Organizational Structure and Innovation: A Comparative Study of Horizontal and Vertical Models in Construction

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Summary

This thesis research how organizational structure influences innovation in service-based construction firms. It compares vertical and horizontal structures to understand their impact on process innovation and utilizes system dynamics modeling to holistically visualize and capture these processes. The study aims to answer the central question: “How do vertical and horizontal organizational structures in service-based construction companies influence process innovation, and how can these be improved to stimulate innovation? ”

A mixed-method research approach was used to answer this question including the following. A systematic literature review, following the PRISMA framework, established a theoretical foundation on organizational structures and innovation. A case study compared two construction firms, analyzing their structures and innovation strategies through semi-structured interviews with 16 key stakeholders. The Gioia method was applied to identify themes, which were then refined into broader aggregate dimensions, including human, vision, external, and organizational factors. These results were integrated as variables into a system dynamics model, forming the basis of a Causal Loop Diagram (CLD) that maps the causal relationships between key variables. This diagram visualized the causal relationships between key variables, offering a comprehensive view of the dynamics shaping innovation within these organizational structures.

System dynamics modeling provides a practical way for firms to assess and refine their strategies before committing resources. By incorporating context-specific insights and flagging the most influential variables, companies can better align their structures with innovation goals. This approach allows them to recognize strengths and weaknesses within their respective context, leading to more informed decision-making and strategically motivated actions that drive long-term performance improvements.

The thesis refines the formulated CLD through additional interviews with the original participants, to validate the model and adapt it for different contexts, specifically: the construction industry, vertically structured firms, and horizontally structured firms. Interview participants identified the most influential factors for each setting which were visually emphasized in the CLD to reflect their impact.

Therefore, three sub-versions of the general CLD were created which, each emphasizing different variables that were particularly important in their respective contexts. The first is the construction industry CLD in which, human-driven innovation, market issues, standardization, and external-driven innovation emerged as focus variables. The second is the vertical structure CLD, which highlighted the importance of leadership-driven culture, organizational structure, and standardization, emphasizing control and efficiency. Finally, the horizontal structure CLD indicated human-driven innovation, agility, leadership-driven culture, and organizational flexibility as central factors, underlining adaptability and responsiveness.

The findings of the semi-structured interviews reveal significant differences between vertical and horizontal structures in fostering innovation. Vertical integration fosters more control over the supply-chain and therefore profit most from, enhanced control, coordination, and resource management across project phases. This structure allows for systemic innovation, ensuring continuity and efficiency in large-scale projects. However, it also introduces high financial and operational costs and complexity, requiring strong management to balance this complexity and performance. Horizontal structures generally prioritize flexibility and specialization, making them well-suited for incremental innovation. These firms can quickly adapt to changes, but they often face challenges in coordinating across different disciplines, leading to inefficiencies in collaboration and long-term knowledge retention.

The horizontal and vertical specified CLDs were developed based on data from Group Jansen and Bulsink. Analyzing their past developments and challenges through these models reveals key insights into their organizational dynamics and innovation processes. For Group Jansen, maximizing the benefits of vertical integration requires greater standardization, strategic alignment, and inter-entity integration. Shared systems, centralized purchasing, and streamlined communication would enhance efficiency. Past integrations indicate the possibilities for a more structured approach, with gradual transitions and deeper collaboration to unlock synergies. Leadership must also focus on "aimed innovation," directing resources toward select high-impact initiatives rather than diffusing efforts too broadly.

In the context of Bulsink agility has driven success, but a lack of structured innovation processes limits long-term potential. To enhance the impact of local innovations across the company, Bulsink should strengthen standardization and knowledge management by establishing clearer workflows and a centralized system for best practices. This would enable successful innovations to be efficiently scaled and integrated across the organization. A dual-structure approach, separating complex projects from fast-paced retail work, could enhance efficiency while maintaining flexibility. A dedicated R&D function would drive continuous innovation, reducing reliance on ad-hoc efforts and individual champions.

By applying insights from the CLD models, both Group Jansen and Bulsink can refine their organizational structures, strengthen innovation capacity, and drive long-term growth. By aligning business models with targeted innovation strategies, companies can streamline workflows, enhance collaboration, and maintain competitive in its dynamic industry.

While this study provides valuable insights into how organizational structures influence innovation in service-based construction firms, several limitations offer opportunities for further research. The complexity of the CLD may hinder practical accessibility, suggesting possible future developments to make it more self-explanatory. Expanding the participant pool to include a broader range of roles and organizations would improve generalizability and reduce bias. Additionally, future research could develop a quantitative model to measure innovation gaps, explore the origins of impactful innovations, and examine cultural and company-specific factors that influence innovation dynamics.

Samenvatting

Deze scriptie onderzoekt hoe de organisatiestructuur innovatie beïnvloedt in dienstgerichte bouwbedrijven. De scriptie vergelijkt verticale en horizontale structuren om hun invloed op procesinnovatie te begrijpen en maakt hierbij gebruik van de zogeheten “system dynamic modeling” om de proces dynamiek te visualiseren en vast te leggen. De hoofdvraag van de studie is de volgende:

“Hoe beïnvloeden verticale en horizontale organisatiestructuren in dienstgerichte bouwbedrijven procesinnovatie, en hoe kunnen deze worden verbeterd om innovatie te stimuleren?”

Een “mixed-method” onderzoek aanpak werd gebruikt om deze vraag te beantwoorden, inclusief de volgende methoden. Een systematische literatuurstudie, volgens de PRISMA-richtlijnen, vormde een theoretische basis over organisatiestructuren en innovatie. Een casestudy vergeleek twee bouwbedrijven en analyseerde hun structuren en innovatiestrategieën door middel van semigestructureerde interviews met 16 medewerkers van de bedrijven. De Gioia-methode werd toegepast om thema’s te identificeren, die vervolgens werden verfijnd tot bredere geaggregeerde dimensies, waaronder menselijke-, visie-, externe- en organisatorische factoren.

Deze resultaten werden geïntegreerd als variabelen in een “system dynamics (SD)” model in de vorm van een “Causal Loop Diagram (CLD)”. Deze diagram brengt de causale relaties tussen de variabelen in kaart en bied zo een compleet beeld van de dynamiek die innovatie binnen deze organisatiestructuren beïnvloedt.

Modellering op basis van SD biedt een praktische manier voor bedrijven om hun strategieën te evalueren en te verfijnen voordat ze middelen inzetten. Door context specifieke inzichten te integreren en de meest invloedrijke variabelen te identificeren, kunnen bedrijven hun structuren beter afstemmen op hun innovatiedoelen. Deze aanpak stelt hen in staat om sterke en zwakke punten binnen hun specifieke context te herkennen. Dit leidt tot beter onderbouwde beslissingen die langdurige verbeteringen stimuleren.

De scriptie verfijnt het geformuleerde CLD door aanvullende interviews met de oorspronkelijke deelnemers. Op basis hiervan wordt model gevalideerd en aangepast op basis van verschillende contexten. Dit zijn de volgende specifieke contexten: de bouwsector, verticaal gestructureerde bedrijven en horizontaal gestructureerde bedrijven. Interviewdeelnemers identificeerden de meest invloedrijke factoren voor elke context, deze werd vervolgens visueel benadrukt in het CLD om hun verhoogde significantie weer te geven.

Dit resulteerde in drie sub-versies van het algemene CLD waarbij elk de nadruk legde op verschillende variabelen die bijzonder belangrijk waren in hun respectieve context. De eerste is het bouwsector CLD, waarin mens gedreven innovatie, marktvraagstukken, standaardisatie en extern-gestuurde innovatie als focusvariabelen naar voren kwamen. De tweede is het verticale organisatiestructuur CLD, dat het belang van een leiderschap gedreven cultuur, organisatiestructuur en standaardisatie benadrukte. Hierbij heeft dit model haar kracht in controle en efficiëntie. Ten slotte wees het horizontale structuur CLD op mens gedreven innovatie, wendbaarheid, een leiderschap gedreven cultuur en organisatorische flexibiliteit als centrale factoren. In deze context zijn het aanpassingsvermogen en de responsiviteit van essentieel belang.

De bevindingen uit de semigestructureerde interviews onthullen aanzienlijke verschillen tussen verticale en horizontale structuren bij het bevorderen van innovatie. Verticale integratie biedt meer controle over de toeleveringsketen en profiteert daarom het meest van verbeterde controle, coördinatie en middelenbeheer gedurende de projectfasen. Deze structuur maakt systematische innovatie mogelijk en zorgt voor continuïteit en efficiëntie in grootschalige projecten. Daarbij brengt het ook hoge kosten en complexiteit met zich mee. Het vereist sterk management om de balans tussen complexiteit en integratie voordelen tot een positief resultaat te brengen. Horizontale structuren geven doorgaans prioriteit aan flexibiliteit en specialisatie, waardoor ze geschikt zijn voor incrementele innovatie. Deze bedrijven kunnen zich snel aanpassen aan veranderingen, maar ondervinden vaak uitdagingen bij het coördineren tussen verschillende disciplines, wat leidt tot inefficiënties in samenwerking en langdurige kennisbehoud.

De gespecificeerde horizontale en verticale CLD's werden ontwikkeld op basis van gegevens van Group Jansen en Bulsink. Doormiddel van het inzetten van de modellen om eerdere ontwikkelingen en uitdagingen binnen deze bedrijven te analyseren, kwamen belangrijke inzichten naar voren over hun organisatie-dynamiek in relatie tot de innovatieprocessen.

Voor Group Jansen vereist het maximaliseren van de voordelen van verticale integratie een grotere mate van standaardisatie en strategische afstemming van de onderdelen van de Jansen Groep. Gedeelde systemen, gecentraliseerde inkoop en gestroomlijnde communicatie zouden de efficiëntie verbeteren. Eerdere integraties tonen de mogelijkheden voor een meer gestructureerde aanpak, met geleidelijke transities en diepere samenwerking om synergiën te benutten. Het leiderschap moet zich ook richten op gerichte innovatie, waarbij middelen worden ingezet op een select aantal initiatieven met hoge impact in plaats van middelen breed te spreiden.

In de context van Bulsink heeft wendbaarheid succes gebracht, maar een gebrek aan gestructureerde innovatieprocessen beperkt het lange termijn potentieel. Om de impact van lokale innovaties binnen het bedrijf te versterken, zou Bulsink standaardisatie en kennismanagement moeten verbeteren door duidelijkere werkprocessen te creëren en een gecentraliseerd systeem voor kennisdeling op te zetten. Dit zou succesvolle innovaties efficiënter schaalbaar en beter te integreren maken binnen de organisatie. Een duale-structuur aanpak, waarbij complexe projecten worden gescheiden van snelle Retail werkzaamheden, zou de efficiëntie kunnen verbeteren zonder flexibiliteit te verliezen. Een toegewijde R&D-afdeling zou continue innovatie stimuleren, waardoor de afhankelijkheid van ad-hoc initiatieven en individuele initiatiefnemers worden verminderd.

Door inzichten uit de CLD-modellen toe te passen, kunnen zowel Group Jansen als Bulsink hun organisatiestructuren verfijnen, hun innovatiecapaciteit verhogen en hun lange termijn groei stimuleren. Door bedrijfsmodellen af te stemmen op gerichte innovatiestrategieën kunnen bedrijven werkprocessen stroomlijnen, samenwerking verbeteren en concurrerend blijven in hun dynamische sector.

De studie bevat enkele beperkingen en daarmee mogelijkheden voor verder onderzoek. De complexiteit van het CLD kan de toegankelijkheid bemoeilijken, toekomstige ontwikkelingen zouden het model meer voor zichzelf sprekend kunnen maken. Het uitbreiden van de deelnemersgroep om een breder scala aan rollen en organisaties te omvatten zou de robuustheid van het onderzoek verbeteren. Daarnaast zou toekomstig onderzoek een kwantitatief model kunnen ontwikkelen om innovatiekloven te meten, de oorsprong van impactvolle innovaties te onderzoeken en culturele en bedrijfsspecifieke factoren te analyseren die de innovatie-dynamiek beïnvloeden.

Abstract

This thesis investigates how vertical and horizontal organizational structures influence innovation in service-based construction companies and applies system dynamics models to create a holistic view of these processes. Utilizing a mixed-method approach, the research integrates semi-structured interviews, Gioia analysis, and system dynamics modeling to analyze two case-study companies with contrasting organizational strategies. One company has a vertically integrated structure and the other a horizontally integrated structure. The study aims to answer the central research question:

*"*How do vertical and horizontal organizational structures in service-based construction companies influence process innovation, and how can these be improved to stimulate innovation?"

A mixed-method approach, including a literature review, case study, and interviews, was used to develop a Causal Loop Diagram (CLD) mapping innovation dynamics. The Gioia method identified themes, which were integrated into a system dynamics model. Additional interviews refined and validated the CLD, adapting it to three contexts: construction industry, vertical structures, and horizontal structures.

These CLDs visualize feedback loops and identify potential leverage points affecting innovation capacity. These diagrams provide a systemic view of the interdependencies between organizational factors, such as leadership, workflow design, and collaboration mechanisms, and their influence on innovation outcomes. Furthermore, the study examines the role of organizational context in shaping innovation dynamics. Hereby stressing how specific organizational frameworks and context interact with market and operational conditions to influence innovation performance.

The thesis reveals that vertical organizational structures can enhance control, coordination, and resource integration across project phases, thereby fostering systemic innovation. However, such structures demand substantial financial and operational resources and involve higher levels of complexity, requiring effective management to ensure good operational performance. In contrast, horizontal structures promote agility and specialization, which enable incremental innovations and faster adaptability. However, these firms often struggle with cross-functional collaboration and face challenges in maintaining clear organizational structures due to their higher flexibility and employee autonomy.

Connecting theoretical insights with practical applications, the study offers actionable recommendations to overcome structural inefficiencies and enhance innovation capacity. Enabling service-based construction firms to optimize their workflows and achieve greater adaptability in the dynamic and competitive market conditions of the construction industry.

Key words: Organizational Structures, Innovation Mechanisms, Vertical Integration, Horizontal Integration, Construction Industry

List of Abbreviations/Glossary

1. **Architectural Innovation:**
   Innovations that restructure system-wide relationships between modules or elements within an organization, often requiring significant changes to organizational workflows (Levitt & Sheffer, 2011).
2. **Barriers to Innovation:**
   Factors that hinder innovation efforts, such as financial constraints, time limitations, regulatory pressures, and resistance to change (Gunduz & Alfar, 2019).
3. **Causal Loop Diagram (CLD):**
   A visual representation of the dynamic relationships and feedback loops between variables that influence a system's behavior, often used in system dynamics modeling (Sterman, 2000).
4. **Dynamic Capabilities:**
   A firm's ability to reconfigure and integrate internal and external resources to respond to changing environments and market demands (Wang et al., 2023).
5. **Exploratory vs. Exploitative Innovation:**
   Exploratory innovation focuses on new ideas and experimentation, while exploitative innovation emphasizes refining and improving existing practices (Duodu et al., 2023).
6. **Horizontal Integration:**
   A structure where firms specialize in particular project phases or disciplines, leading to expertise but limited cross-phase collaboration (Hall et al., 2018).
7. **Human-Driven Innovation:**
   Bottom-up innovation that arises from employees' ideas, skills, and contributions within the organization, complementing strategic top-down initiatives (Sorensen et al., 2018).
8. **Incremental Innovation:**
   Small-scale improvements to existing systems, processes, or products aimed at enhancing efficiency or resolving immediate issues (Hall et al., 2019).
9. **Innovation Capacity:**
   A firm's ability to manage resources, competencies, and processes to foster innovation and generate new ideas or adopt external innovations (Yusof et al., 2022).
10. **Innovation Champion:**
    An individual who advocates for, implements, and sustains innovation within an organization by mobilizing resources and influencing stakeholders (Loosemore et al., 2022).
11. **Innovation Gap:**
    The difference between a firm's current innovation capacity and its desired level of innovation performance.
12. **Innovation:**
    The generation, development, and implementation of ideas, processes, or products that are new to an organization and offer practical or commercial benefits, including the adoption of external innovations (Park et al., 2004).

13. **Mirroring Trap:**
    A phenomenon where tightly aligned organizational structures reinforce rigidity and prevent systemic innovation due to over-specialization and inflexible workflows (Hall et al., 2019).
14. **Modular Innovation:**
    Innovations that update or enhance specific system components without altering the system's overall architecture, typically low in complexity and adaptable (Xie et al., 2015).
15. **Organizational Ambidexterity:**
    The capability to balance exploratory innovations (pursuing novel initiatives) with exploitative innovations (optimizing existing processes) within the same organization (Duodu et al., 2023).
16. **Organizational Structure:**
    The arrangement of roles, responsibilities, and communication pathways within an organization. Structures can be horizontal (specialization within phases), vertical (integration across multiple phases), or longitudinal (collaboration across projects) (Hall et al., 2019).
17. **Servitization:**
    The strategy of integrating services into product offerings to create added value and enhance customer experience, often requiring extensive resource investment (Li et al., 2024).
18. **Supply Chain Integration Practices (SCIPs):**
    Collaborative mechanisms such as project team colocation, multiparty incentivized contracts, and digital tool integration (e.g., BIM), designed to foster innovation through communication and risk-sharing (Hall et al., 2018).
19. **System dynamics (SD):**
    provides a framework for understanding complex problems by modeling interactions and feedback loops within systems. It integrates social, economic, environmental, and technological factors to analyze system behavior over time. SD supports strategic decision-making through scenario testing and sensitivity analysis, allowing stakeholders to explore policies before implementation. Its visual modeling tools improve communication and foster a shared understanding of dynamics. By the possible incorporation of qualitative and quantitative data, SD is a valuable tool for forecasting, planning, and driving systemic change across various fields.
20. **Systemic Innovation:**
    A form of radical innovation that reorganizes value chains by redefining workflows, requiring multiple firms to adapt collaboratively (Taylor, 2005). Examples include modular construction and smart building systems.
21. **PRISMA framework**
    The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework is a standardized guideline designed to enhance the transparency, completeness, and accuracy of systematic reviews and meta-analyses. Originally developed in 2009 and later updated in 2020, PRISMA provides a 27-item checklist and a flow diagram that assists researchers in systematically identifying, selecting, evaluating, and synthesizing relevant studies. While initially developed for healthcare research, PRISMA is widely applicable across various disciplines, including social sciences and management. By following the PRISMA framework, researchers can ensure reproducibility, minimize bias, and facilitate evidence-based decision-making (Page et al., 2021).

22. **Vertical Integration:**
    A structure where multiple lifecycle phases are integrated within a single organization, enabling greater control but requiring significant financial investment (Hall et al., 2018).

