From One-Offs to Roll-Outs

Navigating Organizational Tensions in Product Platform Development towards Industrialized Construction

Master thesis

Management in the Built Environment, Delft University of Technology

E.G. (Eefke) Huisman

Colophon

Author

Name	E.G. (Eefke) Huisman
Student number	5503418

Education

University	Delft University of Technology
Faculty	Architecture and the Built Environment
Master	Architecture, Urbanism and Building Sciences
Master track	Management in the Built Environment

Graduation

Theme	Theme 4: Gamechangers in Transitions
First supervisor	Dr. D.M. (Daniel) Hall Design and Construction Management (MBE)
Second supervisor	Dr. A. (Angela) Greco Real Estate Management (MBE)

Graduation Company

Company	VORM 2050
Company supervisors	R. (Roel) van Heumen Head of Construction VORM 2050 S. (Sander) Overbeeke Head of Engineering VORM 2050

Report

Date	12 June 2025
Version	P5

Preface

The construction sector is facing growing pressure to change, driven by urgent housing needs, environmental demands, labor shortage and rising costs. I've always been interested in how industries respond to these kinds of challenges, especially through innovative and future-oriented approaches. My bachelors background in Global Sustainability Science shaped this interest early on, and it's what motivated me to shift towards the built environment: a field where long-term impact and day-to-day decision-making constantly interact.

During my master's in Management in the Built Environment at TU Delft, I became especially focused on how construction firms balance strategic ambitions with the realities of delivering buildings. How do we build housing that is not only faster and more affordable, but also durable and adaptable over time? Therefore, this thesis began with the broader trends of digitalization and industrialization, and gradually shifted toward the organizational practices behind that transition. My fascination with innovation and change has been a thread throughout my studies, and was further shaped by the Gamechangers graduation lab. It came into full focus during my internship at VORM 2050, where I experienced firsthand the practical challenges of transitioning toward industrialized construction, allowing me to connect theory with daily practice.

A word of thanks must go to my supervisors, Dr. Daniel Hall and Dr. Angela Greco, for their support, feedback, and willingness to think along throughout this journey. Both encouraged me to take the next step, gave me confidence in the process, and helped me sharpen my thinking while staying close to the core of my research.

Also, a word of thanks to VORM 2050 for the opportunity to conduct this research within their organization, and for the openness with which team members shared their time, insights, and experiences. I would like to thank the management team, Marc Vriens, Sander Overbeeke, and Roel van Heumen, for providing the support and resources that made this research possible from within the organization.

With this thesis, I hope to contribute to a better understanding of the organizational dynamics behind industrialized construction, and to support those navigating this transition in practice.

Eefke Huisman
Amsterdam, June 2025

Abstract

Problem statement – The construction industry is increasingly turning to industrialized construction in response to societal pressures such as housing shortages, rising costs, and sustainability demands. This transition, from traditional, project-based delivery models to product-oriented approaches, promises greater standardization, repeatability, and scalability. However, despite the technical potential of industrialized construction, many firms face persistent organizational challenges. Bottlenecks in internal coordination, role clarity, and collaboration, can hinder the effective development of product platforms.

Research method – This study begins with a theoretical background to establish a foundation for understanding the case later on, using academic papers sourced from Google Scholar. The empirical research adopts qualitative methods, focusing on a single-case study of VORM 2050. Semi-structured interviews guided by abductive reasoning align empirical observations with theoretical insights. Organizational ethnography is employed as a secondary method, involving observations of daily practices, meetings, and project documentation. Finally, recommendations will be developed using workshops with VORM 2050 to collectively reflect on tensions and identify improvements to organizational practices.

Goals, objectives, deliverables – The primary goal of this study is to support the transition of construction companies towards industrialized practices. This includes a case study of VORM 2050's ongoing transition, focusing on organizational practices and enhancing understanding through theoretical frameworks. The key outcome is a set of practice-informed recommendations, offering actionable guidance for integrating platform thinking and improving organizational routines. These insights address the lack of managerial perspective on navigating tensions during platform transitions and are applicable to other construction companies. The findings will be shared with VORM 2050 and broader stakeholders, ensuring privacy while making the outcomes available through the TU Delft repository.

Executive summary

Introduction

The construction sector is under growing pressure to change. A severe housing shortage, increasing material costs, labor shortages, and stricter sustainability requirements have accelerated the need for more efficient and scalable building methods. In response, industrialized construction has emerged as a promising strategy, offering standardized, digitally supported, and more predictable ways to deliver housing at scale. However, this shift toward industrialization is not solely technical. It also introduces organizational challenges related to roles, workflows, and decision-making. VORM 2050 serves as a relevant case of a construction company actively engaging with this transition. The company is moving from a traditional, project-based mode of working toward a product-oriented approach, centered around the development of a standardized housing concept. This raises fundamental questions about how construction firms can manage the organizational dimension of such a transition. To address this, the thesis explores how organizational practices shape the transition from traditional to industrialized construction, using VORM 2050 as a case study. The following research question guides this study: ''*How do organizational practices shape the transition of construction companies from traditional to industrialized construction?*''.

Theoretical background

This research builds on two main perspectives: industrialized construction and organizational change management. Firstly, industrialized construction focuses on applying standardized processes, prefabrication, and digital tools to improve efficiency, consistency, and scalability. Inspired by manufacturing, it promotes the use of product platforms, reusable technical and process frameworks that combine repetition with flexibility. While these principles hold great potential, implementing them in the project-based culture of construction proves challenging. Success requires not only technical innovation but also rethinking how work is organized and coordinated.

The second perspective, organizational change management, helps explain how such transitions unfold in practice. Change is rarely a linear or top-down process; it involves navigating persistent tensions, such as standardization versus flexibility or long-term vision versus short-term delivery. Paradox theory offers a useful lens here, viewing these tensions not as problems to fix, but as realities to manage over time. This perspective highlights how change is shaped through sensemaking, coordination, and leadership, emphasizing the importance of how people interpret and respond to shifting roles, goals, and routines.

Methodology

The research adopts a qualitative single-case study design, centered on the construction company VORM 2050. Data collection involved twenty-four semi-structured interviews with team members across a range of departments and roles, providing insight into both strategic perspectives and day-to-day practices. In addition, ethnographic observations were conducted during internal meetings and project discussions, complemented by the analysis of relevant documents. The study followed an abductive reasoning approach, iteratively moving between

theoretical concepts and empirical findings. A thematic analysis was conducted to identify patterns in how the organization navigates its transition toward industrialized construction, resulting in three key themes: organizational change capacity, role ambiguity, and workflow fragmentation. These insights formed the basis for a reflection workshop with team members, which made use of polarity mapping to further explore the recognized tensions. The workshop served both to validate the results and to collaboratively develop practice-informed recommendations. Together, the combination of semi-structured interviews, organizational ethnography, and a focus group workshop provided a grounded understanding of the case, as illustrated in Figure 5.

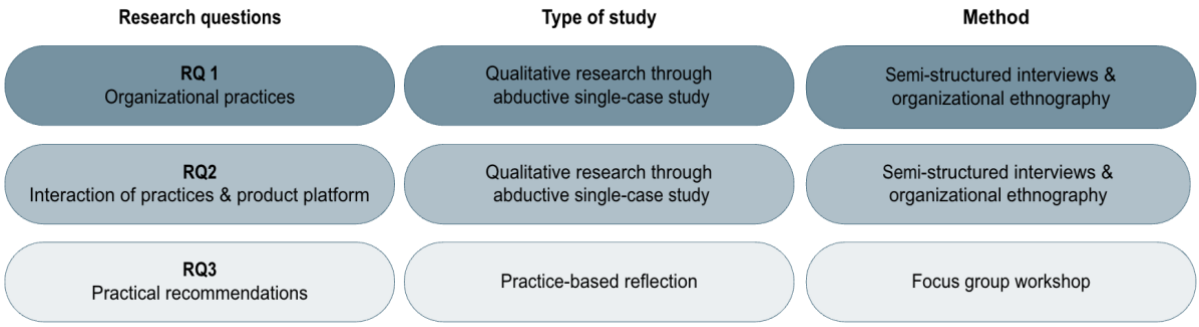


Figure 5: overview methodology per sub-question (source: own work)

Findings

Three key dimensions emerged from the analysis that illustrate the organizational complexity behind VORM 2050's transition to industrialized construction. The first one is the gap between strategic vision and daily practice. While the company expresses strong ambitions for standardization and digital innovation, project pressures often take precedence, limiting the space for reflection, learning, and concept development. Secondly, ambiguity exists in roles and responsibilities. Many employees operate in hybrid functions, balancing project delivery with concept development, yet expectations remain unclear, particularly around ownership, scope, and feedback mechanisms. The third tension concerns workflow fragmentation. Although there is a shared vision of a platform concept, its application across projects varies widely. Informal communication and individually developed routines often replace standardized workflows, leading to inconsistencies and fragmented learning. An overview of these organizational tensions and their underlying dynamics can be found in Table 6.

These tensions are not temporary or incidental, they are structural and persistent. They reflect the paradoxical nature of transitions in construction, where change is expected to emerge from within ongoing operations. The findings suggest that success depends not only on clear strategies but also on how people interpret, enact, and adapt these strategies in practice.

Table 6: Summary of research findings (source: own work)

Dimension	Challenge	Observed organizational practice	Implication for IC transition
Organizational change capacity	Strategic ambition under strain	- Pursuit of product development alongside project execution due to financial pressure - Limited strategic prioritization between concept development and internal improvement efforts (e.g., process standardization, digital tooling) - Misalignment between projects and the 2050 platform, limiting standardization - High share of freelancers affects consistency	- Resource strain and overload - Difficulty embedding long-term thinking - Tensions between short-term project delivery and strategic goals reduce organization's ability to steer towards industrialized practices - Limiting opportunities for feedback loops and continuous improvement
	Emerging development approaches	- The 2050 concept lacks a consistent definition - Teams interpret standardization differently, leading to inconsistent implementation - There is limited time available to evaluate lessons learned or refine the concept	- Increased workload - Innovation risks being implemented without sufficient support - Difficulty translating the concept into repeatable, scalable practices
Role ambiguity	Unspecified organizational responsibilities	- Blurred responsibilities between development, design, and construction roles across entities within the holding - Traditional division of responsibilities leaving less room for standardization of product components	- Confusion about leadership at various project stages hinders effective decision-making and communication - Risk of inconsistent implementation of the 2050 concept
	Unspecified individual responsibilities	- Hybrid roles occur without clearly defined tasks and responsibilities - Strategic roles on concept and process development are not anchored yet - Employees pick up tasks based on engagement rather than mandate	- Lack of accountability and task ownership resulting in less efficient collaborations - Working according to ad hoc solutions, also creating room for creative ideas and initiatives

Workflow fragmentation	Lacking structural coordination	- Overarching support system is missing, including shared operational routines and tools - Critical decisions and actions are inconsistently captured or followed up - New team members lack a clear structure to integrate into shared routines and standards - Level of coordination varies based on whether the organization is in a more traditional role	- Absence of shared operational routines makes it difficult to maintain continuity across projects - Team members compensate with ad hoc solutions, limiting standardization
	Operational autonomy	- Initiative to develop own documentation and coordination methods - Autonomy through the entrepreneurial mindset and flat organizational structure - Falling back on familiar practices rooted in traditional construction processes	- While autonomy fosters ownership and adaptability, it also leads to fragmented and inconsistent ways of working - Personal systems and habits limit interoperability and reduce feedback loops into the product platform

Discussion

The findings demonstrate that the transition to industrialized construction involves persistent organizational challenges alongside technical development. Firstly, while VORM 2050 has made progress in standardizing building components, the supporting organizational processes, such as coordination, workflow routines, and decision-making, have not kept pace. This imbalance reflects a broader industry tendency to prioritize technical solutions over internal change. Mirroring theory and platform leadership help explain this gap, showing how evolving product platforms require aligned structures and clear leadership to avoid fragmentation. Secondly, change did not unfold through a structured, top-down process but emerged from day-to-day practices, improvisation, and local adaptation. In complex, project-based contexts like construction, change is enacted rather than implemented. While this flexible approach allowed learning, selective use of change management tools, such as clarifying roles and communication routines, could have better supported the transition. Finally, the transition was marked by ongoing tensions, such as balancing standardization with flexibility, and strategic goals with project demands. Paradox theory helps frame these as enduring dynamics that must be navigated rather than resolved. Embracing such tensions as part of the innovation process is essential for making platform-based construction viable in practice.

While this research provides valuable insights into the organizational side of industrialized construction, some limitations should be noted. This study is based on a single-case qualitative design, which allowed for deep contextual understanding but limits the generalizability of findings across the broader construction sector and remain context-specific. Additionally, the study primarily reflects internal perspectives, with limited input from external stakeholders.

The findings also represent a snapshot in time, capturing an ongoing transition rather than its full development.

Conclusion

To support construction companies in aligning their internal practices with the demands of industrialized construction, this research proposes a set of practical recommendations. These focus on improving clarity, coordination, and organizational capacity across strategic, team, and individual levels. The recommendations address common misalignments, such as role ambiguity, workflow fragmentation, and capacity constraints, and help organizations manage the ongoing tensions that arise when shifting from traditional to platform-based construction. An overview of these recommendations is presented in Figure 10.

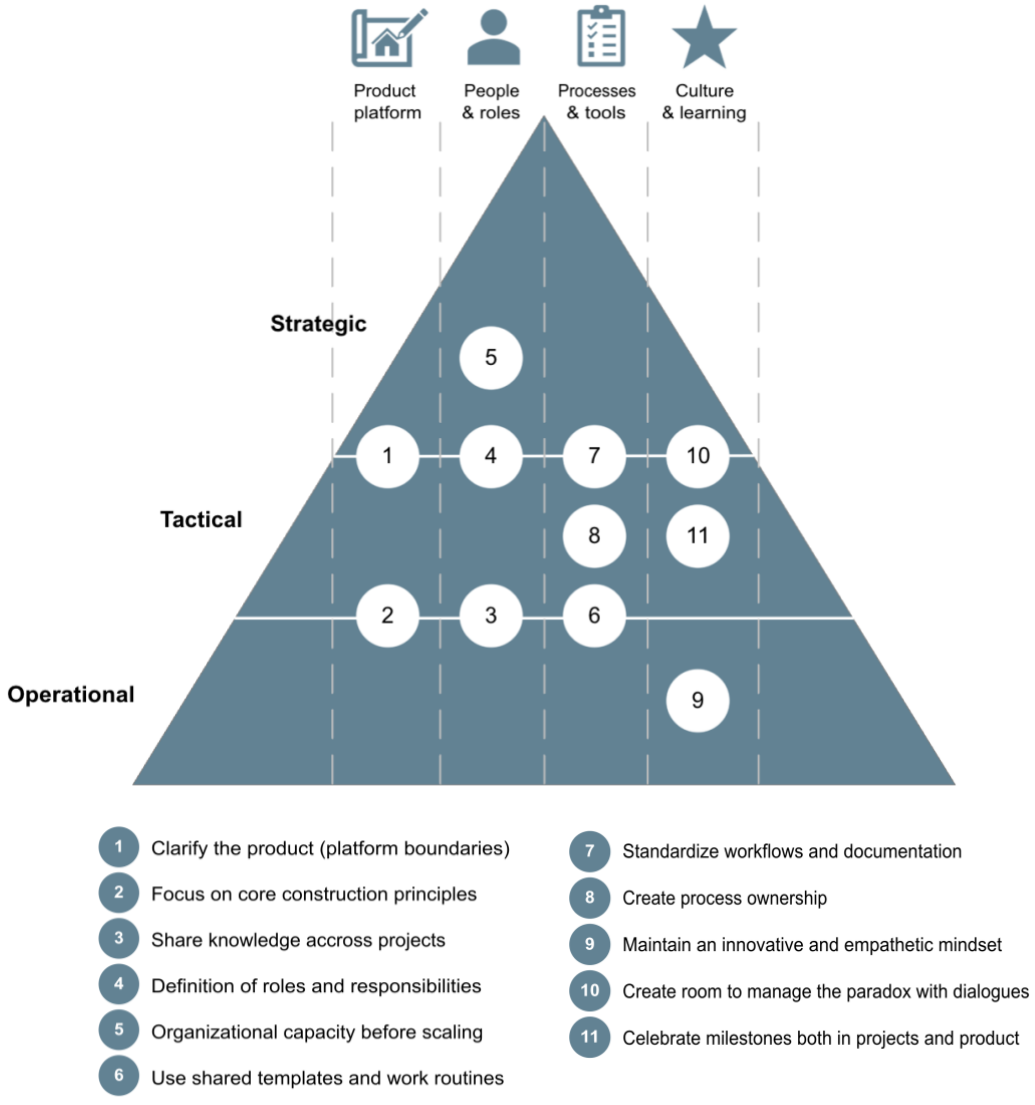


Figure 10: overview of practical recommendations across organizational levels (source: own work)

This research reveals that organizational practices are not just supportive, but essential to product platform development. While platforms offer a structured way to scale construction through technical and process integration, their success ultimately depends on how people

work, coordinate, and make decisions in everyday practice. The transition to industrialized construction introduces persistent tensions: between standardization and flexibility, long-term vision and short-term delivery, centralized control and decentralized initiative. These tensions cannot be resolved through fixed plans alone; they must be continuously navigated. In doing so, organizational practices play a threefold role in this process: they enable repeatability by, clarifying roles and workflows, mediate tensions through shared reflection and adaptive routines, and anchor change by embedding platform logic into daily operations. In short, industrialized construction requires not only technical innovation, but also the active development and alignment of the organizational routines that make it work in practice.

The following recommendations for practice can support organizations in aligning their internal structure with the demands of platform-based construction. First, clarify roles and responsibilities, particularly in hybrid positions, to reduce ambiguity and improve coordination. Second, standardize workflows and documentation to ensure consistency, enable knowledge sharing, and reduce reliance on informal routines. Third, establish structured feedback loops, such as regular reflection sessions or shared digital tools, to foster continuous learning across teams and projects. Finally, organizations should create space to openly address tensions inherent in the transition. Actively engaging with these dynamics, can improve alignment, strengthen collaboration, and support sustainable platform development.

Future research could compare transitions across different organizational settings, explore the role of external partners, and examine how practices evolve over time. Longitudinal studies and insights into leadership and digital tools would further enrich understanding of platform-based construction at scale.

Table of contents

List of figures

List of tables

1. Introduction

1. Introduction

1.1 Background information

The construction industry is undergoing a transformation due to increasing pressure to address a severe housing shortage, while also facing challenges such as labor shortages, rising material costs, and stricter sustainability regulations (Maskuriy et al., 2019; Klein Woolthuis, 2010). In response, industrialized construction is emerging as a promising strategy to improve efficiency, enhance consistency, and increase predictability in project delivery (Jonkman et al., 2022). The Netherlands need 1 million additional homes by 2035, with 750,000 yearly required to address the current housing shortage and projected population growth (ABF Research, 2019). Despite this demand, annual housing production has consistently fallen short, with recent figures hovering around 75,000 units yearly (CBS Statistics Netherlands, 2021).

At the same time, housing projects face challenges such as exceeding budgets and time overruns, underperformance, and significant environmental impacts (Van Oorschot et al., 2020). These challenges underscore the need for innovation in construction practices to address the housing shortage, drawing on lessons from industrialization's success in the manufacturing sector (Lessing, 2006). Firstly, industrialization plays a significant role by reshaping traditional building methods with manufacturing principles to tackle complexities of modern construction projects (Qi et al., 2021). Industrialization has evolved notably since the large-scale prefabrication and standardized technology efforts of the 1960s (CIB, 1965) to encompass techniques such as offsite construction, pre-assembly, and modular construction, where components are manufactured offsite and installed on-site (Qi et al., 2021). A core component of industrialization is unifying processes and products to enhance consistency, efficiency, and scalability in construction practices. Recent developments further emphasize integrating advanced technologies, fostering new business relationships, and enabling continuous process improvement (Gann, 1996; Barlow et al., 2003; Lessing, 2006). The overall goal of industrialized construction, like other sectors, is to maximize resource productivity, elevate product quality, improve operational efficiency, enhance customer satisfaction, shorten execution times, and reduce waste generation (Sotorrío et al., 2023). However, this transition faces industry-wide challenges, including limited scalability, resistance to change, high adoption costs for new methods, and technical issues such as poor software interoperability (Qi et al., 2021).

Product platform development is one of the key strategies construction companies adopt to align with the broader trend of industrialization. In the context of house building, this involves reusing standardized processes and technical solutions to efficiently deliver projects that still meet individual client needs (Jansson et al., 2014). The concept draws inspiration from make-to-order industries such as automotive manufacturing, where products are customized through predefined components and modules rather than entirely bespoke designs. The goal is to combine the efficiency benefits of repetition with the flexibility to accommodate client-specific variations (Thuesen & Hvam, 2011). However, implementing platforms in construction is not straightforward. A deeply embedded norm within the industry resists standardization

and predefined design solutions, making platform thinking difficult to apply in practice (Styhre & Gluch, 2010). As a result, a central challenge lies in translating standardized elements from the platform into project-specific applications (Jansson et al., 2014) that respond to diverse site conditions and evolving client demands. In this context, digital technologies play a supportive role in enabling platform strategies. Tools such as BIM, IoT, and digital twins can help coordinate standardized yet flexible processes across design, production, and construction. They enhance accuracy, transparency, and process integration, key conditions for effectively reusing components at scale (Qi et al., 2021). However, their potential is often underused due to fragmented project structures and limited organizational capacity (Dallasega et al., 2018; Demirkesen & Tezel, 2022). Still, digital technologies offer clear potential in product platform development and are often embedded in the strategic ambitions of companies transitioning toward industrialized construction (Qi et al., 2021).

1.2 Problem statement

The construction sector is under increasing pressure to deliver faster, more cost-effective, and environmentally responsible solutions. In response, many firms are rethinking how buildings are conceived and delivered, shifting away from bespoke project execution toward more systematized approaches. A key element in this transformation is the adoption of product-based strategies that promote efficiency through reuse and continuous learning. By developing product platforms, companies aim to streamline both technical components and internal processes.

However, many construction companies experience organizational challenges when implementing this shift. While the technical potential of industrialized construction is clear, its success depends on more than product innovation alone. In practice, bottlenecks often arise in internal coordination, role clarity, and collaboration, both within organizations and across the supply chain. The transition demands a rethinking of workflows, responsibilities, and support structures to fully leverage the benefits of industrialized methods. Without aligning internal processes to support these new practices, firms risk falling short of their ambitions for efficient housing production.

1.3 Case introduction

VORM 2050 exemplifies a construction company currently undergoing a shift towards industrialized construction, moving away from traditional, project-based delivery to a more product-oriented approach. At the core of this strategy is the development of a product platform that applies standardized technical solutions and production methods. Another important aspect of their approach is long-term collaboration with fixed supply chain partners, with the vision to outsource technical specialization to the market rather than develop in-house manufacturing. The company also promotes a learning-oriented culture, using data and automation to support continuous improvement of both products and processes. To fully realize this transition, VORM 2050 is working to structure and align the internal processes needed to support their industrialized approach, an area that has proven more challenging. By innovating according to the principles of industrialized construction, VORM 2050 has set the ambition to deliver construction projects 20% cheaper and 50% faster. However, the

organization experiences significant challenges in navigating this transition. Further information on the case is provided in Section 3.3.1 of the Method chapter.

1.4 Research gap

Previous studies reveal substantial research on product platform development in construction, predominantly examined through a technical lens with emphasis on modularization, standardization, and cost-efficient design (José & Tollenaere, 2005). A recent systematic review by Kauppinen et al. (2024) confirms this orientation, highlighting a strong focus on prefabrication, manufacturing logic, and systematized production processes, while organizational dimensions receive considerably less attention. Although the theme of 'change' is acknowledged in the literature, it is primarily framed as sector-wide transformation or broader societal shifts, such as urbanization, rather than as a process of organizational change within firms (Kauppinen et al., 2024). As a result, limited guidance exists on how companies internally adapt their structures, capabilities, and routines to embed platform-based strategies. Furthermore, research on change management tends to focus on project-level dynamics, offering little insight into long-term organizational practices (Aldossari et al., 2023). This thesis addresses that gap by examining product platform development not only as a technical effort but also as an organizational change process.

Secondly, the transition to platform-based industrialized construction introduces persistent tensions, such as standardization versus customization, that cannot be resolved through technical solutions alone. These tensions are best understood as organizational paradoxes: interdependent yet competing demands that coexist over time. Although paradox theory provides a valuable conceptual lens to explore such dynamics, it has rarely been applied to the context of platform development in construction. Most management literature remains focused on identifying paradoxes rather than enabling practitioners to navigate them in action. As Greco and Lüscher (2025) note in their book review, this creates a gap between awareness and action: organizations may recognize conflicting demands but lack the tools to address them collectively. Their call for more practice-oriented, relational approaches to paradox navigation suggests the need for research that explores how construction firms can manage platform-related tensions not through resolution, but through organizational learning and coordination. This thesis positions itself within that gap, aiming to bridge technological product-platform development with organizational change management.

Another recognized research gap is based on the emphasis on the Swedish housing sector in the industrialized construction literature. Sweden's extensive experience with industrialized construction, particularly in timber house manufacturing and the renovation of multi-family houses, has been well-documented (Maxwell, 2016). Studies highlight Sweden's integration of industrial production methods within the housing sector, involving both advancements and challenges in aligning these methods with traditional construction practices (Lessing, 2015). In contrast, while the Netherlands has participated in discussions on industrialized construction, the studies are relatively limited compared to the extensive research centered on Sweden.

In short, building on these gaps, this thesis investigates how construction firms navigate the organizational challenges of transitioning toward industrialized, platform-based practices. Rather than approaching this shift solely as a technical redesign, the study focuses on how companies like VORM 2050 experience and manage the paradoxes embedded in industrialization. The corresponding key concepts are displayed in the figure below.

