communication among all stakeholders.

The gradual transition toward more integrated and collaborative organizational structures is viewed as critical to improving the consistency and effectiveness of productivity follow-up in the Swedish construction sector. As discussed extensively earlier in this section (Dubois & Gadde, 2002; Josephson & Saukkoriipi, 2005), the industry's fragmented nature and inconsistent planning practices hinder systemic learning and coordination. Though not all sources specifically mention project management offices (PMOs), the literature generally supports the establishment of defined planning roles to address fragmentation and improve cross-phase coordination.

Participants also emphasized the importance of institutionalizing collaboration through progressive procurement strategies. Eriksson and Westerberg (2011) provide a conceptual framework showing how cooperative procurement procedures-such as early contractor involvement and incentives for joint performance- can positively influence project outcomes. While the NEC3/NEC4 contract models, widely used in the UK, were not directly addressed in their work, these models exemplify the kind of structured collaboration their framework endorses.

Lean construction tools, particularly the Last Planner System (LPS), were cited by both practitioners and researchers as an effective means to improve workflow reliability and coordination across disciplines. While Josephson and Saukkoriipi (2005) point to planning inefficiencies that LPS can address, Kifokeris and Koch (2020) provide a broader synthesis of Lean Construction practices observed in Sweden over the past decade, illustrating how these methods-including LPS-have been adopted with varying degrees of success to enhance planning, coordination, and project outcomes.

Additionally, interviewees pointed to the role of digital technologies in advancing organizational integration, a topic discussed in detail under SRQ3, including the relevance of integrated digital platforms and their contribution to performance monitoring and data-driven decision-making.

5 Discussion

This discussion critically examines the empirical findings in relation to the main research question: How is productivity follow-up currently implemented in Swedish construction projects, and what factors influence its effectiveness? Drawing on literature and qualitative data, this section reflects on systemic issues, industry culture, methodological contradictions, and the transformative potential of improved practices within the Swedish construction sector. In addition, it integrates insights from grounded theory analysis of stakeholder interviews, offering a deeper methodological layer that surfaces implicit norms, adaptive behaviors, and structural gaps shaping current productivity practices.

5.1 Productivity Follow-Up: Methods in Theory vs. Practice

The discrepancy between advanced theoretical models and the everyday tools used on Swedish construction sites reflects a deeper tension in the sector's productivity discourse, one rooted not in a lack of technical knowledge, but in organizational conservatism and entrenched habits. While the literature extensively champions the use of Earned Value Management (EVM), Lean Construction, and BIM-integrated dashboards for delivering real-time, multi-dimensional performance insights (Proaño-Narváez et al., 2022; Koch et al., 2020; Schimanski et al., 2020), empirical data reveals a sobering reality: major firms continue to rely heavily on Excel and PowerPoint for productivity tracking. This is reinforced by our grounded theory findings, particularly the insight from the senior planning specialist, who emphasized that unless digital tools show "immediate utility," teams revert to older systems, which our theory terms selective and superficial adoption of systems.

Notably, the issue is not the absence of awareness or access. Firms do experiment with advanced tools, as shown in Koch et al.'s (2020) documentation of sensor-based tracking and Lean construction practices such as the Last Planner System. However, these technologies often remain confined to pilot projects and fail to be scaled across organizational workflows. The implementation patterns suggest not just uneven uptake but a failure to embed these tools within everyday decision-making hierarchies. Landin and Öberg's (2014) argument about the lack of context-sensitive metrics is reinforced by the finding that even where tools exist, they do not produce actionable insight without standardized integration. As articulated by the lead specialist planner, the use of earned value is often improvised rather than methodologically applied, resulting in "twisted versions" that lack analytic integrity. This observation supports our grounded theory category; Planning Fragmentation Undermines Predictability, which we will expand on later in the upcoming section.

Further complicating the landscape is the way performance data is interpreted or neglected. While KPIs and benchmarking are formally present in many project protocols (Kunkcu et al., 2022; Costa et al., 2006), empirical evidence shows they are often treated as compliance mechanisms rather than tools for real-time decision-making. Koch et al. (2020), for instance, note that benchmarking exercises are routinely conducted but rarely influence operational adjustments on-site. As the lead specialist planner pointed out, "weekly updates are often guesses," due to missing structures and a lack of planning authority. This insight supports our memo Data Quality as a Social Process, which highlights that the challenge is not just technological but epistemic: data is only as reliable as the culture and roles that generate it.

Importantly, this stagnation should not be read as a resource issue. The data suggests that even well-resourced firms with access to cutting-edge digital systems underutilize them for productivity follow-up. This selective adoption stems from institutional beliefs about project autonomy, where site managers often perceive centralized data oversight as intrusive or redundant. The literature tends to highlight the benefits of productivity tracking but may underestimate how deeply project cultures shape resistance to implementation (Koch et al., 2020). As the drone and IT manager emphasized, "every project is its own kingdom," reflecting our grounded theory code under the same name. This autonomy hinders cross-project integration, limits the scaling of digital tools, and reinforces individualized approaches to tracking.

The industry's market configuration further reinforces this pattern. With a few dominant firms overseeing extensive supply networks, legacy practices continue to shape subcontractor behaviour and tool usage (Landin & Öberg, 2014). Productivity tracking is often relegated to the discretion of individual project teams, rarely becoming part of an integrated, cross-project standard. The senior planning specialist explained that tools like Last Planner and takt planning are implemented “only in certain phases,” often without full support or follow-through. This aligns with our grounded theory category Partial Use of Planning Frameworks, which describes the fragmentation and temporal selectivity that prevents such systems from delivering continuous value. The resulting picture is one of partial modernization: advanced tools are visible, but their influence is muted by a lack of procedural reinforcement.

5.2 Fragmentation and Organizational Misalignment

The empirical findings underscore a deep-seated organizational fragmentation within Swedish construction projects. Planners, cost controllers, and subcontractors all recognize the importance of tracking productivity, yet operate without unified systems or shared accountability structures. A senior cost control specialist noted that productivity data is *“rarely synchronized with cost estimations”*, often resulting in skewed projections and reactive decision-making. Our grounded theory findings from this professional reinforce this: cost control in Sweden functions as an interpretive and largely experiential practice, developed *"on the job"* rather than through formal training. The absence of structured career paths or institutional standards in planning and control roles leads to methodological improvisation, where each actor defines and assesses productivity through divergent lenses. This observation is supported by Landin and Öberg (2014), who highlight the lack of standardized productivity measurement systems in Swedish construction, a gap that weakens data consistency and undermines learning across projects.

Moreover, projects frequently operate in isolation, leading to inconsistent definitions and measurements of productivity. These discrepancies are not merely technical but deeply cultural. Our interview with a Lead Project Steering Specialist revealed that site-specific *"micro-cultures"* dominate, where local norms and informal authority structures override formal systems. This disjointedness directly reflects the theoretical category of *"Situated Coordination Under Constraint"*, where planners act more as adaptive navigators than executors of centralized plans. Literature echoes this, with Samuelson and Stehn (2023) and Fufa et al. (2023) attributing inefficiencies in Nordic construction to poor coordination and fragmented documentation, but our grounded theory extends this by showing how these patterns are socially reinforced survival strategies in structurally unsupported environments.

Promising efforts exist to bridge this gap. A senior cost control expert described the adoption of a new system based on *"byggdelar"* (construction parts), structuring costs by discrete work elements with defined scopes, labor hours, and time allocations. This method introduces a potentially transformative shift: anchoring productivity in stable, comparable metrics rather than fluctuating material costs or site-specific habits. This development reflects what our grounded theory refers to as a *"Clarifying Logic"*, an effort to make planning assumptions explicit, quantifiable, and actionable. It also mirrors Lean Construction principles, such as those found in the Last Planner System (Schimanski et al., 2020; Koch et al., 2020). However, grounded findings caution that such innovations are often siloed and selectively applied. As one planning specialist observed, *"We used to be good at Last Planner... then got worse. Now we're trying again."* This cyclical adoption limits cumulative learning and underscores Kifokeris and Koch's (2023) warning that Lean tools, without deep organizational integration, rarely improve long-term productivity.

The issue of organizational learning is further problematized by the interview with a Project Development Manager and Site Supervisor. Despite executing two nearly identical buildings, their teams failed to transfer lessons learned from phase one to phase two, a striking example of what our grounded theory calls *"systemic knowledge breakdown."* Fragmented documentation, staff turnover, and weak cross-phase communication led to the repetition of avoidable mistakes. This is not simply a procedural flaw but a manifestation of the deeper absence of learning loops and internal benchmarking, as described in Koch et al. (2020). Our theory reframes this as a failure of *"planning infrastructure"*, where knowledge, once produced, is not retained, institutionalized, or reapplied.

This pattern is not isolated to project execution. The interview with the aftermarket specialist (section 4.5.2) shows that even when data is collected, such as in CRM systems, it is not systematically acted upon. Grounded theory reveals that the fragmentation is technical, cultural, and structural, with each layer reinforcing the others. This supports and extends the critique by Jacobsson and Linderoth (2012) and Chen et al. (2022), who argue that Sweden's construction sector treats digital tools as *"good enough"* rather than integrating them into a systemic workflow. As our interviews show, data remains siloed not because it is unavailable, but because no structure exists to translate it into collective insight.

What truly emerges from our grounded theory findings is a deeper, systemic explanation that moves beyond what the literature typically presents. Though previous studies acknowledge the lack of standardization and misaligned incentives in Swedish construction, our research shows that fragmentation is not merely a failing; it is an adaptation to absent structures. Planning professionals improvise not out of ignorance, but as a necessity in environments devoid of enforceable standards, integrated systems, or formalized career pathways.

5.3 Cultural Barriers and the Myth of “Lagom”

One of the most pervasive barriers to effective productivity follow-up is cultural. Several interviewees identified a reluctance to formalize, or challenge established routines, even in the face of evidence that structured methodologies yield better outcomes. The dominant approach often defaults to “just enough,” a cultural manifestation of the Swedish concept of lagom, which emphasizes moderation and balance. While socially stabilizing, this mindset acts as a drag-on innovation and rigor, especially in complex, deadline-sensitive projects. The underuse of digital dashboards, the resistance to real-time metrics, and the fear of seeming “too formal” in communication all reflect a deeper cultural hesitation. As one planning specialist remarked, “In Sweden, it’s more like ‘do it, and then fix it.’ In the UK, the mindset is ‘do it right the first time’,” illustrating how the Swedish lagom ethos sometimes privileges reactive flexibility over preventive discipline.

This tolerance for ad-hoc planning has serious implications. Across interviews, there was a recurring theme of methodological drift, where planners improvise metrics and processes rather than adhere to formal frameworks. As the lead specialist planner noted, “A lot of people do something like earned value, but they make it up themselves without realizing there’s a real, international methodology.” This improvisational behaviour is not just about knowledge gaps; it reflects an ingrained cultural comfort with ambiguity and under-specification.

This cultural norm was consistently reinforced in the grounded theory analysis, particularly in the axial coding stage, where "Improvised Planning as Default" emerged as a core category. Interview patterns consistently revealed that reactive problem-solving was not merely tolerated but celebrated, a behavioural pattern closely aligned with Hofstede’s characterization of low uncertainty avoidance cultures, where informal, adaptive behaviours are preferred over rigid frameworks.