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1. Introduction

As the construction business environment becomes increasingly complex and competitive, business model innovation has emerged as an essential factor for sustaining competitive advantage in the global construction market (Jang et al., 2020). While the construction industry has often been criticized for its perceived lack of innovation, research by Brockman et al. (2016) highlights the transformative potential of megaprojects. These large-scale initiatives drive systemic changes and foster multi-level innovation through complexity, interdependence, and the leadership of innovation champions, even achieving breakthroughs like doubling construction speeds through incremental advancements. Such projects underscore the sector's potential for tailored collaboration and contractual flexibility to enable meaningful innovation. The transformative potential of innovation to improve project performance in critical areas such as cost reduction, time efficiency, quality enhancement, and technological progress is widely acknowledged in existing literature. However, the level of innovation adoption in the construction industry remains behind that of many other sectors (Gunduz & Alfar, 2019).

within the construction industry innovation is recognized as a dynamic and market-dependent concept, influenced by organizational structure, vision, and goals (Kamal et al., 2016; Duodo & Rowlinson, 2021). To refine the study's focus, the value disciplines as outlined by Treacy and Wiersema (1993) are integrated. This paper includes multiple value addition methods titled; Operational Excellence, Customer Intimacy, and Product Leadership which together provide a framework for understanding how companies create value. Operational Excellence emphasizes efficiency through streamlined processes, cost reduction, and supply chain optimization, focusing on reliability and low-cost delivery. Customer Intimacy prioritizes personalized solutions and strong relationships, creating value through tailored services and long-term loyalty. Product Leadership focuses on continuous innovation and state-of-the-art product development, driving market differentiation and enhancing customer experiences. Companies typically align their strategies to excel in one of these areas, creating distinct value by focusing either on efficiency, personalization, or product innovation (Treacy, 1993).

According to Li et al. (2024) servitization is occurring within the construction industry. This definition describes the transformation of companies from being product-centric to service-centric. In this context production-centric firms, positioned upstream, manufacture materials like steel and concrete. Their innovation is product-focused, aimed at improving material properties and refining manufacturing techniques, aligning with Product Leadership by advancing construction technologies rather than their application. In contrast, service firms, operating downstream, focus on project coordination, managing logistics, stakeholders, and integrating construction elements. Their innovation is process-driven to improve efficiency and strengthen client relationships, aligning with Operational Excellence and Customer Intimacy strategies (Li et al., 2024).

The construction industry is an inherently fragmented one, operating within a network structure defined by project-based organizations. This fragmentation manifests in three forms: horizontal, vertical, and longitudinal. Horizontal fragmentation occurs within a single project phase, vertical fragmentation spans different phases, and longitudinal fragmentation arises across projects, limiting knowledge retention and innovation scalability (Hall et al., 2019). The industry's project-oriented nature and inflexible structures, often referred to as the "mirror trap, a phenomenon where tightly aligned tasks and structures reinforce rigidity, hindering the adoption of systemic innovations," further hinder systemic innovation and the

adoption of new technologies, making cross-functional integration and long-term collaboration challenging (Hall et al., 2019).

Awareness of organizational structures and strategies is essential to align innovation efforts with specific strengths and performance drivers. Distinct business models that emphasize diversification, resource allocation, or focused efforts provide the foundation for tailored innovation strategies, enhancing profitability, growth, and market adaptability (Jang et al., 2020). However, the sector's historical resistance to change, amplified by a tendency to view innovations as liabilities rather than opportunities, has upheld issues like project delays, cost overruns, high carbon emissions, and construction waste. This "innovation negativism," often rooted in past failures, underscores the urgency of fostering a cultural shift towards embracing innovation (Saad et al., 2023).

According to Duodu et al. (2023) navigating this complexity often brings challenges between exploratory and exploitative innovations. This underpins organizational ambidexterity, a capability to simultaneously pursue novel innovations while optimizing existing processes. However, achieving this balance remains a challenge due to resource competition and managerial tensions. Furthermore, limited investments in research and development (R&D) and structural barriers within firms restrict the effective leveraging of external knowledge, underscoring the importance of addressing organizational inefficiencies.

Innovation diffusion in construction operates on multiple levels: micro (firm-level adoption), meso (inter-firm collaboration), and macro (market-wide adoption). Misalignments across these levels, driven by the industry's fragmented and project-based nature, slow the spread of innovations like Building Information Modeling (BIM). Effective innovation adoption extends beyond technological shifts to encompass workflow adjustments and collaboration strategies, necessitating alignment across organizational and inter-organizational contexts (Papadonikolaki, 2018). Therefore, the thesis research will focus on micro- and meso-level innovation of companies within the construction industry.

However, the level of involvement in the innovation process varies across construction organizations. Consultants and project management firms lead the way, while contractors, suppliers, and owners often face constraints due to limited flexibility or responsibility (Gunduz & Alfar, 2019). The unique characteristics of the construction industry, including site-based operations and temporary supply chains, challenge traditional innovation metrics, calling for context-specific evaluation frameworks (Wang et al., 2023).

According to research by Wang et al. (2023) future research underscores the pivotal role of organizational structures and inter-organizational collaboration in advancing innovation within the construction industry. As information and industrial technologies continue to reshape organizational formats, team management, and collaboration frameworks, these factors are becoming increasingly vital for fostering innovation (Wang et al., 2023).

1.1. Research Problem Definition

In the rapidly evolving construction industry, understanding how organizational structures influence innovation capacity is crucial for ensuring competitiveness and driving transformative progress. Structural barriers such as fragmentation, inefficiencies, and "innovation negativism" have hindered the sector's ability to foster collaboration and achieve sustained and continues progress. Addressing these challenges requires adaptive strategies and a deeper exploration of how organizational frameworks shape innovation processes and industry dynamics.

Despite extensive research on the definitions and drivers of innovation (Van Nguyen, 2023;Yusof et al., 2022; Ozorhon et al.,2015), as well as on the impact of vertical and horizontal structures in construction firms (Want et al., 2023; Yin et al., 2022; Hall et al., 2018), a critical gap remains. Existing studies often fail to provide dynamic, actionable tools that can be used to optimize internal processes and enhance innovation. The fragmented nature of the construction industry, coupled with systemic challenges, stress the urgent need for a practical framework to address these issues.

The interplay of numerous variables actively shaping innovation capacity in service-based construction firms demands a structured approach. The industry's inherent fragmentation and project-driven nature further complicate these dynamics, limiting the effectiveness of conventional empirical methods. Guan et al. (2024) highlight similar challenges, emphasizing the need for interdisciplinary approaches like system dynamics (SD) to better capture these complex interconnections. Therefore, this thesis applies SD to investigate the relationships between organizational structures and innovation. SD enables decision-makers to model real-world systems, visualize feedback loops, and test scenarios, thereby supporting policy evaluation and strategic planning. By integrating qualitative and quantitative data, SD offers a comprehensive framework for optimizing innovation processes in complex organizational environments (Malbon & Parkhurst, 2022).

Building on this, the study aims to develop a system dynamics model. The model is designed to identify potential leverage points within organizational structures, thereby enabling firms to adjust processes, foster innovation, and overcome structural inefficiencies. In this way coupling theoretical insights to practical applications and offering a dynamic, firm-level tool to actively shape innovation outcomes in complex and evolving environments.

1.2. Research Questions

The overarching research question of this thesis is the following:

"How do vertical and horizontal organizational structures in service-based construction companies influence the mechanisms of process innovation, and how can these be improved to stimulate innovation?"

To address the main research question the study is structured around four sub-questions. Each sub-question is designed to systematically address specific aspects of the research, enabling a gradual and coherent progression towards answering the main research question. The sub-questions and respective contribution to the main research question are the following:

The first sub-question is designed to explore the organizational structure characteristics and their influence. In this first phase a systematic literature review will be conducted to answer the following question:

"How do various organizational structures within the construction industry shape innovation capabilities and internal processes, and what modifications can enhance their positive influence?"

This question aims to establish a foundational understanding of the characteristics of organizational structures in construction firms. By identifying the main factors and their influence on innovation, this

phase provides a basis for analyzing how specific organizational components affect internal workflows and innovation capacity. It also explores how modifications to internal connections and processes can mitigate structural inefficiencies and foster innovation.

The second sub-question regards innovation and influential factors within the context of the construction industry and is guided by the following research question:

“What are the key types of innovation in the construction industry, and what factors influence a firm’s capacity to adopt and implement these innovations effectively?”

The purpose of this question is to explore the definition of the concept of innovation, types of innovation, and their relevance to the construction industry. It examines the internal factors that enable or hinder a firm’s innovation capacity, providing insights into the organizational dynamics that support successful innovation. Answering this question lays the groundwork for understanding how internal elements interact with broader factors.

The third sub-question focusses on the formulation of the general Causal Loop Diagram (CLD) which illustrates the inter factor correlations and their influence on the innovation capacity of a construction firm. This sub-question is formulated as follows:

“How can the critical organizational factors and their interrelations be mapped to effectively predict the impact of structural interventions on innovation capacity and overall performance?”

This question focuses on synthesizing the findings from the previous phases into a general CLD. The CLD serves as a visual tool to map the relationships between organizational factors, workflows, and their influence on innovation capacity. By capturing these interdependencies, the diagram provides a comprehensive understanding of the systemic dynamics within a construction firm, allowing for the prediction of outcomes resulting from structural interventions.

The last phase of the research includes the specification of the previously formulated general CLD. The fourth and fifth sub-questions which respectively investigate the differentiation of the CLD regarding organizational structures and influence of the service based construction industry are formulated as follows:

"How do the distinct characteristics of the construction sector shape innovation mechanisms and the relative importance of influential factors in driving innovation?”

&

“How do vertical and horizontal organizational structures influence innovation capacity, and what practical insights can be derived to optimize organizational strategies in service-based construction firms?"

These questions define the last phase which builds on the general CLD by distinguishing the varying importance and influence of specific components within different organizational structures and industry context. It aims to refine the model to capture these structural distinctions and their impacts on innovation mechanisms. The insights gained from this refined CLDs will provide practical

recommendations for optimizing organizational strategies tailored to specific structural contexts within the service-based construction sector.

1.3. Research Design

This thesis employs a structured mixed-method approach. Figure 1 contains an illustration of how the sub-questions are linked to each other and what methods or inputs will be used in order to answer each question. The study begins with a systematic literature review using the PRISMA framework, combined with company documentation, to build a foundational understanding of organizational structures in construction firms and their impact on innovation. It examines key factors that shape innovation capacity, exploring both enabling and limiting internal dynamics. By analyzing how organizational components influence workflows and how structural modifications can mitigate inefficiencies, insides in innovation and their influencing mechanisms are gained. furthermore, it allows for definitions of innovation, its types, and its relevance to the construction industry, offering a basis for understanding the interplay between internal structures and broader innovation drivers.

The research further involves the execution of semi-structured interviews, the Gioia method, and system dynamics modeling, focusing on two privately owned service-based construction firms. Of these firms one is classified as a horizontal organization and the other as a vertical organization. By examining horizontal and vertical integration, the study explores their impact on organizational performance in dynamic market conditions.

Insights from the literature review provide a base to execute the semi-guided interviews, which are analyzed using the Gioia method to develop a CLD. This diagram maps key influential factors and their relationships which determine innovation capacity. To ensure accuracy, the CLD is refined and validated through targeted interviews with company experts.

The research then adapts the CLD to reflect industry-specific factors and organizational structure influences, highlighting strengths and weaknesses of different structures and context. The final outcome provides practical recommendations for optimizing organizational strategies tailored to the demands of vertical and horizontal structures in service-based construction.

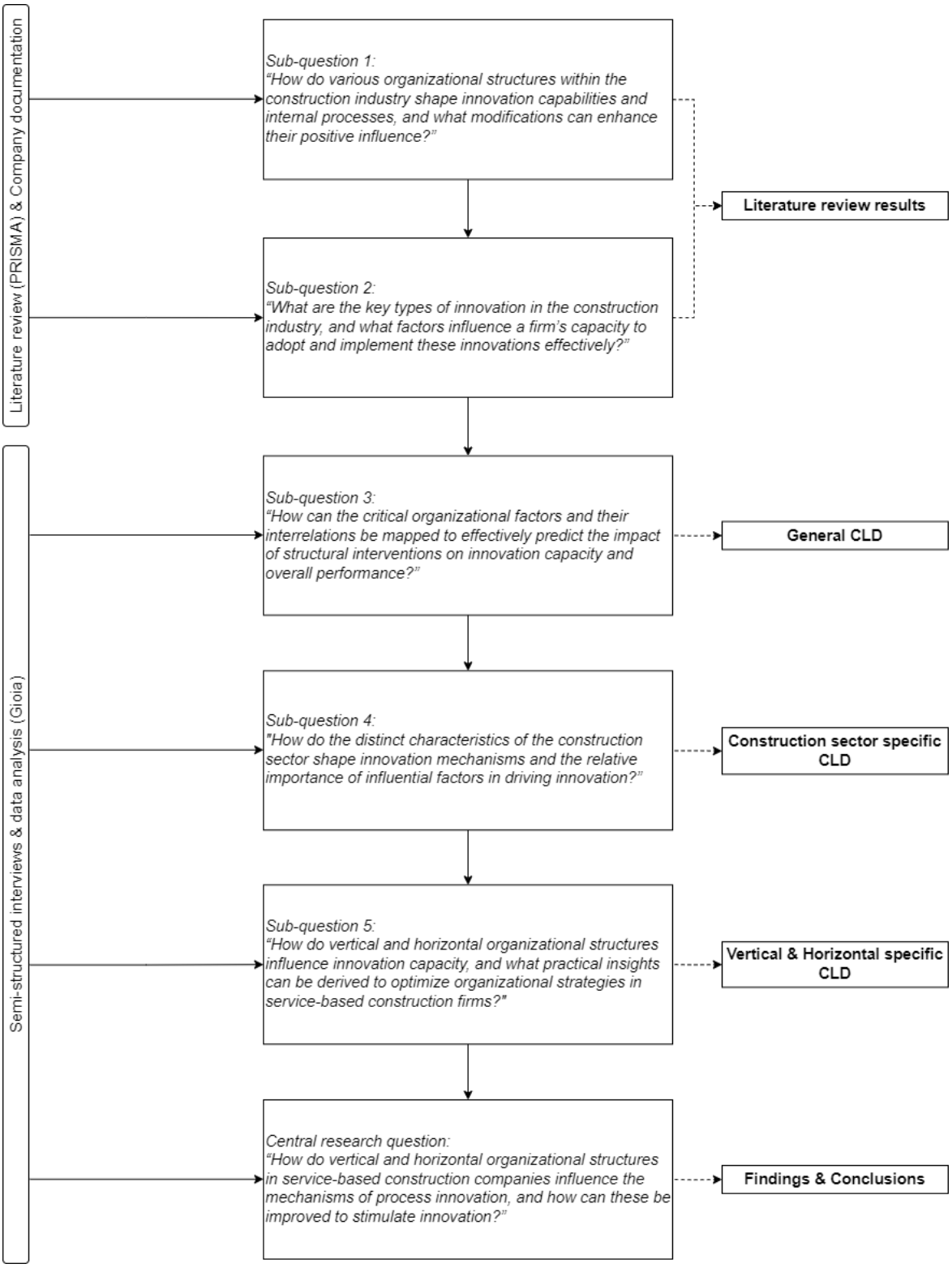


Figure 1: Research design

1.4. Importance of the Research

The study explores the relationship between organizational structure and innovation capacity, offering a pragmatic template for construction organizations to overcome industry issues. Through creating and specification of a CLD, the study provides an interactive tool to visualize systemic interactions in organizations with the influence of innovation. This analysis of vertical and horizontal structures also identifies possible leverage points influencing capacity for innovation that enable firms to optimize strategies to improve processes, better allocate resources to innovative practices, and embed systemic innovations within the workflow. In summary, this study provides construction companies with a robust framework to guide sustainable development, fostering a holistic approach when implementing new innovations or reviewing past ones.

1.5. Reading Guide

The structure of this thesis is designed to provide a clear and coherent overview of the research process, findings, and conclusions. The thesis begins with an Introduction, which frames the challenges of fostering innovation within the fragmented construction industry. This section defines the research problem, objectives, and central research question, emphasizing the role of vertical and horizontal organizational structures in shaping innovation capacity.

Following this, the Literature Review establishes a theoretical foundation by investigating organizational structures and defining key innovation concepts. This section integrates the systematic PRISMA framework to structure data collection and highlight organizational and innovation-related factors that influence the research scope.

The Research Methodology chapter outlines the mixed-method approach adopted for this study, detailing the qualitative techniques used. A key focus is placed on the application of the Gioia method, which identifies themes from qualitative data and refines them into broader aggregate dimensions. Additionally, the methodology incorporates system dynamics modeling, providing a structured approach to mapping complex interactions influencing innovation capacity. The chapter also introduces the case study companies, describes the data collection process, and details the steps taken to ensure analytical transparency and replicability.

The Results section presents the development of a general CLD, which visualizes the intricate interconnections between factors influencing innovation capacity. The Gioia method plays a central role in refining this model by extracting structured themes and respective aggregate dimensions from the interview data. The CLD highlights feedback loops consisting out of causalities between variables and which are categorized under human, vision, external, and organizational factors. Both these variables and the categories are derived using the Gioia method. Each loop examined in detail the included variables to reveal its contribution to innovation dynamics within service-based construction firms. Conducting interviews with experts plays a significant role in refining this model and extracting reoccurring indicated significance of variables. The findings further specify how innovation dynamics differ between vertically and horizontally structured firms, offering distinct perspectives on organizational influence.

The Practical Implications section translates the research findings into actionable recommendations. Here, the refined CLD is used to emphasize key variables that vary in importance depending on

organizational structure. It provides strategic insights into how firms can optimize their structures to enhance innovation capacity, balancing flexibility and control to achieve sustainable growth.

The thesis concludes with a Discussion and Conclusion, summarizing the contributions of the study, its limitations, and possibilities for future research. This final section reflects on how the insights gained can inform both academic discourse and industry practices, suggesting possibilities for further research in construction management and organizational innovation.

2. Literature Review

This study employs the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, a globally recognized standard designed to enhance transparency and rigor in systematic reviews. Originally introduced as the QUOROM (Quality of Reporting of Meta-Analyses) statement, PRISMA was redefined and expanded in 2009 to incorporate advancements in systematic review methodology and extend its applicability across disciplines (Moher et al., 2010). Its structured methodology facilitates the identification, selection, and appraisal of studies, ensuring robust synthesis and reproducibility (Page et al., 2021).

The PRISMA framework is characterized by its flow diagram which standardizes the reporting process to enhance clarity and consistency. It facilitates comprehensive search techniques, clearly stated inclusion and exclusion criteria, and transparent synthesis approaches, which provide assurance of the reliability and replicability of findings. The framework allows for thorough documentation of every stage of the selection process, allowing for precise tracking of the number of studies identified, screened and included in the final review (Moher et al., 2010).