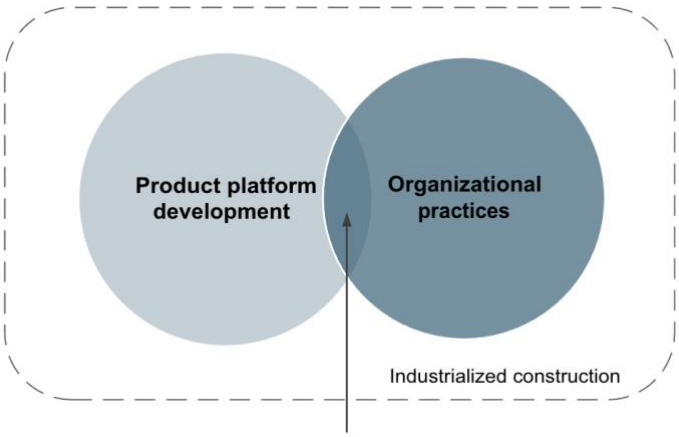


Figure 1: overview of key concepts (source: own work)

1.5 Societal and scientific relevance

This study combines societal and scientific perspectives to ensure a broader impact and practical applicability. From a societal point of view, advancing industrialized construction practices offers great potential to address urgent challenges, such as the pressing housing shortage in the Netherlands. By focusing on the organizational conditions needed to embed platform-based construction strategies, this research investigates how firms can more effectively deliver affordable, sustainable, and scalable housing. Industrialized methods enable more resource-efficient workflows, reduce material waste, and lower emissions, thereby helping to mitigate the environmental footprint of traditional construction. By extending beyond technical solutions and incorporating an organizational perspective, these strategies have the potential to generate broader societal impacts.

From a scientific perspective, this study addresses a gap in the literature on how construction firms navigate organizational paradoxes during the transition to industrialized, platform-based practices. This will be conducted for the specific case of VORM 2050, providing a valuable contribution to the context of industrialization in the Dutch housing market. While paradox theory offers a valuable theoretical lens to understand tensions, it often remains the level of identifying these tensions, rather than offering insight into have such tensions are handled in practice. By examining the case of VORM 2050, this study contributes to that gap, by integrating empirical findings with theoretical perspectives to better understand how organizations can act within paradoxes. Through a qualitative case study, this research seeks to connect theoretical insights with the practical dynamics of construction firms undergoing the transition.

1.6 Research questions

The construction sector is undergoing a major shift, driven by the dual forces of industrialization and digitalization. VORM 2050 represents this transition by adopting a product-oriented model that emphasizes industrialized construction methods. As the identified research gap suggests, the organizational dimension of transitioning to industrialized, platform-based construction remains underexamined. Therefore, the main research question is as follows:

What is the role of organizational practices during product platform development in a construction company's transition towards industrialized construction?

The main research question is explored through sub-questions focusing on current organizational practices, their alignment with industrialized construction principles, and recommendations to further support the transition. Accordingly, the following sub-questions will be discussed:

1) What organizational practices shape the transition of construction companies from traditional to industrialized construction?
2) How do these practices interact with the principles of platform-based industrialized construction?
3) Which practical recommendations can support construction companies in developing their product platform and managing their transition?

2. Theoretical background

2. Theoretical background

This chapter outlines the theoretical foundation needed to understand the empirical case study presented later in this thesis. It begins by outlining the concept of industrialized construction, followed by organizational change management to understand how companies adapt to such transitions.

2.1 Industrialized construction

Drawing inspiration from the manufacturing industry, construction has adopted methodologies such as prefabrication and Lean Production principles as an alternative to site-based production (Lessing, 2015). These principles, originally developed to streamline processes and enhance efficiency in manufacturing, have been applied in construction to improve project outcomes and enhance productivity while reducing cost, waste and errors (Lessing, 2006; Björnfot & Sardén, 2006). Transitioning from the traditional view of projects being entirely unique to adopting repetitive, well-managed construction practices, requires accurate planning, early-stage coordination, and a cultural shift towards embracing uniformity and process optimization (Aapaoja & Haapasalo, 2014).

An important early contribution to the current understanding of industrialized construction was made by Gann (1996). He characterized Japanese building companies as entities that oversee the entire production process, employing advanced building systems and producing components or building parts in highly automated facilities. Following studies, such as Barlow (1999) and Roy et al. (2003), have expanded on this work, covering the transition from traditional craft production to mass customization in housebuilding (Barlow, 1999) and the documentation, standardization, and improvement of construction processes (Roy et al., 2003). Gann (1996), Roy et al. (2003), and Barlow et al. (2003) recognized a broader, integrated production system approach that diverges from conventional construction processes, moving away from traditional production- and project-oriented methods. Building on this, Lessing (2006) conducted research to conceptually understand the industrialization of housing construction in the Swedish context. This research serves as a foundation for further exploring the definition of the concept of standardization of processes. The following definition on industrialized housebuilding is provided by Lessing (2006):

> Industrialized housebuilding is a thoroughly developed building process with a well-suited organization for efficient management, preparation and control of the included activities, flows, resources and results for which highly developed components are used in order to create maximum customer value. (Lessing, 2006, p. 93)

Collectively, these studies emphasize a fundamental reshaping of construction, where industrialization focuses on replicable processes, modern technologies, and collaboration to achieve consistency and value.

2.1.1 Industrialized housebuilding framework

As the definition of Lessing (2006) indicates, industrialized construction is a complex and multifaceted concept that covers various interconnected sub-areas essential for successful project delivery. These include technical solutions, improved procurement processes, enhanced planning, and robust control and monitoring mechanisms (Lessing, 2006). As a result of this study, the framework presented below outlines key principles and strategies for enhancing efficiency, consistency, and quality in construction processes. Figure 2 illustrates the interconnected sub-areas of industrialized construction, such as the systematic planning and control of processes, supported by technical systems and the prefabrication of building parts. Other characteristics of industrialized construction include enduring relationships within the supply chain and production systems, targeting specific markets, and incorporating a high level of product predefinition (Jansson et al., 2014). This often involves a fixed network of supply chain partners, which aims to streamline processes, improve efficiency, and foster innovation by working together on the product platform (Jones et al., 2022).

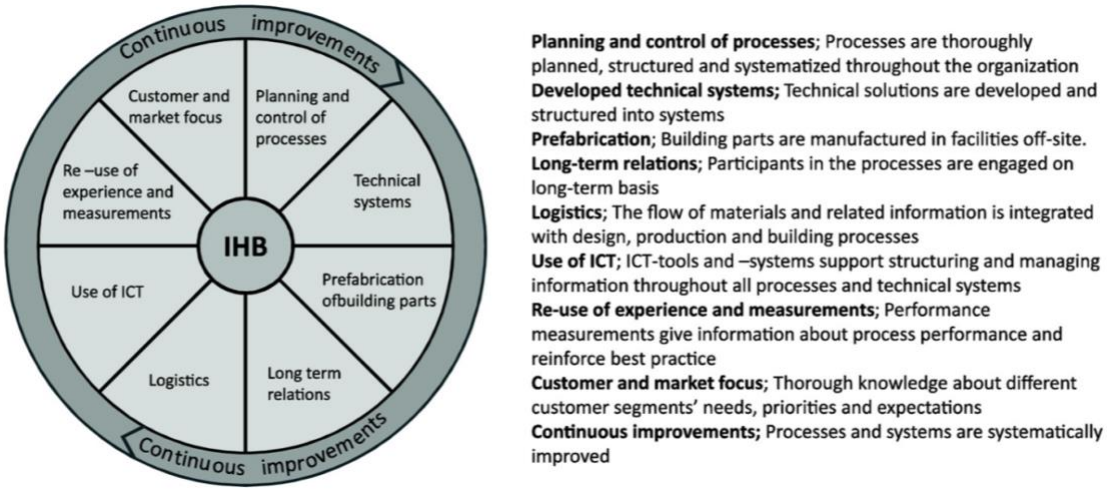


Figure 2: industrialized housebuilding framework (Lessing, 2006)

A distinguishing aspect of this framework is its emphasis on continuous improvements, requiring the integration of all sub-areas to systematically refine and optimize processes over time. Unlike traditional construction, which often relies on fragmented processes and temporary project teams, the industrialized housebuilding framework prioritizes long-term collaboration and integration across all activities. Process-orientation is therefore a cornerstone of industrialized construction, with a focus on of aligning design, planning and production processes with supply chain operations (Jansson, 2010; Söderholm, 2010; Malmgren et al., 2011). This approach involves fostering long-term partnerships among stakeholders throughout the supply chain (Jansson, 2010) and integrates purchasing, logistics, and production processes both internally and across organizations to enhance supply chain efficiency (Bildsten et al., 2010). In practice, this framework has been widely applied in the Swedish construction industry, where companies have effectively utilized prefabrication and systematic planning to achieve higher levels of efficiency and quality (Lessing, 2006).

2.1.2 Product platform

One of the core strategies within industrialized construction is the shift from a project-oriented to a product-oriented approach, operationalized through product platform development. Product-orientation emphasizes repetitive processes supported by standardized solutions or pre-developed platforms, aligning with shifting away from unique designs carried out by temporary teams (Gann & Salter, 2000). A platform is a systematic structure of subsystems, including components, processes, knowledge, people and relationships, used to develop and produce products (Meyer & Lehnerd, 1997; Robertson & Ulrich, 1998). By leveraging standardized building systems, this approach enhances consistency, scalability, and efficient production, ultimately meeting customer demands with predictable and reliable outcomes (Meyer & Lehnerd, 1997). Central to this transition is the adoption of technical platforms, which play a critical role in industrialized housebuilding. These platforms are based on standardized building systems and utilizing tested technical solutions to ensure reliability in construction projects (Björnfot & Stehn, 2007). For technical platforms to effectively support industrialized processes, they must be systematically structured, thoroughly documented, and regularly refined (Persson et al., 2009; Söderholm, 2010; Lessing et al., 2015). Furthermore, integrated IT systems enable the efficient organization of platform-related information, offering support across various stages, including design, manufacturing, assembly, and on-site construction (Jensen et al., 2009); Malmgren et al., 2011). Lessing (2006) developed the following definition of a technical platform:

> A set of common components, modules or parts that form a common structure from which a stream of derivative products can be efficiently developed and produced. (Lessing, 2006, p. 40)

Complementary to the technical platform is the process platform, which is designed to optimize and support the main processes within the construction company. It is developed similarly to a technical platform, but it focuses on creating concrete tools and modules that address process-related needs. These process modules are tailored to specific company demands and are integrated with the technical solutions from the technical platform. An example of a of process module is customer information, ensuring that customer needs are systematically gathered and incorporated into product development. Other modules focus on information flow to facilitate information sharing, or on collaboration routines to foster teamwork, goal alignment and a culture of continuous improvement (Lessing, 2006).

The integration of the technical platform and process platform forms the product platform. The product platform evolves over time through improvements based on the execution of individual construction projects, as displayed in Figure 3. The technical platform focuses on standardizing the design and development of technical components, modules, or systems that are consistently utilized across projects. The process platform emphasizes standardizing operational workflows, such as design coordination, production planning, logistics, and project management practices. Together, these platforms ensure that both the physical and operational aspects of construction projects are aligned. For instance, modular components from the technical platform rely on standardized logistical and assembly processes defined within the process platform. When structured information flows are established, the

integration of platforms offers greater predictability and consistency in project execution (Lessing, 2006).

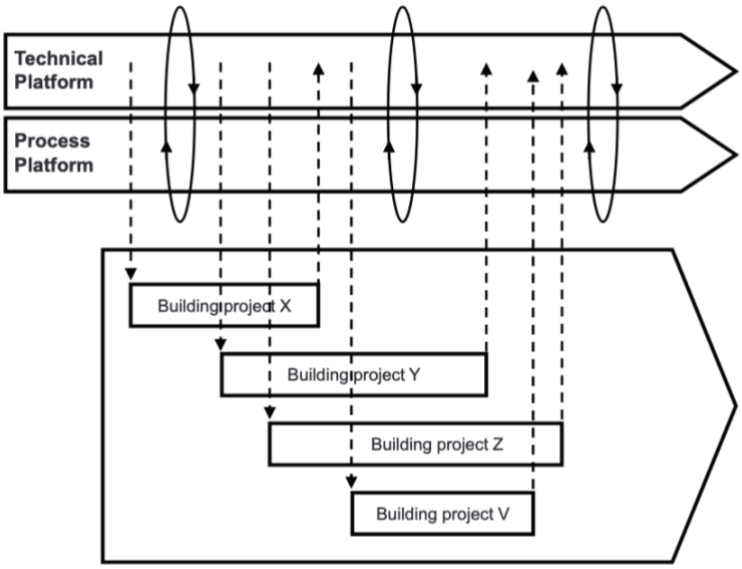


Figure 3: the interplay between the technical and process platform (Lessing, 2006)

While the technical and operational dimensions of product platform development have received much attention in construction research (Lessing, 2006; Björnfot & Stehn, 2007), recent scholarship urges a broader lens on how platforms evolve and are enacted in practice. Zhou (2024) provides a useful framework by distinguishing three strategic models of platforming, shaped by the degree of certainty in customer requirements. These range from simple "kit-of-parts" configurations focused on a single market segment to fully integrated platforms with standardized design rules and interfaces across multiple segments. These models illustrate how firms develop platform capabilities depending on external market stability and internal strategic priorities. Zhou also highlights how platforms are not static technical artifacts but dynamic socio-technical systems that evolve through iterative learning and feedback loops.

Building on this, Hall et al. (2023) illustrate the concept of mirror-breaking provides a useful lens for understanding the organizational disruptions that come along with product platform development. In traditional settings, roles and knowledge systems mirror the product: once the organizational setup is defined, the product tends to follow established lines. However, in the transition toward industrialized construction, this mirroring breaks down. The development of platforms requires navigating uncertainty, experimenting with new roles and knowledge boundaries, and letting go of strict mirroring between tasks and knowledge. This transitional phase of remirroring is both disorienting and essential, as the organization must realign its internal capabilities with the evolving demands of platform-based operating. A similar dynamic is described by Jones et al. (2022), who show that product platform development in construction often emerges through iterative, path-dependent processes across projects, rather than as a standalone initiative. Their case illustrates how role- and service-based boundaries were gradually overcome as platform capabilities emerged.

Moreover, Aksenova and Oti-Sarpong (2024), highlight that product platform development is deeply influenced by industry characteristics such as specialization, fragmentation, and the need for strong platform leadership. In fragmented sectors like construction, coordination across roles and projects requires more than standardization, it demands strategic leadership to define how the platform is governed and evolved over time. This involves setting clear roles, governance mechanisms, and rules of engagement. Without this ownership, platforms risk becoming disconnected or inconsistently applied across the organization. Together, these perspectives underline that product platform development is not only a technical challenge, but also a dynamic organizational process shaped by strategy, experimentation, and situated practice.

2.1.3 Standardization

A fundamental component of industrialization is standardization, which is again applicable for both product- and process-oriented dimensions. Standardization refers to the systematic development and implementation of shared norms, rules, and specifications to ensure consistency and predictability (Aapaoja & Haapasalo, 2014). In management, standardization is often associated with uniformity, contrasting with the creativity and change linked to innovation. However, perspectives are shifting, and standardization is increasingly seen as an enabler for integrating innovative solutions from diverse suppliers. By establishing widely accepted norms and rules, standards provide a foundational platform for interoperability (Viardot, 2021). Product standardization involves the structured application of technical systems and components that collectively create a unique final product. Equally important is the standardization of processes and methods, defined by Lessing (2006) as:

> Standardization is the extensive use of components, methods or processes in which there is regularity, repetition and a background of successful practice and predictability. (Lessing, 2006, p. 40)

When effectively integrated into industrialized construction, standardization enables companies to leverage economies of scale while maintaining the flexibility for project-specific customization. The reuse of solutions, such as prefabricated components and standardized processes, allows for the accumulation of knowledge and experience within platforms. Support methods such as design planning, collaborative design, design optimization, and requirements iteration are critical tools for integrating standardization into practice. These methods help manage and refine the product platform, ensuring that standardized solutions are adapted to the unique requirements of individual projects while maintaining overall process efficiency and consistency (Jansson, et al., 2014). Digital technologies can play a supportive role in enabling and managing this standardization, by facilitating information flow, coordination, and integration across stages. Additional information on digital technologies can be found in Appendix V.

2.2 Organizational change management

The construction industry has traditionally taken a conservative approach to innovation (Hampson et al., 2014). This often results in resistance to organizational change, particularly when core processes are affected. Such resistance becomes particularly visible in the

adoption of new construction approaches, such as industrialized construction, where traditional workflows, roles, and routines are significantly disrupted (Migliaccio et al., 2008). Organizational Change Management (OCM) refers to the process of implementing practices that differ from an organization's existing methods to achieve strategic objectives (Burnes, 2009).

In OCM literature, several frameworks have been proposed, most of which emphasize structured, phased approaches to guiding transitions. For instance, Burati and Oswald (1993) identified four phases: exploring and committing, planning and preparing, implementing, and sustaining. Similarly, Attaran (2000) and Lines and Smithwick (2019) offer comparable stepwise models. Despite variations, these frameworks share a common logic of structured and phased approaches (Aldossari et al., 2023). While these studies offer valuable guidance for structuring organizational transitions, such models may fall short in capturing the ongoing, layered tensions that characterize change processes in industrialized construction settings. In this context, examining organizational practices offers a more situated lens to understand how organizations navigate in daily work, beyond what the frameworks alone can reveal.

This recognition has prompted scholars to look beyond structured models and towards a more practice-based understanding of change. Within this perspective, a key concept is organizational change capacity, an organization's ability to respond to external pressures and internal developments by embedding new practices into daily operations (Pettigrew, 1985; Soparnot, 2011). This lens considers whether an organization has the internal resources, structures, and routines to support strategic ambitions over time.

2.2.1 Organizational practices in change

While traditional change management emphasizes structured strategies and top-down tools, recent research highlights a more situated understanding of change. Scholars such as Jansson (2013) argue that change unfolds through everyday routines, decisions, and interactions, what researchers refer to as organizational practices. These practices consist of recurring, socially embedded patterns of doing, saying, and interacting that constitute everyday work, shaped by specific contexts, power dynamics, and local interpretations. In the context of change, such practices become the medium through which actors make sense of competing demands, adopt to evolving expectations, and navigate uncertainty. As Jansson (2013) emphasizes, this perspective challenges the assumption that change can be managed solely through top-down planning and instead highlights now that change enacted through the lived realities of organizational members. Because of this situated nature of change, organizations must constantly navigate and negotiate tensions, contradictions and power struggles, which are not side of effects of change, but central to it. As Jansson (2013) states, *"tension is in the heart of change"*, a view informed by the broader theoretical contributions of Smith and Lewis (2011) on paradox, Farjoun (2010) on dualities, Schatzki (2002) on practice, and Erkama (2010) on power and resistance in organizational change. In product platform development, this perspective becomes particularly relevant as organizations must standardize core components while remaining responsive to project-specific needs, a process shaped through daily negotiations and adaptations across roles and departments. This makes paradox theory a

valuable lens to understand how such tensions are navigated collectively over time under industrialized conditions.

2.2.3 Paradox theory

While the lens of organizational practices helps reveal how change unfolds in situated, everyday work, paradox theory deepens this understanding by showing how actors experience and navigate persistent tensions that cannot be fully resolved. Together, these perspectives highlight not only how change is enacted, but also why it remains a dynamic and often uncertain process, particularly in complex transitions such as industrialized construction.

At the core of paradox theory lies the idea that organizations are often confronted with "contradictory yet interrelated elements that exist simultaneously and persist over time" (Smith & Lewis, 2011, p. 382). These tensions are not temporary dilemmas to be solved, but ongoing dynamics that must be managed. Paradoxes are inherently inconsistent and continuous, yet interdependent, both forces exist in relation to one another, and neither can be eliminated without consequence. This behavior is further explored in the dynamic equilibrium model proposed by Smith and Lewis (2011), which highlights how organizations manage competing demands to enable both continuity and change.

Importantly, paradoxes can be seen from two angles: they are intrinsic to the system, and socially constructed (Luscher et al., 2006). Some tensions stem from structural contradictions that persist regardless of perception, for example, a platform's need for both flexibility and standardization. Yet how paradoxes are recognized, interpreted, and acted upon is deeply tied to the observer's perspective and the interactions between people (Hahn & Knight, 2021). These authors propose a dual ontology of paradox, showing that tensions can be both embedded in organizational systems and enacted through the meaning-making practices of individuals. Even when not acknowledged, paradoxes embedded in systems continue to shape outcomes, suggesting they are both objectively present and subjectively experienced. This dual nature makes paradoxes particularly relevant for innovation. As Farjoun (2010) notes, stability and change are not opposites but can reinforce each other: stable routines may enable experimentation, while iterative learning can enhance long-term reliability. Jay (2013) builds on this by showing that holding conflicting demands, such as social and commercial logics, in tension can drive innovation. Rather than resolving contradictions, paradoxes can enable creative recombination and the emergence of new practices.

Another key insight from paradox theory is that tensions are not only interpreted individually but also navigated collectively. As Greco and Lüscher (2025) emphasize, paradoxes are relational and socially constructed through shared interactions. Navigating them is less about individual decision-making and more about collective learning, requiring co-creation, mutual adjustment, and a willingness to remain with discomfort rather than resolve tensions too quickly. This process is not purely cognitive, but also emotional. As Pradies et al. (2021) note, paradoxes are often experienced as deeply felt tensions, accompanied by emotions such as anxiety or frustration. These emotional responses shape how individuals interpret and engage with tensions, making paradox navigation as much about emotional resilience as about strategic reflection. Greco and Lüscher (2025) describe paradoxes as "live in and between

us," meaning that organizations can only learn to manage persistent tensions when people engage in shared reflection and adapt their practices together.

A related process is sensemaking, which is further highlighted by Lüscher and Lewis (2008), who show how managers use paradoxical inquiry during times of organizational change. Sensemaking refers to how individuals and groups interpret ambiguous situations by constructing meaning through interaction, reflection, and narrative. In paradoxical settings, it becomes especially important, as it enables people to reframe tensions, explore alternatives, and work toward shared understanding. Rather than seeking resolution, they propose a process of working through ambiguity together. This involves surfacing hidden tensions, exploring conflicting frames, and co-creating new understandings through reflection and action.

In the context of the built environment, paradoxes are particularly present. As Greco and Long (2022) demonstrate, socio-technical transitions, such as the effort for more sustainable and affordable housing, are shaped by ongoing tensions between environmental, social, and economic goals. These tensions are not limited to technical solutions but play out in governance decisions, stakeholder negotiations, and everyday project execution. The fragmented and multi-actor nature of construction further intensifies the experience of paradox, making it a critical lens for understanding the industry's transformation.

In this thesis, paradox theory serves as a lens to explore how tensions are navigated during product platform development. Rather than viewing contradictions as failures of alignment, this perspective emphasizes that paradoxes are an inherent part of transition. One that must be engaged with collectively over time.

2.3 Conclusion

The shift toward industrialized construction demands more than technical innovation; it requires deep organizational transformation. A key element of this transformation is product platform development, which enables companies to move from fragmented, project-based processes to scalable, repeatable systems grounded in standardization. However, embedding such platforms into daily operations disrupts established roles, routines, and decision-making patterns, making organizational change practices central to understanding how this shift unfolds. Rather than viewing change as a linear, top-down process, a practice-based perspective emphasizes how change is enacted through everyday actions, shaped by context, negotiation, and interpretation.

To further understand these dynamics, paradox theory offers a complementary lens by focusing on how organizational actors learn to collectively navigate persistent tensions, such as standardization versus flexibility, innovation versus continuity, and efficiency versus adaptability. As product platforms evolve through ongoing interaction between technical and process elements, these tensions are not resolved but continuously managed through practice. Together, these theoretical lenses offer a richer understanding of how construction companies like VORM 2050 are not only building platforms but also reshaping their ways of working in the broader transition toward industrialized construction.

2.4 Conceptual framework

The theoretical background forms the foundation for the established conceptual framework in Figure 4, which highlights the main concepts of organizational practices and product platform development in industrialized construction.

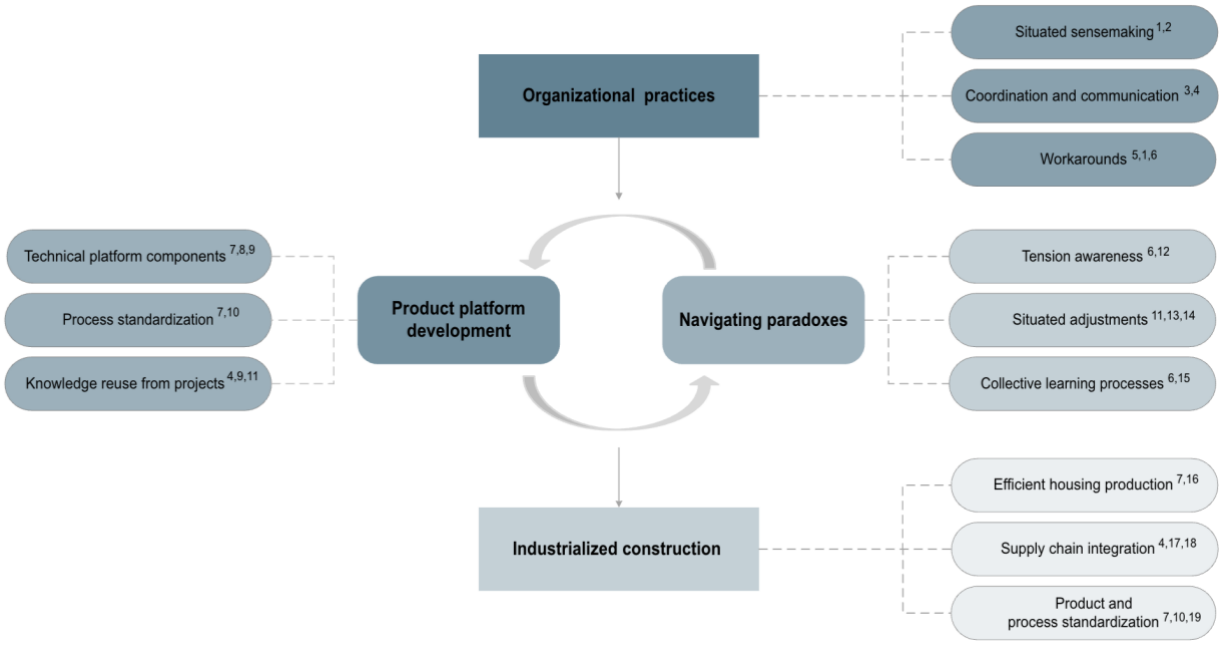


Figure 4: conceptual framework (source: own work, based on [1]Jansson (2013); [2]Lüscher & Lewis (2008); [3]Söderholm (2010); [4]Jones et al. (2022); [5]Schatzki (2002); [6]Greco & Lüscher (2025); [7]Lessing (2006); [8]Björnfot & Stehn (2007); [9]Zhou (2024); [10]Jansson et al. (2014); [11]Hall et al. (2023); [12]Smith & Lewis (2011); [13]Farjoun (2010); [14]Luscher & Lewis (2008); [15]Pradies et al. (2021); [16]Qi et al. (2021); [17]Jansson (2010); [18]Malmgren et al. (2011); [19]Aapaoja & Haapasalo (2014)).