The consequences of this improvisation are severe. Projects suffer from weak feedback loops, delayed detection of deviations, and ultimately lower productivity. One memo from the analysis encapsulated this pattern: “Improvisation isn’t an exception; it’s the organizational default.” The absence of a strong culture of formal controls means that tools like earned value management or real-time dashboards are often seen as bureaucratic rather than beneficial.

This aligns with earlier studies in the literature (e.g., Landin and Öberg, 2014; Koch et al., 2020), which describe Sweden's construction sector as fragmented and weak in control system uptake, but our grounded theory findings go further by identifying why: a culturally reinforced improvisation strategy rooted in soft authority structures and informal trust.

Importantly, the "lagom" mindset does not just discourage ambition, it fosters institutional complacency. As another interviewee stated, "There's no enforcement mechanism for planning methodology. So, everyone fills the gap with their own version." This normalization of informal workarounds means that methodological discipline is not just lacking, it's culturally marginalized. This was further supported by grounded theory open coding memos such as "Lagom as Permission Structure," which revealed that enforcement is socially discouraged, and planners who attempt to 'formalize too much' may risk social friction within the team.

Moreover, this cultural disposition shapes how authority and credibility are perceived in planning. In the absence of structured roles and standardized expectations, expertise often flows through informal recognition rather than positional authority. "You have to earn trust by showing you know how to fix problems. That's more respected than just following a method," explained a project manager. The "fixer" becomes a hero figure, an identity that further cements reactive, not proactive, behaviours.

We argue that the cultural ideal of lagom, so deeply woven into the fabric of Swedish life, has quietly become a barrier to advancing productivity follow-up in construction. What's often celebrated as balance and moderation also discourages the kind of sharp, structured action that complex projects demand. In this setting, pushing for formal methodologies like earned value management can be seen as excessive, even unnecessary. But our findings suggest the opposite: in the absence of strong systems, improvisation fills the gap. Not because people don't care, but because the culture subtly rewards those who adapt and fix rather than those who plan and enforce. The planner becomes the one who salvages, not the one who prevents. Over time, this breeds a comfort with vagueness, data remains soft, feedback delayed, and learning shallow. Lagom, then, isn't just a cultural backdrop; it becomes a permission structure for not changing. If the industry is to make real strides in productivity, it must recognize that the very mindset designed to keep things steady may be what's holding it back.

In the end, we see that our grounded theory synthesis contributes a new perspective by bridging the observed empirical patterns (e.g., soft data, weak enforcement, and planner improvisation) with theoretical gaps in the existing literature. While previous research highlights structural and digital adoption issues, our findings suggest that cultural dispositions, particularly those shaped by lagom, may be the root cause preventing formalization and accountability in Swedish construction planning.

5.4 Contractual Disincentives and Accountability Gaps

Interview data revealed that a major source of inefficiency in the Swedish construction industry lies in how contractual models inadequately incentivize accountability or sustained productivity. The Contracts Specialist underscored how prevailing Swedish contracts, often fragmented and loosely scoped, lack performance-linked metrics and place insufficient emphasis on lifecycle outcomes. In contrast, Finland's sector has matured through deliberate reform, adopting and refining contractual models originally piloted in Sweden, while integrating lessons from UK practices that promote early-phase clarity and accountability. According to the specialist, *"Finland took what Sweden started, but added contractual rigor and clearer stakeholder obligations,"* enabling them to outpace Sweden in cost-efficiency and delivery control.

These deficiencies become particularly apparent post-handover, as evidenced by Aftermarket Specialists, who report a surge in quality issues that trace directly back to vague contractual obligations and poorly scoped responsibilities. One noted, *"We often inherit problems that could have been prevented, but weren't because the contract didn't bind anyone to quality assurance."* In some cases, entire categories of errors such as recurring mechanical failures or unfinished finishes result from departments being bypassed or underfunded. Regional disparities amplify this issue, with aftermarket teams in certain parts of Sweden receiving drastically lower budgets, impairing their ability to intervene early or enforce performance remedies. *"We're not even seen as part of the main process,"* one remarked, highlighting how disconnected communication and reactive coordination marginalize their input, despite its direct bearing on long-term productivity and client satisfaction. These gaps not only inflate reclamation volumes but also perpetuate inefficiencies upstream, as lessons learned rarely translate into contractual or procedural improvements.

These empirical patterns were consistently reinforced during grounded theory analysis. In axial coding, the category *"Contractual Accountability Gaps"* captured how fragmented scopes and absent enforcement structures allow defects to flow unchecked across project phases. Selective coding further developed this theme in memos such as *"Reactive Remedy Culture"*, which described how aftermarket teams are structurally positioned to absorb accountability voids left by vague contracts. These findings suggest that aftermarket labor is not simply reactive but structurally necessitated by upstream failures that contracts fail to prevent or even acknowledge.

Moreover, these gaps were often entangled with regional inequities and role invisibility. The open coding memo *"Situated Coordination Under Constraint"* documented how budgetary constraints and weak integration isolate aftermarket voices from early project decisions, despite their deep experiential knowledge of recurring defects and client-side dissatisfaction.

The literature offers partial context but limited resolution. Seminal studies such as Byggkommissionen (2002) and Josephson and Saukkoriipi (2005) identify systemic inefficiencies and process fragmentation but largely frame solutions in terms of time optimization or lean workflows. More recent contributions, for example Koch et al. (2023) emphasize digital innovation and modularization, but tend to under-theorize the legal and procedural architectures, especially procurement, that determine how responsibility and learning are structured. These findings, while helpful, do not resolve the core issue. Contracts in Sweden often fail to function as instruments of lifecycle accountability.

As a theoretical synthesis, we argue that Sweden's construction sector is held back not by a lack of knowledge or tools, but by a systemic failure to embed accountability across the contractual lifecycle. Escaping this stagnation demands a reconfiguration of procurement models that includes enforceable quality clauses, integrated aftermarket accountability, and cross-phase feedback mechanisms. Contracts must evolve from transactional instruments to strategic enablers of performance. Nonetheless, a limitation of this analysis is the absence of perspectives from client-side actors who shape procurement frameworks and public tender constraints. While this does not undermine the validity of the insights presented, drawn from seasoned professionals across key roles, it signals the need for future research to capture the full policy-contract interface. Recognizing this boundary affirms the rigor of our current findings, while also mapping out a clearer agenda for systemic reform.

We argue that aftermarket compensation has become institutionalized not because of workforce gaps, but due to systemic contractual ambiguity that defers responsibility instead of resolving it. Grounded theory reveals a structural-cultural loop: vague procurement clauses lead to missed quality assurance, which increases aftermarket burden, silences feedback and ultimately prevents contractual improvement. Until contracts explicitly link early-phase obligations with lifecycle performance, Sweden's construction sector will remain reactive, fragmented, and unable to fully capitalize on digital or methodological innovations.

5.5 Skilled Labor Gaps and the Limits of Productivity Tracking

The Swedish construction industry faces a persistent tension between the demand for effective productivity follow-up and the structural gaps in skilled labor supply. Insights from our interview data reveal that these labor shortages, both in quantity and qualification, deeply constrain the reliability and consistency of productivity tracking systems.

As an HR Specialist noted, *"It's always a struggle... there's never the perfect candidate. It's hard to find both specialists and generalists."* This reflects a systemic issue rather than a temporary market imbalance. The shortage spans blue-collar roles such as hydro technicians and electricians, as well as white-collar professionals like site managers and quality engineers. The HR Specialist further noted, *"Eventually we have to take a consultant,"* a workaround that unintentionally erodes long-term productivity tracking, since *"we lose experience when consultants leave."* This reliance on external labor contributes to what we interpret as knowledge leakage, a key limiting factor for sustained productivity measurement across projects.

These observations are corroborated by the Planning Manager (Mega Projects), who emphasized that *"labor shortages affect specialized trades such as plumbers and electricians,"* directly disrupting critical path activities like screeding and technical room preparation. The shortage is not only numerical but qualitative, affecting the industry's ability to plan, coordinate, and execute consistently across project phases.

From a structural perspective, the Lead Planning Specialist traced this issue back to legacy roles: *"Previously, planning was done by generalists, site managers or others... we're moving toward creating a career path for senior schedulers."* This transition toward specialist planning roles is both necessary and incomplete. Many projects still lack embedded planning expertise, resulting in improvised scheduling practices and fragmented productivity tracking. The absence of formal roles and authority for planning professionals sustains what our grounded theory terms a control role vacuum, where no actor is institutionally positioned to enforce methodological discipline or tracking continuity.

The Aftermarket Specialist, while focused on post-handover phases, indirectly confirmed this structural problem by observing that *"We don't have enough information today to see the problem out of statistics."* The issue, they explained, stems from inconsistent installation practices and unclear quality roles, both symptoms of broader labor gaps and fragmented accountability. Without integrated workforce knowledge from execution to follow-up, the value of tracking systems deteriorates over time.

These patterns were substantiated during grounded theory analysis. In the axial coding phase, “Knowledge Leakage and Labor Fluidity” emerged as a key category, linking workforce churn to the erosion of long-term tracking continuity. Selective coding developed this further in memos such as “Control Role Vacuum”, which detailed how unfilled planning positions and high consultant turnover weaken systemized productivity assessment. The open coding memo “Planning Fragmentation by Role Instability” documented how inconsistencies in workforce qualifications and unclear planning mandates lead to reduced tracking legitimacy and poor comparability of project performance data.

The literature offers partial but meaningful support for our findings. Gunduz et al. (2020) emphasize how inconsistent training and variable skill levels contribute to unstable project performance, aligning with our observation that workforce instability undermines productivity tracking systems. While Loosemore and Andonakis (2007) also highlight labor and training deficiencies, their focus on occupational health and safety limits their relevance to our emphasis on measurement and planning continuity. Similarly, the European Construction Sector Observatory (2021) identifies a structural mismatch between vocational training and industry needs, reinforcing the prevalence of under-prepared labor in Swedish construction. However, it stops short of addressing how such mismatches disrupt planning roles or erode the consistency of productivity data. Collectively, these sources acknowledge the role of labor issues in shaping performance but fall short of exploring how workforce instability fragments the institutional knowledge systems required for systematic productivity assessment, an analytical gap our grounded theory directly addresses.

Our analysis suggests that the skilled labor issue in Sweden’s construction sector is not only a workforce problem but a systemic barrier to data reliability and productivity learning, an angle largely underdeveloped in current literature. While existing studies acknowledge the role of skills in performance, they seldom trace how workforce fluidity and role instability directly fragment the knowledge systems that underpin productivity tracking. Our grounded theory offers this deeper structural explanation, revealing how gaps in labor stability not only delay production but corrode the institutional capacity for measurement, benchmarking, and continuous improvement. In this way, our findings move beyond existing literature by identifying the mechanisms, such as the control role vacuum and planning fragmentation, through which labor shortages dismantle the operational architecture needed for sustained productivity development.

Grounded in our empirical findings, we contend that until the sector redefines how labor roles are structured, retained, and supported, particularly around planning and productivity control, systematic tracking will remain limited by the very human systems meant to support it. Grounded theory reveals that labor gaps do not merely slow production but fragment the very knowledge systems meant to improve it. This manifests in measurement inconsistencies, weak role-based authority, and the erosion of institutional learning. Unless Sweden's construction industry invests in role formalization, training alignment, and long-term labor stability, productivity tracking will remain a tool constrained by the absence of those most essential to its function.