In this review, PRISMA has been adopted to systematically evaluate key factors driving innovation in the construction sector. Its focus on minimizing bias and maximizing reproducibility aligns with the need for reliable insights in this multidisciplinary field. The framework underpins the generation of findings that not only advance theoretical understanding but also offer practical relevance to the challenges faced by the construction industry (Liberati et al. 2009; Adeyinka-Ojo, 2021).

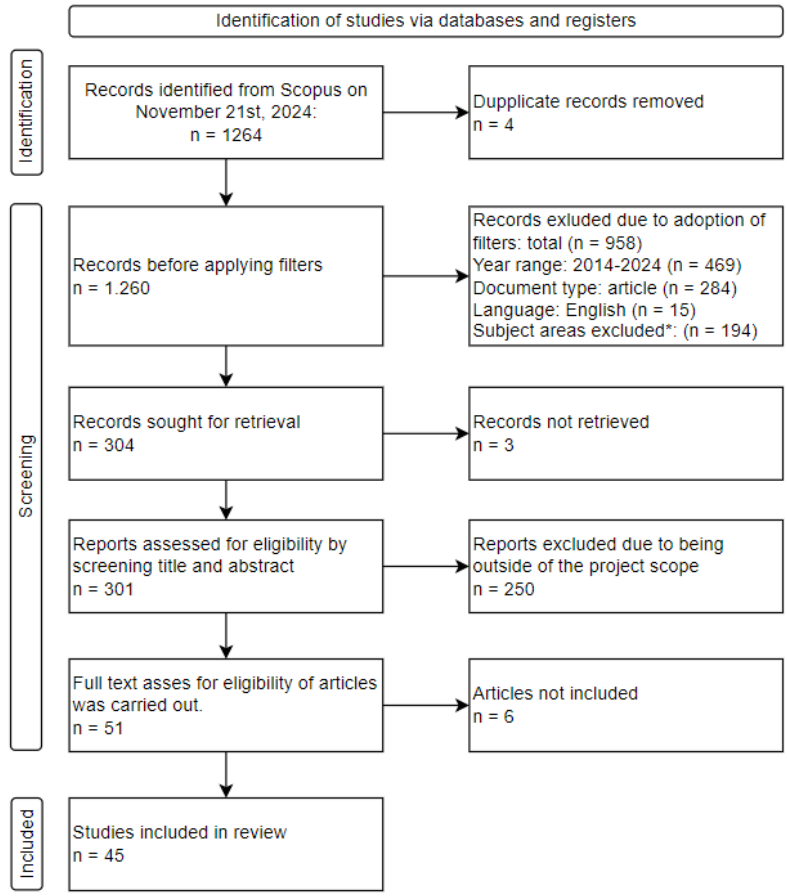
Using this approach, a thorough literature review on background information was performed.

Table 1 displays the search string used for the literature review and serves as a basis for this study. By defining this search string transparency of the research is assured. In addition to that this allows ensuring future research using the same search criteria, which would allow for consistency and comparability in follow-up studies. Figure 2 illustrates the PRISMA flow diagram. In the first round, the Scopus database was used to find 1,264 potentially relevant articles. Hereby only applying general constraints such as the requirement that papers should be no older than 2014. These general constraints are depicted in figure 2. After screening based on eligibility criteria which are summarized below figure 2, 304 articles which met the criteria remained. The review process, which initially screened articles based on titles and abstracts, resulted in the exclusion of 250 articles that did not align with the study's focus. Many of these articles, upon closer examination, fell outside the research scope due to misalignment with the thesis's emphasis on service-based construction companies. Specifically, studies that focused on production companies, material innovations, or product-specific advancements were excluded, as they did not contribute to the organizational and process-related perspective of this research. Furthermore, articles focusing on startup environments, developing countries, or unrelated industries were deemed irrelevant due to their divergence from the dynamics of established companies within the context of western society. This led to a number of 51 articles remaining for full-text review, in order to ensure the selection provided meaningful insights into the relationship between organizational structures and innovation processes within service-based construction firms. Consequently, six more papers were excluded resulting in 45 studies being selected as relevant and methodically strong. The application of the PRISMA framework ensures transparency, replicability, and the selection of a robust literature that underlies the theoretical architecture of the work.

The information source from which the used scientific articles are originating is the Scopus database. The search string which was executed on 21-11-2024 was the following:

Table 1: Utilized search string

Terms searched within **Article title AND Keywords** connected by **OR**	**AND**	Terms searched within **Article title, Abstract, Keywords** connected by **OR**	**AND**	Terms searched within **Article title, Abstract, Keywords** connected by **OR**
"Innovation"		"Construction industr*" **OR** "Construction sector*" **OR** "Project Based Organization*" **OR** "Project-driven*" **OR** "Service compan*" **OR** "Building sector*" **OR** "Building industr*"		"Horizontal" **OR** "Vertical" **OR** "Vertical integration" **OR** "Diversification" **OR** "Organizational structure*" **OR** "Organizational design" **OR** "Structure*" **OR** "Supply chain integration*" **OR** "Integration*"



* Subject areas which are excluded are: Agricultural and Biological Sciences, Arts and humanities, Biochemistry, Genetics and molecular biology, Chemical engineering, Computer Science, Earth and planetary sciences, Energy, Materials science, Mathematics, Medicine, Neuroscience, Physics and astronomy, Nursing, and Immunology and microbiology

Figure 2: PRISMA flow diagram

The systematic application of the PRISMA framework ensured a rigorous selection process, refining a broad pool of studies into a focused body of literature relevant to this thesis. By using a targeted search string and exclusion criteria, only studies aligned with the research objectives—specifically those exploring the relationship between organizational structures and innovation processes in service-based construction firms—were retained. This literature review provides a structured examination of these dynamics, beginning with an analysis of organizational structures, followed by an exploration of innovation types, internal organizational factors, and external influences. The chapter concludes with a discussion of barriers to innovation, offering a comprehensive foundation for addressing the research questions and informing the subsequent analysis.

2.1. Company Structure

The initial part of the literature review was aimed at answering the question: *"How do various organizational structures within the construction industry shape innovation capabilities and internal processes, and what modifications can enhance their positive influence?" Organizational structured are inevitably connected to t*he fragmented structure of the construction industry which often hinders the adoption of systemic innovations. Such innovations, which cross professional and trade boundaries, challenge established standards and redefine how modules are designed and integrated. Research indicates that vertical and horizontal integration within the supply chain significantly enhances the likelihood of systemic innovation adoption (Hall et al., 2018).

According to Hall et al. (2019) vertical integration allows firms to consolidate control over key processes. By integrating design, engineering, and manufacturing workflows can be streamlined. This leads to improved efficiency, and implementation of innovative systems like modular construction. However, this strategy requires significant financial investment and poses operational risks, highlighting the challenges of aligning organizational structures and resources (Hall et al., 2019). Vertical integration is most effective when supported by strong ownership vision, colocation, and early involvement. This fosters collaboration and shared control across the supply chain (Hall et al., 2018).

In contrast Hall et al. (2018) also states that horizontal integration leverages multiparty contracts that distribute risk and reward evenly among project stakeholders. These contracts encourage team accountability and align decisions with project-wide benefits. Tools like BIM and the Last Planner System (LPS) which facilitate communication of changed interfaces and workflows, enabling effective implementation of innovative practices (Hall et al., 2018).

2.1.1.Organizational Evolution and Collaboration

Advancements in information and industrialization technologies are reshaping organizational formats in construction, emphasizing the importance of team management and inter-organizational collaboration. An example of such an advancement is servitization, which is a strategy that integrates services into product development and offers a pathway to value creation. Though resource-intensive at first, it eventually enhances efficiency, service quality, and value chain expansion. Construction firms are advised to undertake servitization and R&D innovation strategically, aligning external development environments with internal resources (Li et al., 2024).

The study by Zulu et al. (2022) explores the relationship between collaboration and organizational evolution, highlighting structural influences on digital adoption. Vertical organizations are in general more hierarchical in nature (Hall et al., 2018). Therefore, these type of organizations face delays in digital transformation due to multi-layered decision-making. In contrast to this decentralized structures, often

being of horizontal nature, promote adaptability. This is due to the positive effects of employee autonomy and bottom-participation which accelerates technology uptake. However, efficient internal processes can mitigate hierarchical constraints, facilitating smoother digital integration. Additionally, larger firms, typically vertical, benefit from greater financial resources, enabling sustained investment in digitalization despite structural rigidity. A collaborative and training-oriented culture further enhances digital transformation by fostering openness to innovation and continuous learning (Zulu et al., 2022).

Both horizontal and vertical synergies are essential for driving innovation. Horizontal synergy, achieved through resource sharing among similar firms and markets, enhances knowledge integration and supports diverse partnerships. Vertical synergy, involving collaboration across the value chain, deepens resource integration and technological advancement. A balance between close collaborations for resource-intensive innovations and broader partnerships enables companies to establish more innovation and be able to explore new markets (Chen et al., 2024).

Zhoa et al. (2023) found that inter-organizational relationships, including trust and communication, play a crucial role in enhancing cross-organizational technological innovation (COTI), particularly in complex construction megaprojects. Centralized innovation networks with strong ties foster collaboration and resource integration among diverse stakeholders, improving innovation outcomes. The effectiveness of these networks is amplified by supportive policies, engineering demands, and an innovation-oriented culture (Zhao et al., 2023). While centralized networks provide clear coordination, decentralized networks, characterized by distributed leadership, can foster more bottom-up innovation initiatives (Papadonikolaki, 2018). Therefore, decentralized networks, driven by distributed leadership, can translate practical challenges into innovative solutions by fostering bottom-up initiatives and collaborative problem-solving.

2.1.2.Conclusion Company Structure

The initial part of the literature review is aimed to answer the first research question:

"How do various organizational structures within the construction industry shape innovation capabilities and internal processes, and what modifications can enhance their positive influence?"

Based on the executed background study the answer to this question is formulated as the following. As Kamal et al. (2016) concluded, the structure of a construction firm plays a defining role in its ability to foster and implement innovation. Some companies focus primarily on developing new technologies, while others specialize in adopting and refining existing solutions. The most innovative firms strike a balance between these two approaches, allowing them to adapt swiftly to changing market demands while maintaining technological leadership. A firm's ability to both identify opportunities and effectively exploit them is crucial for sustaining long-term innovation (Kamal et al., 2016).

Vertical integration enhances control and coordination across different project phases, streamlining workflows and enabling systemic innovation (Hall et al., 2019). By consolidating design, engineering, and production processes, vertically structured firms can optimize efficiency and minimize disruptions. However, this model comes with significant financial and operational risks, requiring strong leadership, strategic planning, and early stakeholder involvement to ensure that innovation efforts are successfully implemented (Hall et al., 2018).

On the other hand, horizontal integration fosters agility and specialization by leveraging external collaborations. Through multiparty contracts, firms distribute both risk and rewards, encouraging cross-disciplinary innovation (Hall et al., 2018). Tools such as BIM and the Last Planner System (LPS) facilitate streamlined communication, improving adaptability within a project's lifecycle. While horizontal structures allow for greater flexibility and market responsiveness, they can also present challenges in maintaining consistency and long-term knowledge retention across different projects.

Beyond these structural differences, advancements in technology and servitization have emphasized the need for stronger inter-organizational collaboration. Trust and knowledge-sharing between stakeholders are crucial for overcoming industry fragmentation and fostering innovation (Zhao et al., 2023). Centralized organizational networks offer structured coordination, supporting large-scale systemic innovation, whereas decentralized networks, driven by low level leadership, promote bottom-up initiatives and organizational adaptability (Papadonikolaki, 2018; Zulu et al., 2022). To maximize their innovation potential, successful firms balance both vertical and horizontal synergies by integrating resource-sharing strategies and aligning their internal capabilities with broader market dynamics (Chen et al., 2024).

Ultimately, a construction firm's innovation capacity depends on its ability to align its organizational structure with its strategic objectives. Vertically integrated firms benefit from centralized decision-making, comprehensive control over internal processes, and optimized resource allocation. However, they must navigate the complexities of financial investment and operational risks. Horizontal firms, in contrast, rely on specialization and external collaboration, enabling them to remain agile and responsive to market fluctuations. By understanding these structural advantages and limitations, firms can develop targeted integration strategies that foster sustained innovation, ensure resilience, and drive long-term growth in a competitive industry.

2.2. Innovation

Further literature research was subsequently done focused on innovation aiming to answer the following question: "What are the key types of innovation in the construction industry, and how do internal organizational factors influence a firm's capacity to adopt and implement these innovations effectively?". Research by Park et al. (2004) found that innovation is a key driver of progress and competitiveness in the construction industry, encompassing the development and application of new ideas, processes, and solutions that enhance value. The definition of innovation formulated in this research, based on background literature, is as follows: Innovation involves the generation, development, and implementation of ideas that are new to an organization and offer practical or commercial benefits, including the adoption of external products or processes (Park et al., 2004). The "PEN" model (Holt & Goulding, 2016) categorizes innovation into three core elements: Proactive Change (P) - intentional actions that drive change; Enhancement of Something Established (E) - building upon or improving existing ideas; and Creation of Something New (N) - introducing novel products, services, processes, or structures. By addressing both short-term improvements and long-term transformative changes, innovation shapes how firms respond to evolving industry demands, project complexities, and client expectations. Understanding the different types of innovation and their impact is essential for firms to align their strategic goals with industry advancements and foster sustained growth and performance.

2.2.1.Types of innovation

Innovation can be broadly categorized into systemic and incremental forms, each with distinct characteristics and applications. Systemic innovation, a form of radical innovation, drives transformative changes by redefining the boundaries of work traditionally handled by individual firms in the supply chain. Unlike incremental improvements, systemic innovations reorganize the entire value chain, requiring multiple firms to adapt their design, prefabrication, and assembly practices in a coordinated manner (Taylor, 2005). These innovations modify the interfaces between system modules or the overall system architecture and are therefore referred to as architectural innovations due to their significant restructuring of systems. While they enhance product value or productivity, they often incur switching or start-up costs for some participants and may reduce or even eliminate roles for others.

Examples of systemic innovations include radiant floor heating and smart building management systems, which introduce new design criteria, alter workflows, or change sequencing processes across multiple disciplines. Because they cross professional and trade boundaries, break industry norms, and require substantial investment and novel expertise, systemic innovations diffuse up to three times more slowly than modular innovations that fit within existing supply chains (Levitt & Sheffer, 2011). Achieving systemic innovation often necessitates a shift from project-based to process- or product-based strategies, leveraging digital tools and fostering cross-disciplinary collaboration to achieve long-term, industry-wide transformation (Hall et al., 2019; Yusof et al., 2022).

In contrast, incremental innovation emphasizes continuous improvements to existing systems, processes, or products, making it well-suited for smaller, ongoing enhancements. Incremental innovation aligns with strategies focused on refining workflows and technologies within the constraints of traditional project delivery models. Systemic or radical innovations drive long-term transformation and industry-wide efficiency gains due to their extensive and disruptive nature, while incremental innovations focus on immediate challenges, offering practical and efficient short-term improvements. Together, these innovation types reflect a spectrum of approaches that construction firms can adopt based on their capabilities, project scope, and strategic objectives. Innovation capability remains a critical determinant in harnessing the potential of both systemic and incremental innovations, shaping their overall impact on business outcomes (Hall et al., 2019; Yusof et al., 2022).

Innovation levels in construction firms vary, with around 25% engaging in product or process innovations. Larger firms often prioritize process improvements, leveraging their scale to enhance efficiency. In addition to that process improvements are inclined to be of a systemic nature and are therefore more resource intensive. Making it more fit for bigger companies which are able spend higher amount of resources on innovation (Barata & Fontainha, 2017). According to research conducted by Nguyen (2024) a Firms' innovation orientation falls into two dimensions: innovation adoption, integrating established solutions, and innovation creation, developing novel ones. The paper emphasizes the need to balance innovation adoption and creation. Stressing that an overemphasis on adoption can suppress creativity, while innovation creation involves greater risk and typically demands more resources. Although the perception of risk can hinder innovation creation, effective risk management encourages experimentation by providing a secure environment for innovation to thrive. In this context, modular innovation plays a key role by updating specific system components with adaptable, low-complexity knowledge, offering a lower-risk pathway to continuous improvement (Xie et al., 2015).

Innovation engagement varies significantly, shaped by factors such as firm size, risk management practices, and strategic orientation. Firm characteristics, including scale and age, also play a pivotal role in aligning innovation efforts with operational contexts to enhance industry competitiveness (Kamal et al., 2016). Larger firms with advanced capabilities often drive transformative outcomes, while smaller firms tend to excel in incremental innovations tailored to client needs. To remain competitive, construction firms must strike a balance between adopting existing innovations and creating new ones, leveraging systemic and modular approaches to support long-term growth and sustainability. Achieving this balance underscores the critical role of innovation in enhancing business performance and driving industry evolution.

2.2.2.Innovation Capability

Innovation capability, as defined by Yusof et al. (2022), refers to a company's ability to effectively manage resources, competencies, technologies, and systems to foster innovation and generate or adopt new ideas, products, or processes that create value. It encompasses both tangible and intangible resources and plays a crucial role in linking innovation efforts to business performance. Innovation capability is crucial for enhancing business performance, where resource investment, R&D collaboration, and training play a vital role. This capability mediates and moderates the relationship between innovation and performance, offering managers actionable insights for tailoring strategies to their organization’s strengths (Yusof et al., 2022).

The impact of different types of innovation on business performance largely depends on a firm's innovation capability, as this reflects its ability to use resources effectively (Kamal et al., 2022; Duodu et al., 2024). Since radical innovations are more resource-intensive, high innovation capability is crucial for firms pursuing systemic innovations to manage the complexities of transformative changes. In contrast, incremental innovations are better suited for firms with lower innovation capability, providing consistent gains through client-focused strategies and established processes. Firms with advanced capabilities should prioritize systemic innovations for maximum impact, while those with limited capabilities can achieve steady progress by focusing on incremental improvements (Yusof et al., 2022).

2.3. Innovation Factors Framework

Innovation in construction is shaped by a dynamic interplay of factors that influence both its initiation and implementation. This study applies the framework developed by Ozorhon et al. (2015) to categorize these factors into four key areas: drivers, enablers, inputs, and barriers. Drivers create the need for innovation, while enablers provide the conditions for its realization. Inputs represent the tangible resources required to implement innovation, whereas barriers present challenges that can hinder progress but are often mitigated by strong enablers (Gunduz & Alfar, 2019). Successful innovation leads to both project-level and firm-level benefits. By understanding the interconnections between influential factors, construction firms can develop targeted strategies that enhance competitiveness, optimize innovation management, and secure long-term growth (Ozorhon et al., 2015).

By categorizing innovation factors, this structured approach clarifies the mechanisms driving innovation, their interrelations, conditions, and constraints. This offers a comprehensive understanding of their impact on processes and innovation. The next chapter explores key drivers, enablers, and inputs of innovation. Followed by an analysis of barriers and resulting innovation outcomes and further implications.