3. Research method

3. Research method

This chapter outlines the methods used to address each sub-question, to fulfil the aim of exploring how organizational practices shape product platform development in the transition towards industrialized construction. An overview of the research design is provided in this section, including selected study type, methods, approach to data collection and analysis, data plan, ethical considerations and objectives.

3.1 Type of study

Developing an effective research design is essential for ensuring consistent and well-justified decisions that guide the study toward its intended outcomes (Blaikie & Priest, 2019). For this research, an exploratory approach was chosen to examine how the transition towards industrialized construction is experienced in practice. Given the limited studies on the relationship between digital technologies and industrialized construction practices, this approach helps identifying emerging trends, challenges, and opportunities. According to Blaikie and Priest (2019), exploratory research is particularly effective for analyzing practical observations, such as those related to VORM 2050 and their industrialized construction practices.

To explore this phenomenon, qualitative research will be conducted, which is well-suited for capturing in-depth insights and subjective perspectives from stakeholders engaged in the transition. These insights will be derived through abductive reasoning as part of a case study. This approach involves an iterative process of moving between empirical observations and theoretical models, also seen as going 'back and forth' between data and theory. Four key factors influence this process: real-world events, existing theories, case development, and the evolving analytical framework. Rather than following a linear path, this method embraces an integrated approach of continuous learning and parallel development. Accordingly, the framework, data sources, and analysis will repeatedly be refined in this study, with the aim of developing theory rather than merely confirming or generating new theories (Dubois & Gadde, 2002).

3.2 Methods and techniques

This study draws on key theoretical concepts from industrialization and change management literature to explore the transition toward industrialized construction. These concepts interact with the qualitative case study of VORM 2050, as shown in Figure 5.

The first sub-question investigates the organizational practices that shape VORM 2050's transition from traditional to industrialized construction through a single case study. Case studies are a valuable method for theory development, offering deep insights into empirical phenomena within their specific contexts (Dubois & Gadde, 2002). VORM 2050 serves as the unit of analysis, with only projects developed under industrialized conditions included to ensure contextual consistency. This study uses descriptive information to support theoretical assumptions, aligning with the principles of a descriptive case study (Lessing, 2006). The

research question is addressed through qualitative data gathered from interviews and organizational ethnography, including internal documents, workshop observations, and field notes. These sources help identify recurring routines, decision-making patterns, and coordination mechanisms that influence how change is enacted in practice. The findings are interpreted through a practice-based lens, allowing for a situated understanding of how transformation takes shape inside the organization.

The second sub-question builds on this by examining how these organizational practices interact with the principles of platform-based industrialized construction. This question is explored abductively by connecting empirical insights from the VORM 2050 case to key concepts from industrialized construction literature, such as standardization and platform thinking. The focus is on tracing where organizational routines align with or diverge from these principles in practice. This involves analyzing the same qualitative dataset through a theoretically sensitized lens, guided by an iterative comparison between empirical observations and conceptual expectations.

The outcomes of the first two sub-questions provide the foundation for the final question, which focuses on generating practical recommendations for VORM 2050. This final step contributes to the overall objective of the study: strengthening the company's organizational practices to support its transition toward industrialized construction. These recommendations are grounded in empirical findings, theoretical insights, and reflections on both past experiences and the current state of practice.

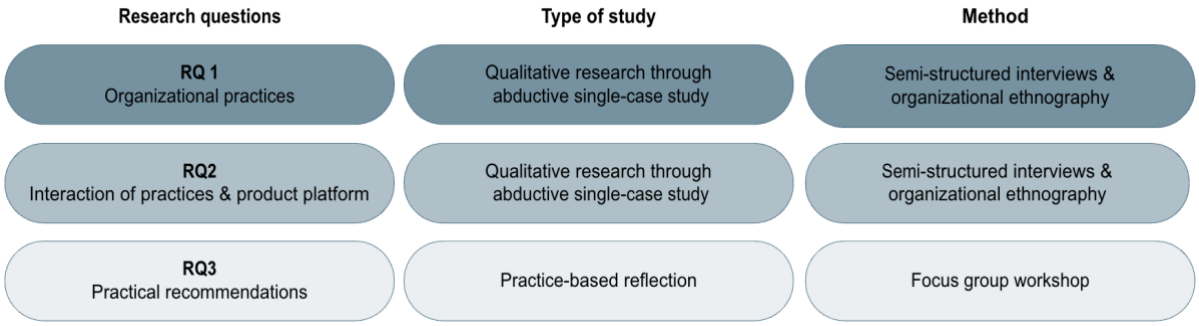


Figure 5: overview methodology per sub-question (source: own work)

To clarify how the sub-questions are interconnected, the research process is visualized using the Double Diamond model (Figure 6). This model illustrates the structure of the study: it begins with a broad exploration through observations and interviews, then narrows through analysis, expands again in a reflection-oriented phase during workshops, and finally converges into a set of practice-informed recommendations.

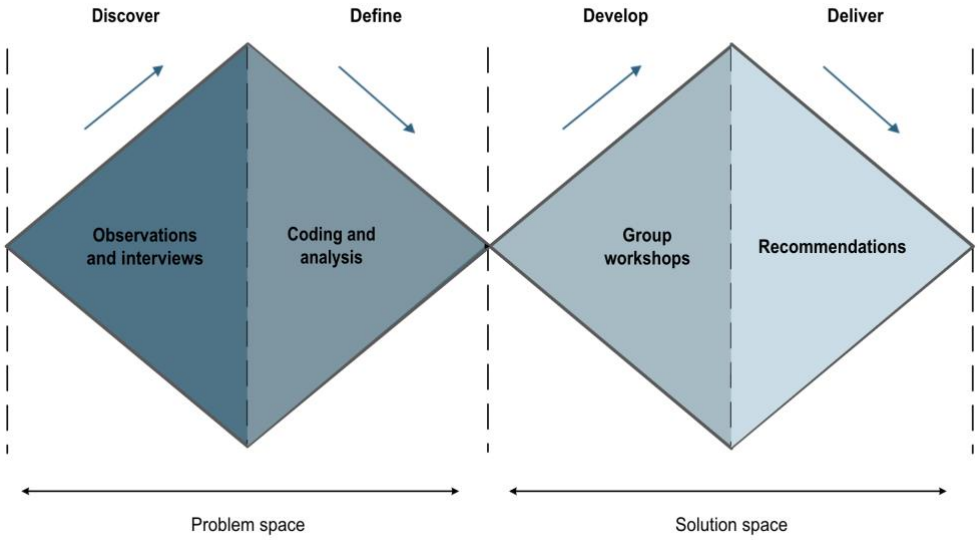


Figure 6: Research process 'Double Diamond' (source: own work, based on Design Council, 2005)

3.3 Data collection

3.3.1 Case study

Data will be collected within the scope of the single case study of construction company VORM 2050. VORM is a leading Dutch construction and development company, established in 1919, known for its innovative approach to urban construction and affordable housing. VORM operates across the entire construction chain, while focusing on sustainability and efficiency. VORM 2050 is one of its newest enterprises that develops and builds according to prefab construction methods to shorten construction execution time and reduce environmental impact. Accordingly, the purpose of VORM 2050 is to address housing challenges in the Netherlands by leveraging industrialized construction practices to deliver scalable, high-quality, and sustainable housing solutions efficiently.

Central to this strategy is the development of a product platform based on a defined set of technical solutions and production methods, including standardized 2- and 3-room layouts, prefab bathrooms as technical core, and scaffold-free construction. Using a centralized library of standardized apartment layouts, VORM 2050 seeks to accelerate design and development. Prefabricated components are manufactured off-site and assembled on-site with fixed partners, aiming to align with their "80/20 principle": 80% standard, 20% customized according to project-specific demands.

In response to the organizational shifts required for industrialized construction, VORM 2050 initially set ambitions to leverage digital technologies as part of its broader transformation strategy. These technologies were intended to enhance process efficiency and support areas such as procurement, workflow optimization, and monitoring to align with the trends of digitalization and industrialization. However, during the development of the product platform, digital integration did not emerge as the highest priority. Instead, it will be considered in this research as a supportive, enabling function, complementing but not steering the core development of the platform of VORM 2050.

Six projects from VORM 2050 are discussed in the case study. One project has been delivered but still involves repair work and warranty issues, another is nearing delivery but also involves repair activities, one project is currently in the execution phase, two projects are scheduled to commence in 2025, and one is planned for 2026 (see Table 1). The repair works predominantly stem from misalignment between industrialized construction practices and project management processes. The variation in project stages offered valuable insights into lessons learned from completed work, the challenges during preparation phases, and execution outcomes. During the internship, additional projects entered the preparation phase and were also included in the organizational ethnography.

Table 1: overview of VORM 2050 projects (source: own work, based on meeting with VORM 2050)

Project	Project phase	Comments
Fibonacci, Amsterdam	Completed	Significant repairs and warranty issues after completion
Houtrak, Amsterdam	Completion week 4 of 2025	Repair work, challenges with the formal handover
High Five, Utrecht	Under execution	Concept and preparation poorly executed leading to delay, difficulties due to specific contract type
GROEI!, Amsterdam	Preparation (starting September 2025)	Designs completed, permits issued, preparing subcontracting
Hessenbergweg, Amsterdam	Preparation (starting end of 2025)	Starting quickly after takeover of land position, design needs adjustments
De Kaai, Rotterdam	DO phase (start Q2 2026, 6-month delay)	Planning objections caused 6-month delay, steps taken during the design phase, unique dwelling type due to the care function

4.3.2 Qualitative interviews

The qualitative component of this research consists of semi-structured interviews with members of the VORM 2050 team. The team includes approximately 30 employees, a significant portion of whom are self-employed contractors (ZZP'ers), particularly within the execution team. This group includes almost all on-site roles such as site supervisors and lead supervisors. To capture a range of perspectives, interviews were conducted with both permanent staff and freelance professionals whenever possible. VORM 2050 is organized around a leadership team and four sub-teams: engineering, project preparation, project development, and execution (see Figure 7). While the engineering team focuses on standardizing both the product (e.g., the "0-building") and related processes, the execution team consists mostly of freelancers, with only one permanent employee and a few recurring collaborators. Aside from its product- and process-oriented focus, the team's structure still largely reflects that of a traditional contractor.

Interviews were conducted with a total of eighteen team members. The leadership team was not interviewed individually but are involved later through tailored meetings. Notably, except for three employees, none of the current employees were part of VORM 2050 under its previous leadership. As a result, the empirical data primarily reflects the perspectives of the current team and their experiences during the ongoing transition. This transition began at the end of 2023 with the appointment of a new leadership team, following a period of underperforming projects and significant staff turnover. Since then, the organization has adopted a revised strategy focused on a new technical concept and organizational approach.

In addition to internal team members, interviews were conducted with several external stakeholders. These included two external partners (an electrical and a mechanical installer involved in Project Houtrak), the director of VORM Bouw (the traditional construction division), the CEO of the VORM Holding and an employee of 'Netwerk Conceptueel Bouwen'. These interviews were carried out at a later stage to provide broader insight into VORM 2050's strategic position and direction. Although additional interviews with other partners were initially planned, this proved difficult due to the organization's preference to retain flexibility for its own evaluation sessions and the sensitive nature of some partnerships. In total, 24 interviews were conducted for this research.

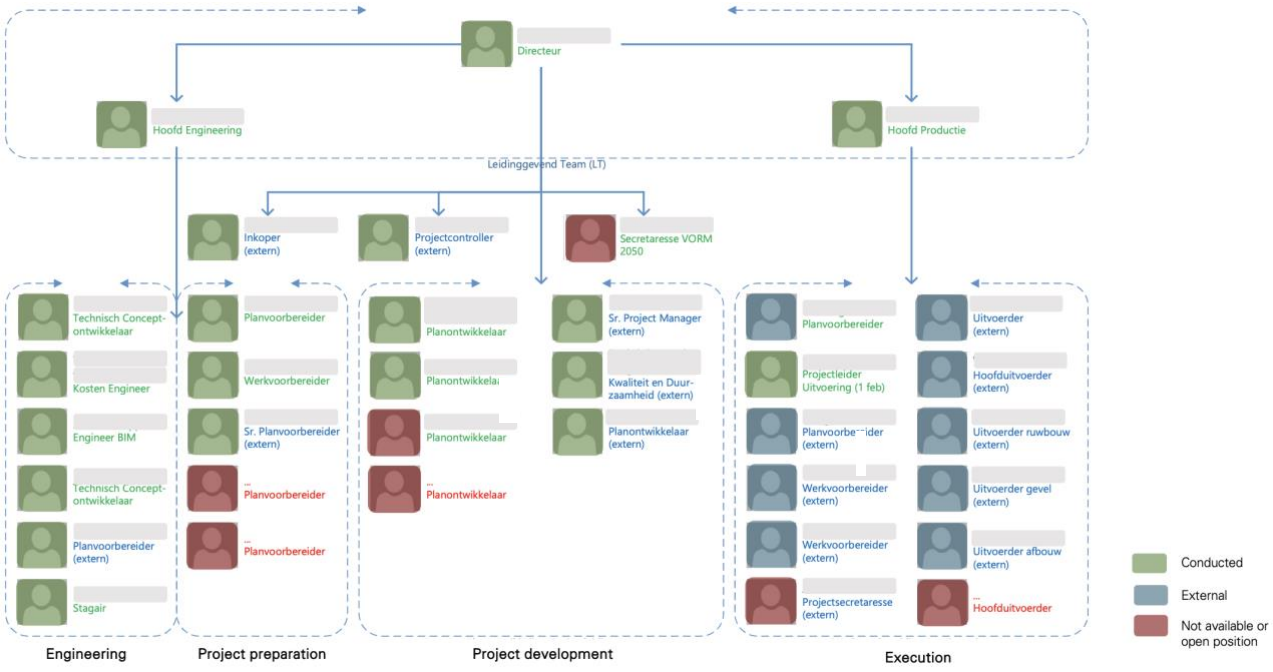


Figure 7: organizational chart with conducted interviews VORM 2050 (source: own work, based on VORM 2050 document)

The purpose of the interviews is to gain in-depth insight into the organizational practices that shape VORM 2050's transition toward industrialized construction. The interviews explore how team members experience the shift in ways of working, including changes in routines, roles, coordination, and decision-making related to product and process standardization. While digital technologies are not a primary focus of this study, participants were initially also invited to reflect on the tools they currently use. These reflections helped position digitalization as a

contextual factor, but it was not included in the core analysis. The interviews followed a semi-structured format, ensuring key themes were addressed while allowing room for participants to raise additional insights relevant to their roles and experiences. Interviews were conducted in person when possible, with virtual alternatives offered based on availability and preference. Each interview lasted approximately 60 minutes and was guided by a set of 8 to 10 core questions. See Appendix I for the interview guide.

3.3.3 Organizational ethnography

In addition to interviews, observations of industrialized construction practices were conducted during the internship at VORM 2050, applying organizational ethnography as a research method. The internship was conducted over a five-month period, with the researcher present in the office four days per week. This involved attending daily activities, participating in meetings, reviewing project documents, and engaging in informal workplace interactions. The goal was to gain an embedded, day-to-day perspective of the organization and its transition processes. An overview of the participants engaged in the interviews and organizational ethnography is presented in Figure 8.

Organizational ethnography provides insight into how employees navigate their work environment, adapt to changes, and interpret ongoing developments around them (Yanow, 2009). It focuses on in-depth, field-based exploration, making it well-suited for uncovering the dynamics and behaviors shaping organizational practices. Observations contribute to data triangulation, supporting the validity of findings by combining multiple sources to examine the same phenomenon (Lessing, 2006). In line with abductive reasoning and the principles of systematic combining (Dubois & Gadde, 2002), this approach allows theory and empirical insights to evolve in parallel. It creates opportunities to uncover dimensions of the research problem that may not have been anticipated at the outset.

Due to the temporal constraints of the internship, the researcher primarily adopted an observational role, taking detailed fieldnotes and documenting events, while engaging in participatory tasks when appropriate. A daily logbook was maintained to record the interaction type, participants, purpose, theme, and a brief description. These interactions varied from strategic project meetings to informal workplace conversations. Throughout the internship, the researcher ensured transparency about the research objectives, methods, and intended use of data. At the beginning, team members were informed of the study's purpose and asked for consent to participate in interviews or observations. Throughout the research, informal conversations and regular interactions helped keep colleagues updated on progress, creating familiarity with the study. In addition, several internal presentations were held with the management team to share early findings and gather feedback. Initial insights were also presented during workshop sessions to initiate discussion and reflection, and a final presentation was delivered at the end of the internship to share the full research narrative. This ongoing interaction helped maintain engagement with the team of VORM 2050. While the researcher remained primarily in an observer role, they were embedded in the team and actively involved in day-to-day activities.

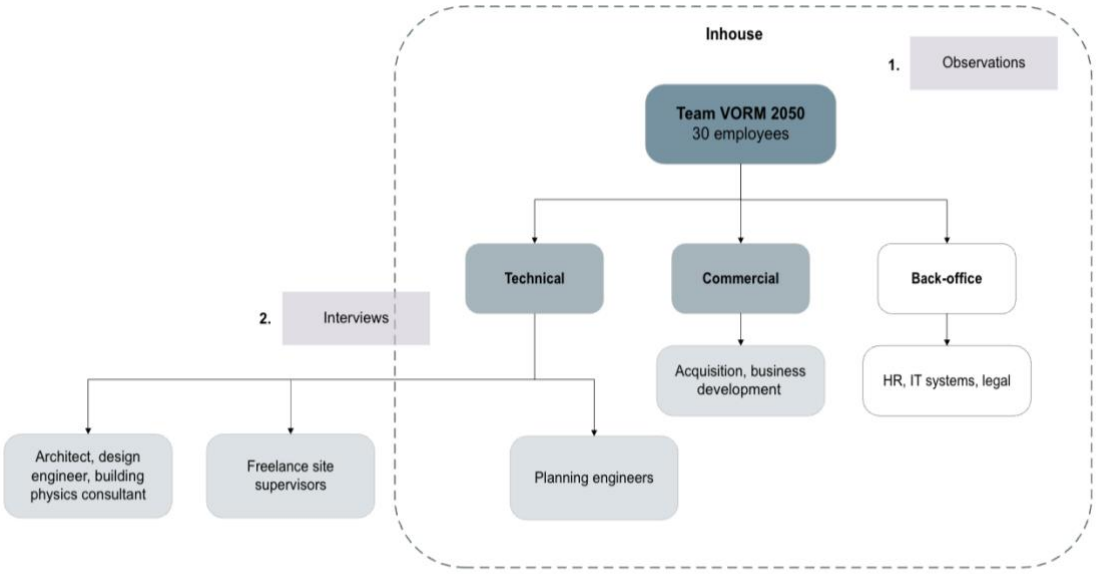


Figure 8: overview research participants (source: own work)

3.3.4 Focus group workshop

A focus group workshop was organized with team members of VORM 2050 to reflect on preliminary findings and explore their practical implications. While the session was originally intended for a broader audience, attendance was limited due to practical constraints such as scheduling and availability. Two sessions were planned, aiming to include a diverse mix of roles from both preparatory and technical execution teams.

Each two-hour session was designed to engage participants from across the organization. The objective was to validate empirical insights gathered through interviews and ethnography, and to collectively examine the challenges of transitioning from a project-based to a product-oriented way of working. The workshop began with a brief presentation by the researcher, introducing the thesis topic, key findings, and the structure of the session.

The core of the workshop was structured around three organizational tensions identified in earlier phases of the research:

1. Long-term vision vs. project-driven operations
2. Contractor vs. developing contractor
3. Need for control vs. demand for flexibility

To encourage deeper reflection on these tensions, a polarity mapping exercise was used. This method helps participants explore the positive and negative consequences of leaning too far in one direction when managing competing organizational demands. Participants were asked to select one of the tensions and then given ten minutes to individually note perceived advantages and disadvantages of each side. This period of personal reflection was followed by a plenary discussion, where participants shared and discussed their perspectives. The group dialogue enabled a richer understanding of how these tensions play out in practice across different roles and functions.

The session concluded with a self-reflection activity, where participants were asked to consider whether they individually tend toward exploration or exploitation, based on ambidexterity principles to reveal some of the team dynamics. The workshop ended with an open round of initial impressions and feedback from participants.

An overview of all collected data, including semi-structured interviews, organizational ethnography, and the focus group workshops, is presented in the table below.

Table 2: overview of collected data (source: own work)

Interviews (24)	#	
Team members	18	From engineering, development, and execution teams
Strategic partners	3	M&E contractor (executing) and structural engineer (advisory) from a past project
Other	3	CEO of VORM Holding, director of VORM Bouw, Netwerk Conceptueel Bouwen
Observations (79)	#	
Strategic meetings	15 (weekly)	High-level meetings on concept development, process standardization, and digital technologies (e.g. Bexel)
Project coordination	29 (2 times per week)	Project-specific meetings covering planning, budgeting and technical design decisions
Informal conversations	35 (2/3 times per week)	Personal interactions insights into team dynamics and everyday work practices
Workshop (2)	# participants	
Focus group 1	7	2 hours using polarity mapping
Focus group 2	6	2 hours using polarity mapping

3.4 Data analysis

All semi-structured interviews were transcribed and thematically coded using ATLAS.ti, based on the main concepts of this study. Similarly, findings from the organizational ethnography, including observations, meeting notes, and informal conversations, were documented as thoroughly as possible and subjected to the same coding process. An initial set of deductive codes was developed based on the theoretical background and research questions. These codes were used to gain a preliminary understanding of key themes emerging across the data. Within this deductive coding scheme, thematic codes were used to capture core concepts directly related to the research questions, such as product and process standardization, while descriptive codes provided contextual information (e.g., stakeholder roles or tone) to support interpretation but were not included in the core analysis.

Importantly, organizational practices were intentionally not included as a predefined thematic code. Given the practice-based nature of the research, organizational change was expected

to emerge inductively through observed behaviors, routines, and tensions described by participants. Tables 3 and 4 provide an explanation of the applied deductive codes.

Table 3: definitions of the deductive thematic codes (source: own work, based on Qi et al. (2021); Jansson et al. (2014))

Group	Code	Definition
Digital technologies (Qi et al., 2021)	Business digitalization	Transformation of construction management through digital systems, using ERP or cloud-based platforms to share and manage processes and project data.
	Computer integrated design	Use of BIM-based 3D and 4D modeling to digitally create, analyze, and optimize building designs in coordination with construction processes.
	Predictive analysis	Use of data-driven techniques, such as simulation, to forecast construction performance and support real-time decision-making in industrialized processes.
Industrialized construction (Jansson et al., 2014)	Product standardization	Using repeatable building components and systems to ensure consistent and efficient construction outcomes.
	Process standardization	Applying proven and repeatable methods, such as planning routines, design practices, and production procedures, to streamline construction workflows.

Table 4: deductive descriptive codes (source: own work)

Group	Code
Stakeholders	Client (developers, housing associations, investors) Partners (long-term suppliers or subcontractors) Holding (parent and sister companies)
Perception	Negative or challenge Positive or opportunity
Time perspective	Past Present Future

During the coding of the interviews, it often emerged that participants were still searching for clarity regarding VORM 2050's role. This applied both at the organizational level, in terms of its position within construction and development processes, its stance in the housing market, and how individual roles are defined. As a result, 'organizational identity' was added as an inductive code group, based on relevant literature. This proved to be a valuable addition for initially mapping how VORM 2050 perceives itself as an organization, in combination with how it views its product and internal processes. According to Gioia et al. (2013b), indicating an organization's identity becomes especially important during periods of transition, as it helps

members understand their role within the broader strategic direction. Organizational identity influences how people make day-to-day decisions and align their actions with what they perceive the organization to stand for.

Table 5: definitions of the inductive thematic codes (own work, based on Gioia et al. (2013b))

Group	Code	Definition
Organizational identity (Gioia et al., 2013b)	Internal sensemaking	The ongoing process by which organizational members interpret, negotiate, and define "who we are" as a collective.
	History	The organization's past actions, core values, and traditions that provide a sense of continuity and guide current perceptions and behaviors.
	External forces	Pressures and influences from the environment, such as market trends, regulation, or societal expectations, that shape the organization's identity over time.
	Leadership vision and strategy	The direction and messaging provided by leaders to shape or redefine how the organization sees itself and is seen by others.
	Tensions or crises	Disruptive events or identity threats that trigger reflection, uncertainty, or change, prompting re-evaluation of the organization's self-understanding.

After coding the interviews and ethnographic observations based on the code schemes described above, second- and third-order codes were developed (see figure 9). Notably, most quotations were related to the codes 'tensions or crises', 'internal sensemaking', and 'daily practices and routines', all part of the organizational identity group. In addition, many quotations were linked to process standardization and business digitalization. For the analytical model, organizational identity is placed at the center, as it provides a lens through which the organization's responses to change, the interpretation of roles, and the implementation of new processes and technologies can be understood. It reveals how members make sense of ongoing transitions and how that sensemaking shapes their behavior and work practices.

Using the Gioia method, the quotations were analyzed to identify patterns and group them into second-order themes, which were then theoretically abstracted into third-order dimensions. Central to this process is the guiding question "what is going on here?", allowing the analysis to move from practical observations, to emerging narratives, and ultimately to higher-level theoretical constructs (Gioia et al., 2013a).