5.6 The Potential of Digital Integration and AI, But Not Yet Realized

While the Swedish construction industry exhibits increasing awareness of digital integration and AI as potential enablers of productivity follow-up, our grounded theory findings identify a fundamental mismatch between ambition and practice, what we term "digital promise without procedural readiness." Across expert interviews, the hope for digital transformation is palpable, yet its realization remains partial, stalled by fragmented planning logic, weak feedback systems, and cultural inertia. This reflects broader concerns in the Scandinavian literature, where AI initiatives are often introduced without clearly demonstrated returns, leading to scepticism among stakeholders about the long-term value of these systems (Lidelöw et al., 2023; Singh et al., 2023).

Our grounded theory labels this as "IT-Led Overreach," where digital initiatives are implemented without sufficient methodological maturity or planning clarity. As the Senior Planning Specialist put it, digital tools *are only adopted when easy to use, otherwise people revert to Excel*, highlighting a pattern of selective and superficial adoption. Even when internal IT systems in place, their transformative power is neutralized by inconsistent uptake and poor alignment with site realities. This mirrors industry-level findings that show fragmented project structures and poor data governance continue to hinder effective AI integration, particularly in decentralized environments like Sweden's (Regona et al., 2022).

The Planning Manager for mega projects reinforced this by noting that tools like PowerBI and 3D models improve planning transparency and real-time feedback, but digital success is contingent on bottom-up, user-cantered implementation: *Failures occur when top-down digital solutions are forced without proper vetting.* The grounded theory concept “Workflow Reconfiguration” is central here; without adapting human routines, even well-designed digital systems falter. This challenge aligns with concerns around AI deployment as a top-down mandate, often led by clients or upper management, without adequate stakeholder engagement, which can erode trust and operationalize resistance (Bang & Olsson, 2022; Melin et al., 2023).

However, some actors see a promising shift. The Drone and IT Manager offers a positive outlook: *Now you can see the whole site on the computer… changes the way you use your time.* The AI-based visual tracking system he described replaces subjective progress estimates with quantified, visual reality checks: *Supplier says 60%, system shows 30%, now there’s proof.* These tools also support earned value validation, enabling subcontractors to invoice based on actual completion levels. This reflects a shift toward what our findings call “Trust and Verification Through Data,” where AI becomes an operational authority, replacing gut feeling with visual evidence. Yet, as highlighted by Hummel et al. (2021), trust in AI systems is conditional upon strong legal frameworks and clear data sovereignty, concerns that remain unresolved in Scandinavian practice.

Still, barriers persist. The Drone and IT Manager emphasizes that the biggest obstacle is not technical, but generational resistance: *Sweden is just thinking about doing it.* Despite success stories in Denmark, Swedish adoption is stifled by decentralized project governance: *each project is its own kingdom.* Thus, the lack of scalability through standardization prevents innovations from becoming industry norms.

Similarly, the Leading Logistics Specialist highlighted that digital productivity systems are often introduced before the basics are in place. As he stated, *you cannot improve what’s not standardized.* Fragmentation in planning practices and site culture leads to disconnected workflows, limiting the effectiveness of even the most advanced tools. Digital dashboards and AI cannot compensate for inconsistent data inputs or the lack of cross-project alignment.

This is echoed by the Lead Project Steering Specialist, who described project environments where plans *grow organically,* and even basic coordination remains strained. Biweekly meetings help *adjust plans in real time but* are not always supported by digital systems. Here, digital tools could theoretically support coordination, but the practical bottleneck remains without early stakeholder involvement and clearly defined roles, AI cannot fix structural ambiguity. Our grounded theory further labels this condition as “Planning Fragmentation.”

Digital tools are introduced in fragmented environments, leading to what the Senior Planning Specialist called a *gap between systems and practice.* AI-supported dashboards, S-curves, and progress tracking are envisioned, but these systems break down without consistent use and cultural buy-in.

What emerges from our findings is a clear recognition that digital integration and AI hold clear potential to revolutionize productivity follow-up in Swedish construction, but this potential remains structurally constrained. Our findings indicate that technological capacity is outpacing organizational readiness. Rather than a lack of tools, the challenge lies in embedding digital workflows into everyday planning logic, supported by clear data structures, cross-project alignment, and a shift from reactive to preventive culture. While much of the literature emphasizes strategic drivers like governance frameworks and client mandates, our data show that the real barriers are often more foundational: the absence of planning discipline, standardization, and methodological clarity on the ground. In this way, AI does not simply encounter resistance but enters environments still negotiating basic routines and responsibilities. Until cultural norms, project governance, and methodological rigor catch up, digital and AI systems will remain underutilized promises, produce localized gains but fail to generate scalable, systemic impact. For digital tools to become productivity accelerators rather than isolated experiments, they must be coupled with planning standardization, clarified roles, and empowered planners who act not just as data users, but as strategic integrators of logic, responsibility, and flow.

6 Conclusion

Sweden's construction industry finds itself at a productivity crossroads not due to a lack of knowledge or innovation, but because of its failure to institutionalize practices that translate vision into execution. While productivity follow-up is no longer an unfamiliar concept, its implementation remains fragmented, often characterized by parallel systems of digital ambition and analogue habits. This conclusion brings together the study's core findings to directly address the research question: *"how productivity follow-up is currently implemented in Swedish construction, and what factors shape its effectiveness?"*, while also reflecting on the deeper patterns that emerged. Productivity follow-up in Swedish construction projects is currently implemented through a hybrid model: partially digitalized, formally recognized, yet operationally inconsistent. Field data confirms that while firms acknowledge the value of structured follow-up, in practice, project teams rely heavily on manual inputs, non-standardized spreadsheets, and improvised reporting mechanisms. The gap between what is theoretically possible and what is operationally routine persists, not for lack of effort, but due to entrenched organizational inertia, cultural norms, and fragmented incentive structures.

The literature and fieldwork together suggest that the Swedish construction sector is not operating in a vacuum of awareness. On the contrary, it is acutely aware of both its challenges and its unrealized potential. From the early warnings of Josephson and Saukkoriipi to contemporary observations on digital underutilization, a consistent thread emerges: the sector continues to operate with blurred accountability, diffused responsibility, and limited enforcement of performance discipline. Planning tools exist. Data is collected. But neither is sufficiently internalized as a basis for decision-making or organizational learning. As seen across the interviews and literature, the prevailing mode is one of adaptation over anticipation, of reacting rather than designing. The factors that most influence the effectiveness of productivity follow-up are not technical constraints but structural disjunctors, including lack of role clarity, weak contractual mechanisms, poor cross-project learning, and a planning culture shaped by informal norms rather than formal accountability.

This research reaffirms that productivity follow-up in Swedish construction is best understood as a cultural and structural problem disguised as a technical one. The barriers are not confined to poor software integration or lack of standardized tools. They reside in how roles are defined, how planning is perceived, and how little continuity exists between knowledge creation and its reuse across projects. While large firms dominate the landscape and often act as gatekeepers of best practices, they simultaneously perpetuate siloed processes that hinder sector-wide learning. New digital tools such as BIM, EVM, and AI-supported dashboards are introduced into planning environments still governed by manual overrides, fragmented documentation, and ad hoc adjustments. The result is a system that collects data but rarely acts on it meaningfully.

Compounding these challenges is the market's structural conservatism. The sector's reliance on traditional procurement routes, contractual rigidity, and legacy organizational models reinforces the marginal status of planners and limits the scalability of innovative practices. While examples of pilot initiatives and progressive contracting exist, they remain the exception rather than the rule, pointing to an ecosystem that has yet to fully embrace productivity as a shared and enforced objective.

The value of productivity follow-up lies not in its measurement alone, but in its capacity to reshape decisions, reassign accountability, and recover lost time and resources. And yet, the prevailing planning culture remains underpowered, treated as support rather than strategy, and managed by individuals often excluded from the circles where critical decisions are made. This disconnect undermines any attempt to create a performance-driven environment. Until planning and follow-up become non-negotiable elements of how projects are conceived, delivered, and evaluated, the sector will continue to repeat avoidable errors under new guises.

What becomes clear through this thesis is not a tale of failure, but of untapped, unrealized potential. Sweden's construction industry has the components of a high-performing ecosystem: technical expertise, organizational capacity, and increasing external pressure for reform. But to move forward, it must evolve from a model of fragmented compliance to one of integrated capabilities. Productivity follow-up should not be an add-on; it must become the nervous system of project execution. Only then can the sector move beyond its current plateau and begin to build not just more, but better.

7 Recommendations

Our study contributes to the practice with six thematic pillars, six precise interventions emerge not as surface-level prescriptions but as structural redesigns grounded in the lived complexity of project realities. First, from the fragmented uptake of productivity methods described in Discussion Theme 1, it becomes evident that tools alone do not transform practice. Routines do. To move beyond partial modernization, firms must develop follow-up literacy across all levels of project actors. This means institutionalizing a minimum methodological threshold such as earned value logic, baseline scheduling, and weekly progress reconciliation that is taught, tested, and embedded through onboarding, not left to individual improvisation. Moreover, firms should not merely invest in digital systems but condition their use on procedural clarity. No tool should be deployed without an accompanying protocol for decision-making based on its outputs.

From the organizational misalignment and planning silos revealed in Discussion Theme 2, the imperative is architectural, not technological. Firms must centralize planning as a system of coordination rather than a dispersed support function. This requires building a Planning Integration Office within major contractors, an internal structure that translates project-level plans into organization-wide standards, aligns productivity metrics across sites, and ensures that experiential learning from one project becomes procedural foresight in the next. Instead of allowing project teams to reinvent planning logic from scratch, organizations must treat planning as infrastructure, non-negotiable, continuous, and centrally supported.

The cultural resistance mapped in Discussion Theme 3 demands an intervention not in tools or structures but in behavioural framing. To confront the "lagom effect" that moderates ambition and muffles accountability, planning must be reframed from over-formalization to risk mitigation. Executives must cultivate a leadership culture that valorises precision without rigidity, where planning accuracy is understood not as control but as respect for time, cost, and people. Cross-functional accountability rituals such as monthly variance reviews where teams defend their forecasts and explain deviations can shift the default from informal tolerance to structured foresight. These rituals should be codified, not optional, embedding discipline into the project rhythm.

Contractual design, as outlined in Discussion Theme 4, is not a neutral container but a performance-shaping instrument. To resolve the accountability vacuum and break the cycle of downstream firefighting, Swedish clients and contractors must adopt contracts as instruments of feedback. This means piloting productivity-linked clauses where downstream learnings such as recurring defects or rework patterns are structurally reported upstream with binding obligations for response. Lifecycle coordination should no longer be aspirational but contractual. Aftercare teams must have defined input into design validation, and suppliers must commit to data transparency through standard reporting templates aligned with earned progress metrics.

Discussion Theme 5, focused on skilled labor fragmentation and the erosion of institutional knowledge, reveals that human continuity is the missing layer in productivity strategy. Here, the sector must break with its over-reliance on consultants and transitory project teams by investing in workforce retention through role formalization. Creating formal career paths for planners, site managers, and aftermarket specialists anchored in skill development, mentorship programs, and incentive structures tied to project learning outcomes can arrest the institutional amnesia that now defines so many transitions between project phases. Moreover, long-term labor planning must be treated with the same seriousness as materials or logistics, including succession planning for key roles and documentation protocols that preserve project memory.