2.3.1.Human Factors

Human factors play a crucial role in driving innovation within the construction industry. The heterogeneity of employees and project participants can both enable and complicate innovative efforts. Effective alignment of motivations, skills, and knowledge across diverse teams ensures successful implementation of complex innovations like BIM. Without this alignment, initiatives may fail due to fragmented goals or insufficient collaboration. Furthermore, fostering a culture that values innovation, safety, organizational trust, and supportive practices is essential for empowering employees to actively contribute to innovation processes. Mechanisms such as transparent decision-making and recognition of contributions motivate employees, particularly idea-owners, and promote sustained engagement in innovative practices (Sorensen et al., 2018).

Another component are champions which are individuals that advocating for, implementing, and sustaining innovation by addressing different facets of the innovation process. The paper by Loosemore et al. (2022) defined four types of champions. Champions of the Concept focus on incremental improvements by aligning initiatives with organizational goals and addressing resistance to change. Champions of Organizations take a top-down approach, emphasizing legitimacy and responding to external pressures. Champions of People lead human-centered innovations that prioritize inclusivity and equity, although they often face challenges with scalability. And finally, Champions of Solutions concentrate on targeted, efficient innovations within specific niches, though their adaptability may be limited (Loosemore et al., 2022).

The combined efforts of these diverse champion types are essential for achieving a balance between incremental and systemic innovation. By building coalitions and networks, champions foster relationships that generate support, overcome resistance, and establish trust among stakeholders. They use persuasive storytelling and tangible demonstrations of innovation benefits, such as enhanced social equity or competitive advantage, to secure buy-in and investment. Adaptability to organizational contexts and the ability to inspire confidence further enable champions to drive resource allocation and influence expectations, ultimately accelerating the adoption and success of innovation initiatives (Rutten et al., 2019).

2.3.2.Leadership Factors

Leadership plays a pivotal role in fostering innovation, acting as a critical enabler through commitment, effective collaboration, and strategic guidance (Gunduz & Alfar, 2019). Leadership styles, particularly transformational leadership, significantly influence a firm's capacity for innovation by creating a culture of adaptability, creativity, and knowledge sharing. Transformational leaders, who inspire and intellectually stimulate teams, drive collaboration and encourage personal growth, making them particularly effective in environments that prioritize innovation. They foster climates of open communication and learning, empowering employees with autonomy to take initiative while supporting them with resources and recognition (Liu et al., 2017; Pham et al., 2022).

Leadership shapes organizational culture which further reinforces innovation adoption by shaping how employees embrace change. Collaborative and interconnected cultures are particularly conducive to digital transformation and other innovation-driven initiatives (Zulu et al., 2023). When leadership and culture align, they foster an environment where innovation can thrive, enabling organizations to navigate change and sustain growth.

Strategic, outcome-focused leadership plays a crucial role in enhancing digital adoption and innovation by balancing long-term benefits with immediate organizational goals. Transformational leaders, who foster supportive environments, cultivate participation and idea generation by inspiring intrinsic motivation and creating a sense of purpose among employees (Chan et al., 2013). In contrast, transactional leadership, which focuses on contingent rewards, can also be effective when employees have high self-efficacy and are motivated by clear performance-based incentives (Zulu et al., 2023). However, leadership approaches that rely too heavily on extrinsic rewards risk stifling creativity and limiting innovative exploration.

To sustain continuous innovation, leaders can implement strategic interventions such as tailored training programs that foster ongoing learning and adaptability (Liu et al., 2017). Early involvement of key stakeholders and the establishment of interfirm project boards further strengthen cross-firm collaboration, ensuring that innovative ideas are thoroughly evaluated and receive the necessary support to succeed (Hall et al., 2018; Wang et al., 2023). By aligning leadership strategies with employee engagement and cross-organizational collaboration, firms can create an environment where innovation thrives, and long-term growth is sustained.

The role of leadership extends beyond internal teams to include external partnerships. In construction supply chains, effective leaders foster collaboration with supply chain partners, positioning leadership as a strategic tool to maintain competitive advantage through shared innovation efforts (Pham et al., 2022). The owner or client also plays a critical leadership role at the project level, with a strong vision for innovation ensuring centralized decision-making and enhanced system integration (Hall et al., 2018).

Top management teams (TMTs) with diverse knowledge bases enhance transformational leadership's effectiveness, boosting strategic flexibility and innovation. Governance structures also influence leadership impact, CEO duality improves innovation quality in less innovative firms but may limit quantity in highly innovative ones. Separating CEO and chairman roles in such firms ensures better oversight and mitigates risks from overconfident leadership (Zhang et al., 2024).

In summary, leadership is essential in driving innovation by fostering adaptability, creativity, and collaboration. Transformational leaders cultivate open communication, empower teams, and encourage proactive engagement, making them highly effective in innovation-focused environments. Strategic leadership enhances innovation by balancing long-term digital adoption with immediate goals, while intrinsic motivation fosters participation and idea generation. Conversely, passive or extrinsically driven approaches may limit creativity. Leadership also influences external partnerships, reinforcing competitive advantage through collaboration. Governance structures shape leadership impact, with diverse top management teams enhancing agility and CEO duality requiring balance to prevent overreach. Ultimately, effective leadership within organizations and across stakeholder networks is essential for sustained innovation and growth.

2.3.3. Vision and Company Culture Factors

As concluded by Papadonikolaki (2018) company’s vision, culture, and leadership are base parameters in shaping its innovation capacity, particularly in modernizing processes and enhancing quality. The company’s vision sets long-term goals and aspirations, serving as a compass that motivates employees to generate and pursue new ideas. A culture that embraces experimentation, risk-taking, and knowledge sharing creates an environment where innovation can thrive. Leadership, especially transformational leadership, plays a crucial role in fostering strategic flexibility by inspiring teams, promoting open

communication, and encouraging collaboration. This alignment between vision, culture, and leadership strengthens dynamic capabilities such as resource integration and opportunity recognition, enabling firms to adapt and innovate effectively.

Firms with strong innovation capabilities can leverage these strengths to pursue systemic innovations that lead to transformative breakthroughs, significantly enhancing their competitive position. Conversely, firms with lower innovation capacity benefit from focusing on incremental, client-driven innovations that improve processes and meet market-specific needs. These incremental innovations often rely on codified knowledge - documented in manuals, procedures, and standards - to support efficiency and consistent improvement. By integrating customer feedback and refining existing resources, companies can enhance their ability to deliver tailored, measurable outcomes (Yusof et al., 2022).

Communication, trust, and organizational commitment are fundamental for fostering knowledge sharing, which mediates the relationship between stakeholder collaboration and technological innovation. Effective knowledge sharing bridges expertise gaps, enabling stakeholders to overcome barriers and contribute to innovation. Trust, in particular, enhances the diffusion and integration of knowledge, underscoring its role in achieving sustained innovation outcomes (Ma et al., 2022).

As proved in the paper by Ning et al. (2024), the successful adoption of green technology innovations for buildings (GTIB) underscores the need for coordinated efforts among government, developers, and consumers. While developers often prioritize profit, sometimes at the expense of compliance with green building standards, consumer pressure and government regulations serve as powerful drivers for sustainable practices (Ning et al., 2024). Aligning these stakeholder interests through a systematic approach to innovation, rather than ad hoc initiatives, ensures sustained progress. By involving diverse stakeholders and cultivating a culture of innovation, organizations can align their processes with broader strategic goals, fostering environments that support the transfer of knowledge and the realization of transformative change (Yepes et al., 2015).

Organizational commitment, in the context of innovation, refers to the consistent support an organization provides to innovation initiatives and their leaders by allocating resources, fostering an open culture for experimentation, and recognizing innovative behavior. This commitment serves as the backbone of successful innovation, ensuring coherence and coordination across champions, resources, and organizational culture (Chan et al., 2013; Loosemore et al., 2022). Organizational commitment is essential for fostering dynamic capabilities, as it strengthens a firm's ability to integrate resources and seize opportunities for innovation. Additionally, it maximizes the impact of human factors by promoting a culture of engagement and collaboration. Support for innovation champions and employees helps overcome barriers like resource constraints and resistance to change, while leadership commitment legitimizes innovative roles, especially in initiatives like social procurement (Loosemore et al., 2021).

Ultimately, aligning innovation strategies with organizational capacity and optimizing vision, culture, and leadership enables firms to maximize their innovation potential and achieve sustainable competitive advantages (Yusof et al., 2022).

2.3.4.Organizational Structure

Organizational structure in the construction industry refers to frameworks that integrate decision-making, strategic outsourcing, and knowledge systems to foster agility, efficiency, and dynamic responsiveness to market changes (Kamal et al., 2016; Sorensen et al., 2018; Wang et al., 2023). Firstly,

decentralized decision-making and strategic outsourcing enhances flexibility and adaptability, enabling firms to effectively respond to market changes and sustain innovation efforts (Kamal et al., 2016). A centralized approach, which concentrates decision-making to top management, has been linked to lower digital uptake. Indicating its negative impact compared to a decentralized structure. In contrast decision-making which is distributed across all levels fosters greater innovation and adaptability (Zulu et al., 2023).

A transparent and structured approach to decision-making fosters trust and collaboration, aligning diverse contributions to sustain innovation processes (Sorensen et al., 2018). Organizational agility is critical for business model innovation, balancing flexibility for adaptability with efficiency for precise resource use and decision-making (Wang et al., 2023). Decentralized hierarchies and digital adoption further enhance innovation capacity, with larger firms often leading due to superior resources, while smaller firms face constraints (Zulu et al., 2023).

Dynamic capabilities refer to a firm's ability to adapt and innovate by integrating resources and identifying market opportunities. These capabilities bridge organizational structure and innovation outcomes by ensuring flexible structures that optimize resource use and efficient systems that enhance opportunity recognition. Strategic flexibility, driven by transformational leadership, helps align resources with changing market demands, promoting continuous innovation (Wang et al., 2023).

Codified knowledge, which refers to explicit, systematically recorded information documented in manuals, procedures, databases, or standards, plays a crucial role in shaping innovation strategies. By facilitating the replication and implementation of existing processes, it supports incremental innovation and enhances efficiency. In contrast, complex and less codified knowledge, often implicit and context-specific, fosters adaptability and is essential for managing the uncertainty and complexity associated with radical innovation. This distinction highlights the need to align innovation strategies with the nature of available knowledge, as incremental improvements rely on standardization, while transformative changes require more flexible, experience-based approaches (Xie et al., 2015).

Finally, a systematic approach to innovation, rather than ad hoc initiatives, ensures sustained progress. By involving diverse stakeholders and cultivating a culture of innovation, organizations can align their processes with broader strategic goals, fostering environments that support the transfer of knowledge and the realization of transformative change (Yepes et al., 2015).

2.3.5.Financial Transparency

Financial transparency, achieved through open-book practices where project costs are openly shared with all stakeholders, is a crucial enabler of systemic innovation. By revealing the true costs of proposed innovations, it reduces cost uncertainty, which is a significant barrier to innovation, by providing project teams with a clear understanding of financial implications. This transparency addresses skepticism, particularly from experienced contractors wary of unforeseen expenses, by replacing theoretical cost projections with detailed cost estimations across all trades. This practice helps identify where cost savings can occur and mitigates the risk of unanticipated expenses that could derail innovation efforts (Lahdenperä 2012)

As shown by Duodu et al. (2023) Financial transparency also fosters innovation ambidexterity (IA). This refers to the balance between exploratory innovations (developing novel solutions) and exploitative innovations (refining existing processes). By mediating the relationship between external knowledge

sources, such as client input and supplier expertise, and financial performance, IA allows firms to translate external knowledge into impactful innovations. Firms with strong IA capabilities often achieve superior outcomes by effectively integrating financial insights with innovative strategies.

Moreover, financial transparency strengthens collaboration and trust among stakeholders by promoting a culture of openness, ensuring that innovation initiatives are viewed as shared opportunities rather than individual risks. Agile cost-shifting mechanisms further enhance systemic innovation by enabling firms to dynamically reallocate resources in response to evolving project needs. This financial flexibility supports both long-term innovations and short-term incremental improvements, helping firms stay adaptive and resilient (Cheng et al. 2016).

In project-based supply chains, agile financial practices allow teams to pursue cross-company innovations more effectively. Combined with a clear vision from project owners and leadership commitment, these practices align all parties with shared innovation goals, reinforcing strategic collaboration and improving project outcomes. Past research emphasizes the importance of exploring agile cost-shifting strategies to optimize financial resource allocation and support systemic innovation in complex projects (Hall et al., 2018).

In summary, financial transparency, when combined with financial agility and a clear innovation vision, not only mitigates risk but also enhances a firm's ability to integrate external knowledge and foster sustainable, value-driven innovation.

2.3.6.Firm Characteristics Factors

Innovation activity varies based on firm size, age, and market reach. Larger firms typically excel in process improvements due to their complex systems and resource capacity, while smaller firms focus on niche markets and client-driven innovations (Barata & Fontainha, 2017). According to Kamal et al. (2016) Younger firms, with their adaptability and flexibility, often lead in adopting and creating innovative practices, whereas older firms may struggle with entrenched routines and centralized structures. Hereby getting caught in the phenomenon which is earlier reference to as the mirroring trap (Hall et al., 2019). However, older firms can still achieve success in niche innovations when they align resources with targeted objectives (Kamal et al., 2016).

Business growth, particularly in expanding firms, enhances adaptability and creativity, underscoring the importance of growth strategies for sustained innovation (Barata & Fontainha, 2017). Internationally operating firms leverage global competition to foster both the creation and adoption of innovations (Kamal et al., 2016). Additionally, while younger employees often drive digital tool adoption, resistance from older staff and insufficient training remain key barriers to widespread implementation (Zulu et al., 2023).

Meng & Brown (2018) argued that the relationship between firm size and innovation is nuanced. While large firms leverage substantial resources, long-term planning, and R&D investments to drive impactful advancements, they often struggle with agility due to organizational complexity. Medium-sized firms balance these dynamics by integrating project and business strategies, fostering collaboration and efficiency. Small firms, though constrained by limited resources, drive innovation through cost-saving measures, rapid adaptability, and client-centered strategies, focusing on survival and immediate market demands (Meng & Brown, 2018).

The scale of firms within the construction industry plays a significant role in shaping innovation strategies. International firms, operating on a larger, global scale, tend to prioritize Green Technology Innovation for Buildings (GTIB) to enhance sustainability and maintain global competitiveness (Li et al., 2022). In contrast, state-level firms operating on a localized scale focus on outperforming regional competitors through both the creation and adoption of innovations. Additionally, rapid industrial growth further accelerates these innovation efforts, with expanding markets fostering a stronger push toward technological advancement (Kamal et al., 2016).

2.3.7.R&D Factors

National R&D spending and GDP per capita have limited impact on construction sector innovation, with firm-level and sector-specific factors playing a more significant role (Barata & Fontainha, 2017). In the study conducted by Konno & Itoh (2018) R&D investments are strongly linked to enhanced competitiveness and long-term profitability. Contractors engaging in R&D achieve better performance, reflected in improved profit-to-capital ratios, though high costs and risks often result in a focus on incremental over breakthrough innovations. Strategic R&D helps contractors meet technical requirements and sustain growth.

Investments in R&D remain a cornerstone for technological advancement, with a consistent and significant positive impact on innovation outcomes. For firms to maximize the potential of R&D, they must align investments with long-term strategies and leverage government incentives to overcome financial and operational barriers (Li et al., 2022; Kamal et al., 2016). By fostering a supportive ecosystem for R&D, stakeholders can advance innovation capabilities, enhance industry competitiveness, and address emerging sustainability challenges.

2.3.8. External factors

Innovation in the construction industry is shaped by internal factors as well as a complex ecosystem of external factors. Each of these elements plays an essential role in influencing the industry's ability to adapt and evolve. Government investments and regulations create a foundation for systemic advancements, while suppliers introduce new technologies and materials that enhance efficiency. Clients often act as coordinators, guiding collaborative processes and driving systemic changes. Additionally, global crises serve as external catalysts, accelerating digital adoption and emphasizing the need for resilience and adaptability. Understanding these ecosystem dynamics is crucial for fostering sustainable innovation and ensuring long-term growth in an ever-changing industry.

2.3.8.1. Governmental Factors

Governmental policies and investments are critical drivers of innovation in the construction industry, particularly in R&D, digital transformation, and sustainable practices. Public procurement systems incentivize R&D through technical proposal requirements, while subsidies and tax incentives reduce financial risks. Collaborative initiatives like public-private partnerships foster systemic innovation by encouraging knowledge sharing and aligning goals (Konno & Itoh, 2018).

Regional BIM policies further enhance innovation by increasing patent applications, particularly in underdeveloped regions where government support bridges resource gaps, and in advanced regions that leverage cutting-edge technologies. Integrating regional and national policies is vital to addressing disparities and fostering cohesive innovation (Li et al., 2023).

Direct government investments, particularly in Green Technology Innovation for Buildings (GTIB), are key during early stages but stabilize over time. Moderate environmental regulations encourage innovation, while overly strict policies can hinder progress, emphasizing the need for balanced approaches (Li et al., 2022).

2.3.8.2. Suppliers Factors

Suppliers play a vital role in driving innovation within the construction industry, introducing new materials, equipment, and technologies that underscore the sector's supplier-dominated nature (Barata & Fontainha, 2017). This reliance contrasts with limited evidence supporting clients as primary innovation drivers, highlighting the centrality of supplier-led initiatives (Barata & Fontainha, 2017).

Supply chain disruptions, including material shortages, logistical challenges, and quality issues, significantly impact project and business performance through delays, cost overruns, and reputational damage (Kissi et al., 2020). To mitigate these challenges, innovation becomes essential. Process innovation streamlines workflows and integrates advanced technologies; product innovation reduces supplier dependency by developing alternative materials; and collaborative innovation strengthens supplier partnerships for improved communication and problem-solving. These approaches enhance flexibility, enabling real-time solutions and resilience against disruptions (Kissi et al., 2020).

In supplier-led frameworks, innovation thrives in competitive environments with minimal client involvement. Suppliers leverage their expertise to create modular or task-specific innovations, driven by performance-based incentives such as outcome-focused contracts. These frameworks foster incremental innovation, promoting cost-efficiency and productivity through supplier specialization and autonomy. By aligning innovation with their strengths, suppliers deliver efficient and high-quality solutions, reinforcing their role as key drivers of industry progress (Lindblad & Guerrero, 2017).

2.3.8.3. Client Factors

Demand-related disruptions, such as changing client requirements, project cancellations, or approval delays, can reduce efficiency and organizational performance (Kissi et al., 2020). In client-led frameworks, innovation is driven by active client involvement, particularly for systemic changes requiring stakeholder collaboration.

Clients act as coordinators, aligning teams and suppliers with strategic objectives like BIM adoption while ensuring long-term standards. Close client-supplier collaboration fosters tailored solutions, and resource allocation removes barriers to innovation. Policy enforcement and oversight standardize practices, making client-led frameworks ideal for systemic innovations requiring broad integration and consistent implementation (Lindblad & Guerrero, 2020).