While the coding process was guided by concepts from the theoretical framework, the resulting third-order dimensions, 'organizational change capacity', 'role ambiguity', and 'workflow fragmentation', were developed inductively through patterns identified in the empirical data. This reflects the abductive nature of the study, in which theoretical constructs were not applied in advance, but iteratively connected to emerging findings. 'Organizational change capacity' was later supported by existing literature to strengthen its conceptual grounding, while the other two dimensions remained empirically informed.

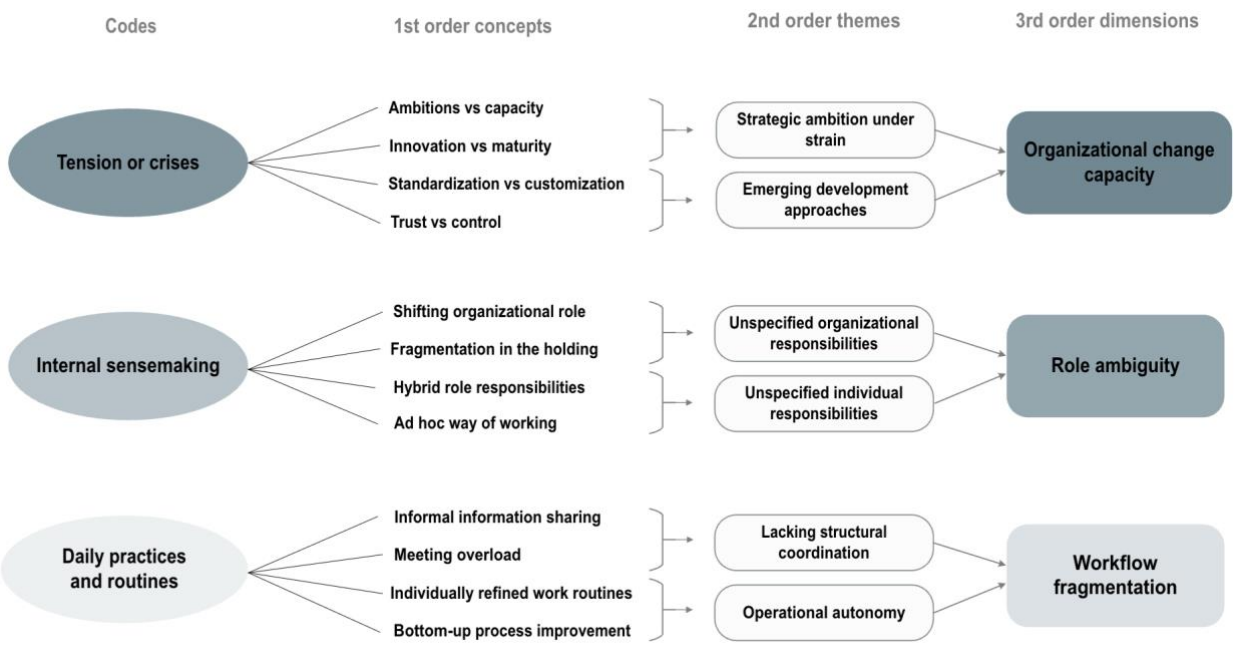


Figure 9: Data structure model (source: own work, based on Gioia, 2013a)

3.5 Data plan

A data management plan has been established to integrate the FAIR Data Principles into this study during the collection, storage, processing, analysis, and sharing of data. These principles provide a framework ensuring digital resources are Findable, Accessible, Interoperable, and Reusable (Jacobsen, 2020). The primary data types include project documentation, observation notes, as well as recordings and transcripts from interviews and workshops. All data will be securely stored on the TU Delft OneDrive to ensure password protection and minimize the risk of loss. Personal data will be anonymized across all sources, and interview transcripts and recordings will remain confidential to ensure participants' privacy. Furthermore, findings from the interviews will be shared with participants throughout the process for confirmation. A final validation will take place during the focus group at the end of the study. Further details of the data management are available in Appendix II, which was created using the TU Delft template via DMPonline.

3.6 Ethical considerations

Ethical principles are essential in research to protect the dignity, rights, and welfare of participants, ensure the integrity of the research process (Hasan et al., 2021). As outlined in the data management plan, personal data will be anonymized, with only participants' roles within the company being relevant for data analysis. Additionally, an important consideration is the privacy of the company serving as the case study, particularly regarding the sharing of sensitive information about their business practices. As such, their confirmation will be required before publishing the study on the TU Delft database. Primary data will not be shared with third parties beyond the involved supervisors. Furthermore, participants will be informed that their privacy concerns and interests are being considered through an informed consent form. Approval will be obtained from each participant before data collection starts, and they

have the right to withdraw at any time or not answer a question. This ensures voluntary participation and awareness of the purpose of the data collection. Ethical considerations will be integrated at every stage of the study. This includes responsibly processing, storing, and sharing data while ensuring participant privacy.

3.7 Research output

3.7.1 Goals and objectives

The ongoing housing shortage and the need for innovation have placed pressure on the construction industry to transition toward more efficient and scalable approaches, such as industrialized construction. While technical solutions like standardization and prefabrication are essential, these shifts also require deep organizational transformation. This study explores how such transitions are enacted in practice by focusing on the organizational dynamics involved in product platform development.

The primary goal of this research is to understand how organizational practices shape and influence the transition to industrialized construction within VORM 2050. This involves building a theoretical foundation, conducting an in-depth qualitative case study, and examining how team members navigate the tensions and changes associated with platform-based ways of working. While digital technologies are considered as a contextual factor, the core focus is on organizational behavior, routines, and coordination. The findings aim to offer practice-informed insights that can support VORM 2050 and similar organizations in managing ongoing transition processes.

3.7.2 Deliverables

The primary deliverable of this study is a set of practice-informed insights and recommendations to support construction companies in their transition toward industrialized construction. These recommendations are grounded in empirical findings and reflect how organizational practices shape product platform development in practice. While tailored to VORM 2050's specific context, the insights address broader challenges related to standardization, platform thinking, and organizational change, and are therefore valuable to other construction companies undergoing similar transitions. These deliverables were developed through a structured, iterative research process, illustrated in Figure 5. The process began by exploring the problem space through interviews and observations, followed by thematic analysis. Insights were further refined in group workshops and ultimately translated into practical recommendations for both VORM 2050 and the wider construction sector.

The study further contributes to theory by addressing the limited management-oriented perspective on organizational transformation in the context of industrialized construction. By employing an abductive research approach**,** theory was developed iteratively through the triangulation of observations, interviews, and a theoretically informed analytical lens. As a result, the findings offer a situated yet transferable understanding of how organizational actors experience and manage tensions during platform development, contributing to broader discussions on change practices in construction.

3.7.3 Dissemination and audience

This study is aimed at construction companies undergoing, or preparing for, a transition toward industrialized construction. While VORM 2050 serves as the primary case, the findings are relevant beyond this specific context. The insights and recommendations developed through the case are tailored to VORM 2050's challenges and ambitions but reflect broader themes of organizational tensions that are common across the sector. As such, the study offers practice-based insights that may inform or inspire other construction and development companies navigating similar transformations, even if their organizational contexts differ. By anonymizing all collected data, this study ensures privacy and transparency, enabling the results to be shared openly. The outcomes will be disseminated to participants and interested stakeholders within VORM 2050 and made available through the TU Delft repository.

4. Findings

4. Findings

This chapter presents findings generated through qualitative data collection on the transition to industrialized construction at VORM 2050. Based on interviews, organizational ethnography, and workshop sessions, the data reveal recurring patterns in organizational tensions, role interpretation, and daily routines. The three core dimensions and six sub-challenges, derived from the analysis presented in Figure 9, are summarized in the overview table below and further elaborated in the subsequent sections. Sections 4.1 to 4.4 provide a detailed discussion of findings from interviews and ethnographic observations, while section 4.5 reflects on the outcomes of the workshop sessions. Additional supporting data can be found in Appendix VI.

Table 6: summary of research findings (source: own work)

Dimension	Challenge	Observed organizational practice	Implication for IC transition
Organizational change capacity	Strategic ambition under strain	- Pursuit of product development alongside project execution due to financial pressure - Limited strategic prioritization between concept development and internal improvement efforts (e.g., process standardization, digital tooling) - Misalignment between projects and the 2050 platform, limiting standardization - High share of freelancers affects consistency	- Resource strain and overload - Difficulty embedding long-term thinking - Tensions between short-term project delivery and strategic goals reduce organization's ability to steer towards industrialized practices - Limiting opportunities for feedback loops and continuous improvement
	Emerging development approaches	- The 2050 concept lacks a consistent definition - Teams interpret standardization differently, leading to inconsistent implementation - There is limited time available to evaluate lessons learned or refine the concept	- Increased workload - Innovation risks being implemented without sufficient support - Difficulty translating the concept into repeatable, scalable practices
Role ambiguity	Unspecified organizational responsibilities	- Blurred responsibilities between development, design, and construction roles across entities within the holding - Traditional division of responsibilities leaving less room for standardization of product components	- Confusion about leadership at various project stages hinders effective decision-making and communication - Risk of inconsistent implementation of the 2050 concept

	Unspecified individual responsibilities	- Hybrid roles occur without clearly defined tasks and responsibilities - Strategic roles on concept and process development are not anchored yet - Employees pick up tasks based on engagement rather than mandate	- Lack of accountability and task ownership resulting in less efficient collaborations - Working according to ad hoc solutions, also creating room for creative ideas and initiatives
Workflow fragmentation	Lacking structural coordination	- Overarching support system is missing, including shared operational routines and tools - Critical decisions and actions are inconsistently captured or followed up - New team members lack a clear structure to integrate into shared routines and standards - Level of coordination varies based on whether the organization is in a more traditional role	- Absence of shared operational routines makes it difficult to maintain continuity across projects - Team members compensate with ad hoc solutions, limiting standardization
	Operational autonomy	- Initiative to develop own documentation and coordination methods - Autonomy through the entrepreneurial mindset and flat organizational structure - Falling back on familiar practices rooted in traditional construction processes	- While autonomy fosters ownership and adaptability, it also leads to fragmented and inconsistent ways of working - Personal systems and habits limit interoperability and reduce feedback loops into the product platform

4.1 Organizational change capacity

Firstly, one of the clearest tensions emerging from the data concerns the mismatch between VORM 2050's innovative ambitions and its current organizational capacity and maturity. While the vision for innovation and transformation is widely shared, participants frequently expressed concerns about the feasibility of realizing these ambitions under existing conditions. Several respondents note that the organization is trying to push forward on multiple fronts, such as product development with ongoing project execution, without having the resources or infrastructure in place to support that effort effectively.

> "We willen alles tegelijk: een nieuwe strategie, het 2050-concept ontwikkelen, én meerdere projecten draaien. Maar we hebben daar gewoon niet de mensen voor." [1] - participant 4

[1] We want everything at once: a new strategy, developing the 2050 concept, and running multiple projects. But we simply don't have the people for that.

> ''Het is helemaal ingestoken als zijnde de partners die gaan onderling het werk regelen. Dat is totaal niet waar en een veel te grote ambitie. We hebben er bijna meer nodig.'' [2] - participant 10

These quotations suggest that while the ambition to lead innovation is strong, the organization is overextending itself at some points with tensions as result.

Secondly, the effort to implement a new way of building, while driving innovation, creates additional pressures. The vision behind the 0-building is to model and engineer a fictitious building in which all construction systems come together through the standardization of floor plans. This serves as a test for both technical feasibility and the financial viability of the project, particularly in terms of whether the financial model can be properly calculated using planning and budgeting methods. However, this is a highly time-intensive process that requires substantial resources to refine the concept and apply it to new projects. Moreover, striking a balance between standardization and customization remains a significant challenge. This arises from the tension between the need to standardize the building process to meet goals of cheaper and faster construction, and the flexibility required to incorporate client-specific needs. The pressure to continuously refine and apply the 0-building concept, while managing ongoing projects, leads to tensions between product development and project execution practices. Another source of tension arises from the intended delegation of responsibility to partners. However, informal work practices cause them to continue functioning like subcontractors, requiring direction and supervision. This undermines the delegation process, complicates accountability, and highlights the need for new capabilities and a different way of collaborating.

> ''Ze denken dat prefab automatisch goedkoper is, maar als je het hele product verandert, kom je uiteindelijk uit op een traditionele bouwmethode met bijbehorende kosten en kost het meer tijd voor iedereen. Daar ontstaat de spanning, de balans tussen standaardisatie en maatwerk.'' [3] - participant 2

This quotation highlights how the continuous development of the product and the flexibility within projects leads to inconsistencies and additional workload for the team. It suggests that VORM 2050's strategic ambition is not inherently unrealistic, but currently under pressure and causing operational struggles in the projects.

Another factor influencing VORM 2050's organizational change capacity is the large share of self-employed professionals (freelancers). Both within the execution teams and in key preparation roles, there is a high degree of workforce flexibility. The risk here is that freelancers may have more difficulty adapting to new processes, are more likely to fall back on their own traditional ways of working, struggle to convey the VORM 2050 vision to the broader network of partners, and valuable knowledge might be lost once they leave. This project-based approach is not fully aligned with the principles of industrialized construction.

[2] The whole idea was that the partners would organize the work among themselves. That's absolutely not true and a far too ambitious assumption. We almost need more people.

[3] They think prefab is automatically cheaper, but if you change the whole product, you end up with a traditional construction method with the corresponding costs, and it takes more time for everyone. That's where the tension arises, the balance between standardization and customization.

While the use of freelancers is partly a deliberate choice by VORM to scale teams up or down quickly based on project needs, in the case of VORM 2050 it is more a result of severe labor shortages. Nevertheless, this reality must be considered in how projects are organized and how knowledge is shared in the long term. This is also indicated by the quotations below.

> ''Het aandeel Zzp'ers kan voor 2050 zeker lastig worden, dan komt de kennis bij externen. Al jouw werkvoorbereiders et cetera die doen heel veel kennis op. Ja, dat moet je borgen.'' [4] - participant 15

> ''Ik heb een uitvoerder horen zeggen: waarom zou ik al met de afbouw starten als de gevel nog niet dicht is, wat is er mis met traditioneel bouwen? ... Het is lastig om dat goed over te brengen aan onderaannemers.'' [5] – participant 6

To conclude, the findings reveal a tension between VORM 2050's strategic ambition and its current organizational capacity. Although there is a clear commitment to innovation and industrialized construction, the internal systems, processes, and available resources have not yet matured to fully support this ambition. This gap places pressure on teams and contributes to operational strain. Several practices reflect this dynamic: the parallel implementation of multiple objectives, such as developing the 2050 concept, launching new strategic directions, and executing ongoing projects, places significant pressure on team members. The 2050 concept is already being applied in practice, even as it continues to develop, which creates additional complexity. As a result, it becomes crucial for VORM 2050 to strengthen its internal organization by clear priorities and the right internal systems to support its ambition. Especially to counter the high share of freelancers, as their temporary involvement makes it difficult to build shared routines or embed consistent working methods across projects. This aligns with the idea of organizational change capacity, which emphasizes that successful transition requires not only a strong strategic vision, but also the internal routines, capabilities, and infrastructure needed to embed that vision into daily operations.

4.2 Role ambiguity

Firstly, the case revealed role ambiguity at the organizational level, particularly in the unclear distribution of responsibilities between VORM 2050 and the wider VORM Holding. While the unit aspires to function as a concept-driven platform team, its relationship to VORM Ontwikkeling, the developing company, remains subordinate and fluid across projects. Employees frequently mention the uncertainty about which entity is responsible at different project stages or in key decisions, causing tension in day-to-day work activities. It emerged that VORM 2050 would take on more of the development role, but this does not happen in practice. As a result, it remains an ongoing process and is simply following the sister company. Additionally, it sometimes works better with a market partner because there is a healthy competitive environment.

[4] The share of self-employed workers could definitely become a challenge for 2050, because the knowledge then ends up with external parties. All your work planners, etc., they gain a lot of knowledge. Yes, you have to secure that.

[5] I heard a site manager say: why should I already start with the interior work when the facade isn't even closed yet, what's wrong with traditional construction? It's hard to communicate that properly to subcontractors.

> ''Zoals we het nu doen ligt een deel van de taken nog bij Ontwikkeling en een deel bij ons. Ik denk dat het daar wringt, want we weten niet wie welke verantwoordelijkheden op zich neemt. Hoe het in de bouwteamovereenkomst staat is niet hoe het eraan toe gaat.'' [6] - participant 13

> ''Zijn we nou gewoon een bouwer, of proberen we echt te ontwikkelen? Want soms voelt het alsof we halverwege blijven hangen.'' [7] – participant 2

These quotations indicate that fragmentation across entities complicates accountability and clarity around decision-making. As responsibilities are shared across organizational boundaries, employees are left to deal with unclear expectations. This results in the tension of falling back into a traditional division of responsibilities between construction and development processes. As a consequence, it becomes more difficult to implement the 2050 concept, including its standardized components, during the early preparation stages of a project.

Secondly, at the individual level, role ambiguity is especially visible within project teams, where hybrid responsibilities are most common. Although the ambition to further develop the 2050 concept is widely supported, only a small portion of the team's capacity is structurally allocated to this. Instead, most development takes place within running projects, where employees must balance short-term delivery and long-term thinking. This creates hybrid roles, for instance, a team member was hired to improve the processes but is now also working as an architect on the standardization of floor plans. As a result, it is often unclear who to approach for specific questions or who is accountable for a task or outcome. Combined with the absence of a well-developed concept, this leads to an ad hoc way of working. Industrialized construction, by contrast, seeks to limit this through product and process standardization.

> "Soms weet ik niet of ik nou projectleider ben of ontwikkelaar." [8] – Participant 4

> "We hebben allemaal namen bedacht voor rollen die net iets anders zijn dan normaal, maar er is geen beschrijving van. Een duidelijke afbakening van verantwoordelijkheden is echt nodig." [9] – Participant 16

These quotations highlight how informal work practices, such as individual task management and unclear role definitions, contribute to confusion over task ownership and accountability.

To conclude, the findings reveal that unclear organizational boundaries and hybrid responsibilities are key sources of role ambiguity within VORM 2050. At the organizational level, the company's evolving position within the broader holding leads to blurred accountability, particularly between development and construction roles. At the individual

[6] The way we're doing it now, part of the tasks still lie with Ontwikkeling and part with us. I think that's where the friction is, because we don't know who's responsible for what. The way it's in the construction team agreement doesn't reflect how it works in practice.

[7] Are we just a builder, or are we really trying to develop? Because sometimes it feels like we're stuck somewhere in between.

[8] Sometimes I don't know whether I'm a project manager or a developer.

[9] We all came up with names for roles that are slightly different than usual, but there's no description attached. A clear definition of responsibilities is really needed.

level, employees navigate overlapping tasks without clear role definitions or guidance, resulting in inconsistent ownership, ad hoc activities, and challenges in aligning efforts across projects. This fragmentation complicates coordination, increases the risk of delays, and contributes to confusion around decision-making, especially when projects are under pressure.

4.3 Workflow fragmentation

Firstly, at VORM 2050, the absence of shared routines for communication and documentation presents clear coordination challenges. Meetings, while intended to align teams, are often perceived as too lengthy and not sufficiently tailored, which distracts from core project work. Without a centralized knowledge system or consistent methods for documenting decisions and assigning follow-ups, teams risk duplicating efforts and losing momentum. As a result, well-intentioned initiatives often become fragmented. This reliance on informal communication and independently developed work methods could lead to workflow inconsistencies, inefficiencies, and difficulty maintaining alignment across teams.

> "Zaten nu 1 keer in de twee weken met het hele team samen om alles te bespreken waardoor het overleggen van drie uur tijd werden, maar eigenlijk een deel voor een functie maar relevant is." [10] – participant 23

> "Informatie is nog verspreid over verschillende plekken, het lijkt te veel zwevend. … Soms werken mensen aan zaken waar al besluiten over zijn genomen, maar dat nog niet weten." [11] – participant 16

These quotes reflect growing awareness at VORM 2050 of challenges in meeting focus, information sharing, and action follow-up. It should be noted that this awareness is also present within the management team, and efforts are underway to develop a new approach to task allocation among all VORM 2050 team members.

Secondly, a clear pattern in the daily practices at VORM 2050 is the use of individually refined work routines, shaped by the organization's entrepreneurial culture. This mindset appears rooted in the broader holding, where the pragmatic "Rotterdam character" continues to influence working styles. As a result, team members often design their own systems for documentation, task management, and collaboration, drawing on personal preferences and prior experiences. Similar practices are found with tools like Excel, SharePoint, or Teams, used in ways that best fit individual workflows. While this autonomy encourages ownership and initiative, it also presents coordination challenges. The absence of shared templates, formalized roles, or standard workflows means practices become fragmented and shaped more by habit than by alignment. Without clear organizational guidance, employees tend to rely on familiar methods from earlier roles or teams, leading to isolated systems that lack interoperability. Moreover, familiar methods are often rooted in traditional construction processes, disrupting the process platform. Although steps are being taken to integrate Microsoft Project, Planner, and Teams, the real challenge lies in embedding these tools into

[10] Now we meet once every two weeks with the whole team to discuss everything, which turns the meeting into three-hour sessions, while only part of it is actually relevant for a single role.

[11] Information is still scattered across different places, it feels too fragmented. … Sometimes people work on things that decisions have already been made about, but they don't know that yet.

collective routines, especially in the fast-paced reality of project work. At the same time, incorporating enough flexibility to accommodate individual working styles also needs to be taken into account.

> "Iedereen doet het op zijn eigen manier... We hebben geen vaste afspraken over hoe we verslagen moeten maken, en omdat iedereen van een andere organisatie komt, neemt ook iedereen zijn eigen werkwijze mee." [12] – participant 8

> "Je moet ook niet te ver gaan met standaardiseren. Als ik een bepaalde taak heb dan wil ik niet behandeld worden als een leek die een stappenplan moet gaan volgen. ... Er zit dus een begrenzing aan het uitplannen, we bouwen geen Ikea kast.' [13] - participant 5

These quotations indicate that shared standards and project routines are mostly absent. Making it difficult to trace actions, ensure accountability, or onboard new colleagues efficiently. They highlight the tension between the freedom to adapt to personal working styles and the need for a set of operational routines and tools to ensure consistency and accountability in the projects.

To conclude, the findings indicate that workflow fragmentation at VORM 2050 stems primarily from the absence of shared coordination practices**,** not a lack of effort. While employees are highly engaged, the reliance on personal systems, informal communication, and varying documentation styles leads to inconsistencies and coordination difficulties. The lack of standardized templates or clear follow-up routines means that valuable insights and actions can get lost, resulting in duplicated work**,** unclear responsibilities, and difficulty onboarding new team members. Organizational practices such as individualized documentation tools (like OneNote or Excel) and informal evaluations are common, but without a more formalized system, these practices fail to facilitate effective collaboration.

4.5 Workshop-based reflection

Building on the interview insights, the focus group workshop highlighted key tensions within VORM 2050's transition to industrialized construction, particularly between the long-term product vision and the short-term demands of project delivery.

4.5.1 Organizational change capacity

During the first workshop, one of the most prominent tensions was the imbalance between strategic ambition and organizational capacity. While previous interviews had already indicated a degree of pressure coming from VORM 2050's broad innovation goals, the workshop made this tension more tangible. Participants openly talked about whether the organization should prioritize the development of the 2050 product concept or focus on delivering current projects. The nature of a project strongly influences whether it fits the 2050 concept, but this alignment is currently lacking according to the participants. This discussion highlighted a deeper issue:

[12] Everyone does it in their own way... We don't have fixed agreements on how to write meeting notes, and since everyone comes from different organizations, they bring their own working methods.

[13] You shouldn't go too far with standardization either. If I have a certain task, I don't want to be treated like a layperson who has to follow a fully step-by-step plan. … There's a limit to how much you can plan out, we're not building an IKEA cabinet.

the lack of strategic prioritization. One participant noted, *"Je stuurt mensen op pad die niet weten waar ze naartoe moeten lopen,"* [14] *– participant 4*. Rather than a clear guidance for balancing short-term execution with long-term development, teams often operate in a dual mode of "doing and developing," without the clarity or capacity to manage both effectively. The result is not just operational strain, but a misalignment between the organization's ambitions and its current way of working. This observation adds to the notion of organizational change capacity, suggesting that without explicit choices and focus, ambitions risk becoming unmanageable.

Building on this, the discussion in Workshop 2 centered on a more foundational question: *What exactly is the 2050 concept?* Is it a technical platform (e.g., prefab concrete, scaffold-free construction, CD20 floor slabs), a performance ambition (20% cheaper, 50% faster), or a way of working (e.g., data-driven design, standardized processes)? Participants shared varying interpretations, with some emphasizing greater flexibility and others calling for strict commitment to the technical standards. This lack of a shared definition reflects strategic ambiguity, which in turn weakens the organization's ability to prioritize. Moreover, the workshop highlighted a growing concern about the misalignment between the concept and the types of projects currently being executed. Current projects were often described as not fully suitable for the 2050 approach, yet were pursued out of necessity. One participant remarked: "*We blijven een project gedreven organisatie. Kosten wat het kost worden projecten door geduwd die eigenlijk niet in het plaatje passen."*[15] – participant 10. Lastly, participants pointed to a shrinking internal capacity to further develop the concept. While the organization's ambition remains the same, fewer team members are actively working on refining or implementing the 2050 product model. As one team member put it, "*De laatste paar maanden tikt niemand meer zijn taken af voor het 2050-gebouw."* [16] - participant 5. Others reflected that even when assigned to concept-related tasks, project demands often took priority.

In summary, the combined insights from both workshops indicate that organizational change capacity is not only constrained by available resources, but also by the absence of a shared definition of the concept, a clear project selection process, and support systems that keep long-term goals on track. Without clearer boundaries and coordination, the organization risks drifting away from its strategic ambition under the weight of daily execution pressure.

4.5.2 Role ambiguity

Similar to the interviews, the uncertainty about roles was strongly emphasized again in Workshop 1. Participants repeatedly described situations where it was unclear who was responsible for what. Tasks such as requirements management, design coordination, and verification were discussed, but ownership often remained undefined. As one participant explained, *"Ik weet soms ook niet goed bij wie ik de vraag nou kan stellen, wie is*

[14] People are being sent off without a clear sense of direction or destination.
[15] We remain a project-driven organization. Projects are pushed through at all costs, even when they don't actually fit the concept.