Finally, Discussion Theme 6 exposes the misplaced faith in digital transformation without readiness. The response must be to synchronize digital ambition with procedural maturity. AI, BIM, and dashboards must not be positioned as plug-and-play solutions but introduced only when baseline planning, standardized inputs, and feedback cycles are demonstrably in place. Each digital initiative should begin with a human audit: what routines will this replace, what decisions will it support, and what training ensures that planners do not just input data but interpret it meaningfully. Until digital tools are introduced with this operational scaffolding, they risk amplifying confusion rather than clarity. The success of AI in this domain will not be measured by adoption alone but by how effectively it strengthens planning intelligence, enforces data truth, and redistributes authority from guesswork to governance.

Limitations remain. This study relies on practitioner perspectives drawn largely from contractor-side actors, with limited access to client and policymaking voices that influence procurement frameworks and regulatory change. It also does not follow projects longitudinally to capture delayed or cumulative impacts of productivity reforms. Furthermore, while rich in qualitative depth, the study stops short of quantifying how specific interventions translate into measurable performance gains, suggesting a need for future studies to evaluate the cost-benefit impact of role formalization, planning standardization, and contract reform across diverse project types.

What this research ultimately uncovers is that the Swedish construction sector is not short of solutions; it is short of integration. Each of the above interventions is feasible. What remains is the resolve to enact them not as isolated projects, but as a cohesive movement from fragmented productivity follow-up to a systemic architecture of foresight, accountability, and learning. Without this integration, the sector will continue to mistake movement for progress, and tools for transformation. With it, however, Sweden can position itself not as a laggard in productivity, but as a global reference point for how tradition, technology, and trust can converge to deliver not only buildings, but better ways of building.

8 Limitations

This study's contribution lies not only in what it uncovers but in how its boundaries signal unresolved complexities within the field. By focusing on the organizational and cultural architecture of productivity follow-up in Swedish construction, it exposes both structural inertia and untapped reform potential. Yet, the methodological and epistemic contours of the research necessarily shape and constrain the generalizability and scope of its insights.

While the thesis offers a grounded account of how productivity follow-up is enacted and obstructed within contractor organizations, it does so from a single vantage point. The exclusion of client-side actors, policymakers, and procurement authorities creates an asymmetry in the data that limits insight into how top-down regulatory or contractual forces shape follow-up conditions on the ground. Consequently, while the findings expose how contracts fail to function as instruments of lifecycle accountability, they do not capture the legislative, financial, or governance rationales that inform those contractual choices. Future work must trace the institutional feedback loops between public procurement mandates and on-site productivity behaviours, particularly within frameworks like LOU (Lagen om offentlig upphandling), to render a more systemic picture.

Methodologically, the use of semi-structured interviews and grounded theory privileged experiential nuance and practitioner truth, but it necessarily prioritized subjective interpretation over observable process data. This creates a representational bias toward how productivity systems are perceived rather than how they function over time. For example, the study reveals that follow-up systems are inconsistently used and poorly integrated, yet it cannot measure how these inconsistencies impact project performance longitudinally. Without time-based, comparative project data, such as deviations from cost baselines or schedule drift relative to follow-up maturity, the causal relationship between productivity systems and outcomes remains inferential. This signals the need for future mixed-methods studies that combine ethnographic insight with performance analytics across multiple project phases.

Moreover, the sample composition, while rich in cross-functional expertise within contractor organizations, reflects the structure of firms large enough to articulate reform ambitions. Smaller firms, subcontractor collectives, and regional actors who may face different constraints or cultural dynamics are underrepresented. This creates a partial view of the ecosystem, skewed toward those already attempting change. Future research must examine productivity follow-up in firms with limited planning infrastructure to explore whether fragmentation is a product of choice, constraint, or marginalization within supply chains.

The grounded theory approach, though suitable for theorizing from practice, necessarily favoured depth over coverage. In doing so, it captured dominant behavioural logics such as improvisation, soft enforcement, and planner marginalization but did not account for how exceptional projects break from these norms. As such, the thesis cannot distinguish between systemic failure and isolated success. A comparative case design across projects with divergent outcomes could isolate the variables including leadership, contractual models, or planning maturity that allow certain teams to overcome sector-wide inertia.

Finally, the research does not evaluate the role of emerging technologies beyond their reported usage. While digital dashboards and AI-based tracking systems appear promising, this study cannot validate their impact on productivity learning or accountability in practice. The digital promise without procedural readiness observed here demands testing. Do digital interventions embedded within standardized planning routines improve follow-up outcomes? This question requires controlled pilots in which digital tools are introduced alongside governance redesign. This is an approach future studies must pursue.

In recognizing these constraints, the thesis does not undermine its findings but positions them as provisional within a field in flux. It maps the contours of resistance and possibility and invites further inquiry into the systemic, temporal, and policy dimensions of productivity transformation in construction. Where this study theorizes the conditions of stagnation, the next step is to test the architecture of change.

9 References

Abioye, S. O., Oyedele, L. O., Akanbi, L., Ajayi, A., Dávila Delgado, J. M., Bilal, M., Akinade, O. O., & Ahmed, A. (2021). Artificial intelligence in the construction industry: A review of present status, opportunities and future challenges. *Journal of Building Engineering, 44*, Article 103299. https://doi.org/10.1016/j.jobe.2021.103299

Aramali, V., Sanboskani, H., Gibson Jr, G. E., El Asmar, M., & Cho, N. (2022). Forward-looking state-of-the-art review on earned value management systems: The disconnect between academia and industry. *Journal of Management in Engineering, 38*(3), 03122001. https://doi.org/10.1061/(ASCE)ME.1943-5479.0001019

Asadi, S., Fayek, A. R., & Pedrycz, W. (2023). A fuzzy rule-based decision-making framework for assessing the impact of rework on construction productivity. *Frontiers in Built Environment, 9*, Article 1143829. https://doi.org/10.3389/fbuil.2023.1143829

Azizi, A., & Taghavi, M. (2023). Implementing lean construction: A literature study of barriers, enablers, and implications. *Buildings, 13*(2), 556. https://doi.org/10.3390/buildings13020556

Bang, S., & Olsson, N. O. E. (2022). Artificial intelligence in construction projects: A systematic scoping review. *Engineering, Construction and Architectural Management, 29*(7), 2162–2181. https://doi.org/10.1108/ECAM-12-2020-1075

Barbosa, F., Woetzel, J., Mischke, J., Ribeirinho, M. J., Sridhar, M., Parsons, M., Bertram, N., & Brown, S. (2017). Reinventing construction: A route to higher productivity. *McKinsey Global Institute*.

Biesenthal, C., Clegg, S., Mahalingam, A., & Sankaran, S. (2018). Applying institutional theories to managing megaprojects. *International Journal of Project Management, 36*(1), 43–54. https://doi.org/10.1016/j.ijproman.2017.06.006

Blackwell, T., Holgersen, S., & Wallstam, M. (2023). Dreaming of efficient markets? Residential construction, competition and affordability in the Swedish housing sector. *European Planning Studies*. Advance online publication. https://doi.org/10.1080/09654313.2023.2188767

Bondemark, A., Westermark, K., & Gordon, A. (2024). Barriers to spurring innovation in Swedish transport infrastructure construction. *Case Studies on Transport Policy, 15*, Article 101041. https://doi.org/10.1016/j.cstp.2023.101041

Borg, L., & Song, H.-S. (2013). Quality change and implications for productivity development: Housing construction in Sweden 1990–2010. *Working Paper Series, 13/18*. Royal Institute of Technology.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brucker Juricic, B., Galic, M., & Marenjak, S. (2021). Review of the construction labour demand and shortages in the EU. *Buildings, 11*(1), 17. https://doi.org/10.3390/buildings11010017

Boverket. (2024). Nya byggregler – vad innebär de? Retrieved April 25, 2024, from https://www.boverket.se/sv/PBL-kunskapsbanken/regler-om-byggande/byggregelsystemet/nya-byggregler/

Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. *Oncology Nursing Forum, 41*(5), 545–547. https://doi.org/10.1188/14.ONF.545-547

Charmaz, K. (2014). *Constructing grounded theory* (2nd ed.). SAGE Publications.

Chen, K., Zhou, X., Bao, Z., Skibniewski, M. J., & Fang, W. (2025). Artificial intelligence in infrastructure construction: A critical review. *Frontiers of Engineering Management, 12*(1), 24–38. https://doi.org/10.1007/s42524-024-3128-5

Chen, X., Chang-Richards, A. Y., Pelosi, A., Jia, Y., Shen, X., Siddiqui, M. K., & Yang, N. (2022). Implementation of technologies in the construction industry: A systematic review. *Engineering, Construction and Architectural Management*. Advance online publication. https://doi.org/10.1108/ECAM-06-2022-0530

Choi, B. C. K., & Pak, A. W. P. (2005). A catalog of biases in questionnaires. *Preventing Chronic Disease, 2*(1), A13. PMCID: PMC1323316

Chowdhury, T., Adafin, J., & Wilkinson, S. (2019). Review of digital technologies to improve productivity of New Zealand construction industry. *Journal of Information Technology in Construction, 24*, 569–587. https://doi.org/10.36680/j.itcon.2019.032

Cicmil, S., Hodgson, D., Lindgren, M., & Packendorff, J. (2017). The projectification of everything: Projects as a human condition. *Project Management Journal, 48*(4), 4–16. https://doi.org/10.1177/875697281704800402

Costa, D. B., Formoso, C. T., Kagioglou, M., Alarcón, L. F., & Caldas, C. H. (2006). Benchmarking initiatives in the construction industry: Lessons learned and improvement opportunities. *Journal of Management in Engineering, 22*(4), 158–167. https://doi.org/10.1061/(ASCE)0742-597X(2006)22:4(158)

Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). SAGE Publications.

Culmo, M. P. (2011). *Accelerated bridge construction: Experience in design, fabrication, and erection of prefabricated bridge elements and systems: Final manual* (FHWA-HIF-12-013). U.S. Department of Transportation, Federal Highway Administration. https://rosap.ntl.bts.gov/view/dot/41034

Dave, B., & Koskela, L. (2009). Collaborative knowledge management—A construction case study. *Automation in Construction, 18*(7), 894–902. https://doi.org/10.1016/j.autcon.2009.03.015

Das, D. K. (2023). Project management as an anti-planning measure for the effective preparation and implementation of urban development plans in the Global

South. *Cogent Engineering, 10*(1), 2215570. https://doi.org/10.1080/23311916.2023.2215570

De Waard, E. J., & Kalkman, J. P. (2022). Synthesizing extreme-context studies in project management journals: Introducing a time-based project management typology. *International Journal of Managing Projects in Business, 15*(5), 886–912. https://doi.org/10.1108/IJMPB-08-2021-0227

Dubois, A., & Gadde, L.-E. (2002). The construction industry as a loosely coupled system: Implications for productivity and innovation. *Construction Management and Economics, 20*(7), 621–631. https://doi.org/10.1080/01446190210163543

El Masry, A. (2025). Factors influencing big data adoption for sustainability in the Swedish construction industry: Technical, economic, and organizational perspectives. *Buildings, 15*(10), 1671. https://doi.org/10.3390/buildings15101671

Elghaish, F. A. K., Abrishami, S., Hosseini, M. R., Abu-Samra, S., & Gaterell, M. (2019). Integrated project delivery with BIM: An automated EVM-based approach. *Automation in Construction, 106*, Article 102907. https://doi.org/10.1016/j.autcon.2019.102907

Engebø, A., Lædre, O., Young, B., Larssen, P. F., Lohne, J., & Klakegg, O. J. (2020). Collaborative project delivery methods: A scoping review. *Journal of Civil Engineering and Management, 26*(3), 278–303. https://doi.org/10.3846/jcem.2020.12186

Eriksson, P. E., & Westerberg, M. (2011). Effects of cooperative procurement procedures on construction project performance: A conceptual framework. *International Journal of Project Management, 29*(2), 197–208. https://doi.org/10.1016/j.ijproman.2010.01.003

Eriksson, P. E., Volker, L., Kadefors, A., Lingegård, S., Larsson, J., & Rosander, L. (2019). Collaborative procurement strategies for infrastructure projects: A multiple-case study. *Proceedings of the Institution of Civil Engineers – Management, Procurement and Law, 172*(5), 197–205. https://doi.org/10.1680/jmapl.19.00016

European Construction Sector Observatory. (2020). Improving the human capital basis (Analytical Report 2020). Publications Office of the European Union. https://ec.europa.eu/docsroom/documents/41261

European Construction Sector Observatory. (2021). Country fact sheet Sweden 2021. European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs.