2.3.8.4. Global Crisis

In the context of innovation, global crises, such as COVID-19, serve as external catalysts, compelling companies to adapt rapidly to new challenges. In the construction industry, this has accelerated the adoption of digital tools like remote supervision and drones, alongside improved health and safety protocols. However, crises often shift focus toward incremental innovation, as companies prioritize continuity and immediate problem-solving over transformative advancements. While this approach refines existing systems, it may limit resources and strategic focus required for systemic innovation. To overcome this, companies should leverage incremental innovations initiated during crises as

foundational platforms for pursuing long-term, transformative advancements once stability is achieved (Kim et al., 2024).

2.3.9.Barriers to Innovation

According to Gunduz & Alfar (2019) Financial constraints are among the most significant barriers to innovation in the construction industry, further intensified by time limitations, insufficient experienced staff, and unsupportive organizational cultures. These financial limitations restrict investments in research and development (R&D) or advanced technologies, delaying or decreasing the impact of innovative efforts. Structural challenges, such as the "mirroring trap," where task and organizational boundaries hinder the reorganization needed for adopting new systems, also pose significant obstacles. High costs associated with vertical integration often deter firms from pursuing capital-intensive innovative strategies. Additionally, the project-based nature of the construction industry limits the scalability of innovations across different projects, creating longitudinal barriers due to knowledge loss between project teams, thereby hindering progress (Gunduz & Alfar, 2019; Hall et al., 2019).

Risks associated with innovation include financial pressures from high costs, technical uncertainties related to performance, and market resistance due to a lack of demand or acceptance. Cultural resistance often stems from entrenched practices and an aversion to change. Firms also face operational disruptions, regulatory uncertainties, and leadership gaps that prevent successful adoption of new technologies. To address these issues, systematic management approaches, including standardization and integration, can improve project outcomes and efficiency. Modern construction methods tailored to client needs further boost productivity and ensure timely project completion (Yepes et al., 2015; Gunduz & Alfar, 2019).

To mitigate risks, firms must develop comprehensive strategies. Allocating financial resources effectively and leveraging government incentives can ease the burden of innovation costs. Pilot testing technologies on a small scale minimizes the risk of widespread failure, while proactive stakeholder engagement ensures innovations align with market needs. Training employees and fostering a culture that values innovation help address technical and organizational challenges, while early collaboration with regulatory bodies ensures compliance and reduces legal uncertainties (Nguyen, 2024).

Resistance to new technology adoption often stems from workflow incompatibility, perceived complexity, and limited trialability. However, intuitive and beneficial technologies, supported by leadership advocacy and peer influence, are more readily accepted. Effective communication and training programs are essential, especially in organizations that prioritize flexibility and innovation. Face-to-face communication methods, such as meetings and presentations, effectively resolve disagreements, foster knowledge, and reduce resistance by providing both technical and social support (Ishak & Newton, 2016; Ma et al., 2023).

Socio-cultural dynamics also hinder the adoption of innovation, especially digital innovations are often hindered due to rigidity of the older workforce. These barriers include insufficient leadership, inadequate training, lack of collaboration, and procedural misalignment. Successful digital transformation requires fostering a collaborative culture, adopting human-centric leadership approaches, and clear digital strategies. Misaligned goals, coordination challenges, and poor supply chain integration further complicate implementation, highlighting the need for comprehensive socio-technical strategies to support innovation (Shojaei & Burgess, 2022).

Balancing exploration and exploitation in innovative efforts adds another layer of complexity. Pursuing novel innovations (exploration) often conflicts with refining existing processes (exploitation), creating tensions in resource allocation and managerial priorities. These challenges underscore the importance of strategic focus and effective management to align innovation initiatives with organizational capabilities (Duodu et al., 2023).

2.4. Conclusion innovation

The section a synthesis of the findings concerning the following research question can be found:

"What are the key types of innovation in the construction industry, and what factors influence a firm's capacity to adopt and implement these innovations effectively?"

The initial part of this second sub-question concerns the categorization of innovation into systemic, incremental, modular, and architectural types. Systemic innovations drive transformative changes by redesigning value chains and integrating systemic advancements, such as modular construction or digital platforms. Incremental innovations focus on continuous improvements to existing processes and technologies, addressing immediate challenges within traditional project delivery models. Modular innovations enhance localized efficiency by updating specific system components with adaptable technologies, while architectural innovations restructure the relationships within systems to optimize workflows and resource allocation.

The main factors which are addressed in referenced literature are summarized in table 2. Based on these definitions and mentioned interrelations the following can be concluded.

Table 2: Main influential factors to innovation derived from literature

Factor	Description
Human	Human factors in the construction industry refer to the alignment of diverse employee motivations, skills, and knowledge. Hereby, the role of champions who advocate, implement, and sustain innovation is essential for successful execution of complex initiatives (Sorensen et al., 2018; Loosemore et al., 2022).
Leadership	Leadership is a critical enabler of innovation, as transformational and strategic leaders foster a culture of adaptability, creativity, and knowledge sharing through open communication, employee empowerment, and robust collaboration both internally and with external partners (Gunduz & Alfar, 2019; Liu et al., 2017; Pham et al., 2022; Chan et al., 2013). Effective leadership aligns organizational culture and governance to balance long-term goals with immediate performance goals resulting in sustain continuous innovation (Zulu et al., 2023; Hall et al., 2018; Wang et al., 2023; Zhang et al., 2024).
Vision and Culture	Vision and culture are essential in aligning long-term aspirations with a work environment that stimulates experimentation and knowledge sharing. This is closely linked to leadership which reinforces these values through guidance and open communication (Papadonikolaki, 2018; Yusof et al., 2022; Chan et al., 2013). Innovation oriented vision and culture motivate employees to generate new ideas while harnessing dynamic capabilities, resource integration, and stakeholder collaboration (Ma et al., 2022; Yepes et al., 2015).

Organizational Structure	Organizational structure in the construction industry refers to frameworks that integrate decision-making, strategic outsourcing, and codified knowledge systems to foster agility, efficiency, and dynamic responsiveness to market changes (Kamal et al., 2016; Sorensen et al., 2018; Wang et al., 2023). By aligning transparent decision-making processes and stakeholder engagement with dynamic capabilities these structures create an environment conducive to both incremental and radical innovation (Zulu et al., 2023; Xie et al., 2015; Yepes et al., 2015).
Financial Transparency	Financial transparency in the construction industry is a critical enabler of innovation by reducing cost uncertainty, mitigating risks, and addressing contractor skepticism (Lahdenperä, 2012). By integrating external knowledge with clear financial insights, it fosters innovation ambidexterity, strengthens stakeholder trust and collaboration, and aligns diverse parties (Duodu et al., 2023; Cheng et al., 2016; Hall et al., 2018).
Firm Characteristics	Firm characteristics in the construction industry play a determining role in shaping innovation activities, with larger firms leveraging complex systems and abundant resources for process improvements while smaller, younger firms rapidly adapt to client-specific demands and niche opportunities (Barata & Fontainha, 2017; Kamal et al., 2016; Meng & Brown, 2018). Older firms may struggle with entrenched routines and digital adoption barriers that limit agility. Internationally operating and expanding firms take advantage of global competition and strategic growth (Hall et al., 2019; Zulu et al., 2023; Li et al., 2022).
R&D	R&D in the construction industry involves strategic investments in research and development that drive technological advancement, enhance competitiveness, and foster long-term profitability (Konno & Itoh, 2018; Li et al., 2022). targeted firm-level and sector-specific R&D initiatives enable contractors to achieve improved profit-to-capital ratios while navigating high costs and risks that tend to favor incremental innovations (Kamal et al., 2016)
External factors	External factors in the construction industry refer to the dynamic ecosystem of influences including; governmental policies and investments, supplier innovations, client-driven coordination, and global crises (Konno & Itoh, 2018; Li et al., 2022; Barata & Fontainha, 2017). These factors include technological inputs and market pressures that influence uncertainties and priorities. Collaborative stakeholder management and input ultimately drives or obstructs sustainable industry advancements (Kissi et al., 2020; Lindblad & Guerrero, 2017; Kim et al., 2024).

Innovation outcomes in the construction industry are closely tied to improved collaboration, flexibility, and sustained project and organizational success. Effective implementation of innovations hinges on trust, communication, and organizational flexibility. Collaborative environments that balance autonomy and integration not only foster smoother innovation adoption but also encourage strategic alignment across stakeholders. These dynamics underscore the need for adaptable policies and frameworks that promote incremental and strategic innovation, steering clear of rigid regulators (Papadonikolaki, 2018). Hall et al. (2018) compliments this by distinguishing systemic innovations from modular or incremental changes, which require substantial cross-disciplinary coordination. Supply Chain Integration Practices (SCIPs) - including team colocation, multiparty contracts, and the use of Building Information Modeling (BIM) - promote stronger collaboration and communication among stakeholders. These practices mitigate risks and align financial incentives helping to overcome industry fragmentation and enabling systemic innovation (Hall et al., 2018).

The integration of organizational structures with collaboration mechanisms is essential for overcoming the inherent fragmentation in construction and fostering effective innovation. Vertical and horizontal

integration strategies, supported by strong leadership and advanced technologies, create synergies that amplify innovation outcomes by enhancing inter-organizational collaboration and leveraging dynamic innovation networks. This alignment of organizational strategies with innovation goals ensures adaptability and sustained competitiveness within an evolving industry landscape (Ozorhon et al., 2013). Complementing these efforts, dynamic capabilities that balance flexibility and efficiency play a critical role in maximizing a firm's innovation potential. Tailored strategies enable smaller firms to capitalize on their agility, while larger firms can focus on improving organizational flexibility to drive impactful innovations. Collaborative efforts, supported by government policies and frameworks, further bolster resilience, adaptability, and the strategic alignment of innovation initiatives across the sector (Barata & Fontainha, 2017).

Internal organizational factors significantly shape a firm’s capacity to adopt and implement these innovations. Leadership is critical, with transformational leaders stimulating a culture of innovation by inspiring adaptability, fostering collaboration, and aligning innovation efforts with strategic objectives. Skilled and motivated employees play a central role, particularly when their diverse expertise is aligned with organizational goals. Firms characteristics such as size, age, and adaptability affect innovation capacities. Firms can enhance their innovation capacity by cultivating a collaborative culture that emphasizes trust and knowledge sharing, authorizing employees with decision-making, and investing in skill development. Research and development efforts further strengthen a firm’s ability to leverage emerging technologies and remain competitive. Aligning innovation initiatives with the organization’s strategic goals ensures sustainable growth and a competitive market position.

The human element remains a central driver of innovation, as evidenced by the role of innovation champions who utilize their enthusiasm and strategic foresight to mobilize resources and galvanize stakeholder commitment. These champions not only accelerate the adoption of new technologies but also enhance inclusivity and collaboration, ensuring broad and sustainable impacts. Structured evaluations highlight the importance of prioritizing drivers like client requirements and sufficient capital, which serve as critical catalysts for innovation (Rutten et al., 2019; Gunduz & Alfar, 2019).

These findings from the literature study stress the complex interplay between organizational structures, innovation types, and internal & external factors. It can be concluded that vertical structures particularly drive systemic and architectural innovations due to their centralized control, streamlined workflows, and strong knowledge retention. These characteristics support large-scale, transformative changes. In contrast, horizontal structures foster incremental and modular innovations, leveraging their flexibility, specialization, and adaptability to drive continuous improvements and tailored solutions. However, both organizational types are influenced by interventions such as leadership development, collaboration, and digital tool adoption. The effect and implications of such interventions are hard to oversee. Similarly, the interaction between innovation types and internal factors provide a complex mix of parameters. Making it challenging to understand how construction firms can strategically position themselves to drive innovation. Using this theoretical background as a base, additional research can be done in a structured and way to formulate an actionable models fit to guide better motivated choices regarding innovation capacity of construction companies.

3. Research Methodology

In response to the lack of scientific research papers on the dynamics underlying the effect of organizational structures in relation to the innovation capacity of construction firms, this study aims to investigate these dynamics. More specifically this study aims to investigate how service-based companies within the construction industry can make better informed decisions in order to improve their innovativeness and positively stimulate developments within the company and market.

3.1. Data Analysis

This section outlines the data analysis methods used to explore the organizational factors influencing innovation capabilities and to develop a practical decision-making tool. A skemetical representation is depicted in the figure below.

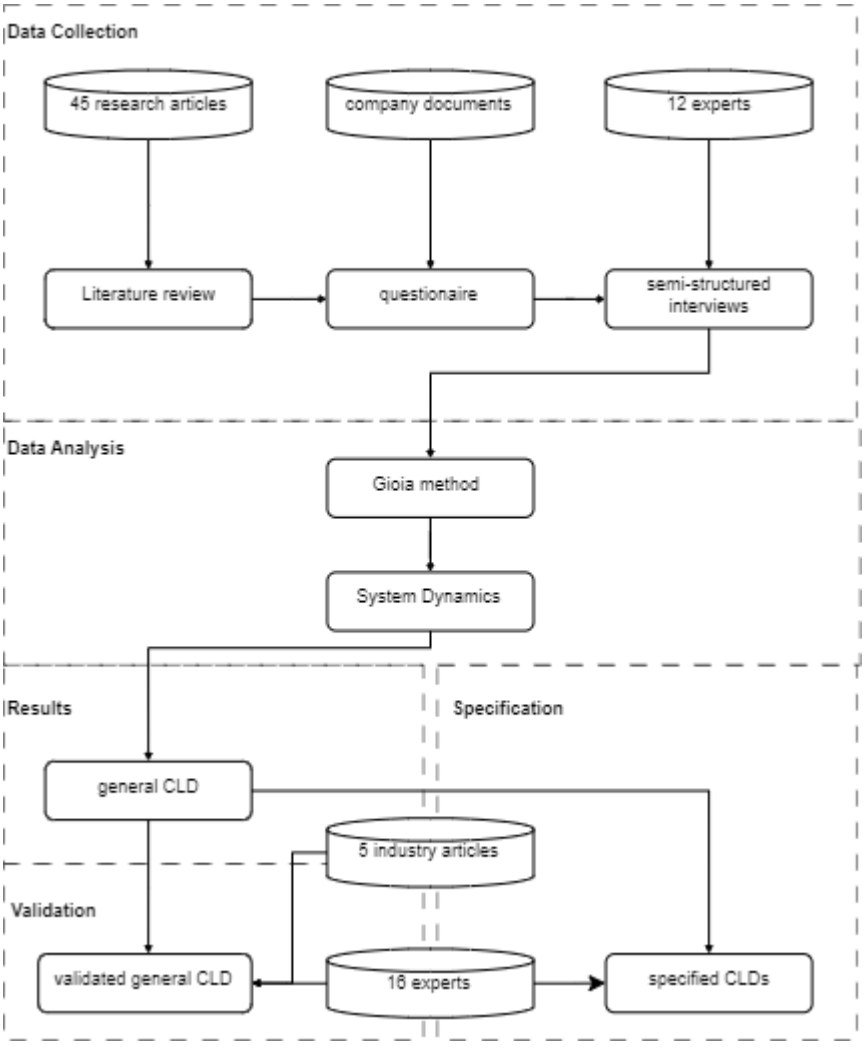


Figure 3: Flow chart

To develop a comprehensive understanding of the organizational factors influencing innovation capabilities and to formulate an actionable decision-making tool, a mixed-method research approach was employed. A systematic literature review, following the PRISMA framework, formed the theoretical foundation on organizational structures and innovation. To enhance practical applicability, a case study

approach was applied. In this case study two construction firms, one categorized as horizontal and the other as vertical, were incorporated. A detailed description of these firms can be found in Section 3.2.

Before formal data collection, an initial familiarization phase was initiated through informal meetings with employees and company document analysis to gain contextual knowledge of the firms' structures and challenges. This preliminary understanding, combined with insights from the literature review, provides a solid basis for designing and executing semi-structured interviews. These interviews were conducted to capture expert insights from professionals operating within the case study firms. Given the study's focus on company- and department-wide decision-making, most participants were selected based on their involvement in strategic decisions. However, to gain a holistic view of decision-making dynamics and their impact across various organizational levels, participants also included project engineers, project managers, and account managers.

To ensure a systematic and unbiased analysis of the collected data, the Gioia method developed by Gioia et al. (2012) was applied. This qualitative approach is particularly effective in capturing the perspectives of organizational members as "knowledgeable agents," who possess firsthand insights into their roles, actions, and decision-making processes. The Gioia method unfolds in three distinct stages. First, in First-Order Analysis, the researcher acts as a "glorified reporter," systematically documenting participants' terminology and viewpoints without imposing external interpretations, generating a detailed dataset that authentically reflects employees' lived experiences. Next, in Second-Order Analysis, the data is elevated to a theoretical level by identifying patterns and relationships among the emerging categories. This synthesis allows for the extraction of broader insights, facilitating a deeper understanding of organizational dynamics. Finally, in the Formation of Aggregate Dimensions, the second-order concepts are refined into aggregate dimensions, representing higher-order theoretical constructs. These dimensions encapsulate the core drivers and barriers of innovation, linking empirical observations to overarching theoretical themes (Gioia et al., 2012).

The defined aggregate dimensions, including human, vision, external, and organizational factors, were integrated as clusters. These clusters were used to classify the identified themes, which serve as variables within the system dynamics model. Therefore, the results derived from the Gioia method form the basis of a Causal Loop Diagram (CLD) that maps the causal relationships among key variables. This diagram visualized the causal relationships between key variables, offering a comprehensive view of the dynamics shaping innovation within these organizational structures.

The System Dynamics method complements the Gioia approach by introducing a qualitative modeling framework to analyze the dynamic relationships within the organization. This method focuses on the flow of information, delays, and feedback loops that shape the behavior of complex systems like those in construction firms (Forrester, 2007). The CLD consists of variables, links indicating relationships between variables, signs on the links to denote the nature of these relationships, and loop signs that illustrate whether behaviors are reinforcing or balancing. By linking multiple loops, the diagram provides a concise visualization of systemic dynamics (Sterman, 2000; Park et al., 2004).

While the Gioia method identifies key constructs through systematic coding, SD translates these insights into causal relationships, offering a structured approach to studying complex, fragmented industries like the construction industry (Guan et al., 2024). By mapping variables from Gioia analysis, company documentation, and interviews, the CLD illustrates reinforcing and balancing loops, providing a systemic

view of innovation dynamics (Sterman, 2000; Park et al., 2004). SD enables real-world modeling, scenario testing, and strategic planning, supporting policy evaluation (Malbon & Parkhurst, 2022).