[16] In the past few months, no one has been ticking off their tasks for the 2050 building anymore.

verantwoordelijk voor wat?" [17] - participant 2. This uncertainty is not limited to one-off tasks, it reflects a broader structural issue where functions are not clearly described and responsibilities are not consistently assigned. Moreover, the ambiguity is also influenced by the new roles that have been introduced (e.g., technical concept developer, requirements manager) without clear definitions or deliverables. One participant noted *"Dat betekent ook dat de verantwoordelijkheden die je normaal traditioneel hebt, dat die anders worden. Dat mensen hun functie gaan combineren."* [18] - participant 5. Interestingly, some participants viewed this ambiguity as a natural byproduct of a start-up environment, part of the growing pains of developing a new way of building. The willingness to "figure it out" individually, while valuable, cannot substitute for clear organizational support.

It was observed that Workshop 2 placed greater emphasis on role ambiguity across the different disciplines, particularly concerning the shifting responsibilities between execution and development. This aligns with the findings from the interviews, which highlighted overlapping activities and blurred boundaries between VORM 2050 and its sister companies within the holding. In addition, a notable insight from the second workshop was that tasks were sometimes picked up because of personal engagement rather than role alignment. As one team member described, *"Als je naar functie X kijkt, dat is net een magneet, hij neemt veel op zich en duikt overal in. En voordat je het weet, weet hij alles omdat hij zelf dat eigenaarschap neemt. Anderen lopen hier juist van weg."* [19] – participant 10. While this initiative is admirable, it also signals a lack of formal delegation, which makes continuity and accountability difficult to sustain. In practice, roles were shaped more by project pressure than by structural intent. This also reflects a broader interpersonal mismatch observed during the workshops: some individuals proactively take initiative and 'pull the bell,' while others tend to deflect responsibility or delegate it without ownership.

Together, both workshops make clear that role ambiguity within VORM 2050 is not an isolated issue, but a systemic challenge that affects coordination, project efficiency, and collaboration on equal terms. The findings from Workshop 2 reveal that this ambiguity extends beyond internal confusion, it also plays out in unclear boundaries between departments and blurry responsibilities in project collaborations. Without clearer role definitions, decision rights, and aligned handovers, the risk is that accountability becomes personality-driven. This results in individuals taking ownership based on initiative rather than formal delegation. While this can foster creativity and innovation, such initiative needs to be supported by a certain degree of coordination to also enable organizational learning.

[17] Sometimes I honestly don't know who to direct my question to, who is responsible for what?

[18] That also means the responsibilities you would traditionally have are changing. People are starting to combine multiple functions within one role.

[19] If you look at role X, it's like a magnet, he takes on a lot and gets involved in everything. Before you know it, he knows everything because he naturally takes ownership. Others, by contrast, tend to shy away from it.

4.5.3 Workflow fragmentation

The discussion during workshop 1 made clear that fragmentation is not just a coordination issue, it reflects an absence of shared standards, knowledge flows, and clear ownership over processes. Several participants pointed to the lack of basic operational routines, such as shared templates, consistent file naming, or a common folder structure. One participant remarked: "*Een mappenstructuur is nodig op de korte termijn, samen met een documentenlijst, die zijn nog niet aanwezig.*" [20] - participant 7. This absence of tools leads teams to develop their own ways of working, creating variability between projects and lowering repeatability. Beyond tooling, participants described the breakdown of communication around decisions**,** resulting in confusion. Finally, there was little evidence of systematic feedback loops between ongoing project work and the refinement of the 2050 concept. While some participants acknowledged lessons being learned on the job, it remains a challenge to translate these into adjustments to the product platform. The limited sharing of knowledge both across projects and between projects and the concept, combined with a small group of team members holding much of the knowledge, creates the risk of knowledge silos, where information remains centralized.

Workshop 2 highlighted some signs of improvement, such as a growing awareness of the need for pinned document versions and formal planning milestones. However, most of the discussion revealed continued inconsistency, especially in the handover and coordination between teams. Several participants pointed out the lack of clear document versioning and decision points, which leads to confusion over what is current or final. One participant described searching through folders to find the status of a deliverable: *"Nu ook met het project moet ik in SO, VO, DO-mappen dingen gaan zoeken. Welke onderdelen zijn op welk onderdeel afgerond? Dit moet vastgelegd worden."* [21] - participant 5. Others described the difficulty of locking decisions and preventing endless iterations. This lack of closure causes teams to work in a continuous development loop without clear baselines, delaying handovers.

Another key insight from Workshop 2 was the impact of VORM 2050's varying role within projects. When operating as a traditional contractor, teams reported more coordination, clearer deliverables, and tighter planning. It seems that the focus remained on the core principles of construction projects; planning, budget and quality. As one participant explained: *"Bij dit project werken we nu echt naar definitieve momenten van planning, ABK. Die druk is heel anders verdeeld. Het heeft minder tijd gekost terwijl het gedetailleerder is gepland."* [22] - participant 2. In contrast, in projects where VORM 2050 acts as a developing contractor, roles are more fluid, and process boundaries become less defined. This flexibility often leads to more engineering changes, unclear scopes, and delays in planning finalization.

[20] A folder structure is needed in the short term, along with a document list, both are currently missing.

[21] Now, even with the current project, I have to search through SO, VO, and DO folders to find things. Which elements are completed in which phase? This needs to be documented.

[22] In this project, we are really working toward fixed planning milestones, like the ABK. The pressure is distributed very differently. It has taken less time, even though it has been planned in more detail.

Both workshops confirmed that workflow fragmentation is a persistent challenge at VORM 2050, driven by missing support systems, unclear responsibilities, and inconsistent documentation practices. While Workshop 1 exposed the everyday impact of fragmented tools and ad-hoc coordination, Workshop 2 showed how the degree of fragmentation varies by project role, more structured in traditional contractor roles, more fluid in developing roles.

Besides the observed organizational challenges, it should be noted that important strengths within the organization came across as well. Firstly, the strategic vision is widely supported, creating a strong foundation for alignment. Secondly, the entrepreneurial mindset of team members, while contributing to ad hoc practices, also reflects a culture of ownership, flexibility, and initiative. Finally, there is clear engagement and a willingness to learn, with many employees expressing a need for more clarity, coordination, and feedback, being not resistance to change. These qualities suggest that VORM 2050 holds the capacity to move forward. By balancing its entrepreneurial drive with clearer structures and shared routines, the organization is well positioned to realize its platform ambitions.

5. Discussion

5. Discussion

5.1 Interpretation of findings

This chapter reflects on the key findings of the research considering theoretical concepts outlined in the theoretical background. The goal is to create a dialogue between literature and empirical insights, what Dubois and Gadde (2002) describe as a hallmark of an abductive research process. The discussion is organized around three interrelated themes that emerged from the comparison between theory and practice: product platform development, organizational change, and the tensions encountered in the transition towards industrialized construction.

5.1.1 Process falling behind product

The case demonstrates a clear imbalance between advancing the technical systems and the organizational processes needed to support them. While significant progress may be made in standardizing components and architectural solutions, the evolution of process platforms, routines for coordination, decision-making, and workflow integration, often lags behind. Literature emphasizes that the success of product platforms hinges on the integration of both technical and process elements (Lessing, 2006; Jansson et al., 2014). When this balance is not achieved, organizations risk undermining the very repeatability and efficiency platform thinking offers.

This asymmetry reflects a broader industry tendency to prioritize visible technical innovations over the less tangible, but equally critical, development of organizational capabilities (Söderholm, 2010). Such emphasis reflects the previously outlined research gap: while the literature focuses largely on the technical aspects of industrialized construction, it offers limited insight into the organizational practices and internal dynamics as experienced during such transitions. The process side of platform development, such as role clarity, cross-functional coordination, and consistent documentation, tends to emerge informally and unevenly. The result is often fragmented implementation, where teams struggle to operate within a unified system, falling back on project-specific improvisations. This was also observed in the case: while significant effort was placed on developing and standardizing core building elements, organizational routines for coordination, knowledge sharing, and planning remained ad hoc, revealing a gap between technical progress and the organizational systems required to support it.

Mirroring theory and platform leadership offer useful theoretical perspectives for understanding this imbalance. Firstly, as Hall et al. (2024) describe, mirroring theory highlights the close, mutual relationship between product design and organizational structure. In construction, decomposing products into standardized subsystems is a necessary response to complexity. Yet this division into discrete subsystems can lead to fragmented responsibilities, where teams focus on isolated parts of the platform without maintaining a shared view of the overall system. Rather than creating coherence, this fragmentation risks undermining the system-level integration required for platform-based approaches. Mirroring theory underscores that product and organization shape one another in ways that are neither

linear nor predetermined. Instead, they evolve in parallel, through ongoing negotiation, adaptation, and at times, friction. What may appear as ambiguity or disorder is, in fact, an inherent part of platform development, reflecting the necessary process of aligning evolving products with evolving organizational structures.

Secondly, this tension underlines the importance of platform leadership, as described by Aksenova et al. (2021). Platform leadership involves more than setting technical direction; it requires actively aligning teams, defining the platform's scope, and bridging the gap between strategic ambition and operational execution. Without such leadership, platform efforts risk fragmentation: components may be standardized without a shared understanding of how they fit into a broader system, and platform goals may become disconnected from day-to-day practices.

Together, these perspectives demonstrate that the focus on technical platform development is more than a challenge in practice, it reflects deeper organizational dynamics. Platform-based industrialization in construction is not only about product innovation; it also demands an organizational transformation. Advancing such platforms requires leadership that ensures coordination across roles and teams, supports the development of shared routines, and keeps platform ambitions connected to the realities of daily work.

5.1.2 Changing by doing

While the previous section outlined structural imbalances in platform development, this second insight shifts the focus to how organizational change actually unfolds in daily practice. While traditional Organizational Change Management (OCM) frameworks emphasize structured, top-down approaches, the findings in this study point to a more emergent, practice-based process. In the observed case, change unfolded through routines, improvisation, and local adaptation. This shifted the focus of the study from formal OCM practices toward broader organizational practices, in line with scholars such as Jansson (2013) and Schatzki (2002), who argue that change is enacted through socially embedded actions rather than implemented through predefined steps.

In the case context, organizational routines were still forming, roles remained fluid, and team boundaries were shifting. Although the ambition to industrialize was clearly stated, the organizational response proved to be non-linear and, at times, fragmented. This challenges the direct applicability of conventional change models in complex, project-based settings and highlights the need for more flexible and situated approaches to transition. While the emergent nature of change offered valuable learning opportunities, the findings also suggest that some applying OCM tools, such as role clarification, shared communication routines, or adjusted workload distribution, could have provided greater support throughout the process. This emergent nature of change helps explain why tensions persist and must be navigated rather than resolved, which is further explored in the next section.

5.1.3 Navigating product platform tensions

Building on the previous two insights, the emergence of persistent tensions reveals a deeper layer of complexity in the transition of construction companies. These include tensions between standardization and flexibility, long-term vision and short-term project demands, and control versus adaptation. Rather than incidental problems to be solved, these are ongoing dynamics that lie at the heart of product platform development. As described by Smith and Lewis (2011), paradoxes are characterized by elements that are contradictory yet interrelated, existing simultaneously and persisting over time.

The ambition to develop standardized, scalable solutions through platform development inherently clashes with the realities of project-based work. While platforms aim to deliver consistency and efficiency through repetition and reuse, construction continues to demand responsiveness to site-specific conditions and customer needs. These tensions surfaced throughout this research, particularly in the polarity mapping workshop, where participants discussed the difficulty of balancing platform goals with project realities. Rather than viewing such tensions as disruptions, paradox theory encourages interpreting them as normal and even productive features of innovation.

This aligns with Smith and Lewis's (2011) notion of dynamic equilibrium, which suggests that organizations do not resolve paradoxes, but engage with them over time by shifting, adjusting, and rebalancing. In the case study, platform development required ongoing trade-offs: for instance, between strict standardization and the need for technical exceptions, or between centralized guidance and local project autonomy. These adaptations did not follow a linear, pre-defined path but reflected an ongoing attempt to balance competing demands in practice, what Farjoun (2010) would describe as finding stability through change and vice versa.

From this view, product platform development in construction is not simply about introducing a standardized system but about navigating the push-and-pull between competing logics. This illustrates Hall et al.'s (2023) idea of "mirror-breaking", where traditional alignments between organizational roles and product architecture are disrupted. In the observed case, team boundaries, responsibilities, and communication flows often mirrored the modular structure of the platform. Yet, as the platform evolved, these mirroring structures became misaligned, leading to redefinition of roles, coordination routines, and strategic direction. The organization found itself in an ambiguous state, not yet fully structured around the platform, but also no longer aligned with traditional ways of working.

Here, paradox theory helps explain why this ambiguity is not a sign of failure, but a defining feature of transition. As Luscher and Lewis (2008) and Hahn and Knight (2021) argue, paradoxes are both embedded in organizational systems and enacted through daily sensemaking. Participants in the workshop reflected on these tensions not as distant strategy issues, but as lived realities, struggling to balance short-term delivery with long-term ambitions. This supports the view of paradox as not just structural but also relational and emotional (Pradies et al., 2021), requiring a willingness to engage with discomfort and uncertainty over time.

These findings suggest that the value of platforms lies not only in their technical structure but also in their ability to surface and structure organizational tensions. Rather than removing all friction, leadership should recognize which tensions can drive learning and adaptation. Paradox theory thus provides a powerful lens for understanding the non-linear, situated, and evolving nature of industrialized construction.

5.2 Limitations

Firstly, the research was conducted as a single case study focused solely on VORM 2050. While this allowed for an in-depth and context-rich analysis, it limits the ability to compare findings across different organizational settings. Although the insights derived are grounded in recognizable sector-wide dynamics and therefore have a certain degree of transferability, the analysis would have been strengthened by including multiple organizations.

Secondly, the workshop setting was constrained by some practical factors. Participation was limited to a relatively small group, and the discussion was largely shaped by more outspoken team members, which may have influenced the outcomes and limited the diversity of perspectives shared.

The limited timeframe of the internship also played a role in shaping the scope and depth of the research. Given the ongoing nature of VORM 2050's transition, the study focused primarily on current organizational dynamics rather than offering a longitudinal or retrospective view. As such, changes over time or the influence of past developments were not fully captured. This is particularly relevant given that, aside from a few individuals, most team members at VORM 2050 had only recently joined the organization.

In terms of data collection, there is the potential for interview bias, as participants may have framed their responses in ways they thought were expected or selectively emphasized certain aspects of their experience. Additionally, my dual role as both intern and researcher may have influenced the data. While this position provided valuable access and insight, it also meant I was not fully seen as an external observer, which could have impacted how openly some issues were discussed.

Lastly, the study included limited input from external partners and advisors, particularly those outside VORM 2050. While efforts were made to include a range of voices, the perspective of the broader network could have enriched the findings and offered a better understanding of the organizational environment.

Despite these limitations, the study offers valuable insights into the organizational dynamics of transitioning toward industrialized construction, and it provides a foundation for further research and practical reflection.

6. Conclusion

6. Conclusion

6.1 Answers to research questions

SQ1: What organizational practices shape the transition of construction companies from traditional to industrialized construction?

The transition from traditional to industrialized construction is shaped not by a single strategic shift, but by everyday organizational practices. This process is influenced by how construction firms balance long-term ambition with operational demands, navigate emerging roles, and coordinate work across teams. The findings from this study reveal that change is not implemented through a fixed roadmap, but through day-to-day improvisations, trade-offs, and coping strategies. These dynamics are reflected in three recurring dimensions: organizational change capacity, role ambiguity, and workflow fragmentation. Key practices that emerged include:

1. Balancing project delivery and concept development

Simultaneously executing multiple projects while developing the standardized concept, creating significant pressure on resources and teamwork. This development also requires clarity on what the concept entails: Is it focused solely on the technical platform, the vision of building faster and cheaper, or does it include the way of working, i.e., the process platform? Moreover, it raises the question of when deviations from the concept are allowed within projects and what takes priority under pressure.

2. Operating through hybrid roles

The transition to industrialized construction has resulted in hybrid role responsibilities, where team members take on multiple tasks across different areas. While this allows for flexibility, it creates uncertainty in task ownership and coordination issues. With roles overlapping and lacking clear definitions, it becomes difficult to determine who is responsible for what, leading to confusion and inefficiencies in project execution.

3. Relying on informal, non-standardized workflows

The absence of standardized workflows leads to reliance on informal communication and individually developed routines, often rooted in traditional construction practices. While this allows for personal flexibility, it reduces consistency and efficiency across projects. It also limits knowledge sharing, increasing the risk of silos and hindering organizational learning.

4. Managing capacity reactively across projects

Rather than planning capacity across teams in a coordinated way, workload is often managed on a case-by-case basis, depending on which project is most urgent. This means that time for developing the concept is frequently pushed aside by day-to-day project demands. Because there are no shared systems to track who is working on what, or to reserve time for concept development, it becomes difficult to maintain continuity. As a

result, ideas and lessons learned in one project are not always shared or followed up in others. This makes it harder to build on previous experiences and improve the platform over time.

5. Overlooking core construction principles

In the effort to innovate and develop the 2050 concept, core project elements like budget control, planning reliability, and quality checks sometimes get less attention. Teams are often focused on figuring out new ways of working or applying the concept within tight timelines, which can make it harder to stick to the basics of construction delivery.

In summary, these organizational practices demonstrate how the transition to industrialized construction is shaped by daily trade-offs between innovation and delivery, and highlight the need for new routines.

SQ2: How do these practices interact with the principles of platform-based industrialized construction?

The organizational practices observed in this study largely act as constraints on the effective implementation of platform-based industrialized construction. While key principles, such as process standardization, integration of technical and process platforms, and long-term collaboration, are present in strategic intent, they are not yet consistently realized in day-to-day operations.

Firstly, the absence of standardized workflows is one of the primary barriers to implementing industrialized construction effectively. This lack of standardization is further increased by role ambiguity, where unclear responsibilities and hybrid roles contribute to inconsistent processes and practices across the organization. The organizational practices observed demonstrate that the need for repeatability and systematic processes**,** key elements of industrialized construction, is not being fully realized. Moreover, the core principles of construction, such as price, quality, and planning, have also become less centralized during the transition, which undermines the ability to deliver consistent outcomes and meet foundational project goals.

Secondly, the integration of technical and process platforms requires clear alignment between product and process development, yet both capacity strains and role ambiguity significantly hinder this alignment. The transition to industrialized construction has placed considerable pressure on internal resources, and hybrid roles have further complicated decision-making and coordination across departments. This misalignment between the technical aspects of product development (e.g., prefab components) and the supporting processes (e.g., coordination, planning, logistics) has created barriers to smooth integration. As observed, these challenges stem from unclear role definitions, fragmented workflows, and inconsistent coordination, making it essential for companies to implement a more structured approach to managing both technical and process platforms to bridge the gap.

Thirdly, the transition to industrialized construction depends on long-term collaboration with a stable network of strategic partners. These partnerships are essential for fostering innovation, streamlining coordination, and supporting the continuous development of the product platform. However, managing such relationships introduces complexity, as it requires balancing the use of existing capabilities with the joint exploration of new solutions. Despite the importance of innovation, the lack of standardized processes and ongoing capacity constraints can hinder the development of long-term partnerships. When internal communication, role clarity, and decision-making are underdeveloped, external collaboration also becomes fragmented. This creates the risk of undermining trust needed for successful partnerships.

In summary, the current organizational practices reveal a clear gap between the ambition of industrialized construction and the realities of its implementation. These practices interact with platform principles by exposing the tensions between flexibility and structure, ambition and capacity, innovation and control.

SQ3: Which practical recommendations can support construction companies in developing their product platform and managing their transition?

The transition from traditional to industrialized construction reveals a range of organizational challenges that require practical interventions. The figure below presents a set of recommendations that address the observed misalignments with industrialization principles and help construction companies navigate these complexities. They are organized by relevance to different organizational levels, consisting of strategic, team-based, or individual, depending on where they are most applicable in practice. As indicated, many recommendations involve multiple levels, such as strategic actions that rely on input and engagement from team members. The main themes are discussed in more detail in the following section.

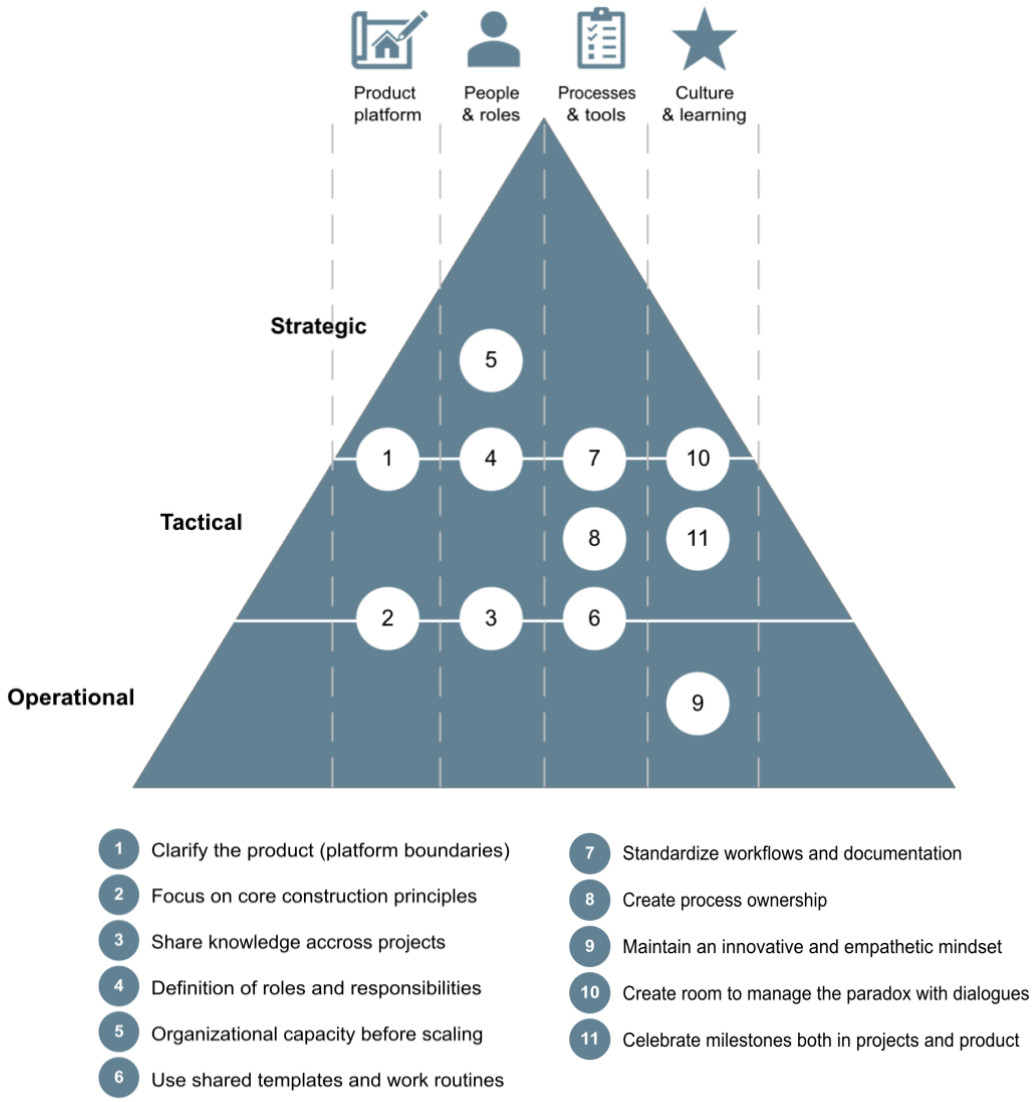


Figure 10: overview of practical recommendations across organizational levels (source: own work)

1. Clarify and operationalize the product

A significant challenge is the lack of a shared definition of the product concept, whether it relates to technical systems, a working method, or performance outcomes. While a single format is not required, it is crucial to communicate the process clearly and systematically. Standardization, thorough planning, and a complete process narrative are essential for coherence. To address this, companies could create a reference document or project handbook outlining the concept's scope, objectives, technical standards, and workflows.

2. Strengthen organizational capacity before scaling

Companies in transition face the challenge of advancing innovation while simultaneously executing complex projects. To counter this, it is recommended to prioritize and phase the development of the product concept, allowing time for internal routines and capabilities to mature. Dedicated capacity should be allocated to concept refinement, separated from immediate project demands. To address this, it would be beneficial to appoint someone

who maintains a strategic, end-to-end overview of all processes from a business-oriented perspective, independent from the technical development itself.

3. Clarify roles, responsibilities, and workflows

Clear role definitions could be formalized, particularly for hybrid functions such as concept developers or requirements managers. In parallel, protocols for project handovers, both internal and external, should be introduced to ensure continuity and reduce miscommunication. Moreover, the reliance on individually developed tools and informal coordination practices are best to be avoided. Companies should invest in shared templates, folder structures, and project documentation protocols. It would be beneficial if business digitalization tools include version control and decision tracking to maintain key deliverables. A centralized knowledge base for lessons learned will support feedback loops, foster continuous improvement, and enhance alignment across projects.

6. Create room to manage paradoxes

Tensions between flexibility and standardization, control and creativity, long-term vision and project urgency, are not problems to be solved, but paradoxes to be managed. Emphasizing not only the processes but also how employees interact with each other and share their experiences within the projects is crucial in navigating these tensions. Tools like structured dialogue sessions can help teams surface these tensions and manage them collaboratively, creating opportunities for open communication and knowledge exchange. Recognizing paradoxes as a source of learning, rather than obstacles, can help align different perspectives and maintain strategic focus without dismissing operational reality.

7. Tangible milestones and celebrations

For organizations undergoing the transition to industrialized construction, it is essential to set tangible milestones throughout both project execution and concept development. Given the complexity of this transition, achievable and visible milestones are needed maintain focus and provide a sense of progress. Additionally, it is essential to celebrate these milestones as they are reached, not only within the team but also with key external stakeholders. For instance, organizing an event or gathering with the partner network can help foster a sense of shared achievement, knowledge sharing, and exchange of experiences.