Eurostat. (2024). Construction production and turnover – Annual enterprise statistics for construction [Dataset].

Fan, S.-L., Lee, C.-Y., Chong, H.-Y., & Skibniewski, M. J. (2018). A critical review of legal issues and solutions associated with building information modelling. *Technological and Economic Development of Economy, 24*(5), 2098–2130. https://doi.org/10.3846/tede.2018.5695

Felicioni, L., Lupíšek, A., & Gaspari, J. (2023). Exploring the common ground of sustainability and resilience in the building sector: A systematic literature review and analysis of building rating systems. *Sustainability, 15*(1), 884. https://doi.org/10.3390/su15010884

Flick, U. (2018). *An introduction to qualitative research* (6th ed.). SAGE.

Forsberg, A., & Saukkoriipi, L. (2007). Measurement of waste and productivity in relation to lean thinking. In *Proceedings of the 15th Annual Conference of the International Group for Lean Construction* (pp. 67–76). International Group for Lean Construction.

Fox, S., Marsh, L., & Cockerham, G. (2001). Design for manufacture: A strategy for successful application to buildings. *Construction Management and Economics, 19*(5), 493–502. https://doi.org/10.1080/01446193.2001.9709625

Fox, S., Marsh, L., & Cockerham, G. (2010). Constructability rules: Guidelines for successful application to bespoke buildings. *Construction Management and Economics, 20*(2), 113–123. https://doi.org/10.1080/01446190110098979

Fufa, S. M., Brown, M. K., Hauge, Å. L., Johnsen, S. Å., & Fjellheim, K. (2023). User perspectives on reuse of construction products in Norway: Results of a national survey. *Journal of Cleaner Production, 408*, 137067. https://doi.org/10.1016/j.jclepro.2023.137067

Fulford, R., & Standing, C. (2014). Construction industry productivity and the potential for collaborative practice. *International Journal of Project Management, 32*(2), 315–326. https://doi.org/10.1016/j.ijproman.2013.05.007

Gadde, L.-E., & Dubois, A. (2010). Partnering in the construction industry—Problems and opportunities. *Journal of Purchasing and Supply Management, 16*(4), 254–263. https://doi.org/10.1016/j.pursup.2010.09.002

Gao, S., Low, S. P., & Nair, K. (2018). Design for manufacturing and assembly (DfMA): A preliminary study of factors influencing its adoption in Singapore. *Architectural Engineering and Design Management, 14*(1), 1–17. https://doi.org/10.1080/17452007.2018.1502653

Gerhardsson, H., Lindholm, C. L., Andersson, J., Kronberg, A., Wennesjö, M., & Shadram, F. (2020). Transitioning the Swedish building sector toward reuse and circularity. *IOP Conference Series: Earth and Environmental Science, 588*(4), 042036. https://doi.org/10.1088/1755-1315/588/4/042036

Gharaibeh, L., Matarneh, S. T., Eriksson, K., & Lantz, B. (2022). An empirical analysis of barriers to building information modelling (BIM) implementation in wood construction projects: Evidence from the Swedish context. *Buildings, 12*(8), 1067. https://doi.org/10.3390/buildings12081067

Ghodrati, N., Yiu, T. W., Wilkinson, S., Poshdar, M., Talebi, S., Elghaish, F., & Sepasgozar, S. M. E. (2022). Unintended consequences of productivity improvement strategies on safety behaviour of construction labourers: A step toward the integration of safety and productivity. *Buildings, 12*(3), 317. https://doi.org/10.3390/buildings12030317

Giorgio, B., Blanchet, P., Barlet, A., & Gaudelas, A. (2025). Using prefabricated wood light-frame in multi-storey and non-residential construction projects: Motivations and barriers of professionals in Quebec. *BioResources, 20*(1), 625–671.

Green, S. D. (1999). The dark side of lean construction: Exploitation and ideology. In *Proceedings of the 7th Annual Conference of the International Group for Lean Construction* (pp. 21–32). University of California, Berkeley.

Gunduz, M., & Abu-Hijleh, A. (2020). Assessment of human productivity drivers for construction labor through importance rating and risk mapping. *Sustainability, 12*(20), 8614. https://doi.org/10.3390/su12208614

Gunduz, M., Nielsen, Y., & Özdemir, M. (2020). Assessment of human productivity drivers for construction labor through importance rating and risk mapping. *Sustainability, 12*(20), 8614. https://doi.org/10.3390/su12208614

Hällgren, M., Rouleau, L., & de Rond, M. (2018). A matter of life or death: How extreme context research matters for management and organization studies. *Academy of Management Annals, 12*(1), 111–153. https://doi.org/10.5465/annals.2016.0017

Hasan, A., Baroudi, B., Elmualim, A., & Rameezdeen, R. (2018). Factors affecting construction productivity: A 30-year systematic review. *Engineering, Construction and Architectural Management, 25*(7), 916–937. https://doi.org/10.1108/ECAM-02-2017-0035

Hobbs, B., & Aubry, M. (2007). A multi-phase research program investigating project management offices (PMOs): The results of phase 1. *Project Management Journal, 38*(1), 74–86. https://doi.org/10.1177/875697280703800108

Hofstede, G. (2001). *Culture's consequences: Comparing values, behaviors, institutions, and organizations across nations* (2nd ed.). SAGE Publications.

Höök, M., & Stehn, L. (2008). Lean principles in industrialized housing production: The need for a cultural change. *Lean Construction Journal, 2008*, 20–33. https://doi.org/10.60164/03a3c4g7c

Hooper, M. (2015). BIM standardisation efforts – The case of Sweden. *Journal of Information Technology in Construction, 20*, 332–346. http://www.itcon.org/2015/21

Hummel, P., Braun, M., Tretter, M., & Dabrock, P. (2021). Data sovereignty: A review. *Big Data & Society, 8*(1). https://doi.org/10.1177/2053951720982012

Hwang, B.-G., & Ng, W. J. (2013). Project management knowledge and skills for green construction: Overcoming challenges. *International Journal of Project Management, 31*(2), 272–284. https://doi.org/10.1016/j.ijproman.2012.05.004

Issaoui, A., Örtensjö, J., & Islam, M. S. (2023). Exploring the General Data Protection Regulation (GDPR) compliance in cloud services: Insights from Swedish public organizations on privacy compliance. *Future Business Journal, 9*(1), 39. https://doi.org/10.1186/s43093-023-00285-2

Jacobsen, E. L., Teizer, J., & Wandahl, S. (2023). Work estimation of construction workers for productivity monitoring using kinematic data and deep learning. *Automation in Construction, 152*, 104932. https://doi.org/10.1016/j.autcon.2023.104932

Jacobsson, M., & Linderoth, H. C. J. (2012). User perceptions of ICT impacts in Swedish construction companies: "It's fine, just as it is." *Construction Management and Economics, 30*(5), 339–357. https://doi.org/10.1080/01446193.2012.672757

Josephson, P.-E., & Saukkoriipi, L. (2005). Slöseri i byggprojekt – Behov av förändrat synsätt (FoU-Väst Rapport 0507). Sveriges Byggindustrier.

Josephson, P.-E., & Saukkoriipi, L. (2005). Waste in construction projects: Call for a new approach (Report 0507). Chalmers University of Technology.

Josephson, P.-E., & Saukkoriipi, L. (2007). Waste in construction projects: Call for a new approach. Chalmers University of Technology. ISBN 978-91-976181-7-5

Jørgensen, B., & Emmitt, S. (2008). Lost in transition: The transfer of lean manufacturing to construction. *Engineering, Construction and Architectural Management, 15*(4), 383–398. https://doi.org/10.1108/09699980810886874

Kadefors, A. (2004). Trust in project relationships—Inside the black box. *International Journal of Project Management, 22*(3), 175–182. https://doi.org/10.1016/S0263-7863(03)00031-0

Kadefors, A., Aaltonen, K., Gottlieb, S. C., Klakegg, O. J., Lahdenperä, P., Olsson, N. O. E., Rosander, L., & Thuesen, C. (2024). Relational contracting in Nordic construction: A comparative longitudinal account. *International Journal of Managing Projects in Business, 17*(8), 22–46.

Kamali, M., & Hewage, K. (2016). Life cycle performance of modular buildings: A critical review. *Renewable and Sustainable Energy Reviews, 62*, 1171–1183. https://doi.org/10.1016/j.rser.2016.05.031

Kapelko, M., Horta, I. M., Camanho, A. S., & Oude Lansink, A. G. J. M. (2015). Measurement of input-specific productivity growth with an application to the construction industry in Spain and Portugal. *International Journal of Production Economics, 166*, 64–71. https://doi.org/10.1016/j.ijpe.2015.03.030

Kent, D. C., & Becerik-Gerber, B. (2010). Understanding construction industry experience and attitudes toward integrated project delivery. *Journal of Construction Engineering and Management, 136*(8), 815–825. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000188

Kifokeris, D., & Koch, C. (2020). Swedish lean construction practices identified in the last decade of research. In L. Scott & C. J. Neilson (Eds.), *Proceedings of the 36th Annual Conference of the Association of Researchers in Construction Management (ARCOM 2020)* (pp. 435–444). Association of Researchers in Construction Management.

Kifokeris, D., & Koch, C. (2023). Lean construction – the current situation (Slutrapport SBUF Projekt 13940). Chalmers University of Technology & Halmstad University.

Koch, C., & Lundholm, A. (2018). Produktivitetsläget i svenskt byggande [Productivity in Swedish construction]. *SBUF Report 13642*.

Koch, C., Shayboun, M., Manès, A., & Nordlund, T. (2020). Produktivitetsläget i svenskt byggande 2018: Lokaler, flerbostadshus, grupphus och anläggning (SBUF Rapport 13642). Svenska Byggbranschens Utvecklingsfond (SBUF).

Kreuter, F., Presser, S., & Tourangeau, R. (2008). Social desirability bias in CATI, IVR, and Web surveys: The effects of mode and question sensitivity. *Public Opinion Quarterly, 72*(5), 847–865. https://doi.org/10.1093/poq/nfn063

Krippendorff, K. (2018). *Content analysis: An introduction to its methodology* (4th ed.). SAGE Publications.