Together, the Gioia method and system dynamics offer a robust framework for a qualitative analysis. The Gioia method provides deep qualitative insights into organizational processes, while SD translates these insights into actionable models. By integrating these methods, the study offers a holistic approach to understanding and optimizing organizational structures to foster innovation. This interdisciplinary approach captures complex interconnections, enabling the formulation of a qualitative dynamic firm-level tool that informs decision-making and optimizes innovation strategies.

To refine the initially formulated CLD and ensure its applicability across different organizational contexts, additional interviews were conducted to validate and specify the model. The additional interviews served two goals, validation, and specification of the model. Firstly, additional questions were asked by participants regarding the included variables and their correlations. To further validate the general CLD non-scientific literature was consulted in the form of strategy consulting reports in order to explore if the general CLD was in line with their practical findings regarding organizational characters and their effect on innovation. Secondly, the additional interviews enabled a contextual adaptation of the CLD, tailoring it to the construction industry, vertically structured firms, and horizontally structured firms. Participants identified the most influential factors in each setting, which were visually emphasized in the CLD sub-versions to reflect their relative impact. Based on these insights, three context-specific sub-models were derived from the general CLD, each highlighting variables that emerged as particularly critical within their respective environments.

By conducting semi-structured interviews at the case study companies, analyzing the data using the Gioia method, and using these results as input into a system dynamics model, this research aims to develop a practical tool to assess and refine their innovation strategies before committing significant resources. Context-specific insights enable companies to recognize their structural strengths and weaknesses, allowing them to align organizational design with innovation objectives. The resulting models serve as decision-support tools, guiding firms toward more informed, strategically motivated actions that enhance long-term performance and adaptability within their respective operational contexts.

3.2. Data collection

Data collection took place from September 2024 until Januari 2025 and was done using multiple data sources in order to produce a more comprehensive view of the phenomenon being studied. In literature this is referred to as data triangulation (Sargeant, 2012; Flick et al., 2004). Data was collected using the following methods: (1) Data collection due to reviewing company documentation, (2) observations and (informal) communication within the company, and (3) by executing semi-structured interviews. When selecting the interviewees specific attention was paid to them having other backgrounds and roles within the company. This is in order to get as complete of a representation of the company as possible. In table 3 the data collection methods, sources, and their respective added values are represented.

Table 3: Data sources and analysis

Data Source	**Data characteristics**	**Added value of data**
Company documentation	Organizational charts, process flow charts, onboarding documents, internal presentations, etc.	- Understanding of company structure

		- Origin and company development over time - Information flows - Understanding of inter-company activities
Internal company observations	(informal) meetings, communication lines, onboarding, etc.	- Connecting with employees - Identifying key players - Generating ideas - Influential factors among employees
Semi-structured interviews	Data collection due to interviewing of: Group Jansen 1. COO[1] (SUMI[2]) 2. Strategy Manager (JIS) 3. Project Director Program & Processes (JIS) 4. CSO[3] (JIS[4]) 5. CCO[5] (JIS) 6. Business Development & Marketing Lead (L&C[6]) 7. Account manager (L&C) 15. R&D manager (JIS) 16. CEO[7] (JIS) Bulsink 8. COO 9. Project Engineer 10. CEO 11. Marketing & Communication Specialist 12. Manager Operations 13. CFO[8] 14. Project Engineer	- Internal communication - Factors influencing innovation - Current company status - Challenges - Competitive advantages - Future vision - Inter & intra company communication

1 Chief operating officer
2 SUMI is a subsidiary specializing in building automation solutions
3 Chief strategic officer
4 Jansen Internal Services
5 Chief commercial officer
6 Jansen Labs and Cleanrooms
7 Chief executive officer
8 Chief financial officer

As illustrated in table 3, 16 semi-structured interviews were conducted with industry professionals working at the case study companies, Group Jansen and Bulsink. These interviews served as the main source of data for the formulation of the general CLD as well as its specifications. The following section presents an overview of these two construction firms, providing the necessary background for understanding their organizational structures and innovation dynamics. The global organizational diagrams can be found in appendix I which illustrate the company structure of the included case study firms.

3.2.1. Case study company: Group Jansen

Group Jansen is a Belgian construction company founded in 1972 by five brothers of the Jansen family. Initially focused on plastering, the company diversified into multiple market areas and, by the early 2000s, began specializing in construction management as a general contractor. This strategic shift marked a significant turning point in its development.

Over the last 6 years, Group Jansen began rapidly acquiring and integrating other building companies, expanding its expertise and establishing the Jansen Group. Today, the group consists of 14 companies organized into four main divisions: Makers, focused on producing prefabricated elements and modular systems; Builders, specializing in construction and renovation projects; Sustainers, responsible for maintenance and lifecycle services; and Cleanrooms & Labs, which design and construct controlled environments for specialized industries. As commented by the CEO of Group Jansen: “By integrating more activities within the value chain we create a competitive advantage, establishing a one-stop-shop. This approach removes the additional costs typically paid to subcontractors, retains margins within the group, and enables higher overall profitability while offering lower prices and fostering greater synergy across the value chain.”

The adoption of this vision aligns closely with the principles of vertical integration and its potential to optimize organizational performance. Many companies incorporated into the Jansen Group were previously partners of Jansen Building Projects (JBP), ensuring a foundation of trust and familiarity. In the words of the CEO of Group Jansen, “As JBP, we have established extensive experience and familiarity with these companies through repeated collaboration. Based on this experience, we have confidence in their compatibility with other entities within the Jansen Group, suggesting that their integration into the group can be achieved with relative ease and will yield in the added value of the Jansen Group as a whole. This integration not only retains margins that previously exited the value chain but also preserves and leverages the expertise and knowledge of the acquired company and its employees.”

Recent acquisitions illustrate this vertical integration strategy. SUMI, the latest addition to the Jansen Group, specializes in advanced building automation, enhancing efficiency, sustainability, and user experience. This expands Group Jansen’s in-house capabilities concerning building data management, automation, and energy efficiency.

Similarly, the 2023 acquisition of Vinitex, a Dutch laboratory furnishings manufacturer is a relevant example. This acquisition aimed to fill a supply chain gap and support Jansen Labs & Cleanrooms (JLC). When JLC’s initial supplier declined to sell, they leveraged ownership of their furniture blueprints to transition to Vinitex. However, Vinitex’s integration faced challenges. Its reliance on manual processes clashed with Jansen’s automation goals, as employees lacked the skills for new systems, and existing workflows were incompatible with automation. This led to reduced efficiency, underused equipment, and operational disruptions.

These most recent additions to Group Jansen showcase the strategic benefits and integration challenges of vertical integration. SUMI showcases successful capability expansion, while Vinitex underscores the need to assess operational readiness and cultural fit for effective integration.

Group Jansen is positioned as an innovation-driven organization, emphasizing its commitment to integrating innovation into all aspects of its operations. However, as this study focuses on service companies and process innovation, the Makers division is excluded from the analysis. Nonetheless, it is important to provide context on Group Jansen's overarching vision to understand its strategic direction.

Group Jansen’s current vision centers on vertical integration, with a strong focus on expanding its Makers division. This strategy aims to diversify product offerings by enhancing their applicability across various contexts and meeting stringent certification requirements. The shift from a purely project-oriented

approach to incorporating production seeks to create more stable revenue streams, reducing reliance on fluctuating project-based income.

Numerous initiatives reflecting this vision have been launched within a short time span, showcasing Group Jansen's intense focus on innovation and growth. These include the development and certification of new wall products like J-click and J-plus, designed for both cleanroom and standard applications, as well as the creation of Cicé ceramics, which transforms industrial waste into refined ceramic products. Simultaneously, significant efforts are underway to optimize production, including the relocation of machinery from Portugal to Belgium and the expansion of production capacity in Oudsbergen. These developments support the rollout of a new production line, expected to be fully operational within three years. Although the Makers division falls outside the scope of this study, these initiatives underscore Group Jansen's strong commitment to strategic diversification and investment in the makers division.

The group operates under a centralized structure, with general services like human resources, finance, and marketing managed through Jansen Internal Services (JIS). This approach ensures consistency and efficiency across subsidiaries while allowing them operational autonomy. To mitigate risk and prevent dependency on internal projects, a key policy requires subsidiaries to generate at least 60% of their revenue from external clients.

As mentioned, this structure allows the group to consolidate profit margins across disciplines by integrating subsidiaries as subcontractors for Jansen Building Projects. However, it also increases the group's overall exposure to project risks, as both the general contractor and subcontractors are part of the Jansen Group and share responsibility. The centralized profit model aligns with the group's strategy of capturing value across the entire project chain but requires careful risk management.

3.2.2. Case Study Company: Bulsink

The other company which is investigated in this study is Bulsink, a company founded in 1928, which has grown from a small Dutch family business into an internationally active general contractor with offices in the Netherlands, Germany, and France. Originally engaged in diverse construction projects, the company shifted its focus to business-to-business (B2B) projects after the 2008 economic crisis, first targeting mainly the retail sector. At a later point this was expanded to additional sectors like hospitality, offices, and leisure, where branding and expertise are vital selling points. Recent international expansion highlights Bulsink's commitment to innovation and adaptability, solidifying its role as a key player in the European construction industry.

Bulsink operates as an internationally active general contractor, taking full responsibility for the construction process and final outcome, managing design, engineering, planning, and construction to deliver turnkey projects. This integrated approach allows Bulsink to act swiftly and efficiently, ensuring high-quality results with speed, precision, and accountability. Guided by its slogan, "We get the job done, we don't ask for extra time, we go the extra mile," the company's vision is to be the single point of contact for clients, providing complete project delivery from concept to completion. While Bulsink's leadership promotes a "LEAN and mean organization," reflecting a focus on efficiency and operational agility, the CEO's acknowledgment of the need for more structure by stating, "We keep reinventing the wheel, and that only gets us so far". This reveals a mainly reactive leadership style that prioritizes short-term demands in contrast with the desire to invest more in strategic innovation. This duality highlights both the strengths of Bulsink's flexible, fast-paced operations and the limitations imposed by a lack of standardized processes, potentially constraining long-term, future-oriented initiatives.

Bulsink's organizational structure is defined by its flat, flexible design, prioritizing agility to meet the fast-paced demands of the retail sector, where speed is crucial to control costs and reduce revenue loss. While this structure supports rapid project execution, it poses challenges in knowledge management, process standardization, and operational efficiency. Inconsistent documentation and varying practices across Project Engineer (PE) and Project Manager (PM) teams can lead to inefficiency.

To address these issues, Bulsink introduced a management team to delegate daily operations, allowing the CEO to focus on strategic direction and fostering a leadership-driven culture to promote innovation. However, this shift faced challenges, prompting a move toward a more autonomous, self-managing team structure aimed at reducing hierarchy and encouraging bottom-up innovation. While this approach empowers employees, it has created confusion around roles, responsibilities, and communication lines.

To optimize this structure, Bulsink aims to have clearer role definitions and transparent communication processes to balance autonomy with accountability. Supporting this goal, the company established a centralized internal service center for finance, HR, and marketing, enabling teams to focus on their core strengths. This development enhances efficiency and leverages specialized knowledge

Over the past years, Bulsink has advanced the development of an internal BIM department, marking a step toward vertical integration within its predominantly horizontal structure. This department enhances autonomy by independently producing accurate, comprehensive design and working drawings, aligning with Bulsink's agile approach. In addition to this, Bulsink introduced Bluebeam software, which enabled project managers to extract quantities from PDF plans. This supports agility but compromises the precision of fully modeled BIM processes. Other developments, such as mobile on-site scanning, highlight the department's efforts to increase autonomy and reduce reliance on external partners.

3.3. Conclusions

This case study explores the organizational structures, operational strategies, and innovation-driven approaches of both Group Jansen and Bulsink, providing comparative insights into how these companies have navigated challenges and leveraged growth opportunities within the construction industry.

Group Jansen is characterized as a vertically integrated company, having expanded significantly in recent years by acquiring and incorporating additional disciplines into its operations. This approach enables Jansen Building Projects, its central general contracting entity, to consolidate a wider range of works within its supply chain. By integrating subsidiaries as subcontractors, Group Jansen captures value across multiple project phases, benefiting from a centralized service structure while managing the associated risks of this comprehensive responsibility.

Conversely, Bulsink exemplifies a horizontally integrated company, with its focus on specialization in turnkey delivery of specific building types for business-to-business (B2B) clients. The company's emphasis on managing costs, planning, and subcontractors positions it as a coordinator rather than an executor of diverse disciplines. This strategy has allowed Bulsink to adapt to market conditions and expand internationally, solidifying its role in the European construction industry.

While both companies demonstrate innovation and adaptability, their integration strategies diverge, reflecting differing approaches to market specialization and operational control. Group Jansen's vertical integration emphasizes control over the entire project chain, while Bulsink's horizontal specialization prioritizes efficiency and expertise in managing targeted project types. These contrasting strategies

underline the diverse pathways companies can take to achieve competitiveness and resilience in the construction sector.

4. Results

This chapter presents the findings of the study, providing an analysis of the factors shaping innovation within vertically and horizontally structured service-based construction firms and the interactions among them. Drawing on the methodological framework outlined in the previous chapter, the results integrate insights from the Gioia method and system dynamics modeling to construct a holistic understanding of the dynamics shaping innovation capacity.

The findings first introduce the results of applying Gioia method which serve as a base for the development and specification of the Causal Loop Diagram. This approach ensures a detailed exploration of how organizational structures, workflows, stakeholder interactions, and other factors influence innovation. The subsequent sections contain the CLD and its specifications.

By situating these findings within the broader challenges of the construction industry, this chapter lays a strong foundation for Chapter 5, which presents the discussion and conclusion of the thesis. It forms a clear connection between theoretical insights and actionable recommendations, incorporating practical value derived from the case-study companies to enhance their innovation capabilities.

4.1. Gioia method

To construct the Causal Loop Diagram effectively, the Gioia method is utilized as outlined in the methodology section of this report. The Gioia method ensures a balance between quantitative rigor and the discovery-driven nature of the research. Through this approach, variables included in the CLD are formulated clearly and constructively, incorporating both the perspectives of informants and the researcher's contributions in organizing and conceptualizing participant feedback. This process highlights the progression from raw data to theoretical concepts in a structured and systematic manner. Figure 4 presents the results of the semi-structured interviews and their analysis using the Gioia method (Gioia et al., 2012).

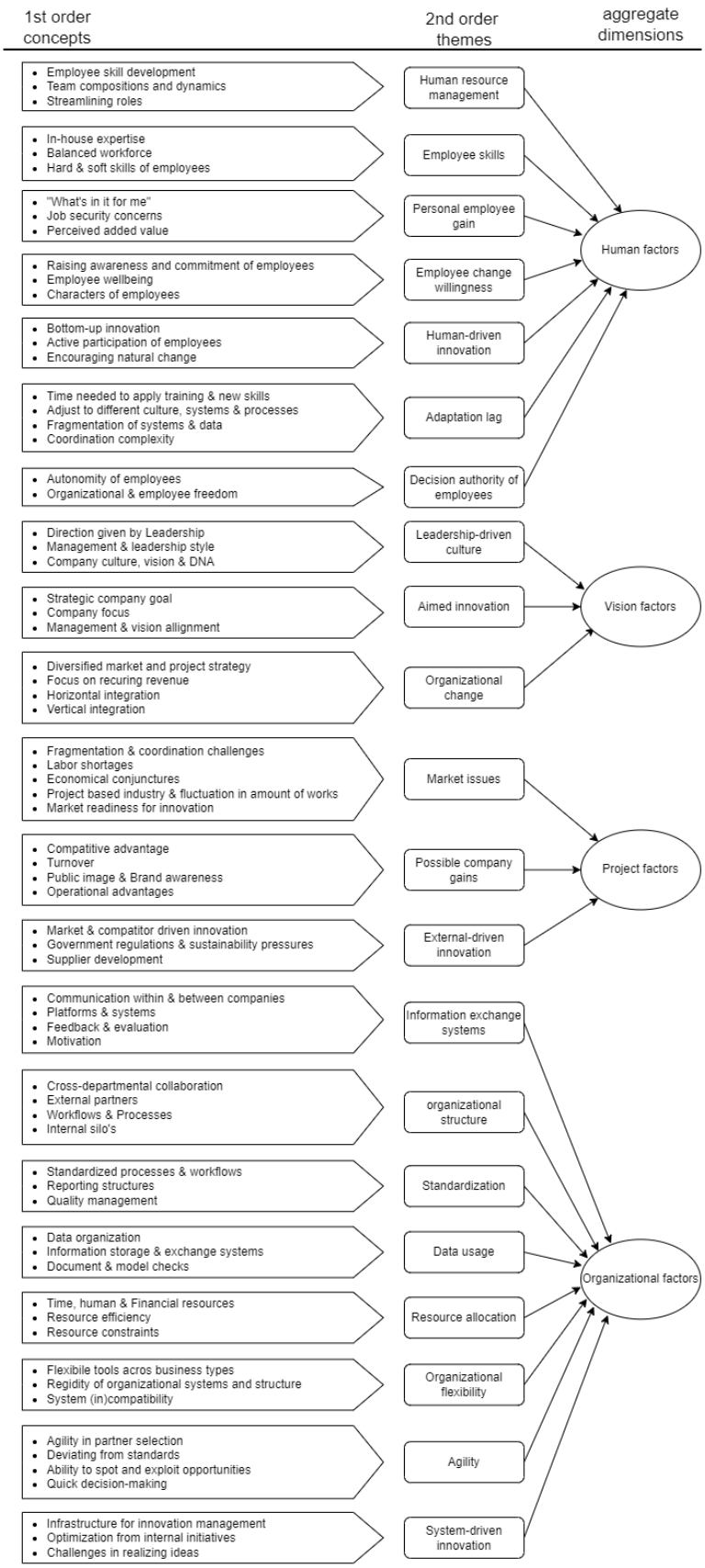

1st order concepts
2nd order themes
aggregate dimensions
Employee skill development
Team compositions and dynamics
Streamlining roles
Human resource management
In-house expertise
Balanced workforce
Hard & soft skills of employees
Employee skills
"What's in it for me"
Job security concerns
Perceived added value
Personal employee gain
Raising awareness and commitment of employees
Employee wellbeing
Characters of employees
Employee change willingness
Human factors
Bottom-up innovation
Active participation of employees
Encouraging natural change
Human-driven innovation
Time needed to apply training & new skills
Adjust to different culture, systems & processes
Fragmentation of systems & data
Coordination complexity
Adaptation lag
Autonomity of employees
Organizational & employee freedom
Decision authority of employees
Direction given by Leadership
Management & leadership style
Company culture, vision & DNA
Leadership-driven culture
Strategic company goal
Company focus
Management & vision allignment
Aimed innovation
Vision factors
Diversified market and project strategy
Focus on recuring revenue
Horizontal integration
Vertical integration
Organizational change
Fragmentation & coordination challenges
Labor shortages
Economical conjunctures
Project based industry & fluctuation in amount of works
Market readiness for innovation
Market issues
Compatitive advantage
Turnover
Public image & Brand awareness
Operational advantages
Possible company gains
Project factors
Market & compatitor driven innovation
Government regulations & sustainability pressures
Supplier development
External-driven innovation
Communication within & between companies
Platforms & systems
Feedback & evaluation
Motivation
Information exchange systems
Cross-departmental collaboration
External partners
Workflows & Processes
Internal silo's
organizational structure
Standardized processes & workflows
Reporting structures
Quality management
Standardization
Data organization
Information storage & exchange systems
Document & model checks
Data usage
Organizational factors
Time, human & Financial resources
Resource efficiency
Resource constraints
Resource allocation
Flexibile tools acros business types
Regidity of organizational systems and structure
System (in)compatibility
Organizational flexibility
Agility in partner selection
Deviating from standards
Ability to spot and exploit opportunities
Quick decision-making
Agility
Infrastructure for innovation management
Optimization from internal initiatives
Challenges in realizing ideas
System-driven innovation

Figure 4: Data structure

The 2nd-order themes, illustrated in Figure 4, represent the variables that form the foundation for constructing the Causal Loop Diagram. In the subsequent chapter the causal relationships between the variables are defined. Thereby enabling the construction of the CLDs in Sections 5.2 and 5.4. The CLD serves as a dynamic representation of the interconnections between these variables, offering insight into the system's behavior and its underlying mechanisms.