The practical recommendations outlined above emphasize the need for clarity, coordination, and collective engagement, all essential for embedding a scalable, repeatable platform-based construction model. Rather than focusing solely on technical progress, these steps aim to build the organizational infrastructure required for successful industrialization: roles, routines, tools, and shared understanding. Only when internal conditions are better aligned can the overall ambition of delivering affordable housing at scale be fulfilled.

RQ: What is the role of organizational practices during product platform development in a company's transition towards industrialized construction?

This research explores the role of organizational practices during product platform development in the context of a company's transition toward industrialized construction. Based on the case of VORM 2050, it becomes clear that this role is not supportive, but foundational. While product platforms offer a structured means to increase efficiency, repeatability, and scalability through standardized technical and process elements, their successful implementation depends on how an organization functions in practice.

Organizational practices, defined as the recurring routines, interactions, and decision-making behaviors that structure daily work, serve as the means through which platform ambitions are translated into action. In the case of VORM 2050, these practices both enable and constrain the transition. On the one hand, the organization demonstrates a strong innovation drive and commitment to change. On the other, it faces significant challenges such as fragmented workflows, role ambiguity, and the simultaneous pressure to execute projects while refining the platform. These challenges are not isolated obstacles, but structural tensions that reflect deeper paradoxes embedded in the shift toward industrialization, such as standardization versus flexibility, long-term vision versus short-term delivery, and centralized control versus entrepreneurial autonomy.

Rather than viewing these tensions as problems to be solved, this thesis adopts paradox theory to understand them as persistent dualities that must be navigated collectively. The findings show that organizational practices are the primary mechanism through which these tensions are managed. Whether through informal coordination, ad hoc decision-making, or emerging learning routines, it is in everyday practice that the success of the platform is shaped.

Therefore, the role of organizational practices in product platform development is threefold:

1. Enabling system: providing clarity in roles, workflows, and handovers to support process repeatability;
2. Mediating tension: facilitating the navigation of strategic paradoxes through shared reflection and adaptive routines;
3. Anchoring change: embedding the platform not just in technical systems, but in how people work, collaborate, and make decisions.

In conclusion, the transition to industrialized construction is not simply a technical or strategic shift, it is a deeply organizational one. Product platforms will only scale if the practices that support them are actively developed, aligned, and continuously improved. The findings of this thesis highlight that without addressing the human and organizational dimensions of change, platform logic remains idealistic. Organizational practices are not just supportive of this transition, they are central to making it happen.

6.2 Recommendations

6.2.1 For practice

This research does not offer a guideline for industrialized construction, nor does it present a prescriptive model for platform development. Instead, its contribution lies in revealing the

organizational dynamics, including routines, ambiguities, and tensions, that shape the everyday realities of a construction company like VORM 2050 during a period of transition. What emerges is not the need for more ambition, but for organizational alignment that is as structured as the technical innovations themselves. While standardized floor plans and prefab bathrooms are easy to visualize, the practices that enable them, how decisions are made, how roles are defined, how knowledge is shared, remain less visible, but no less essential. This study reveals that product platforms cannot function without also investing in the organizational practices that support it. To make such platforms truly work, they must be anchored in everyday collaboration and shaped by shared learning over time. This is not only relevant for VORM 2050, but also serves as a broader call for organizations in transition to approach tensions not as problems to solve, but as realities to navigate together. This thesis encourages firms to see these tensions as a natural part of change, something to engage with through integrated systems and reflective practices. What ultimately matters is whether the organization can recognize these tensions, make them discussable, and develop routines that help teams live and work with them productively.

6.2.2 For further research

The contribution of this thesis lies in bridging the often-separated domains of technical product innovation and organizational behavior in construction. Future research could build on this foundation by exploring how other firms experience and navigate similar tensions. In addition, it would be valuable to experiment with interventions that make organizational paradoxes more actionable in practice.

One promising direction is the development of practical tools and facilitation methods rooted in paradox theory. The use of polarity maps in this study proved effective in indicating competing demands in team settings. More work is needed to refine such tools and study their long-term impact on organizational learning and alignment under the industrialized context.

Another area for exploration is the interplay between the internal organization and external collaboration. While this study focused on the organizational dynamics within the organization, the success of industrialized construction depends heavily on relationships with partners, clients, and suppliers. Research that extends the lens to these relationships could result in important insights into how platform thinking can be coordinated across organizational boundaries.

Finally, more longitudinal studies are needed to understand how transitions like VORM 2050's develop over time. Organizational change is not a one-off event but a joint, iterative process. By following organizations as they evolve, through leadership transitions, project cycles, and market shifts, researchers can better capture how industrialization becomes not just a strategy, but an embedded way of working.

7. Reflection

7. Reflection

7.1 Research topic within master

At the start of my graduation period, my main interest lay in the digitalization of the construction industry. I was particularly interested in the human factor involved in implementing new technologies, especially within a conservative and fragmented sector like construction. As my research progressed, the topic of industrialized construction emerged through the selection of my internship at VORM 2050. This innovative way of building and working, combined with exploring organizational identity through the lens of change management literature, aligns closely with the core of the Management in the Built Environment (MBE) master track. Many aspects of managing the built environment came together in my thesis, such as aligning diverse stakeholder objectives, structuring workflows, and managing design and construction processes. By focusing on organizational change and using an abductive case study approach, I was able to apply theoretical frameworks in a practical setting and address the challenges VORM 2050 is facing as a construction company in transition. This points out that the built environment is not just about physical construction, but about complex organizational and managerial processes behind it. Eventually, this thesis enabled me to integrate technical and organizational perspectives, corresponding with the interdisciplinary nature of the MBE track.

7.2 Research approach

At the start of this thesis, I aimed to combine both qualitative and quantitative research methods to broaden my methodological knowledge. I initially planned to do this through interviews and a social network analysis, mainly driven by curiosity, as it was a method I had no prior experience with. However, as the research progressed, it became clear that the social network analysis developed into a separate track and did not provide valuable input for answering my research question.

After being accepted as an intern at VORM 2050, the focus of my thesis shifted significantly. I decided to move away from the initial concept of digitalization and instead concentrate on a single case study, fully centered on the organizational practices observed within VORM 2050. My aim was to create a triangulation between semi-structured interviews, organizational ethnography, and a theoretical lens. Rather than beginning with an extensive literature review, I adopted an abductive approach, starting with the organizational phenomena as they unfolded in practice and only later returning to theory. This method suited me well, as it allowed me to fully engage myself in the organization's daily dynamics before stepping back to reflect analytically. The final approach combined three key components: interviews, ethnographic observations, and a collective reflection workshop using a polarity map. Interpreting the large amount of data took time, especially when identifying core organizational themes.

In short, focusing deeply on the case, engaging with almost the entire team through interviews, attending daily meetings, and frequently discussing insights with team members provided a strong foundation for my thesis. This research process not only made the work more solid but also enjoyable and engaging for me.

7.3 Research process

The P1 phase was, obviously, marked by uncertainty, especially without an internship to connect theory in practice. I initially followed a deductive approach, aiming to apply abstract concepts like digitalization to the construction sector. However, its broad and technical nature made it difficult to translate into a clear research focus. After my P2 presentation, a follow-up meeting with my supervisors questioned some of the foundational ideas, particularly the role of information asymmetry and the feasibility of a social network analysis (SNA). These concepts, out not to connect to the real issues VORM 2050 was facing.

Starting my internship in February was an exciting moment for me. It was interesting to see similarities from the literature on product platforms and I was welcomed with enthusiasm and support from the VORM 2050 team. People made time for interviews, shared internal documents, and were eager to reflect on their own experiences. A remarkable point was the presentation to the management team. I wasn't sure how it would be received, but it was appreciated to see how their strategic intentions sometimes clashed with day-to-day realities. That moment gave me confidence and helped me identify the red thread in my story.

In this period, I also began to see a disconnect between VORM 2050's original research request around digital technologies, it became clear that digitalization was more of a long-term ambition. That realization allowed me to let go of digitalization as the core theme. Instead, I focused on industrialization and organizational change, both of which turned out to reflect deeply with the case. Looking back, I spent quite a long time navigating and redefining the scope of my research, but eventually, everything came together through those two main themes. This not only aligned with the reality at VORM 2050 but also with the academic guidance from both of my supervisors.

The guidance from my TU Delft supervisors really helped me in this transition. I wasn't sure what kind of support and guidance I needed, but I'm grateful for the balance they offered. Both provided me with sharp theoretical perspectives from their own academic backgrounds. One was focusing more on content and introducing innovative ideas, while the other supported me in shaping the thesis in a more practical and reflective way. This complementary guidance made me feel supported. What I found more difficult was the number of people involved in the process. With two TU supervisors, two internship supervisors, a supervisor from another VORM department and input from VORM 2050's senior management, there were many different perspectives, each valid, but sometimes conflicting. It wasn't always easy to manage these expectations, but it worked out well.

In the end, the positive feedback, conversations with colleagues and supervisors, and the collaborative mindset of those around me really helped not going through the process alone.

7.4 Academic and societal value

Looking back on the initial ambitions formulated in the introduction, this thesis has indeed added value on both academic and societal levels. Academically, the thesis addressed a notable gap in existing literature by shifting attention from the technical and strategic layers of industrialized construction toward the organizational realities that organizations in transition

are undergoing. While the theoretical background focused more on concepts like product standardization, the empirical research showed that these transitions are ultimately shaped by less tangible dynamics, such as routines, informal communication, and evolving roles. By embedding paradox theory and practice-based change perspectives into a construction context, the thesis not only operationalized abstract frameworks but also contributed to a more rounded understanding of how tensions are navigated in practice.

Societally, the Dutch housing shortage, coupled with rising sustainability demands, necessitates faster and more scalable construction models. However, this study showed that technical solutions alone are not enough. Without organizational alignment and learning mechanisms, innovations risk being hindered. By capturing how a company like VORM 2050 is experimenting with new ways of building, and where it currently struggles, the thesis contributes insights that could support more effective implementation of industrialized practices across the sector.

7.5. Personal reflection

During this thesis, I improved my qualitative research skills, particularly in conducting and analyzing interviews. I learned how to guide conversations without influencing participants and how to identify broader organizational patterns from individual perspectives. Applying an abductive case study allowed me to move between theory and practice, a process I found especially valuable. I've always been interested in connecting academic insights with real-world challenges, particularly in the construction industry, where practical project outcomes often come first. This thesis made that connection tangible by how the theory of paradox can be found in the day-to-day practices of the case. With a large amount of data collected through interviews and observations, I also developed my ability to narrow down key insights the vast input.

Looking back at this graduation project, one of the most significant lessons was learning to take full responsibility for the process, from setting the direction to managing deadlines and adjusting the plan along the way. Having mostly worked in teams before, working independently on a topic I was deeply engaged in was both challenging and rewarding. It pushed me to structure my work realistically, stay flexible within an iterative process, and put in the time and effort needed to dive into the material. This experience taught me not only how to manage a complex project on my own, but also how to stay motivated and building trust throughout.

8. References

8. References

Aapaoja, A., & Haapasalo, H. (2014). The challenges of standardization of products and processes in construction. In Proceedings of the 22nd Annual Conference of the International Group for Lean (pp. 983-993).

ABF Research, 2019. Primos 2019: Prognose van bevolking, huishoudens en woningbehoefte 2018–2050.

Aksenova, G., & Oti-Sarpong, K. (2024). Beyond "platformania" in the construction sector: Conceptualisations and implications of product platformisation in the UK. Construction Management and Economics, 42(3), 229-250. https://doi.org/10.1080/01446193.2023.2259015

Aldossari, K. M., Lines, B. C., Smithwick, J. B., Hurtado, K. C., & Sullivan, K. T. (2023). Alternative project delivery method adoption in the AEC industry: An organizational change perspective. *International Journal of Construction Education and Research*, *19*(2), 150-165. https://doi.org/10.1080/15578771.2021.2013997

Attaran, M. (2000). Why does reengineering fail? A practical guide for successful implementation. Journal of Management Development, 19(9), 794–801. https://doi.org/10.1108/02621710010378237

Barlow, J. (1999). From craft production to mass customisation: innovation requirements for the UK housebuilding industry. Housing Studies, 14(1), 23–42. https://doi.org/10.1080/02673039982984

Barlow, J., Childerhouse, P., Gann, D., Hong-Minh, S., Naim, M., & Ozaki, R. (2003). Choice and delivery in housebuilding: Lessons from Japan for UK housebuilders. *Building Research & Information*, 31(2), 134–145. https://doi.org/10.1080/09613210302003

Bildsten, L., Björnfot, A., & Sandberg, E. (2010). Value-driven vs. market-driven purchasing of kitchen cabinets. In Annual Conference of the International Group for Lean Construction: 14/07/2010-16/07/2010 (pp. 202-211). Technion-Israel Institute of Technology.

Björnfot, A., & Sardén, Y. (2006). Prefabrication: a lean strategy for value generation in construction. In Annual Conference of the International Group for Lean Construction: 25/07/2006-27/07/2006 (pp. 265-277). Catholic University of Chile, School of Engineering.

Björnfot, A. & Stehn, L. 2007. Value delivery through product offers: a lean leap in multistorey timber housing construction. Lean Construction Journal, 3, 33-45.

Blaikie, N., & Priest, J. (2019). Designing social research: The logic of anticipation. John Wiley & Sons.

Burati, J. L., Jr., & Oswald, T. H. (1993). Implementing TQM in engineering and construction. Journal of Management in Engineering, 9(4), 456–470.

Burnes, B. (2009). Managing Change, Prentice-Hall, London.

CBS Statistics Netherlands, 2021. Voorraad woningen; standen en mutaties vanaf 1921, 5 January 2025, from CBS StatLine website: https://opendata.cbs.nl/#/CBS/nl/dataset/82235NED/table?dl=4A213

CIB 1965 Towards Industrialised Building. The third CIB Congress, 1965 Copenhagen. International Council for Building Research, Studies and Documentation – CIB.

Dallasega, P., Rauch, E., & Linder, C. (2018). Industry 4.0 as an enabler of proximity for construction supply chains: A systematic literature review. Computers in industry, 99, 205-225. https://doi.org/10.1016/j.compind.2018.03.039

Demirkesen, S., & Tezel, A. (2022). Investigating major challenges for industry 4.0 adoption among construction companies. Engineering, Construction and Architectural Management, 29(3), 1470-1503. https://doi.org/10.1108/ECAM-12-2020-1059

Dubois, A., & Gadde, L. E. (2002). Systematic combining: an abductive approach to case research. *Journal of business research*, *55*(7), 553-560. https://doi.org/10.1016/S0148-2963(00)00195-8

Erkama, N. (2010). Power and resistance in a multinational organization: Discursive struggles over organizational restructuring. Scandinavian journal of management, 26(2), 151-165. https://doi.org/10.1016/j.scaman.2010.02.002

Farjoun, M. (2010). Beyond dualism: Stability and change as a duality. Academy of management review, 35(2), 202-225. http://www.jstor.com/stable/25682409

Fan, J., Chen, L., & Chen, K. (2024). Digitalizing Industrialized Construction Projects: Status Quo and Future Development. Applied Sciences, 14(13), 5456. https://doi.org/10.3390/app14135456

Gann, D. M. 1996. Construction as a manufacturing process? Similarities and differences between industrialized housing and car production in Japan. Construction Management & Economics, 14, 437-450. https://doi.org/10.1080/014461996373304

Gann, D. M., & Salter, A. J. (2000). Innovation in project-based, service-enhanced firms: The construction of complex products and systems. Research Policy, 29(7-8), 955–972. https://doi.org/10.1016/S0048-7333(00)00114-1

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013a). Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organizational research methods*, *16*(1), 15-31. https://doi.org/10.1177/1094428112452151

Gioia, D. A., Patvardhan, S. D., Hamilton, A. L., & Corley, K. G. (2013b). Organizational identity formation and change. *Academy of Management annals*, *7*(1), 123-193. http://dx.doi.org/10.1080/19416520.2013.762225

Greco, A., & Long, T. B. (2022). Towards Sustainable Cities and Communities: Paradoxes of Inclusive Social Housing Strategies. In World Scientific Encyclopedia of Business Sustainability, Ethics and Entrepreneurship (pp. 113-135). https://doi.org/10.1142/12405-vol2

Greco, A., & Lüscher, L. (2025). [Review of the book *Navigating Leadership Paradox: Engaging Paradoxical Thinking in Practice*, by R. K. Nielsen, F. Béfort, T. D. Henriksen, A.-M. Hjalager, & D. B. Lyndgaard]. *Academy of Management Learning & Education*.

Hahn, T., & Knight, E. (2021). The ontology of organizational paradox: A quantum approach. Academy of Management Review, 46(2), 362-384. https://doi.org/10.5465/amr.2018.0408

Hall, D. M., Whyte, J. K., & Lessing, J. (2020). Mirror-breaking strategies to enable digital manufacturing in Silicon Valley construction firms: a comparative case study. Construction management and economics, 38(4), 322-339. https://doi.org/10.1080/01446193.2019.1656814

Hampson, K. D., Kraatz, J. A., & Sanchez, A. X. (2014). The global construction industry and R&D. In R&D investment and impact in the global construction industry (pp. 4-23). Routledge.

Hasan, N., Rana, R. U., Chowdhury, S., Dola, A. J., & Rony, M. K. K. (2021). Ethical considerations in research. *Journal of Nursing Research, Patient Safety and Practise (JNRPSP)*, *1*(01), 1-4.

Jacobsen, A., de Miranda Azevedo, R., Juty, N., Batista, D., Coles, S., Cornet, R., ... & Schultes, E. (2020). FAIR principles: interpretations and implementation considerations. *Data intelligence*, *2*(1-2), 10-29.

Jansson, G. (2010). Supporting the design phase of industrialised house building: Exploring organisational issues. Jönköping University.

Jansson, N. (2013). Organizational change as practice: A critical analysis. Journal of organizational change management, 26(6), 1003-1019. https://doi.org/10.1108/JOCM-09-2012-0152

Jansson, G., Johnsson, H., & Engström, D. (2014). Platform use in systems building. Construction management and economics, 32(1-2), 70-82. https://doi.org/10.1080/01446193.2013.793376

Jay, J. (2013). Navigating paradox as a mechanism of change and innovation in hybrid organizations. Academy of management journal, 56(1), 137-159. https://www.jstor.org/stable/23414348

Jensen, P., Hamon, E., & Olofsson, T. (2009). Product development through lean design and modularization principles. Proceedings of the 17th Annual Conference of the International Group for Lean Construction, Taiwan, 487–496.

Jones, K., Mosca, L., Whyte, J., Davies, A., & Glass, J. (2022). Addressing specialization and fragmentation: product platform development in construction consultancy firms. Construction management and economics, 40(11-12), 918-933. https://doi.org/10.1080/01446193.2021.1983187

Jonkman, A., Meijer, R., & Hartmann, T. (2022). Land for housing: Quantitative targets and qualitative ambitions in Dutch housing development. Land Use Policy, 114, 105957. https://doi.org/10.1016/j.landusepol.2021.105957

Kauppinen, L., Annunen, P., & Haapasalo, H. (2024). Systematic literature review of themes and definitions of industrialized construction. Smart and Sustainable Built Environment. https://doi.org/10.1108/SASBE-06-2024-0224

Klein Woolthuis, R. J. (2010). Sustainable entrepreneurship in the Dutch construction industry. Sustainability, 2(2), 505-523. https://doi.org/10.3390/su2020505

Smith, W. K., & Lewis, M. W. (2011). Toward a theory of paradox: A dynamic equilibrium model of organizing. Academy of management Review, 36(2), 381-403. https://www.jstor.org/stable/41318006

Lessing, J. (2006). Industrialised house-building: Concept and processes. Department of Construction Sciences, Division of Design Methodology, Lund University.

Lessing, J. (2015). Industrialised House-Building-Conceptual orientation and strategic perspectives.

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

Lines, B. C., & Smithwick, J. B. (2019). Best practices for organizational change management within electrical contractors. International Journal of Construction Education and Research, 15(2), 136159. https://doi.org/10.1080/15578771.2018.1479723

Luscher, L. S., Lewis, M., & Ingram, A. (2006). The social construction of organizational change paradoxes. Journal of Organizational Change Management, 19(4), 491-502. https://doi.org/10.1108/09534810610676680

Lüscher, L. S., & Lewis, M. W. (2008). Organizational change and managerial sensemaking: Working through paradox. Academy of management Journal, 51(2), 221-240. https://www.jstor.org/stable/20159506

Malmgren, L., Jensen, P., & Olofsson, T. (2011). Product modeling of configurable building systems: A case study. Journal of Information Technology in Construction (ITcon), 15, 354–368.

Maskuriy, R., Selamat, A., Ali, K. N., Maresova, P., & Krejcar, O. (2019). Industry 4.0 for the construction industry—how ready is the industry?. Applied Sciences, 9(14), 2819. http://dx.doi.org/10.3390/app9142819

Maxwell, D. (2016). Platforms for industrialised construction–lessons from Sweden. In *International Conference of the Architectural Science Association 2016*. The University of Adelaide.

Meyer, M. H., & Lehnerd, A. P. (1997). The power of product platforms: Building value and cost leadership. Free Press.

Migliaccio, G. C., Gibson, J., . G. E., & O'Connor, J. T. (2008). Changing project delivery strategy: An implementation framework. Public Works Management & Policy, 12(3), 483–502. http://dx.doi.org/10.1177/1087724X07311805

Pettigrew, A. (1985). The Awakening Giant: Continuity and change in Imperial Chemical Industries Basil Blackwell. *New York*.

Persson, S., Malmgren, L. & Johnsson, H. 2009. Information management in industrial housing design and manufacture. International Journal of IT in Architecture, Engineering and Construction, 14, 110-122.

Pradies, C., Aust, I., Bednarek, R., Brandl, J., Carmine, S., Cheal, J., ... & Keller, J. (2021). The lived experience of paradox: How individuals navigate tensions during the pandemic crisis. Journal of Management Inquiry, 30(2), 154-167. https://doi.org/10.1177/1056492620986874

Qi, B., Razkenari, M., Costin, A., Kibert, C., & Fu, M. (2021). A systematic review of emerging technologies in industrialized construction. Journal of building engineering, 39, 102265. https://doi.org/10.1016/j.jobe.2021.102265

Renz, A., & Zafra Solas, M. (2016). Shaping the future of construction a breakthrough in mindset and technology. World Economic Forum, (pp. 11-16).

Robertson, D. & Ulrich, K. 1998. Platform product development. Sloan Management Review, 39, 19-31.

Roy, R., Low, M., & Waller, J. (2003). Documentation, standardization and improvement of the construction process in house building. Construction Management and Economics, 21(1), 57–67. https://doi.org/10.1080/0144619042000287787

Schatzki, T.R. (2002), "Social science in society", Inquiry, Vol. 45 No. 1, pp. 119-138. https://doi.org/10.1080/002017402753556652

Söderholm, N. (2010). The building system as a strategic asset. Luleå University of Technology.

Soparnot, R. (2011). The concept of organizational change capacity. *Journal of Organizational Change Management*, *24*(5), 640-661. https://doi.org/10.1108/09534811111158903

Sotorrío Ortega, G., Cobo Escamilla, A., & Tenorio Ríos, J. A. (2023). Industrialized construction and sustainability: A comprehensive literature review. Buildings, 13(11), 2861. https://doi.org/10.3390/buildings13112861

Styhre, A., & Gluch, P. (2010). Managing knowledge in platforms: boundary objects and stocks and flows of knowledge. Construction management and economics, 28(6), 589-599. https://doi.org/10.1080/01446190903450061

Thuesen, C., & Hvam, L. (2011). Efficient on-site construction: learning points from a German platform for housing. Construction Innovation, 11(3), 338-355. https://doi.org/10.1108/14714171111149043

Van Oorschot, J. A., Halman, J. I., & Hofman, E. (2020). Getting innovations adopted in the housing sector. Construction innovation, 20(2), 285-318. http://dx.doi.org/10.1108/CI-11-2018-0095

Viardot, E., Mccarthy, I. P., & Chen, J. (2021). Standardization in a digital and global world: State-of-the-art and future perspectives. IEEE Transactions On Engineering Management, 68(1), 11-17. https://doi.org/10.1109/TEM.2020.3006302

Yanow, D. (2009). Organizational ethnography and methodological angst: myths and challenges in the field. *Qualitative Research in Organizations and Management: An International Journal*, *4*(2), 186-199. https://doi.org/10.1108/17465640910978427

Zhou, S. (2024). Platforming for industrialized building: a comparative case study of digitally-enabled product platforms. Building research & information, 52(1-2), 4-18. https://doi.org/10.1080/09613218.2023.2200157

Appendices

Appendix I – Interview protocol

Geachte deelnemer,

Hierbij is de uitnodiging om deel te nemen aan mijn onderzoek genaamd ‘Double Trouble: Industrialized Construction in the Digital Age’. Deze studie wordt uitgevoerd door Eefke Huisman, masterstudent van de opleiding Management in the Built Environment aan de TU Delft, in samenwerking met het bedrijf VORM 2050 gevestigd te Rotterdam.

Het toenemende woningtekort in Nederland stuurt de bouwsector te transformeren naar meer digitalisering en snellere, efficiëntere bouwmethoden. Het doel van dit onderzoek is om de transitie naar een conceptuele manier van bouwen te ondersteunen met behulp van de inzet van digitale technologieën. Door middel van een theoretische analyse en een casestudy van VORM 2050 worden inzichten verzameld om praktische aanbevelingen te formuleren.

De bijdrage vanuit dit interview zal ongeveer 45 tot 60 minuten in beslag nemen. Hierin bespreken we uw ervaringen over de conceptuele bouwprocessen, digitalisering en organisatorische veranderingen. Deelname is vrijwillig en er kan op elk moment aangegeven worden om te stoppen of een vraag over te slaan. Daarnaast is er de mogelijkheid om uw gegevens achteraf in te zien, te corrigeren of te verwijderen.

Alle verzamelde gegevens worden vertrouwelijk behandeld en opgeslagen op een beveiligde TU Delft-server. Het wordt uitsluitend gebuikt voor dit academische onderzoek en in geanonimiseerde vorm verwerkt.