Krumpal, I. (2013). Determinants of social desirability bias in sensitive surveys: A literature review. *Quality & Quantity, 47*(4), 2025–2047. https://doi.org/10.1007/s11135-011-9640-9

Kunkcu, H., Koc, K., Dagou, H. H., & Gurgun, A. P. (2022). Using key performance indicators in construction project literature. *Proceedings of International Structural Engineering and Construction, 9*(2), CON-12-1–CON-12-8. https://doi.org/10.14455/ISEC.2022.9(2).CON-12

Lahdenperä, P. (2012). Making sense of the multi-party contractual arrangements of project partnering, project alliancing and integrated project delivery. *Construction Management and Economics, 30*(1), 57–79. https://doi.org/10.1080/01446193.2011.648947

Landin, A., & Öberg, M. (2014). Measuring construction productivity: A survey of Swedish practice. *Engineering, Construction and Architectural Management, 21*(3), 386–402. https://doi.org/10.1108/ECAM-04-2013-0039

Landin, A., & Öberg, M. (2014). Productivity and efficiency in the development of the Swedish construction sector. *American Journal of Industrial and Business Management, 4*(6), 307–318. https://doi.org/10.4236/ajibm.2014.46038

Landin, A., & Öberg, M. (2014). Productivity and efficiency in the Swedish construction sector. *International Journal of Construction Management, 14*(1), 1–10. https://doi.org/10.1080/15623599.2014.922734

Larsson, J., & Larsson, L. (2020). Integration, application and importance of collaboration in sustainable project management. *Sustainability, 12*(2), 585. https://doi.org/10.3390/su12020585

Lee, T. Y., Ahmad, F., & Sarijari, M. A. (2023). Current status and future research trends of construction labor productivity monitoring: A bibliometric review. *Buildings, 13*(6), 1479. https://doi.org/10.3390/buildings13061479

Lessing, J., Stehn, L., & Ekholm, A. (2015). Industrialised house-building – Development and conceptual orientation of the field. *Construction Innovation, 15*(3), 378–399. https://doi.org/10.1108/CI-06-2014-0032

Liang, C.-J., Le, T.-H., Ham, Y., Mantha, B. R. K., Cheng, M. H., & Lin, J. J. (2024). Ethics of artificial intelligence and robotics in the architecture, engineering, and construction industry. *Automation in Construction, 162*, 105369. https://doi.org/10.1016/j.autcon.2024.105369

Lidelöw, S., Engström, S., & Samuelson, O. (2023). The promise of BIM? Searching for realized benefits in the Nordic AECO industries. *Journal of Building Engineering, 76*, 107067. https://doi.org/10.1016/j.jobe.2023.107067

Lindhard, S., & Larsen, J. K. (2016). Identifying the key process factors affecting project performance. *Engineering, Construction and Architectural Management, 23*(5), 657–673. https://doi.org/10.1108/ECAM-08-2015-0123

Linderoth, H. C. J. (2017). From visions to practice – The role of sensemaking, institutional logic and pragmatic practice. *Construction Management and Economics, 35*(6), 324–337. https://doi.org/10.1080/01446193.2016.1250930

Ljungblom, M., & Lennerfors, T. T. (2021). The Lean principle respect for people as respect for craftsmanship. *International Journal of Lean Six Sigma, 12*(6), 1209–1230. https://doi.org/10.1108/IJLSS-06-2020-0085

Loosemore, M., & Andonakis, N. (2007). Barriers to implementing OHS reforms – The experiences of small subcontractors in the Australian construction industry. *International Journal of Project Management, 25*(6), 579–588. https://doi.org/10.1016/j.ijproman.2007.01.015

Love, P. E. D., Matthews, J., Simpson, I., Hill, A., & Olatunji, O. A. (2014). A benefits realization management building information modeling framework for asset owners. *Automation in Construction, 37*, 1–10. https://doi.org/10.1016/j.autcon.2013.09.007

Lu, W., Tan, T., Xu, J., Wang, J., Chen, K., Gao, S., & Xue, F. (2020). Design for manufacture and assembly (DfMA) in construction: The old and the new. *Architectural Engineering and Design Management, 16*(1), 1–20. https://doi.org/10.1080/17452007.2020.1768505

Maraqa, M., & Sacks, R. (2021). Quantitative assessment of the impacts of BIM and lean on process and operations flow in construction projects. *Engineering, Construction and Architectural Management, ahead-of-print*(ahead-of-print). https://doi.org/10.1108/ECAM-12-2020-1068

Matos, B. C., Cruz, C. O., & Branco, F. B. (2024). Digitalization and procurement in construction projects: An integrated BIM-based approach. *Journal of Information Technology in Construction, 29*, 400–423. https://doi.org/10.36680/j.itcon.2024.019

Mayo-Alvarez, L., Alvarez-Risco, A., Del-Aguila-Arcentales, S., Sekar, M. C., & Yañez, J. A. (2022). A systematic review of earned value management methods for monitoring and control of project schedule performance: An AHP approach. *Sustainability, 14*(22), 15259. https://doi.org/10.3390/su142215259

Mechtcherine, V., Nerella, V. N., Will, F., Näther, M., Otto, J., & Krause, M. (2019). Large-scale digital concrete construction – CONPrint3D concept for on-site, monolithic 3D-printing. *Automation in Construction, 107*, 102933. https://doi.org/10.1016/j.autcon.2019.102933

Meng, X., & Gallagher, B. (2012). The impact of incentive mechanisms on project performance. *International Journal of Project Management, 30*(3), 352–362. https://doi.org/10.1016/j.ijproman.2011.08.006

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass.

Minkov, M., & Hofstede, G. (2011). The evolution of Hofstede's doctrine. *Cross Cultural Management: An International Journal, 18*(1), 10–20. https://doi.org/10.1108/13527601111104269

Moradi, S., & Sormunen, P. (2023). Implementing lean construction: A literature study of barriers, enablers, and implications. *Buildings, 13*(2), 556. https://doi.org/10.3390/buildings13020556

Moscati, A., & Engström, S. (2019). Digitalisation and industrialisation: Exploration of the current and future challenges in the Swedish built environment sector. In C. Gorse & C. J. Neilson (Eds.), *Proceedings of the 35th Annual ARCOM Conference* (pp. 386–395). Association of Researchers in Construction Management.

Nilsson, J.-E., Nyström, J., & Salomonsson, F. J. (2019). Produktivitet i bygg- och anläggningssektorn (SBUF Rapport Nr. 13606). Svenska Byggbranschens Utvecklingsfond (SBUF).

Nilsson, J.-E., Nyström, J., & Salomonsson, J. (2024). Sweden versus Europe in construction sector productivity – A TFP approach (VTI Working Paper 2024:1). Statens väg- och transportforskningsinstitut (VTI).

Núñez Varela, E., Öhrling, K., & Moscati, A. (2022). Analysis of the challenges in the Swedish urban planning process: A case study about digitalization. *Sustainability, 14*(24), 16333. https://doi.org/10.3390/su142416333

Ofori-Kuragu, J. K. (2025). *Development of a conceptual benchmarking framework for the construction industry*. International Journal of Business Performance Management, *26*(1), 83–103. https://doi.org/10.1504/IJBPM.2025.143645

Olanipekun, A. O., & Sutrisna, M. (2021). *Facilitating digital transformation in construction—A systematic review of the current state of the art*. Frontiers in Built Environment, 7, Article 660758. https://doi.org/10.3389/fbuil.2021.660758

Organisation for Economic Co-operation and Development. (2021). *Innovation diffusion in Blekinge, Sweden* (OECD Regional Development Papers No. 2021/08). OECD Publishing.

Organisation for Economic Co-operation and Development. (2024). *Strengthening the governance of the Swedish skills system*. OECD Publishing.

Park, H. S. (2006). Conceptual framework of construction productivity estimation. *KSCE Journal of Civil Engineering, 10*(5), 311–317. https://doi.org/10.1007/BF02830084

Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice* (4th ed.). SAGE Publications.

Perez, L., & Kim, S. (2021). *Urban sustainability frameworks*. Routledge.

Proaño-Narváez, M., Flores-Vázquez, C., Vásquez Quiroz, P., & Avila-Calle, M. (2022). Earned value method (EVM) for construction projects: Current application and future projections. *Buildings, 12*(3), 301. https://doi.org/10.3390/buildings12030301

Rahman, S. H. A., Endut, I. R., Faisol, N., & Paydar, S. (2014). The importance of collaboration in construction industry from contractors' perspectives. *Procedia - Social and Behavioral Sciences, 129*, 414–421. https://doi.org/10.1016/j.sbspro.2014.03.695

Rathnayake, A., Murguia, D., & Middleton, C. (2024). Measuring activity-level construction productivity. *Journal of Construction Engineering and Management, 150*(8), 04024099. https://doi.org/10.1061/JCEMD4.COENG-14602

Regona, D. A., Alaloul, W. S., Liew, M. S., Musarat, M. A., & Mohammed, B. S. (2022). Artificial intelligence in the construction industry: A systematic review of research trends and future directions. *Buildings, 12*(3), 316. https://doi.org/10.3390/buildings12030316

Regona, M., Yigitcanlar, T., Xia, B., & Li, R. Y. M. (2022). Opportunities and adoption challenges of AI in the construction industry: A PRISMA review. *Journal of Open Innovation: Technology, Market, and Complexity, 8*(1), 45. https://doi.org/10.3390/joitmc8010045

Regeringskansliet. (2015). *Bättre samarbete vid byggande och drift av järnväg* (SOU 2015:105).

Salem, O., Solomon, J., Genaidy, A., & Luegring, M. (2005). Site implementation and assessment of lean construction techniques. *Lean Construction Journal, 2*(2), 1–21. https://doi.org/10.60164/e2i9e2h1d

Sacks, R., Pikas, E., Brilakis, I., & Xie, H. (2017). *Building Lean, Building BIM: Changing construction the Tidhar way*. Routledge. https://doi.org/10.1201/9781315300511

Samuelson, O., & Stehn, L. (2023). Digital transformation in construction – A review. *Journal of Information Technology in Construction, 28*, 385–404. https://doi.org/10.36680/j.itcon.2023.020

Schimanski, C. P., Marcher, C., Monizza, G. P., & Matt, D. T. (2020). The Last Planner® System and Building Information Modeling in construction execution: From an integrative review to a conceptual model for integration. *Applied Sciences, 10*(3), 821. https://doi.org/10.3390/app10030821

Schreier, M. (2012). *Qualitative content analysis in practice*. SAGE Publications. https://doi.org/10.4135/9781529682571

Shehata, M. E., & El-Gohary, K. M. (2011). Towards improving construction labor productivity and projects' performance. *Alexandria Engineering Journal, 50*(4), 321–330. https://doi.org/10.1016/j.aej.2012.02.001

Shehu, M. O., Almeida, R., & Mahapatra, K. (2025). Opportunities for digital tracking technologies in the precast concrete sector in Sweden. *Frontiers in Built Environment, 11*, Article 1566784. https://doi.org/10.3389/fbuil.2025.1566784

Shibeika, A., & Harty, C. (2015). Diffusion of digital innovation in construction: A case study of a UK engineering firm. *Construction Management and Economics, 33*(5–6), 453–466. https://doi.org/10.1080/01446193.2015.1077982

Singh, A., Dwivedi, A., Agrawal, D., & Singh, D. (2023). Identifying issues in adoption of AI practices in construction supply chains: Towards managing sustainability. *Operations Management Research, 16*, 1667–1683. https://doi.org/10.1007/s12063-022-00344-x

Statistics Sweden. (2023). *Construction statistics 2022 – Final report*. Retrieved March 17, 2024, from https://www.scb.se/en/finding-statistics/statistics-by-subject-area/construction-and-property/construction-activities/construction-statistics/

Statens offentliga utredningar. (2012). *Vägar till förbättrad produktivitet och innovationsgrad i anläggningsbranschen* (SOU 2012:39). Regeringskansliet.