Table 2 provides detailed definitions of the aggregate dimensions derived from the analysis. Each aggregate dimension is assigned a distinct color to visually indicate which 2nd-order themes belong to which corresponding aggregate dimensions. These colors are used in the CLD to clearly distinguish how each theme aligns within the broader system. Therefore, the findings from the Gioia method serve as a base input for the results chapter. Laying the foundation for the formulation and resulting insights of the companies presented in following sections.

Table 4: Aggregate dimension definition

Aggregate dimension	**Color**	**Definition**
Human factors	Green	Human Factors describe the collective psychological, behavioral, and skill-based attributes of employees that influence an organization's capacity to adapt, innovate, and achieve strategic goals. This dimension encapsulates the correlation between employee readiness for change, individual and collective skill development, resource management, and personal motivation. It also considers the dynamic processes of human-driven innovation and adaptation lag. Thereby stressing the need for strategic alignment between organizational goals and the human elements driving them. Ultimately, Human Factors highlight the central role of employees as both enablers and potential barriers in fostering organizational innovation and growth.
Vision factors	Blue	Vision factors represent the strategic and cultural elements driven by an organization's leadership and innovation-oriented mindset. This dimension focuses on the organization's ability to incorporate innovation into its identity and align its culture and long-term strategy with concrete goals. It emphasizes the role of leadership in inspiring and shaping a culture of innovation, empowering teams to embrace creative problem-solving and addressing complex industry challenges. Vision factors direct organizational efforts, ensuring that innovation remains central to achieving sustainable success and addressing both current and future market demands.
External factors	Yellow	External Factors include the structural, strategic, and operational elements that shape how an organization manages and executes its projects within their market environments. This dimension highlights the interplay between market demands, innovation strategies, and internal processes to ensure project success. It includes the coordination of roles, communication, and resources to address market fragmentation and complexity while aligning innovation with customer needs and operational challenges. By

		delegating decision-making authority to employees and managers, it fosters organizational freedom and adaptability. Structural changes, like horizontal and vertical adjustments, organizational change to evolve the company along with market conditions.
Organizational factors	Purple	Organizational Factors illustrate the internal structures, processes, and systems that enable an organization to operate efficiently, adapt to changes, and foster innovation. This dimension includes the effective use of data, standardized practices, and flexible structures which determine the manner of communication, collaboration, and decision-making. Organizational factors indicate the importance of agility in responding to opportunities, resource allocation for optimized outcomes, and information exchange systems to support continuous improvement. Furthermore, it includes optimizing both internally driven innovation and externally sourced developments from suppliers, competitors, and regulatory influences. Together, these factors define how an organization aligns its resources, processes, and strategies to achieve operational excellence and sustained innovation.

4.2. General CLD

Figure 5 presents the resulting Causal Loop Diagram (CLD), which illustrates the interplay between various organizational and external factors influencing innovation capacity. At its core, the CLD visualizes the firm's current innovation capacity alongside its desired innovation capacity, with the gap between the two defined as the innovation gap. This gap reflects the intrinsic motivation within the firm to enhance its innovation capabilities. The mapping of these factors serves as a tool for firms to critically evaluate and adapt their internal processes and strategies, aiming to close this innovation gap.

The CLD captures complex interdependencies, where multiple second-order variables exert both direct and indirect influences on innovation capacity. Four essential components of the diagram are: variables, causal links, link polarity, and loop polarity. These provide a structured framework for understanding how organizational factors interact dynamically. Variables represent the key factors influencing innovation capacity, while causal links, represented as arrows, denote the relationships between these variables. A positive causal link (+) signifies a direct relationship, where an increase in one variable leads to an increase in another. Conversely, a negative causal link (-) indicates an inverse relationship, where an increase in one variable leads to a decrease in another. Furthermore, some causal links have a double line intersecting the arrow, this indicates a delay between the occurrence of one variable as a consequence of the other.

These causal relationships form feedback loops, which can be categorized as either reinforcing or balancing. Reinforcing loops amplify changes, driving variables further in a particular direction and often leading to compounding effects. Balancing loops, on the other hand, stabilize outcomes, maintaining variables near an equilibrium state. Together, these loops reveal the dynamic nature of the system, showing how changes in one variable propagate through the network of interdependencies to influence innovation capacity. The general CLD is depicted in Figure 5, the definitions of each of the variables can be found in appendix II.

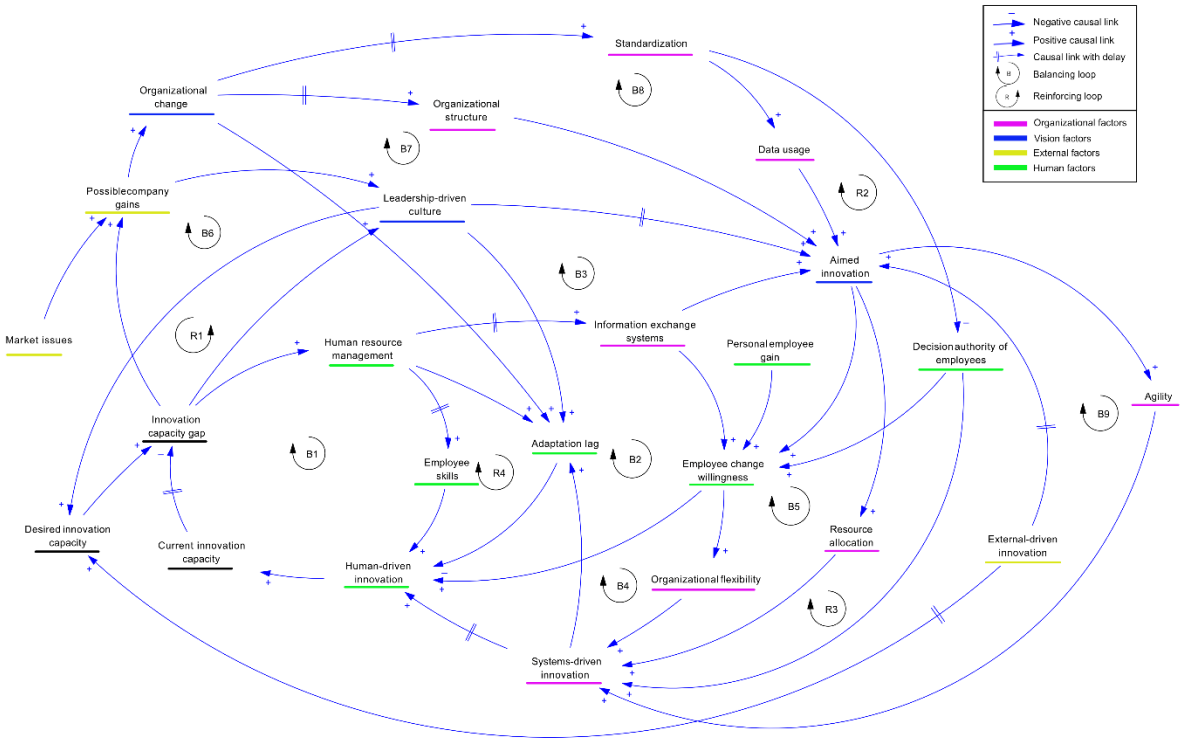


Figure 5: General CLD, Visualizing organizational and external factors influencing company Innovation capacity gap

In the sections that follow, the feedback loops within the CLD are analyzed in detail. This analysis explores how these mechanisms drive shifts in the firm's innovation potential and identifies strategic leverage points for fostering sustainable innovation growth. By understanding these feedback dynamics, organizations can make informed decisions to strengthen their innovation processes and achieve their desired innovation goals. In total the general model features nine balancing feedback loops and four reinforcing feedback loops.

4.2.1.Balancing loop 1: Employee Skills

Figure 6 shows the first and most central feedback loop in the Causal Loop Diagram (CLD) is the "Employee Skills Loop," which emphasizes the pivotal role of human resource dynamics in enhancing a firm's innovation capacity. As noted by one interviewee, *"The human factors are essentially the core of your model, which I think is exactly where they should be."* This loop captures the interconnected relationships that drive

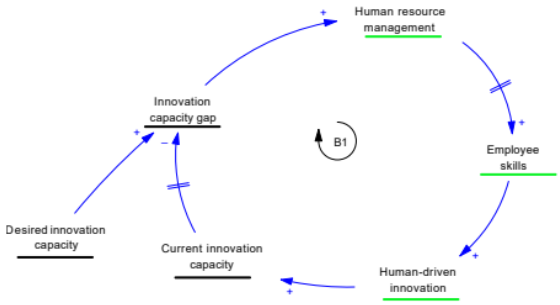


Figure 6: Employee skill loop

improvements in organizational innovation capabilities, reinforcing the importance of human factors as the foundation of innovation dynamics.

The loop is initiated by the **innovation capacity gap**, a disparity between the firm's current and desired innovation capacity. This gap positively influences **human resource management**, prompting strategic adjustments in the allocation of roles, development of employee skills, and optimization of workforce resources. Human resource management in this context focuses on aligning employee expertise with organizational goals, fostering skill development, and effectively utilizing in-house talent to maximize the firm's innovative potential.

As human resource management improves, it leads to an increase in **employee skills**, which are enhanced through targeted training, well-balanced team compositions, and the integration of new and experienced staff. This combination of diverse expertise and adaptability enables the workforce to adopt new technologies, solve problems creatively, and contribute to a culture of continuous improvement.

The development of employee skills directly drives **human-driven innovation**, wherein employees actively contribute to the organization's innovation efforts through their ideas and hands-on input. This bottom-up innovation complements top-down strategic initiatives by enabling practical and ad-hoc solutions to emerge from within the workforce.

As human-driven innovation increases, the **current innovation capacity** of the firm improves, gradually narrowing the innovation capacity gap. This balancing feedback loop works to bring the organization closer to its desired innovation level, demonstrating how targeted investment in human resource management and skill development can foster sustainable innovation growth.

4.2.2.Balancing loop 2: Employee Change Willingness

The second balancing loop, known as the "Employee Change Willingness Loop," shares similarities with the first but introduces a distinct focus on the role of organizational communication and motivation in fostering innovation. This loop is illustrated in Figure 7 and begins with the influence of **human resource management** on **information exchange systems**, which are structured processes designed to facilitate collaboration, effective communication, feedback, and the sharing of knowledge within the organization. These systems play a crucial role in supporting continuous improvement and ensuring that employees are well-informed and aligned with organizational goals.

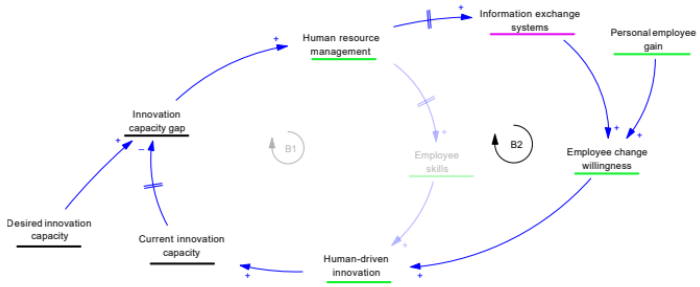


Figure 7: Employee change willingness loop

The effectiveness of these information exchange systems positively impacts **employee willingness to change**, which reflects the collective readiness of the workforce to embrace and adapt to organizational changes. This willingness is cultivated through a supportive and engaging organizational culture, where employees feel valued and are encouraged to adopt a change-oriented mindset. Leadership plays a key role in setting the tone, while peer interactions within teams further reinforce this adaptability.

A crucial element in enhancing change willingness is the perception of **personal employee gain**, often referred to as the "what's in it for me" factor. As one interviewee explained, "*'What's in it for me' is about personal profit and, to put it bluntly, it is essential in successful innovation. Because if employees think, 'Oh, we can do the same work with fewer people, so I'll get laid off,' then they will never proactively implement that innovation. But if there's a clear monetization scenario, such as generating double the output with the same team, you'll see much more willingness to innovate.*" When employees perceive tangible benefits, such as skill development, career growth, or improved work conditions, they are more likely to support and actively engage with new innovations. This heightened willingness to change directly fuels **human-driven innovation**, where employees play a central role in shaping and implementing innovative ideas.

As human-driven innovation increases, the **innovation capacity gap** narrows, bringing the organization closer to its desired innovation capacity. This balancing loop highlights the importance of fostering a culture of open communication, mutual benefit, and adaptability to drive sustainable innovation within the firm.

4.2.3.Balancing loop 3: Leadership-Driven Aimed Innovation

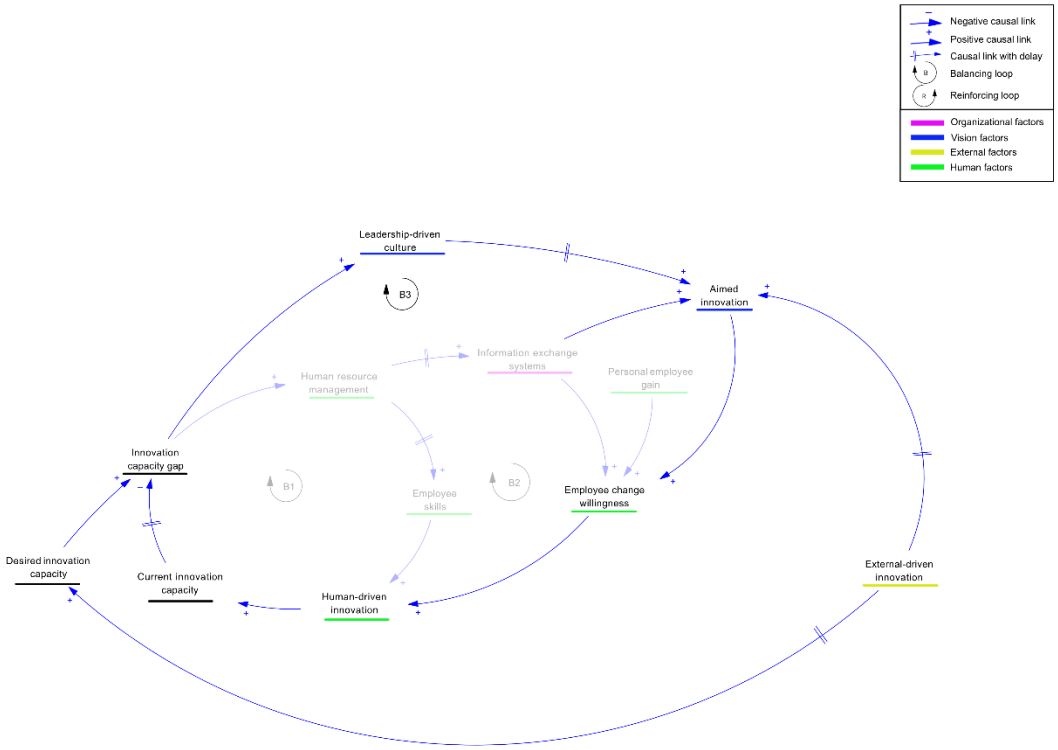


Figure 8: Leadership-driven aimed innovation loop

The third balancing loop, illustrated in Figure 8 is the "Leadership-Driven Aimed Innovation Loop," emphasizes the crucial role of leadership in fostering a culture of innovation. The **innovation capacity gap** acts as a motivator for leaders, particularly the CEO and other key decision-makers, to enhance the

leadership-driven culture within the organization. This factor reflects the ability of top management to inspire teams, encourage creative thinking, and proactively address both current and emerging challenges. This is underscored by the insight shared by an interviewee: "*For successful innovation, both support from management and a clear vision are crucial. If the vision is not right or doesn't align with innovation, it must be adjusted in the company's mission and culture.*" By aligning the vision with innovation goals, leadership can create a cohesive strategy that strengthens organizational resilience and drives meaningful change.

This is represented in the CLD by the component of **aimed innovation**, a strategic, mission-driven form of innovation that aligns with the organization's culture and long-term vision. Aimed innovation focuses on well-defined, forward-thinking initiatives that leverage specialized expertise to address evolving industry demands. By embedding this approach into the organization's framework, leaders ensure that innovation efforts remain intentional, impactful, and resilient to external pressures, ultimately strengthening the organization's capacity for sustainable growth and transformation.

This clarity of vision and direction positively influences **employee willingness to change**, creating a workforce that is more engaged, adaptable, and proactive in embracing new innovations. As discussed in earlier loops, an increase in employee change willingness contributes to **human-driven innovation**, which in turn narrows the innovation capacity gap. This loop underscores the importance of strong, visionary leadership in guiding the organization toward sustainable, strategically aligned innovation.

However, this loop also integrates **external-driven innovation**, which involves adopting advancements developed by suppliers, competitors, or industry leaders. Regulations and governance established by authorities further compel organizations to innovate to comply with standards, secure certifications, or access subsidies. External-driven innovation can increase the **desired innovation capacity** by creating competitive pressure or responding to regulatory requirements, thereby widening the **innovation capacity gap**. This highlights the dual role of external influences as both drivers of structured innovation and contributors to the need for more substantial innovation efforts, reinforcing the importance of strong leadership to guide these efforts strategically.