Heeft u vragen? Neem gerust contact met mij .
Als u akkoord gaat met deelname, verzoek ik u onderstaande verklaring te ondertekenen

Bij voorbaat dank.

Met vriendelijke groet,
Eefke Huisman

Vink het juiste antwoord aan:

	Yes	No
A: Algemene overeenkomst – onderzoeksdoelen, taken van de deelnemer en vrijwillige deelname		
1. Ik heb de informatie over het onderzoek gedateerd 01/03/2025 gelezen en begrepen, of deze is aan mij voorgelezen. Ik heb de mogelijkheid gehad om vragen te stellen over het onderzoek en mijn vragen zijn naar tevredenheid beantwoord.	☐	☐
2. Ik doe vrijwillig mee aan dit onderzoek, en ik begrijp dat ik kan weigeren vragen te beantwoorden en mij op elk moment kan terugtrekken uit de studie, zonder een reden op te hoeven geven.	☐	☐
3. Ik begrijp dat mijn deelname aan het onderzoek de volgende punten betekent: • Er zal een audio opname worden gemaakt van het interview. • Het interview zal getranscribeerd worden om te analyseren in de software Atlas.it. • De interview opnames zullen verwijderd worden na afronding van het onderzoek.	☐	☐
4. Ik begrijp dat de studie 18/06/2025 eindigt.	☐	☐
B: Mogelijke risico's van deelname (inclusief gegevensbescherming)		
5. Ik begrijp dat mijn deelname de volgende risico's met zich meebrengt, zoals het delen van herleidbare informatie en het niet op mijn gemak voelen tijdens het interview. Ik begrijp dat deze risico's worden geminimaliseerd door: • Anonimiseren, veilige opslag en vertrouwelijke verwerking van alle gegevens. De interview opname zal verwijderd worden na het verwerken. • De participant bepaalt zelf welke informatie gedeeld wordt en kan ieder moment stoppen met interview.	☐	☐
6. Ik begrijp dat de persoonlijke informatie die over mij verzameld wordt en mij kan identificeren, zoals mijn naam en functie, niet gedeeld worden buiten het onderzoeksteam om.	☐	☐
7. Ik begrijp dat de persoonlijke data die over mij verzameld wordt, vernietigd wordt op 18/06/2025.	☐	☐
C: Onderzoek publicatie, verspreiding en toepassing		

8. Ik begrijp het onderzoek de geanonimiseerde informatie gebruikt zal worden voor de publicatie van de masterscriptie op de TU Delft repository website.	☐	☐
9. Ik geef toestemming om mijn antwoorden, ideeën of andere bijdrages anoniem te quoten in resulterende producten.	☐	☐

D: (Langdurige) opslag, toegang en hergebruik van gegevens

10. Ik geef toestemming om de geanonimiseerde data vanuit het interview die over mij verzameld worden gearchiveerd worden in de database van de TU Delft opdat deze gebruikt kunnen worden voor toekomstig onderzoek en onderwijs.	☐	☐

Hierbij verklaar ik dat ik bovenstaande punten heb gelezen en ik akkoord geef op het deelnemen aan dit onderzoek.

_____ _____

Naam ondertekende *Handtekening* *Datum*

Ik, de onderzoeker, verklaar dat ik de informatie en het instemmingsformulier correct aan de potentiële deelnemer heb voorgelezen en, naar het beste van mijn vermogen, heb verzekerd dat de deelnemer begrijpt waar hij/zij vrijwillig mee instemt.

_____ _____ _____

Naam ondertekende *Handtekening* *Datum*

Contactgegevens onderzoeker:
Eefke Huisman
e.g.huisman@student.tudelft.nl
+31619963132

Semi-structured interview questions (English version)

Introduction

1. Could you briefly describe your role and responsibilities within VORM 2050?

2. Have your previous experiences been more focused on the design and development phases, or on execution?

Transition to industrialized construction practices

3. How have you experienced the transition towards industrialized construction at VORM 2050? (challenges, bottlenecks, opportunities and key lessons from previous projects)

4. What changes have had, or are expected to have, the biggest impact on your day-to-day activities?

5. Could you walk me through how your current work processes are structured? What aspects work well, and what areas could be improved?

Digital Technologies

8. What digital technologies are currently being used in your projects, and do they support your work or contribute to the project's progress?

9. What challenges have you faced in adopting and integrating digital technologies into your work?

Future Vision

10. In your opinion, which stages of VORM 2050's development and construction processes offer the biggest opportunities for improvement?

11. What steps do you think are necessary to drive this improvement, and how could digital technologies support this process?

Interview opzet (Nederlandse versie)

Introductie

1. Zou je jouw functie en verantwoordelijkheden binnen VORM 2050 kunnen beschrijven?

2. Zijn je eerdere werkervaringen meer gefocust geweest op ontwerp en ontwikkeling, of meer op de uitvoering?

3. Zou je mij mee kunnen nemen in hoe je dagelijkse werkzaamheden (en processen) eruit zien? (Wat is een typische werkdag en wat vergt de meeste aandacht?)

Transitie conceptueel bouwen

4. Hoe ervaar je de transitie naar de conceptuele manier van bouwen binnen VORM 2050? (uitdagingen en kansen, belangrijkste lessen vanuit eerdere projecten)

5. Welke uitdagingen binnen deze transitie hebben de meeste impact gehad op je dagelijkse werkzaamheden? (Zijn er bepaalde knelpunten die nog steeds spelen?)

6. Binnen je werkprocessen, wat werkt op dit moment goed en waar zie je nog verbetermogelijkheden? Wat is je eigen aanpak hierin geweest?

Digitale technologieën

7. Welke digitale technologieën worden momenteel gebruikt binnen jouw projecten, en hoe ondersteunen ze het proces?

8. Welke uitdagingen heb je zelf ervaren in het gebruiken en integreren van digitale technologieën?

Toekomstige verwachtingen

9. Vanuit jouw perspectief, waar ligt binnen de ontwikkel- en bouwprocessen van VORM 2050 de meeste ruimte voor verbetering? Is dit een specifieke fase?

10. Welke stappen zijn volgens jou nodig om deze ontwikkeling te realiseren? Kunnen digitale technologieën hierin bijdragen?

Appendix II – Data management plan

The data management plan below is based on the TU Delft template and retrieved from dmponline.tudelft.nl.

Plan Overview

A Data Management Plan created using DMPonline

Title: MBE Msc Graduation Project - Double Trouble: Industrialized Construction in the Digital Age - Interviews and organizational ethnography (thesis in repository only)

Creator: Eefke Huisman

Principal Investigator: Eefke Huisman

Data Manager: Eefke Huisman

Project Administrator: Eefke Huisman

Affiliation: Delft University of Technology

Template: TU Delft Data Management Plan template (2025)

Project abstract:

This research explores the transition of VORM 2050, a Dutch construction company, from a project-oriented to a product-oriented model through the integration of industrialized construction principles and digital technologies. The study addresses key research questions regarding the challenges of this transition, the role of Organizational Change Management (OCM) practices, and the impact of digital tools on construction workflows.

To investigate these questions, data is collected through semi-structured interviews, organizational ethnography, and a single-case study of VORM 2050's ongoing projects. The research examines construction sites, team workflows, and stakeholder perspectives, assessing how digital tools support procurement, process optimization, and real-time project monitoring. Data analysis follows a research-through-design approach, culminating in the development of a strategic roadmap to guide the adoption of industrialized construction methods.

The study takes place within VORM 2050's operational sites and involves employees, management, and external experts in industrialized construction. Data includes interviews, field observations, and project documentation. Findings contribute to a deeper understanding of how digitalization can enhance industrialized construction, while offering practical recommendations for improving efficiency, reducing project delays, and aligning digital tools with organizational workflows. The study's outcomes will be shared with VORM 2050 and relevant stakeholders to support broader industry adoption.

ID: 168829

Start date: 10-02-2025

End date: 30-06-2025

Last modified: 30-04-2025

MBE Msc Graduation Project - Double Trouble: Industrialized Construction in the Digital Age - Interviews and organizational ethnography (thesis in repository only)

0. Adminstrative questions

1. Provide the name of the data management support staff consulted during the preparation of this plan and the date of consultation. Please also mention if you consulted any other support staff.

Janine Strandberg, Data Steward at the Faculty of Architecture and the Built Environment, has reviewed this DMP on [date of review].

2. Is TU Delft the lead institution for this project?

- Yes, leading the collaboration – please provide details of the type of collaboration and the involved parties below

Within my thesis research, TU Delft takes the lead, but I will conduct my research through an internship at a company. This company is VORM 2050, a part of VORM Holding as a construction company. I will work closely with them and conduct all interviews within the VORM 2050 team. All final data will be shared with them, and I will regularly ask for feedback on my results. This refers to data that does not contain any personal information, such as anonymized quotations from interviews.

I. Data/code description and collection or re-use

3. Provide a general description of the types of data/code you will be working with, including any re-used data/code.

Type of data/code	**File format(s)**	**How will data/code be collected/generated?** *For re-used data/code: what are the sources and terms of use?*	**Purpose of processing**	**Storage location**	**Who will have access to the data/code?**

Personally identifiable information: participant's name, position within the company, email.	.docx	Contact information for participants taking part in interviews, received from the internship company. Informed consent forms are shared during the interview.	For administrative purposes: obtaining informed consent and communicating with participants	TU Delft OneDrive	Eefke Huisman and thesis supervisors Daniel Hall and Angela Greco
Some documentation related to the projects of the internship company will be shared and used. Also general documentation of the company, such as the annual plan, can be used as input.	.docx .pdf files	These documents will be read and incorporated into my thesis when made available by the internship company.	Gaining insight into the case and project information at the internship company	TU Delft OneDrive	Same as above
Audio recordings of interviews with team members of the internship company	.mp3	Interviews are conducted during my internship. Audio-recordings are made on an external device by using Microsoft Teams. Recordings are deleted after processing.	Gaining insight into the case by capturing opinions from the team members of the internship company	External recording device (temporary) and TU Delft OneDrive (primary)	Same as above
Notes or audio recordings from observations during internship	.docx and .mp3	Notes will be taken of meetings and informal conversations. The team members of the internship company are aware of this. When possible, recordings are made with an external device. Recordings are deleted after processing.	Gaining insight into the case by capturing opinions from the team members of the internship company	External recording device (temporary) and TU Delft OneDrive (primary)	Same as above
Anonymous transcriptions of interviews and observations	.docx	Anonymous transcriptions created manually based on audio-recordings.	Privacy-preserving data on industrialized construction practices from team members of the internship company	TU Delft OneDrive	Same as above together with the internship company (when demanded)

Anonymized data on the perspectives of the team members of the internship company on industrialized construction practices	.csv or .pdf	The interview and observation transcriptions will be coded using Atlas software.	Reviewing and analyzing the different perspectives on industrialized construction practices.	TU Delft OneDrive	Same as above together with the internship company (when demanded)
Audio recordings of the expert panel and focus group	.mp3	The expert panel and focus group will take place at the end-phase of the data collection. Audio-recordings are made on an external device by using Microsoft Teams. Recordings are deleted after processing.	Validating research outcome by asking for the field experts' opinions.	TU Delft OneDrive	Same as above
Anonymous transcriptions of the expert panel and focus group	.docx	Anonymous transcriptions created manually based on audio-recordings.	Privacy-preserving data on industrialized construction practices from a field expert point of view	TU Delft OneDrive	Same as above
Report / thesis	.pdf	Serves as a record of the process as well as documentation.	Long-term documentation	TU Delft Onedrive	Same as above together with the internship company

II. Storage and backup during the research process

4. How much data/code storage will you require during the project lifetime?

- < 250 GB

5. Where will the data/code be stored and backed-up during the project lifetime? (Select all that apply.)

- Project Data Storage (U:) drive at TU Delft

- TU Delft OneDrive

III. Data/code documentation

6. What documentation will accompany data/code? (Select all that apply.)

- Data – Methodology of data collection

IV. Legal and ethical requirements, code of conducts

7. Does your research involve human subjects or third-party datasets collected from human participants?

If you are working with a human subject(s), you will need to obtain the HREC approval for your research project.

- Yes – please provide details in the additional information box below

I intend to apply for ethical approval from the Human Research Ethics Committee, but have not yet done so.

8. Will you work with personal data? (This is information about an identified or identifiable natural person, either for research or project administration purposes.)

- Yes

9. Will you work with any other types of confidential or classified data or code as listed below? (Select all that apply and provide additional details below.)

If you are not sure which option to select, ask your Faculty Data Steward for advice.

- Yes, confidential data received from commercial, or other external partners

10. How will ownership of the data and intellectual property rights to the data be managed?

For projects involving commercially-sensitive research or research involving third parties, seek advice of your Faculty Contract Manager when answering this question.

The intellectual property rights are framed by a graduation agreement between Delft University of Technology, myself and VORM 2050.

11. Which personal data or data from human participants do you work with? (Select all that apply.)

- Names as contact details for administrative purposes
- Free text fields (for instance, in questionnaires) in which participants could unintentionally share personal data
- Proof of consent (such as signed consent materials which contain name and signature)
- Audio recordings

All participants take part in both the interviews and the organizational ethnography and have been informed about this. They are all employees of the VORM 2050 team. Therefore, all of the above-mentioned data applies to the same participants, and they have all been included in the same informed consent process.

12. Please list the categories of data subjects and their geographical location.

Interview and focus group participants will be employees from the company VORM 2050. The participants for the expert panel have not yet been finalized but will consist of academics with expertise in the field.

13. Will you be receiving personal data from or transferring personal data to third parties (groups of individuals or organisations)?

- No

16. What are the legal grounds for personal data processing?

- Informed consent

17. Please describe the informed consent procedure you will follow below.

The researcher will inform the potential participants about the goals and procedures of the research project. The researcher will also inform them about the personal data that are being processed and for what purpose. This information will be provided to the potential participants as follows: a digital copy

of the information will be emailed to participants before the interview. All participants will be asked for their consent for taking part in the study and for data processing by signing a digital informed consent form before the start of the interview.

18. Where will you store the physical/digital signed consent forms or other types of proof of consent (such as recording of verbal consent)?

The proof of consent (digital copy of signed document) will be preserved on the TU Delft Project Data Storage (U:) drive

19. Does the processing of the personal data result in a high risk to the data subjects? (Select all that apply.)

If the processing of the personal data results in a high risk to the data subjects, it is required to perform a Data Protection Impact Assessment (DPIA). In order to determine if there is a high risk for the data subjects, please check if any of the options below that are applicable to the processing of the personal data in your research project.

If any category applies, please provide additional information in the box below. Likewise, if you collect other type of potentially sensitive data, or if you have any additional comments, include these in the box below.

If one or more options listed below apply, your project might need a DPIA. Please get in touch with the Privacy team (privacy-tud@tudelft.nl) to get advice as to whether DPIA is necessary.

- None of the above apply

23. What will happen with the personal data used in the research after the end of the research project?

- Anonymised or aggregated data will be shared with others

24. For how long will personal research data (including pseudonymised data) be stored?

- Personal data will be deleted at the end of the research project

25. How will your study participants be asked for their consent for data sharing?

- In the informed consent form: participants are informed that their personal data will be

anonymised and that the anonymised dataset is shared publicly

V. Data sharing and long term preservation

27. Apart from personal data mentioned in question 23, will any other data be publicly shared?

Please provide a list of data/code you are going to share under 'Additional Information'.

- All other non-personal data/code produced in the project

29. How will you share research data/code, including those mentioned in question 23?

- I am a Bachelor's/Master's student at TU Delft and I will share the data/code in the body and/or appendices of my thesis/report in the Education Repository

31. When will the data/code be shared?

- At the end of the research project

VI. Data management responsibilities and resources

33. If you leave TU Delft (or are unavailable), who is going to be responsible for the data/code resulting from this project?

My supervisor Daniel Hall (Management in the Built Environment) with email address d.m.hall@tudelft.nl

34. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

No financial costs will be incurred, and the researcher will dedicate sufficient time to ensure data management and the protection of participants.

Appendix III – Research plan

The figure below shows a general planning that was drawn up at the start of the execution phase of this thesis research.

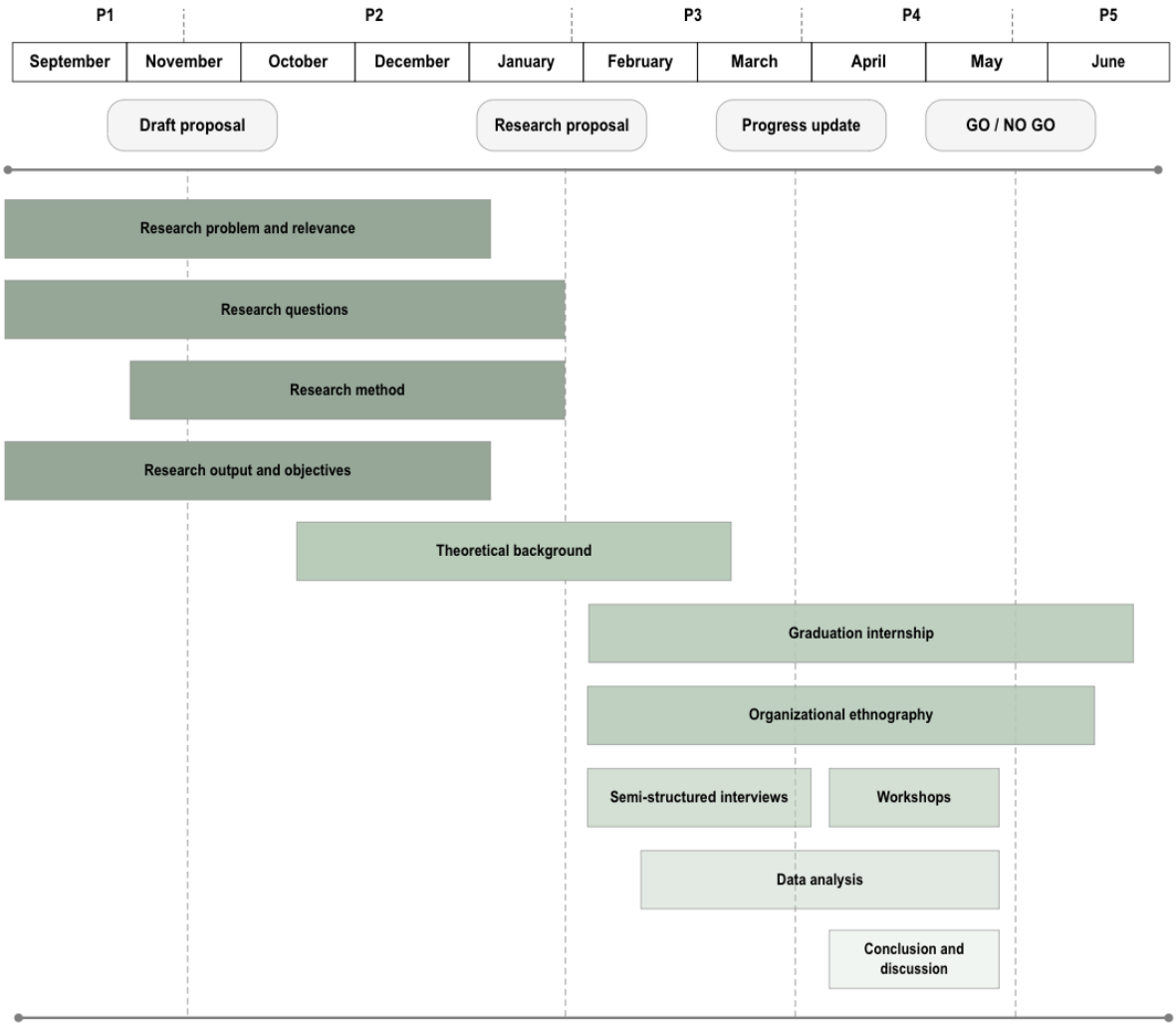


Figure 11: main tasks and milestones (source: own work)

Appendix IV – Digital technologies literature

The following appendix provides a theoretical background on the role of digital technologies in industrialized construction. Although this topic is no longer the primary focus of the thesis, it formed an earlier part of the theoretical exploration.

Industrialized construction continues to face challenges such as insufficient communication, inadequate quality inspection systems for manufacturing and installation, and inefficiencies in the supply chain (Zhang et al., 2018). The adoption of emerging technologies presents opportunities to overcome these barriers, mainly due to the factory-based nature of industrialized construction (Abanda et al., 2017). The relatively stable working environment with repetitive processes in such context lowers the complexity of integrating new digital technologies. Accordingly, management practices within industrialized construction projects can significantly be enhanced, driving improvements across various operational areas (Qi et al., 2021). The manufacturing industry has already emphasized comprehensive digital technologies with a focus on the integration of digital ecosystems, aiming to deliver fully integrated solutions aligned with Industry 4.0 (Oesterreich & Teuteberg, 2016). Key features include real-time data processing, machine-to-machine communication, and human-machine collaboration (Qi et al., 2021).

Types of digital technologies

According to Qi et al. (2021), four types of digital technologies can be recognized as relevant under industrialized construction conditions. Firstly, *Business digitalization* implying the shift from traditional, paper-based management to digitalized processes. This can be achieved through Enterprise Resource Planning (ERP), systems that link project planning, purchasing, production and logistics, and Cloud-based Platforms and Standards, enabling seamless data sharing to support collaborative workflows and data traceability throughout the project lifecycle. Secondly, *Computer integrated design*, of which BIM has revolutionized the design process by 3D and 4D modelling. This way, intelligent models store and transfer standardized, parametric building data. Thirdly, *Data acquisition, optimization and predictive analysis*, whereby technologies like the Internet of Things (IoT) enable real-time data collection and monitoring of construction activities. This supports proactive decision-making, improves safety, and enhances resource allocation during projects. Lastly, *Robotics and automation* to streamline the manufacturing, assembly and inspection of prefabricated components, reducing errors and improving efficiency.

Across construction lifecycle

Fan et al. (2024) studied the status quo and future development of digital technologies for each project stage, see Figure 6. Starting with the design phase of industrialized construction, the focus lies on integrating advanced design methods, such as parametric and discrete design. These methods facilitate the creation of efficient designs that optimize fabrication and assembly processes, particularly for complex geometrical forms, while improving overall building performance. Additionally, incorporating performance simulations, such as energy

analysis and life cycle assessments, into the design process enables early-stage optimization of a building's energy efficiency and environmental impact.

The second phase, production, focuses on integrating advanced manufacturing techniques with digital tools. Technologies such as 3D printing and CNC machining facilitate the production of customized precast elements. Simultaneously, digital tools like digital twins enhance production flexibility, enabling better adaptation to uncertainties and changing demands. Additionally, advanced measurement technologies are increasingly used to automate quality inspections, ensuring precision in element dimensions and surface quality (Fan et al., 2024).

Thirdly, the construction phase leverages technologies like the Internet of Things (IoT) and Artificial Intelligence (AI) for intelligent monitoring, predictive analytics, and proactive optimization of construction progress, logistics, and safety measures. Industrial robots are also increasingly used to enable customization and automate assembly processes (Fan et al., 2024).

In the last project phase, operation and maintenance phase, digital technologies enhance intelligent management and sustainability. Tools like BIM, digital twins, and sensors enable real-time monitoring, structural health assessment, and predictive maintenance. Integrating monitoring data with digital models supports sustainability initiatives, such as energy efficiency optimization, noise management, and informed maintenance decisions (Fan et al., 2024).

Configuration

However, an essential technology supporting every stage of industrialized construction is the configurator. Configurators bridge design and production by automating and streamlining workflows across project phases. By breaking buildings into subsystems (e.g., slabs, walls, roofs), configurators allow designers to generate and assess layouts while ensuring compatibility with industrialized manufacturing methods (Cao & Hall, 2019). Configurators enable designers to create building layouts while embedding constraints from manufacturing and assembly processes (both). The kits-of-parts used in configurators are governed by a set of predefined rules, including composition, compatibility, dependency, and cardinality, as noted by Cao et al. (2021). Furthermore, configurators enhance productivity by automating the generation of project documentation, such as Bills of Materials (BOMs) and production drawings, which streamline workflows and support mass customization. This ensures that project-specific designs meet client requirements while maintaining the cost advantages of standardization (Cao et al., 2021). Configurators also integrate seamlessly across all project stages, from site layout and floor planning to 3D model generation, enabling collaboration among architects, engineers, and manufacturers. Their centralized nature preserves knowledge for future projects, further improving efficiency and productivity (Cao & Hall, 2019).

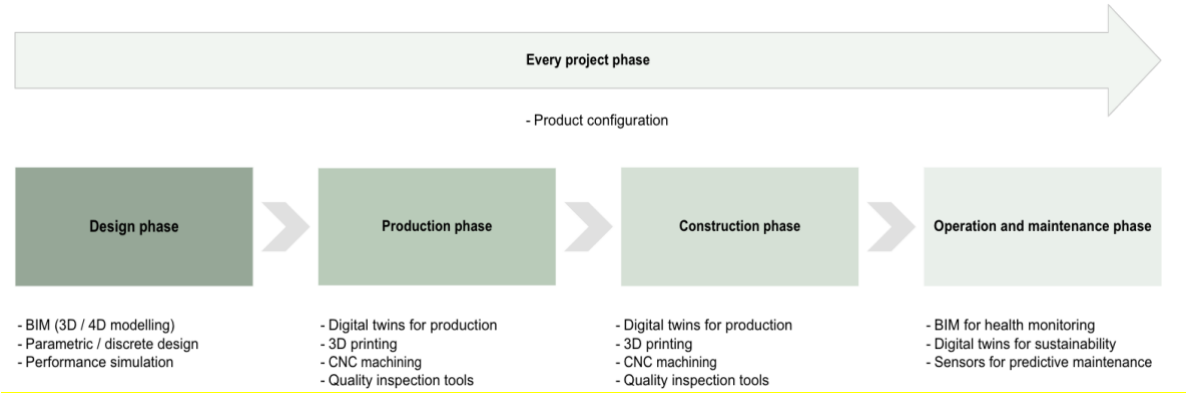


Figure 12: overview of examples of digital technologies per project phase (source: own work, based on Fan et al., 2022; Cao et al., 2021)

While substantial research on digital technologies in industrialized construction explores functional and operational benefits, such as enhanced automation, quality control, and resource optimization, much of the focus has been on technical aspects of adoption. Technologies like BIM, IoT, digital twins, robotics, and ERP have been widely studied for their ability to streamline workflows and improve project-level efficiency.