Söderlund, J. (2014). Project management and the temporary organization: An institutional perspective. In R. Turner (Ed.), *Gower Handbook of Project Management* (5th ed., pp. 157–175). Routledge. https://doi.org/10.4324/9781315585741

Swedish Construction Federation. (2024). *Construction forecast 2024–2026.*

Tourangeau, R., & Yan, T. (2007). Sensitive questions in surveys. *Psychological Bulletin, 133*(5), 859–883. https://doi.org/10.1037/0033-2909.133.5.859

Uhlhorn, B., Geißler, G., & Jiricka-Pürrer, A. (2024). Exploring the uptake of advanced digital technologies in environmental assessment practice: Experiences from Austria and Germany. *Journal of Environmental Management, 345*, 121412. https://doi.org/10.1016/j.jenvman.2024.121412

Ulfvarson Östlund, M. (2008). Measures to change the Swedish planning and building legislation and its application. In *FIG Working Week 2008: Integrating Generations* (pp. 1–7). International Federation of Surveyors.

Ussing, L. F., Svidt, K., & Wandahl, S. (2016). Legal aspects connected to the use of BIM in the Danish building sector. In *Construction Research Congress 2016: Old and New Construction Technologies Converge in Historic San Juan* (pp. 528–537). American Society of Civil Engineers. https://doi.org/10.1061/9780784479827.054

Vandevoorde, S., & Vanhoucke, M. (2006). A comparison of different project duration forecasting methods using earned value metrics. *International Journal of Project Management, 24*(4), 289–302. https://doi.org/10.1016/j.ijproman.2005.10.004

Vanhoucke, M. (2011). On the dynamic use of project performance and schedule risk information during project tracking. *Omega, 39*(4), 416–426. https://doi.org/10.1016/j.omega.2010.09.006

Viklund Tallgren, M., Roupé, M., & Johansson, M. (2015). An empowered collaborative planning method in a Swedish construction company: A case study. In A. B. Raidén & E. Aboagye-Nimo (Eds.), *Proceedings of the 31st Annual ARCOM Conference* (pp. 793–802). Association of Researchers in Construction Management.

von Malmborg, F., Rohdin, P., & Wihlborg, E. (2023). Climate declarations for buildings as a new policy instrument in Sweden: A multiple streams perspective. *Building Research & Information, 51*(5), 479–496. https://doi.org/10.1080/09613218.2023.2222320

Whyte, J. (2019). How digital information transforms project delivery models. *Project Management Journal, 50*(2), 177–194. https://doi.org/10.1177/8756972818823304

World Health Organization. (2023). *Air quality guidelines*. Retrieved March 12 https://www.who.int/airquality

Yi, W., & Chan, A. P. C. (2014). Critical review of labor productivity research in construction journals. *Journal of Management in Engineering, 30*(2), 214–225. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000194

Zhang, S., Lee, J.-K., Venugopal, M., Teizer, J., & Eastman, C. M. (2013). Building information modeling (BIM) and safety: Automatic safety checking of construction models and schedules. *Automation in Construction, 29*, 183–195. https://doi.org/10.1016/j.autcon.2012.05.006

Zhang, X., & Wang, Y. (2023). Digital transformation in construction: A review of research trends and practical implications. *Buildings, 13*(4), 1092. https://doi.org/10.3390/buildings13041092

Zulu, S. L., Saad, A. M., & Omotayo, T. (2023). The mediators of the relationship between digitalisation and construction productivity: A systematic literature review. *Buildings, 13*(4), 839. https://doi.org/10.3390/buildings13040839

Zwikael, O., Globerson, S., & Raz, T. (2000). Evaluation of models for forecasting the final cost of a project. *Project Management Journal, 31*(1), 53–57. https://doi.org/10.1177/875697280003100108

10 Appendices

10.1 Interview Questions

We have different set of questions to each role that were specified in our methodology section. below is an example of the questions we had asked one of our interviewees. It is worth noting that the questions used to change and vary depending on the interviewee's position and involvement in certain projects. Also, geographical location was taken into consideration when interviewing the professional and certain questions were tailored to test the regulatory differences between different locations in Sweden.

Site Supervisors (On-site Management)

Role focus: Day-to-day management of construction activities on site, ensuring that work progresses according to plan and addressing issues in real time.

Theme: Project Time Planning & Scheduling Challenges

Understanding the Plan: *Can you describe how the project schedule or time plan is communicated to you on site?* How involved are you in setting or adjusting that plan, and do you feel it reflects the reality of on-site work?

Challenges in Execution: *What are the biggest challenges you face in trying to follow the project's time plan or production schedule on site?* For example, are there frequent changes, resource shortages, or other obstacles that make it hard to stick to the schedule?

Adapting to Changes: *When the schedule needs to change (e.g. due to delays or unexpected issues), how is that handled?* Are you able to adjust plans on site easily, and do you feel supported when you need to make those adjustments?

Theme: Disconnect Between Planning and Site Execution

Realism of Higher-Level Plans: *In your experience, how well do the plans made by upper management or planners align with what actually happens on the ground?* Can you share an example of a time when the high-level plan didn't match site conditions or realities?

Communication and Feedback: *If you notice that a centrally made schedule isn't working on site, what do you do?* Do you feel comfortable reporting these issues back to management, and how do they typically respond?

Ownership of the Schedule: *Do you and your crew feel a sense of ownership over the project schedule?* For instance, are you involved in planning meetings or updates, or do you feel the schedule is "handed down" with little input from the site team?

Workflow Bottlenecks and Delays

Identifying Bottlenecks: *What parts of the construction process on site most often slow down progress or cause delays?*

Impact on Completion: *How do these bottlenecks affect the project's ability to finish on time?* Can you describe a situation where a specific bottleneck significantly impacted the schedule?

Resolving Issues: *When a bottleneck or delay occurs, how is it usually addressed on site?* Do you have the authority and resources to resolve it quickly, or do you rely on decisions from higher up to fix the situation?

Digital Tools and AI in Scheduling

Current Tools Usage: *What tools or systems do you use to track progress or manage your daily/weekly schedule on site (if any)?*

Usefulness and Challenges: *How effective are these tools for your needs on site?* Are they user-friendly and do they help you save time or work more efficiently, or do they sometimes feel like extra paperwork?

Openness to New Technology: *Have you heard of or used any advanced tools like digital dashboards or AI-driven scheduling systems that update plans automatically?* If so, what has your experience been? If not, how do you feel about the idea of using AI or smarter software to help with scheduling and productivity tracking on site?

Support and Training: *Do you feel you have adequate training and support to use digital tools provided by the company?* What would make it easier for you and your team to adopt new tools (like mobile apps or AI-based planners) for managing the project schedule?

10.2 Example of Content Analysis Table

This table reflects a systematic content analysis of recurring themes across 15 interviews, in line with methodologies suggested by authors such as Krippendorff (2018) and Schreier (2012) for qualitative content analysis. This is an example table from many other thorough analysis tables we have. This example is set to show frequency of certain productivity factors across the interviews.

Table 6 Content Analysis: Full Table

Productivity Factor	Frequency (across Interviews)	Example Contexts
Resource Constraints	12	Labor shortages for electricians and plumbers; logistical limitations in urban areas
Design Changes	11	Late client-driven modifications; budget not updated with revised drawings
Warranty Claims Management	9	HVAC system defects; water leaks; subcontractors reluctant to return post-handover
Planning Standardization Issues	10	No unified planning method; reliance on individual planner experience
Subcontractor Coordination	10	HVAC-piping-electrical sequencing misaligned; frequent scheduling conflicts
Digital Tool Adoption	8	Uneven adoption of Power BI and 3D modelling; resistance to new AI scheduling tools
Contractual Ambiguities	9	Loose terms delaying rectifications; weak enforcement of security bonds
Logistics and Site Access	7	Cranes blocked by public transit; restricted delivery windows in dense areas
AI and Technology Utilization	6	AI underutilized in planning; EVM only partially implemented
Organizational Culture and Communication	8	Micro-cultures across sites; lack of systemic knowledge transfer; siloed planning

10.3 Example of Grounded Theory Analysis

Example Grounded Theory Process: Interview with Drone and IT Manager

Step 1: Initial Coding Table

Table 7 Grounded Theory: Initial Coding Table

	Transcript Excerpt	Initial Code
1	"That became a big problem because there is a security part of it, but everybody can access everything."	Security concerns in early digital implementations
2	"Find a way to track progress in construction sites."	Tasked with developing automated progress tracking
3	"We should eliminate humans from this whole thing."	Organizational push to automate human-driven processes
4	"Discrepancy between human reporting and system output."	Unreliability of manual progress reporting
5	"Laser scanning... very heavy... don’t need millimetre accurate things..."	Evaluating trade-offs between accuracy and usability

6	"Laser scan models... 20–30 gigabytes... very heavy."	Data processing/storage constraints of high-fidelity tools
7	"360 captures... more feasible... storage and usability."	Preference for lightweight visual documentation methods
8	"Foreign company... could analyse captures and give information... AI does the whole thing."	Selection based on unique AI capabilities
9	"AI compares photos to 4D model... cross-checking system."	Use of AI for visual verification against planning models
10	"QR codes on each floor... system identifies location based on QR."	Localization through passive visual markers (QR codes)
11	"System captures time-lapse... selects best photo automatically."	Automated and selective image capturing workflow
12	"Denmark has been using it extensively... moving project to project."	Peer-country adoption and scaling of innovation
13	"Sweden is just thinking about doing it."	Organizational inertia in domestic market
14	"It's expensive... who is paying?"	Cost sensitivity and funding ambiguity as adoption barriers
15	"Can now see whole site on the computer... changes the way you use your time."	Digital tools restructure daily operations and time allocation
16	"Reduces number of site engineers needed... replaces people on site."	Human resource reduction via technology integration
17	"Framework in Denmark... who does what, when... weekly calendar."	Formalized workflows supporting digital adoption
18	"Supplier says 60%, system shows 30%... now there's proof."	Improved dispute resolution through factual verification
19	"System enables prediction of project completion."	Forecasting capability enabled by digital progress tracking
20	"Identifies construction issues early... e.g., pipe behind ceiling."	Early error detection prevents costly rework
21	"Subcontractors in the system... use data to invoice."	Integration of subcontractor workflows and billing into digital platforms
22	"Single source of truth... everyone refers to same data."	Unified data stream reduces miscommunication and uncertainty
23	"Cost of system 8–10K EUR/month... cost vs. value debate."	High subscription cost prompts ROI justification
24	"Client owns data... supports facility maintenance and long-term value."	Lifecycle benefits through client data ownership
25	"Aftermarket use not even included in ROI... huge value."	ROI underestimates long-term data utility
26	"Predicts and corrects quality issues before they affect later stages."	Pre-emptive quality assurance via model-based visual matching
27	"Training AI to detect tasks not modelled in 3D, like painting."	Custom task tracking through system training
28	"AI acts like an assistant site engineer... with entire model in memory."	AI supports and extends human cognition on-site
29	"Biggest barrier is not technical, it's generational... older people in charge don't adopt."	Generational resistance to digital transformation
30	"Each project is its own kingdom... needs management mandate."	Decentralized project autonomy hinders standardization
31	"System aligns with earned value methodology... helps validate invoices."	Financial validation aligned with standardized project control practices
32	"Clients can verify construction progress independently using the platform."	Transparency enables client-side validation
33	"No gut-based feelings... everything is factual."	Factual, data-driven decision-making replaces intuition

34	"System must be hosted in Sweden for security reasons."	Local data sovereignty requirements in sensitive projects
35	"Training is easy... max 3 months to full efficiency."	Short learning curve encourages adoption

Step 2: Focused Coding Table

Table 8 Grounded Theory: Focused Coding Table

Focused Code	Supporting Initial Codes	Interpretive Meaning
Automation and Human Displacement	- Directive to automate progress tracking - Reduces site engineers - AI replaces manual reporting - Client verifies progress via system - AI acts like site engineer	The technology is designed to reduce human dependency on-site and reassign roles through automation, aiming for efficiency and cost control.
Trust and Verification through Data	- Discrepancy in human vs. system reporting - Supplier says 60%, system shows 30% - Single source of truth - System enables prediction - Invoicing based on system data	The system introduces objectivity and verifiability into processes traditionally governed by estimation and interpersonal negotiation.
Barriers to Adoption	- Generational resistance - Each project is its own kingdom - Organizational inertia - Lack of awareness among clients - Need for training and structured workflow	Cultural, structural, and generational inertia prevent system-wide adoption, despite proven benefits. The resistance is political and rooted in decentralization.
Cost vs. Value Justification	- €8–10K monthly cost - ROI calculation needed - Aftermarket value not included in ROI - Client or project must absorb cost	The high cost requires strong justification, yet the long-term benefits are often underestimated or not visible to decision-makers.
Workflow Reconfiguration	- Weekly calendar framework (Denmark) - Who does what, when - Without workflow, tool fails - Customer success team facilitates use	Effective use of the system demands reengineering of site workflows. Adoption depends not only on the tool, but also on restructuring of human routines.
Knowledge Localization and Support	- System training takes 3 months - Localized languages - Customer success training - Transferable experience across projects	Adoption improves with proper onboarding, language adaptation, and community of practice. Training and support are key to successful scaling.
Digital Twin as Long-Term Asset	- Client owns data - Historical data for repairs - System tracks built-in installations - Predictive maintenance possibilities	The digital capture of construction processes enables a living record of the built environment, with ongoing value for facility management and claims resolution.
Visual Intelligence Integration	- AI compares photos to 4D - QR code localization - Trained to detect painting/colour - Pre-emptive quality checks - Time-lapse selection	Visual data capture (360° photos) powered by AI transforms site monitoring into a real-time, data-rich process with predictive and diagnostic capabilities.
Client Education as Key Driver	- Clients unaware - Clients need to demand it - Sweden “acts like never heard	Broader use of advanced digital systems depends heavily on client understanding and demand. Contractors play a key role in promoting awareness and literacy.

	of it" - Contractor must educate clients	
Scalability through Standardization	- Denmark formalized use - Repeated use across projects - Without mandate, system stays local - Some countries ahead (Denmark, Norway), others slow	Successful adoption in one region can offer templates or standards for others, showing the importance of national/institutional frameworks to enable broader adoption.

Step 3: Axial Coding Table

Table 9 Grounded Theory: Axial Coding Table

Core Category (Focused Code)	Subcategories (Properties/Dimensions)	Conditions	Actions/Interactions	Consequences
Automation and Human Displacement	- Replacing site engineers - AI-based verification - Fewer manual reports	Pressure to improve efficiency Cost-cutting expectations	Delegating progress tracking to AI Reducing staff on-site	Labor reduction, role redefinition, improved data consistency
Trust and Verification through Data	- Dispute reduction - Single source of truth - Evidence-based project monitoring	Lack of trust in manual reporting	System validates completion and supplier claims	Conflict reduction, reliable invoicing, objective accountability
Barriers to Adoption	- Generational resistance - Political culture - Decentralized project control - Lack of vision	Senior leadership control Lack of centralized strategy	Hesitancy in adoption Decision paralysis	Limited diffusion, fragmented implementation, unrealized potential
Cost vs. Value Justification	- High monthly fees - ROI overlooked - Long-term savings - Hidden value (aftermarket)	Budget constraints Client scepticism	Business case preparation Selective project targeting	Delayed scaling, restricted access to innovation
Workflow Reconfiguration	- New scheduling models - Weekly task capture - Defined roles and timelines	Need for structured use of tool	Formalizing usage routines Adapting existing processes	Increased adoption success, smoother integration, optimized resource use
Knowledge Localization and Support	- Language adaptation - Customer success teams - Learning curve (3 months) - Transferability between projects	Varying tech literacy levels Multilingual workforces	Local training Hands-on support Knowledge transfer	Higher competence, reduced user error, better tool longevity
Digital Twin as Long-Term Asset	- Data for repairs - Historical record - Owner access - Predictive value	Long building life cycles Asset management needs	Capturing site over time Client-side data hosting	Enhanced FM, reduced lifecycle costs, traceable build history
Visual Intelligence Integration	- Image-based tracking - 4D model comparison - QR code localization - Object recognition	Site complexity Task diversity	Camera-based capture AI cross-referencing with BIM	Real-time verification, early error detection, precision site overview
Client Education as Key Driver	- Awareness gap - Technical illiteracy - Passive client role	Clients not informed Contractors hold knowledge	Demonstrations Client workshops Use in pilots	Informed demand, proactive investment, reduced resistance
Scalability through Standardization	- National differences - Mandated tools (Denmark) - Informal experimentation - Country-specific maturity	Lack of corporate mandates Cultural/market variance	Pilot-to-policy translation Cross-border benchmarking	Uneven adoption, missed efficiency gains, potential for organizational best practice formulation

Step 4: Memo Writing

Below is a set of 2 memos out of 10 memos from this interview.

Memo 1: Automation and Human Displacement

This theme captures a profound shift in how labor is structured and experienced on construction sites. The introduction of the system removes the need for several long-standing tasks, manual progress tracking, on-site visual inspections, and routine error reporting, among others. Crucially, it does not merely support the work of engineers; it begins to take over key responsibilities traditionally held by them. The result is a leaner staffing model and faster execution timelines, but these gains come with deeper implications. Engineering roles are being redefined, with a noticeable drift from on-site expertise to off-site system monitoring. While the technology is widely framed as an enabler, it also introduces a quiet but significant disruption, particularly to traditional labor hierarchies and job security. What emerges is not just a new workflow, but a reimagination of what it means to be present, and valuable, on a construction site.

Memo 2: Trust and Verification through Data

The emphasis on "factual information" surfaces repeatedly, suggesting a shift in how trust is built and maintained on site. Previously, much of the daily workflow relied on human estimates and negotiations, subcontractors offering completion percentages, suppliers communicating delivery progress. These were often subjective, sometimes optimistic, and occasionally strategic. The new system changes that landscape by offering time-stamped, locationally grounded data outputs, verified through AI analytics linked to 4D models. These outputs are not only used for planning, but also for billing and dispute resolution. As a result, the locus of authority begins to move. Decision-making, once grounded in relationships and intuition, now leans increasingly on digital verification. Trust is no longer interpersonal; it is algorithmic. This introduces a quiet reconfiguration of site power dynamics, authority shifts from the spoken word to the system's record.

Step 5: Theoretical Coding Map

The core category is: Constructing Digital Authority in Construction Sites

Here we see 2 examples out of 9. This process is shaped by and interlinked with the following interdependent categories:

1. **Automation and Human Displacement**
   → As digital tools replace manual tasks, the locus of operational authority shifts from people to machines. Site engineers are no longer inspectors; they become coordinators of AI input.
2. **Trust and Verification through Data**
   → Data becomes the arbiter of truth. Disputes, schedules, and planning are resolved not through dialogue but through system-generated evidence. This creates a new epistemology of "factuality."

Step 6: Theoretical Proposition

The following theory was developed after completing steps 1 through 5 to reach the final stage. The example below is the result of analysing 10 memos and 9 theoretical coding map categories, with only their corresponding examples provided above.

"The adoption and impact of AI-driven construction tools depend less on their technological sophistication than on the sociopolitical processes that legitimize their authority as trusted sources of operational truth."

10.4 CRM Data Provided from the After Market team

We received an Excel file containing 27,000 reclamation cases from the aftermarket team of the company we collaborated with. We analysed the data using Power BI to gain insights into the issues occurring post-production. This analysis allowed us to identify links between the data and themes such as labor shortages, contractual clauses related to quality deficiencies, and organizational fragmentation. These findings were incorporated into our thesis and aligned with the methodology outlined in the methodology section.

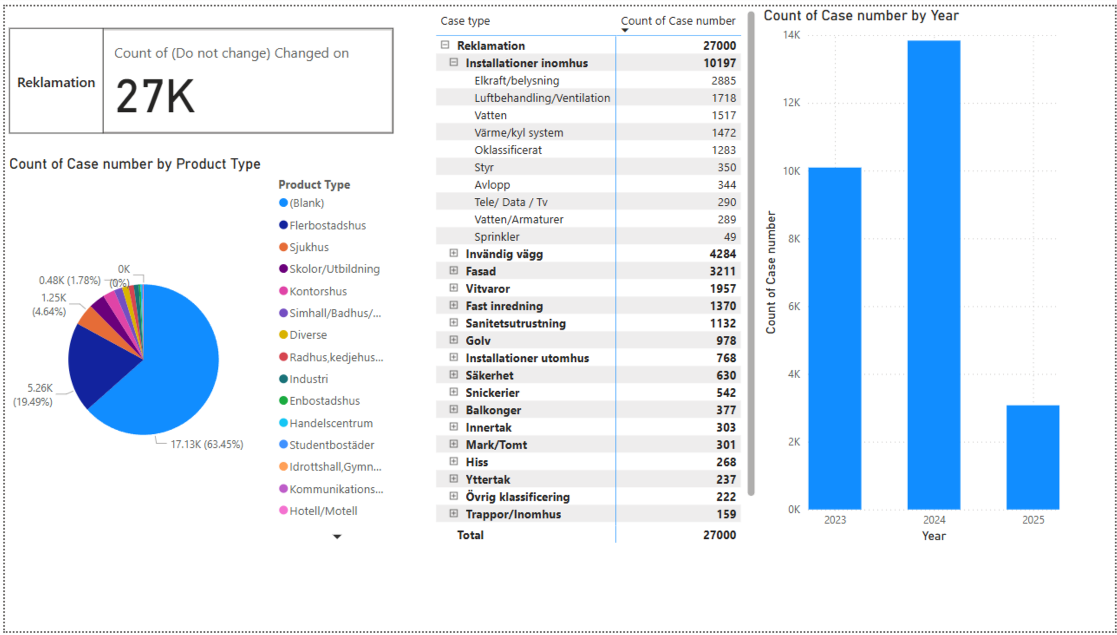

Figure 3 CRM Data: PowerBI Analysis

Disclaimer: *The screenshot below provides a superficial representation of the data. We are unable to disclose substantial portions of the dataset due to confidentiality requirements. This screenshot is intended solely to illustrate the general structure of the CRM data and to offer transparency regarding our analytical approach.*

DEPARTMENT OF ARCHITECTURE AND CIVIL ENGINEERING
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2025
www.chalmers.se

CHALMERS
UNIVERSITY OF TECHNOLOGY