References digital technologies

Abanda, F. H., Tah, J. H. M., & Cheung, F. K. T. (2017). BIM in off-site manufacturing for buildings. *Journal of Building Engineering, 14,* 89–102. https://doi.org/10.1016/j.jobe.2017.10.002

Cao, J., & Hall, D. (2019, July). An overview of configurations for industralized construction: typologies, customer requirements, and technical approaches. In *EC3 Conference 2019* (Vol. 1, pp. 295-303). European Council on Computing in Construction. https://doi.org/10.35490/EC3.2019.145

Cao, J., Bucher, D. F., Hall, D. M., & Lessing, J. (2021). Cross-phase product configurator for modular buildings using kit-of-parts. *Automation in construction*, *123*, 103437. https://doi.org/10.1016/j.autcon.2020.103437

Fan, J., Chen, L., & Chen, K. (2024). Digitalizing Industrialized Construction Projects: Status Quo and Future Development. Applied Sciences, 14(13), 5456. https://doi.org/10.3390/app14135456

Oesterreich, T. D., & Teuteberg, F. (2016). Understanding the implications of digitisation and automation in the context of Industry 4.0: A triangulation approach and elements of a research agenda for the construction industry. *Computers in Industry, 83,* 121–139. https://doi.org/10.1016/j.compind.2016.09.006

Zhang, W., Lee, M. W., Jaillon, L., & Poon, C. S. (2018). The hindrance to using prefabrication in Hong Kong's building industry. *Journal of Cleaner Production, 204,* 70–81. https://doi.org/10.1016/j.jclepro.2018.08.190

Appendix V – OCM practices literature

The following appendix provides a theoretical background on Organizational Change Management (OCM) practices which were initially considered as a core component of this research. Although the study has since shifted towards a broader focus on organizational practices and paradoxes, it could still be relevant for understanding these practices.

OCM variables

In the study conducted by Maali et al. (2020), seven OCM practices were identified based on a review of previous literature. The first practice is Senior-leadership commitment, meaning active and consistent involvement from a senior leader to ensure alignment with organizational objectives and address resistance. The second practice, Training resources, highlights the importance of providing adequate training to develop skills necessary to implement and maximize the potential of new technologies. Third, Communicating the benefits of change, involves clearly mentioning the advantages of a proposed change, along with the risks of not adopting it, to reduce uncertainty and resistance among employees. The fourth practice is Establishment of a realistic timeframe by incorporating long-term strategic planning to ensure sufficient time for adoption. The fifth, Change agent effectiveness, underscores the role of internal change agents to guide the transition and provide support. Sixth, Clear and measured benchmarks, emphasizes setting clear goals and tracking the progress to create momentum. Lastly, Workload adjustments, which are essential for successful change adoption to avoid overloading employees with additional tasks. The detailed definitions of these OCM practices, as established by Maali et al. (2020), are displayed in Figure 7.

OCM Variables	Definition
Senior-leadership commitment	The organization's senior leaders were committed to making the change a success (i.e., they "walked the talk").
Training resources	Employees had a clear understanding of the action steps for how to implement the change in their job functions.
Communicated benefits	Employees had a clear understanding of how the change would benefit them in their job functions.
Realistic timeframe	The speed at which the organization implemented the change was appropriate.
Change-agent effectiveness	The change agents (transition team) responsible for managing the change in the organization were effective.
Measured benchmarks	The organization established clear benchmarks to measure the success of the change.
Adjusted workload	The organization's leaders appropriately adjusted staff members' workloads so they could focus on implementing the change.

Figure 13: definitions of OCM practices (Maali et al., 2020)

References OCM practices

Maali, O., Lines, B., Smithwick, J., Hurtado, K., & Sullivan, K. (2020). Change management practices for adopting new technologies in the design and construction industry. *Journal of Information Technology in Construction*, *25*, 325-341. https://dx.doi.org/10.36680/j.itcon.2020.019

Appendix VI – Additional data

This appendix presents additional quotations from interviews, organizational ethnography, and workshops to support the findings discussed in the main chapter.

Interviews

Table 7: additional interview quotations (source: own work, based on primary data)

Participant	Quotation	Theme
Participant 23	"En de organisatie en processen zijn daar niet in mee gegroeid. En wat ga je dan krijgen? Dan krijg je van dit soort groeiverschijnselen, waardoor, je je verplichtingen niet meer na kan komen."	Organizational change capacity
Participant 8	"Stel we doen een keer een paar stapjes terug in de projecten? Iets minder omzet maar met dezelfde mensen. Ik zeg dat nu al 5 jaar, maar het voelt een beetje als roepen in de woestijn. Dat is gewoon echt de cultuur hier in dit gebouw."	Organizational change capacity
Participant 5	"Wij moeten nog steeds de kar wel echt trekken, het is nog niet samen bouwen aan een product. Misschien is dat nog steeds wel de traditionele gedachte en het probleem met vertrouwen wat we in de bouw hebben."	Organizational change capacity
Participant 2	"Wij houden ons nog vooral bezig als bouwer en haken aan op een verder ontwikkeld plan. … Ik weet nog niet wat voor rol wij gaan aannemen voor dit project, maar ik verwacht wel dat het een andere rol zal zijn"	Role ambiguity
Participant 1	"We zitten allemaal in hetzelfde schuitje, dat bedoel ik niet negatief. Maar ik vind de samenwerking onderling erg begripvol en we zoeken elkaar op in het proces. Ik hoop wel dat lukt om de leermomenten mee te kunnen nemen. Ik vraag me alleen af of iedereen het hier niet veel te druk voor heeft, dat zou een gemiste kans zijn."	Workflow fragmentation
Participant 8	"Acties moeten dus goed bewaakt worden door iedereen. Het is niet alleen het signaleren van het probleem, maar ook hoe worden die acties opgepakt en uitgewerkt?"	Workflow fragmentation
Participant 12	"Hierin vind ik evaluatie momenten erg belangrijk. … Ik merk niet dat dit ook gebeurt overkoepelend aan de projecten. Dit valt ook niet binnen mijn takenpakket of verantwoordelijkheid."	Workflow fragmentation

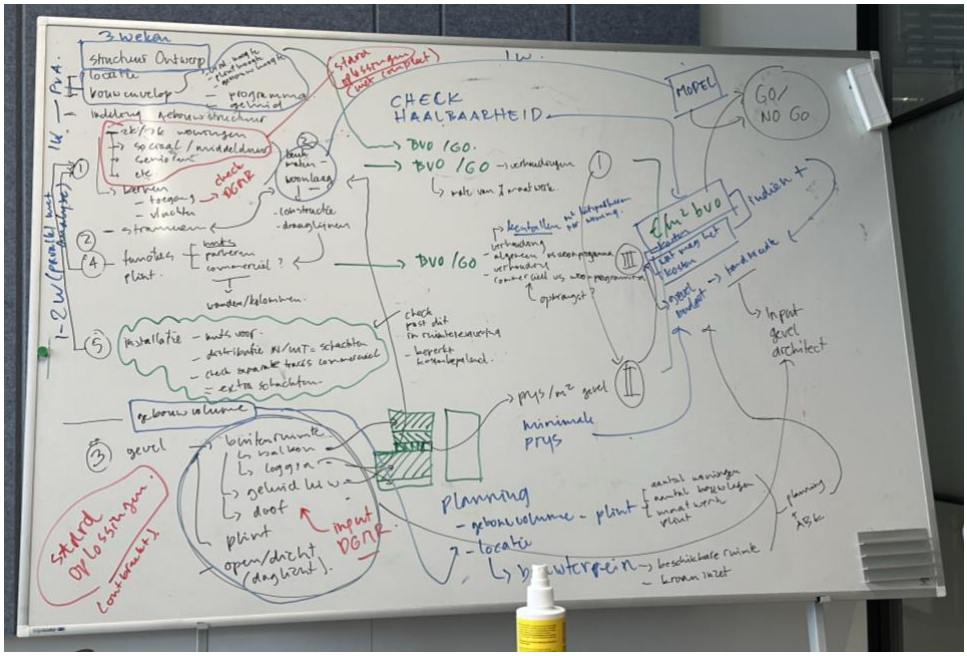
Organizational ethnography

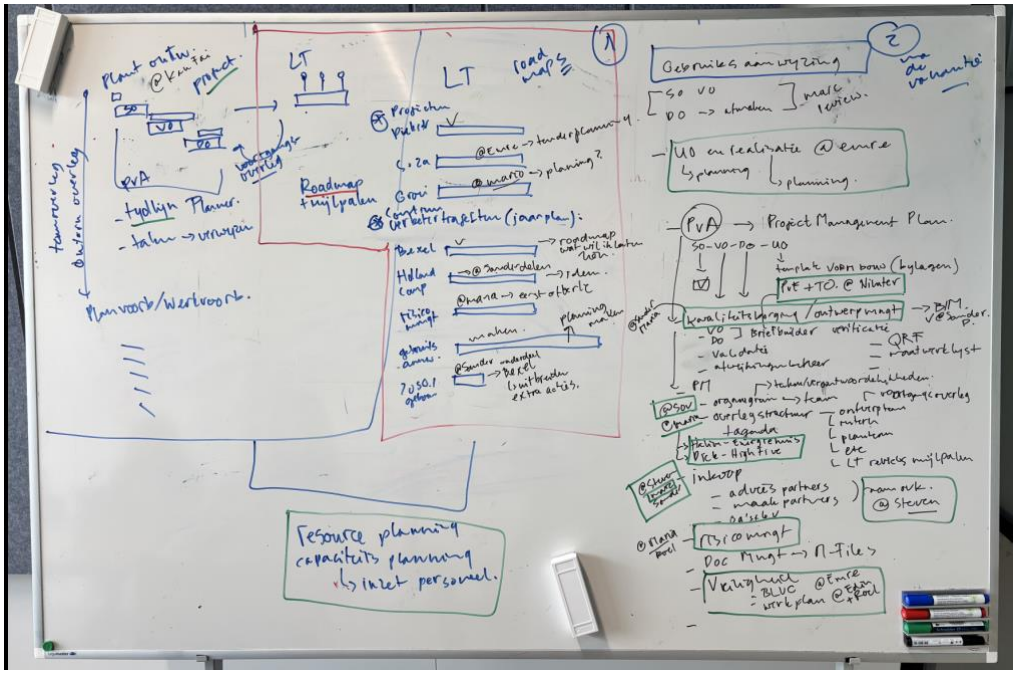
The figure below gives an impression of how the daily logbook for the organizational ethnography observations has been structured.

	Interactie type	Deelnemers	Doel	Thema	Beschrijving	Opmerkingen
10-02						
1	Double weekly	Development Concept development VORM 2050	Markt updates, interne updates en team bonding	-	Informele presentatie met inbreng vanuit teamleden. Besproken: - Activiteiten (goede doelen, sociale, sportieve, verjaardagen, nieuwe collega's) - Markt updates - Tender updates - Informatieve presentatie van Nieman: geautomatiseerde technische beoordeling van plan op basis van miniBIM of BENG.	
2	Informeel gesprek	Developer vanuit Sustainer	Soms aanwezig op kantoor om op de hoogte te zijn van projectontwikkelingen en behoeften	Externe relaties	Vorm van nauw contact, staan dus ervoor open om mee te denken in de transitie	Meenemen in interview
13-02						
8	Vergadering	Hoofd engineering, technisch conceptontwikkelaar, planning, kostendeskundige	Gebruiksaanwijzing SO / VO / DO (ontwikkel): uniform ontwerpproces opstellen aan de hand van de nieuwe projecten	Procesmatig (planning, financieel)	Zie notulen	Thema's binnen industrialization maken en CPMs koppelen
9	Informeel gesprek		Kennismaking planvoorbereider die is overgestapt naar inkoop	Externe relaties (marktpartijen)	Marktpartijen Leveranciers of marktpartijen benoemen wel vaak dat ze eerder betrokken willen worden in het proces, maar als ze die kans krijgen zie je vaak dat ze niet de regie durven of willen te nemen (verantwoordelijkheid in ontwerp, aansprakelijkheid, garantie). Lukte onderaannemers niet om als 'hoofdaannemer' op hun eigen bouwonderdeel of specialisme te opereren. Daardoor mindere kwaliteit en proceswaarborging.	

Figure 14: logbook organizational ethnography (source: own work)

During the meetings, several sketches were created to outline the processes VORM 2050 is following. The figures below provide an overview of this progression, starting with initial rough sketches and evolving into a more structured overview. It is noteworthy that most of these processes closely resemble traditional construction practices.





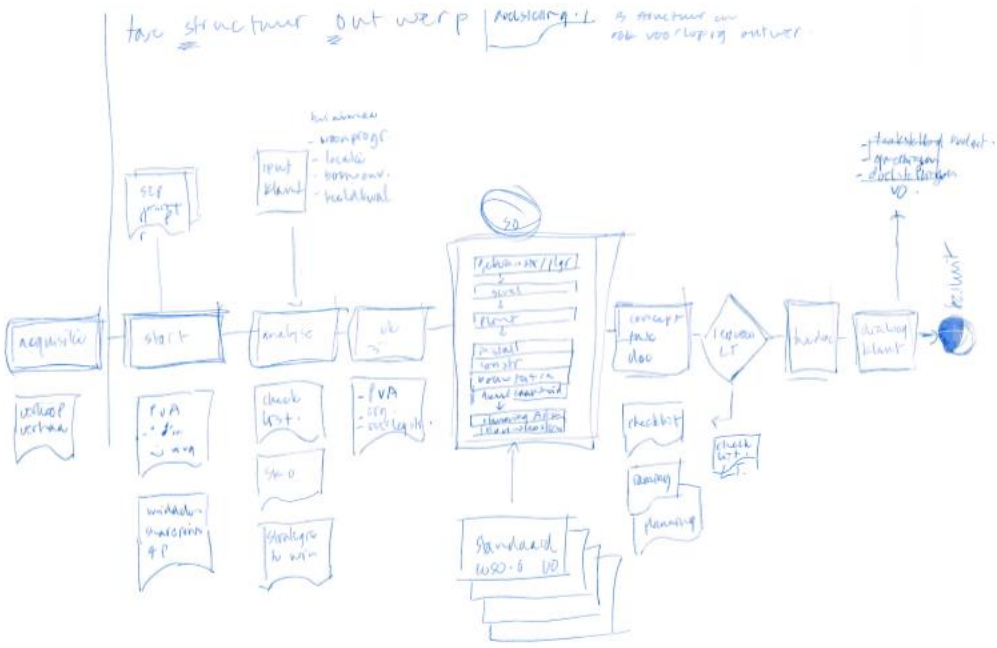


Figure 15: sketches of the processes (source: pictures from VORM 2050 meeting)

Table 8: additional quotations organizational ethnography (source: own work, based on primary data)

Interaction number	Quotation or observation	Theme
29	"Je moet niet opnieuw beginnen met modelleren, maar dit gebeurt wel als mensen in paniek zijn trekken ze alles naar zich toe. Of door tijdsdruk, of omdat dit project toch weer als uniek wordt gezien. Als er te ver wordt afgeweken dan is het beyond the repair."	Organizational change capacity
33	"We hebben een discussie gehad over auto's, zijn we dan een Tesla met een kwalitatief goede menukaart die je kan aankleden waar een directeur ook in kan rijden, wel een elektrische auto want duurzaam, of zijn we een Dacia waarin alles het doet en het rijdt. Zijn we dan een sociale huurwoning? Hoe uitgebreid maak je de menukaart?'	Role ambiguity
37	"Het is vaak voor mij onduidelijk welke richting de overleggen op gaan, wat het doel is en wat er van mij verwacht wordt. Omdat het soms van de hak op de tak gaat is het voor mij lastig om goed te luisteren en de juiste input te kunnen leveren."	Workflow fragmentation
68	During an evaluation session using the KISS method about collaborations with partners in previous projects, valuable points were raised. However, the discussion often drifted toward technical problems or detailed design issues.	

Figure 16: evaluation session partnerships, interaction 68 (source: meeting VORM 2050)

Focus group workshops

The workshop started with a presentation introducing the thesis, the product platform strategy and some of the main findings from the interviews with examples of quotations, see Figure 17.

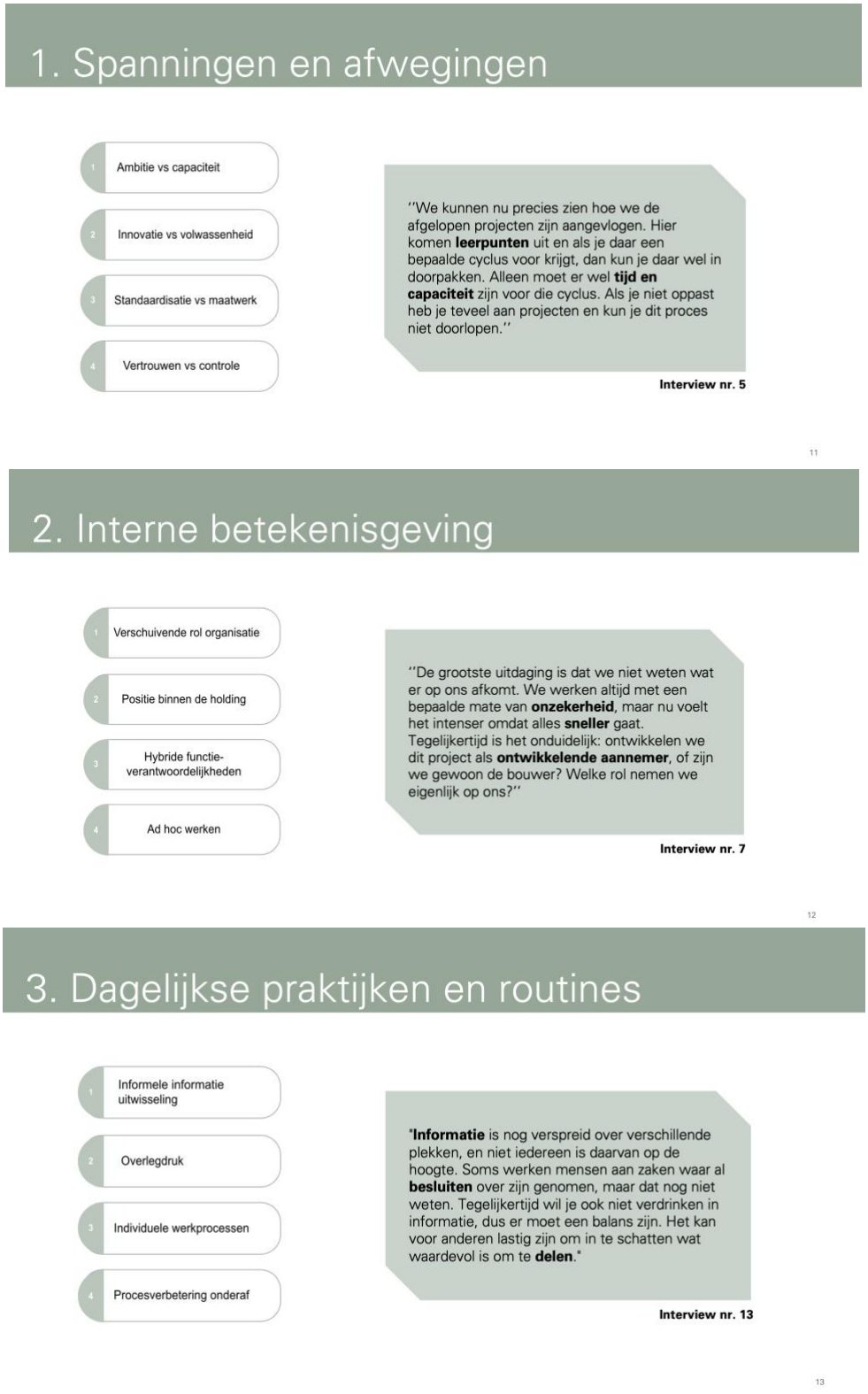


Figure 17: workshop sheets with the main interview findings (source: own work)

After the introduction, the workshop started with the polarity map structure. The workshop was ended with a short self-reflection.

Figure 18: workshop sheets with the polarity map tensions (source: own work)

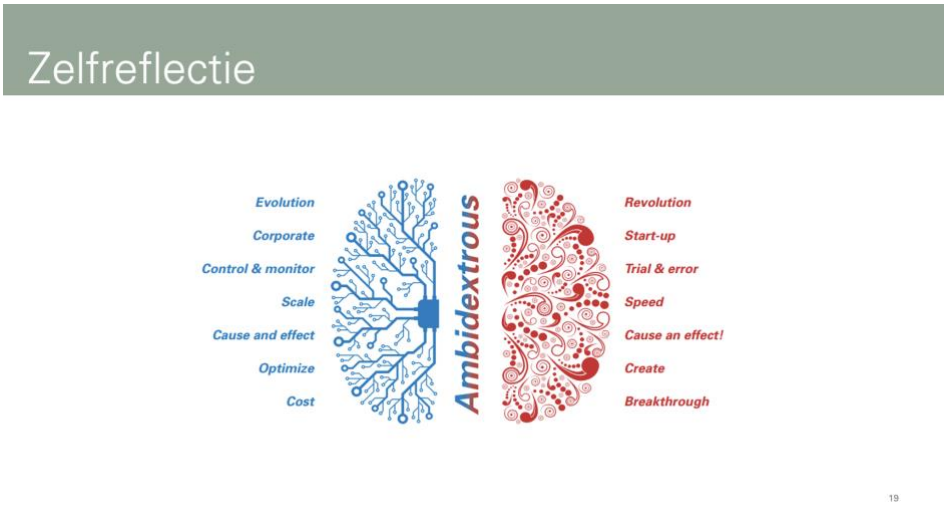


Figure 19: workshop sheet with self-reflection as closing (source: own work)

The figures below present the workshop results from both groups regarding the first tension: focusing on the long-term vision of product development versus the short-term focus on operational execution in projects.

Figure 20: polarity map workshop results group 1 (source: collectively with VORM 2050 team)

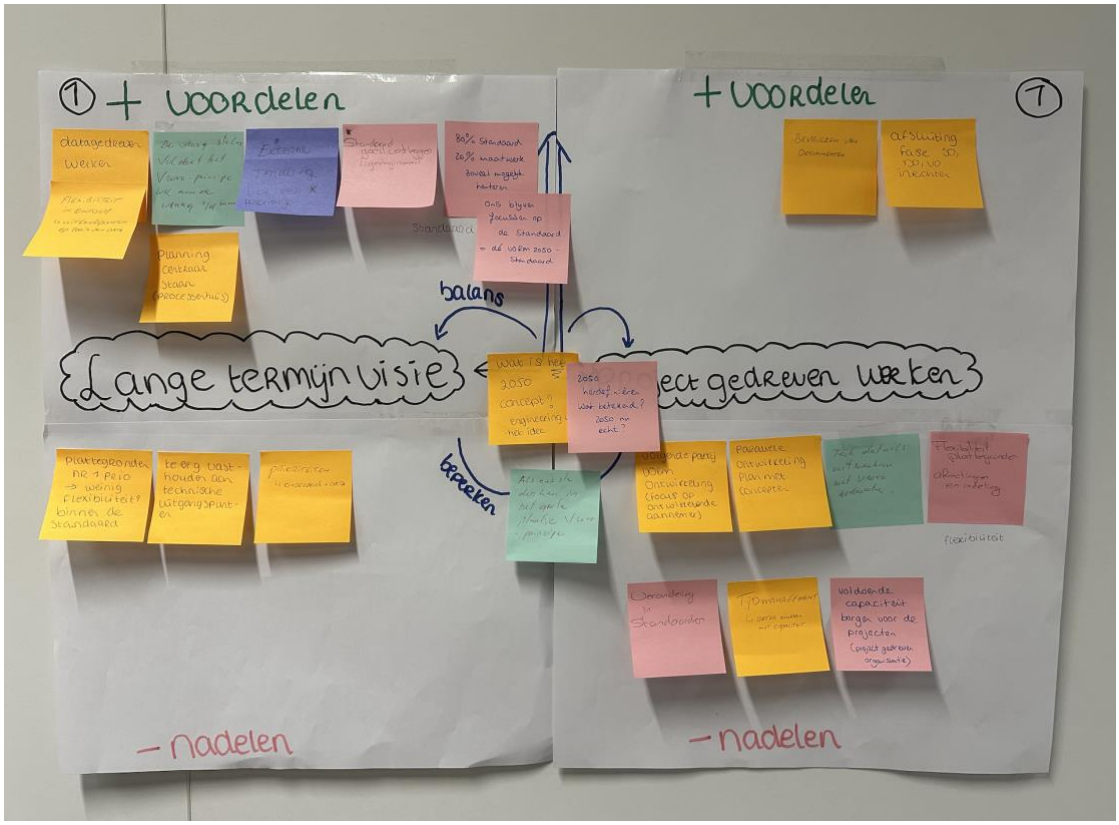


Figure 21: polarity map workshop results group 2 (source: collectively with VORM 2050 team)

Table 9: additional quotations workshop (source: own work, based on primary data)

Participant	Quotation	Theme
Participant 10, workshop 1	"Bij elk nieuw project passen we het concept weer aan. Er is nog geen basisversie. Dat zorgt voor ruis."	Organizational change capacity
Participant 1, workshop 2	"Ik weet nog niet wat voor rol wij gaan aannemen voor dit project, maar ik verwacht wel dat we een andere rol gaan innemen."	Role ambiguity
Participant 8, workshop 1	"Niet statisch, maar dynamisch handelen, werken, denken, uitvoeren. We zitten nog een beetje vastgeroest in het statische."	Workflow fragmentation
Participant 5, workshop 1	"We vormen daar een bibliotheek. Om die ook te kunnen gebruiken. Wel een beetje met elkaar in verbinding blijven. Alleen de middelen. De platforms. Of de bestandstypen Die zijn er nog niet. Die moeten we zelf vormgeven. Dat is de omgekeerde factor."	Workflow fragmentation