4.2.4.Balancing loop 4: Organizational Flexibility

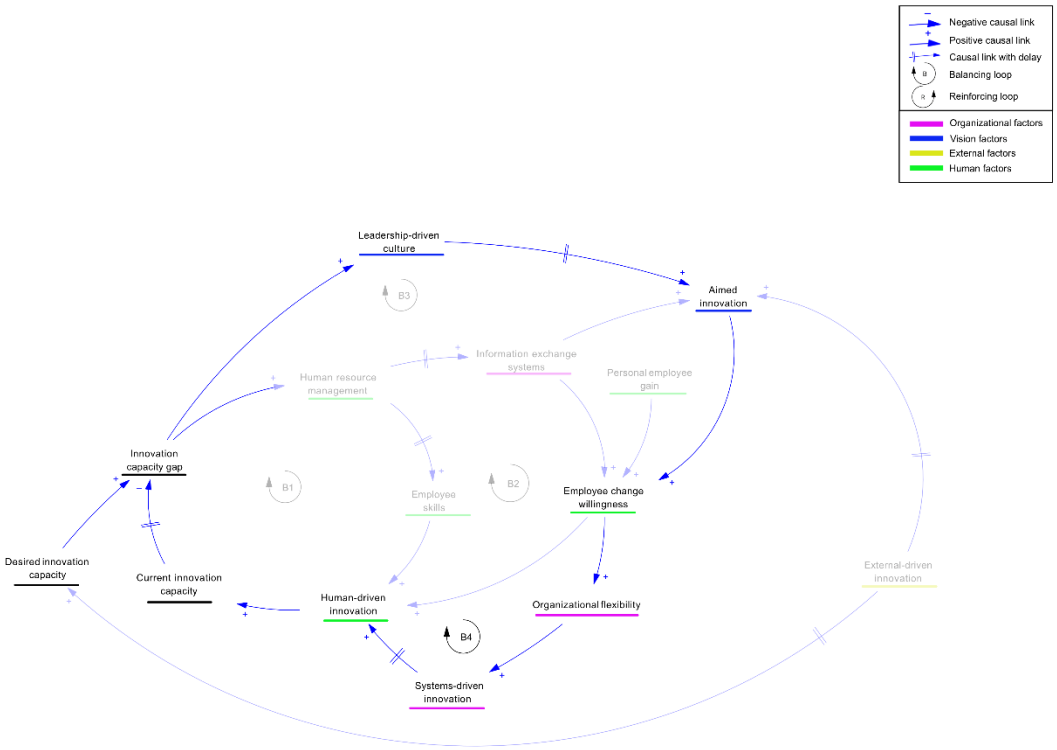


Figure 9: Organizational flexibility loop

The fourth balancing loop depicted in Figure 9, termed the "Organizational Flexibility Loop," highlights the importance of **employee change willingness** in fostering innovation, with **organizational flexibility** playing a central role. Flexibility represents the organization's ability to adapt and implement new processes or systems, but it is often constrained by the complexity of established practices, diverse operational needs, and ingrained systems. When flexibility is high, however, it creates an environment conducive to transformative innovation.

As one interviewee noted: "There is the current situation and the future state you can plan for, but innovation evolves along the way, so you can't always know in advance what you want to achieve. This is something that should be represented somewhere." This emphasizes that true organizational flexibility requires not only planning for change but also adapting to evolving outcomes, reinforcing the need for a dynamic approach to innovation that embraces uncertainty and continuous learning.

Increased organizational flexibility positively impacts **systems-driven innovation**, which refers to structured processes, strategies, and collaborative frameworks designed to foster creativity and idea generation within the organization. These systems may include dedicated R&D departments, adaptive organizational strategies, and open platforms for employees to contribute ideas. By formalizing and supporting innovation through structured mechanisms, the organization creates a sustainable foundation for generating and implementing new ideas.

High levels of **system-driven innovation** act as a tool to enhance **human-driven innovation**, empowering employees to actively engage in and contribute to innovation initiatives. By providing the necessary support structures, such as streamlined processes and advanced tools, system-driven innovation creates an environment where human creativity and problem-solving can thrive. As one expert noted, "*Most fundamentally, you need people to drive innovation; these people need to be curious in order to innovate... And if you have that curiosity, you also need the capabilities to turn that curiosity into output.*" This highlights that while curiosity is a key driver of innovation, it must be paired with the right tools and capabilities to yield meaningful outcomes. The synergy between system-based and human-driven innovation increases the organization's **current innovation capacity**, ultimately reducing the **innovation capacity gap**. This loop underscores the importance of combining organizational adaptability with structured innovation processes, demonstrating how system-oriented strategies can drive sustainable progress toward achieving innovation goals.

4.2.5.Balancing loop 5: Resource Allocation

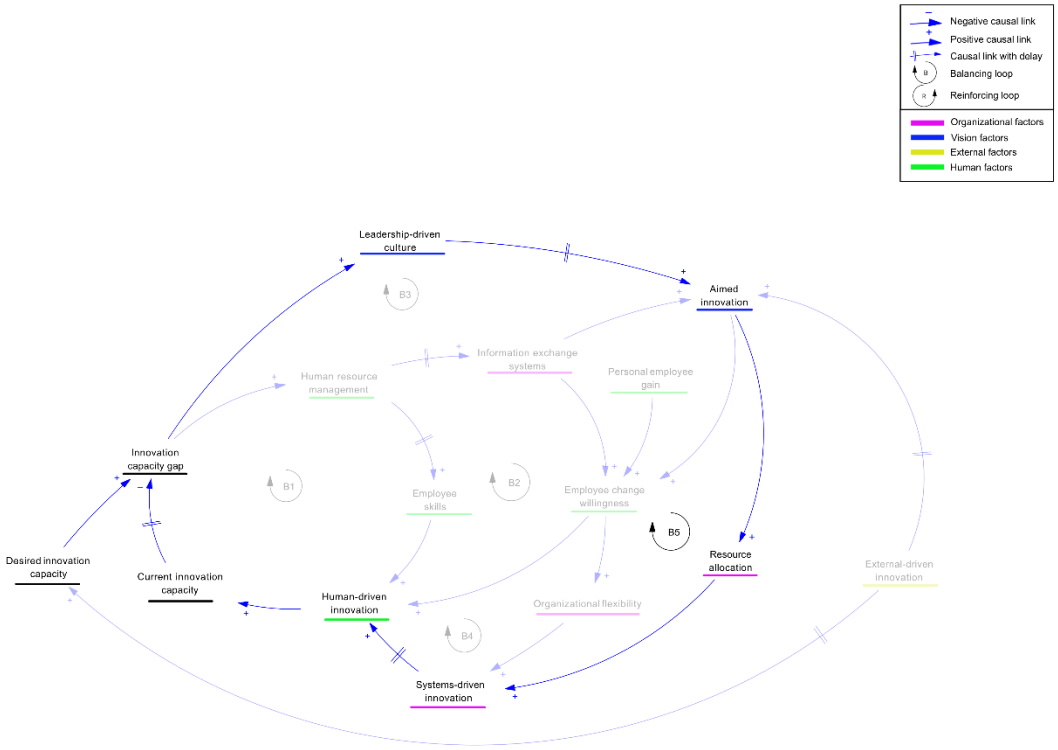


Figure 10: Resource allocation loop

Figure 10 provides an illustration of the "Resource Allocation Loop" is based on the principle that **aimed innovation** leads to more efficient resource utilization. According to an interviewee*, "better targeted market research helps in better resource utilization,"* highlighting how aimed innovation refines the focus of resource distribution. Additionally, aimed innovation improves reaction times, accelerating decision-making processes, which further enhances resource allocation.

Resource allocation refers to the strategic distribution of financial, human, and operational resources to optimize outcomes and support innovation initiatives. Improved resource allocation strengthens systems-driven innovation by creating structured processes and environments that foster continued innovation. This increase in **systems-driven innovation** helps narrow the **innovation capacity gap**, enhancing the organization's internal capabilities and improving its ability to use the resources at their disposal efficiently.

4.2.6.Balancing loop 6: Possible Company Gains

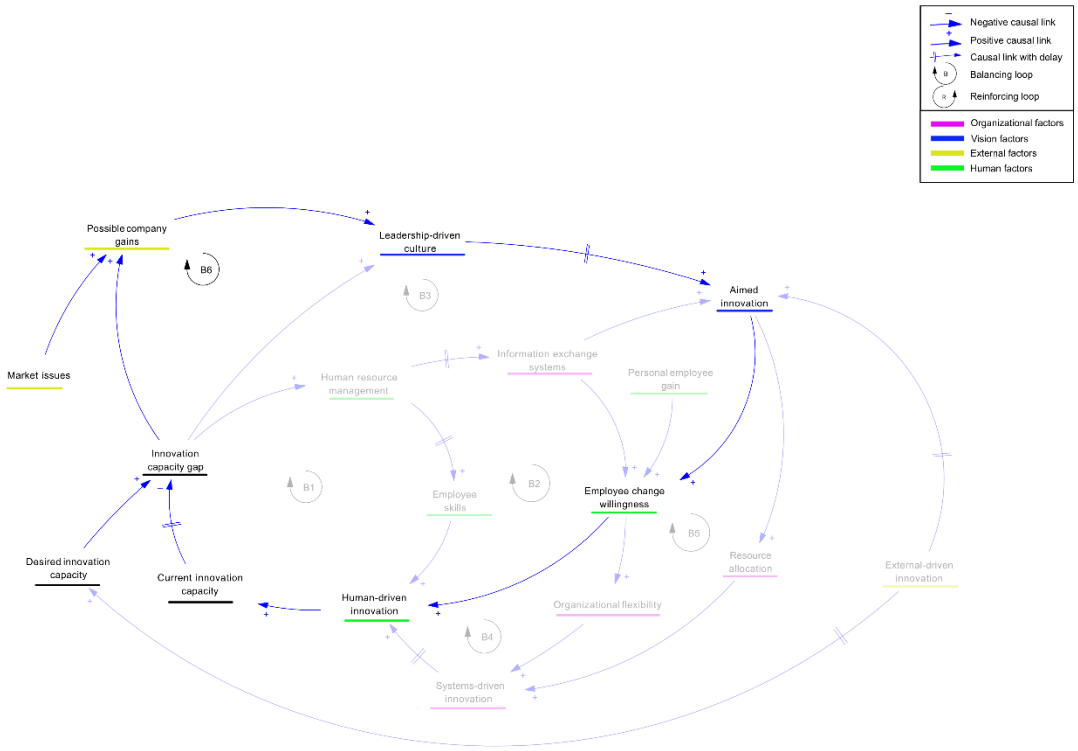


Figure 11: Company gains loop

The seventh balancing loop illustrated in Figure 11 centers around the factor of **company gains**, a significant motivator for top management's commitment to achieving innovation goals. The pursuit of company gains such as; increased market share, profitability, visibility, and competitive advantage. Drives leadership to foster a culture of innovation. This ambition is closely tied to the opportunities presented in the market, represented in the CLD by the market issues factor.

Market issues refer to project-based characteristics that affect clarity and confidence in financial and strategic decision-making within project-driven industries. These issues include factors like budget certainty, sustainable planning, and alignment with client expectations for cost-effective, innovative solutions. When market issues are well-defined and manageable, they build trust and confidence among stakeholders. Conversely, an increase in market issues introduces unpredictability, hampers consistent progress, and erodes trust between stakeholders. Therefore, more market issues signify more urgency

and higher marktet demand. While market issues are external factors beyond the company's control, they remain critical in shaping opportunities that companies must leverage to succeed.

When there is a high number of pressing **market issues,** more opportunities often arise, creating the potential for increased company gains and motivating leaders to prioritize innovation. As one interviewee noted, "There has to be a demand from the market. If there is no problem, there's no need for innovation." Another interviewee reinforced this by stating that "90% of innovation impulses come from the clients." These perspectives highlight how external pressures and client demands serve as key catalysts for innovation efforts. In response, leadership is compelled to cultivate and sustain an innovation-oriented culture within the organization, fostering an environment that supports creativity and growth. This focus on innovation positively influences several interconnected factors, such as **employee change willingness, systems-driven innovation,** and **leadership-driven culture,** reinforcing the organization's capacity to adapt and thrive in a dynamic market.

Ultimately, this loop contributes to reducing the **innovation capacity gap** by reinforcing the organization's commitment to innovation and its ability to capitalize on market opportunities. It underscores the importance of external market dynamics in shaping internal innovation strategies and driving sustained organizational growth.

4.2.7.Balancing loop 7: Organizational Change & Structure

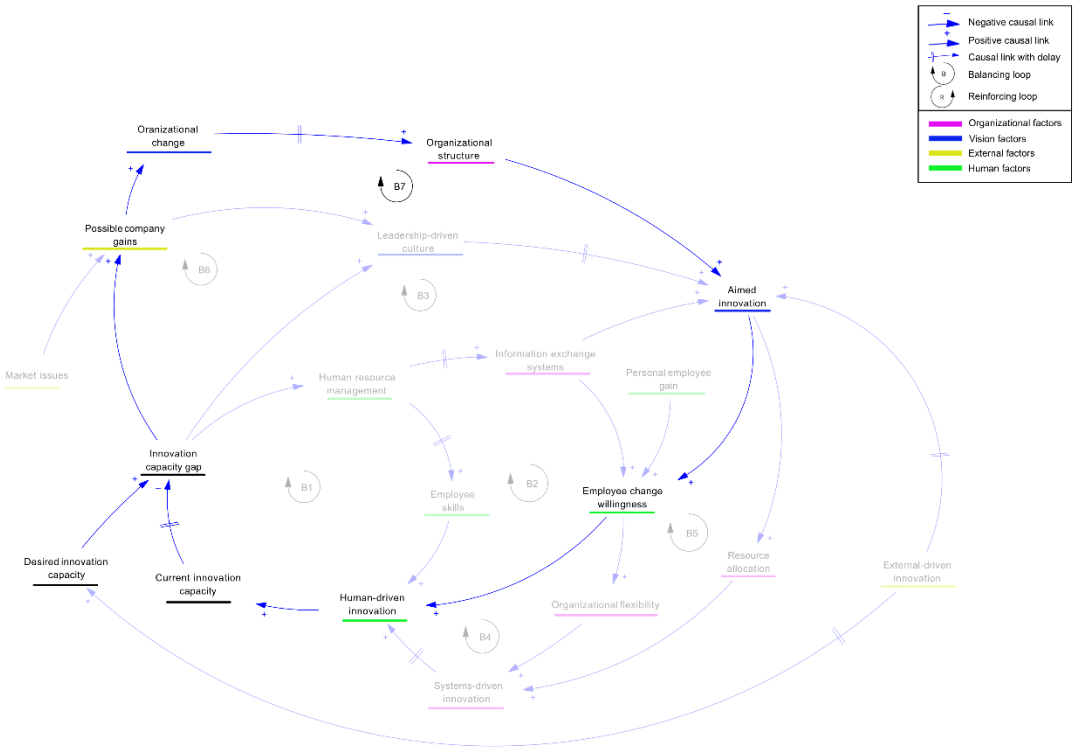


Figure 12: Organizational change & structure loop

Figure 12 above depicts the “Organizational change & structure loop”. Building on the concept of **possible company gains**, the drive for these gains also acts as a catalyst for **organizational change**. Organizational change refers to structural adjustments within a company, encompassing changes in strategies, workflows, and overall organizational design. These changes aim to enhance adaptability and certainty in response to evolving market demands. Central to this process are **horizontal and vertical adjustments**, which ensure that the company can operate efficiently and remain competitive in dynamic environments.

Organizational change is inherently linked to the factor of **organizational structure**, which represents the company’s internal mechanisms aiming to align and manage interconnected processes, stakeholders, and specialized roles within often fragmented market landscapes. A well-designed organizational structure facilitates clear communication, coordinated decision-making, and strategic resource allocation, all of which are critical for smooth project execution and effective innovation management.

When organizational structure is well-organized, it positively influences the degree of **aimed innovation**, ensuring that innovation efforts are focused, strategic, and aligned with long-term objectives. This alignment ultimately contributes to a reduction in the **innovation capacity gap**, reinforcing the organization’s ability to adapt, innovate, and sustain competitive advantage.

4.2.8.Balancing loop 8: Standardization

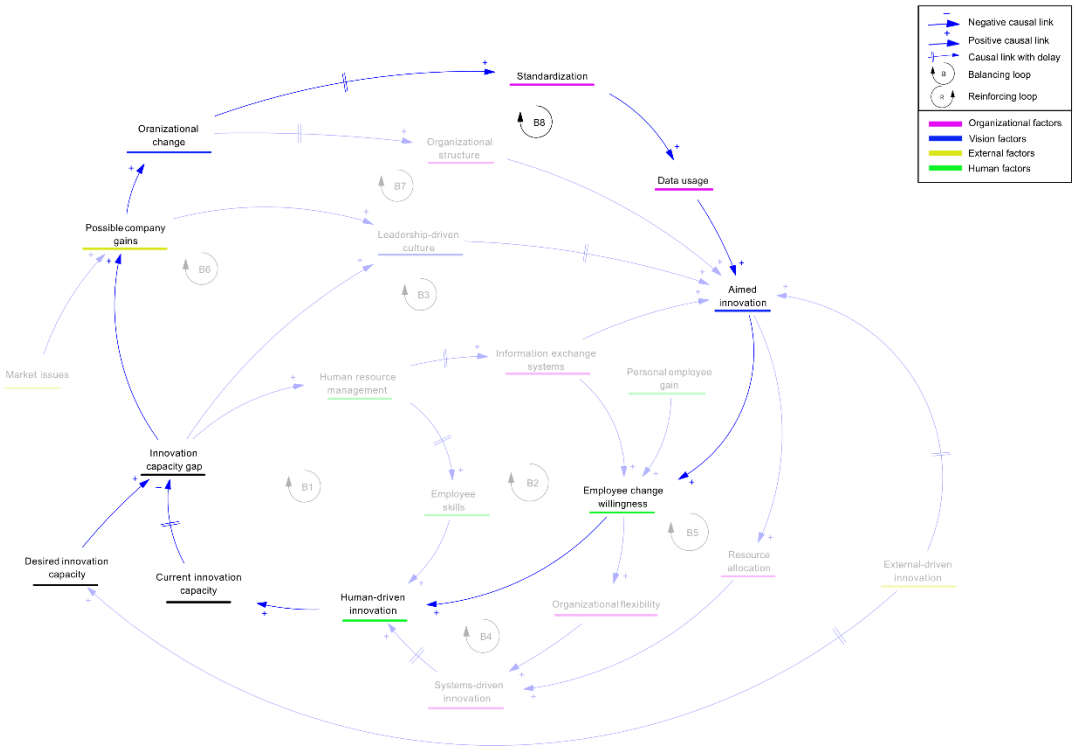


Figure 13: Standardization loop

Organizational change introduces both opportunities and risks, with uncertainties often accompanying structural adjustments. One effective way to mitigate these uncertainties is through **standardization**, which involves implementing consistent processes, tools, and systems across the organization. The dynamics of the "Standardization loop" is illustrated in Figure 13. As one interviewee emphasized, *"One key aspect of a quality management system is ensuring handovers and feedback for continuous improvement."* This highlights the importance of structured transitions and feedback to maintain quality and support organizational learning. Another interviewee noted that *"There should be a document check on files delivered, ensuring they meet all requirements,"* reinforcing the role of thorough documentation reviews in upholding consistency and quality. By embedding these practices, standardization promotes clear communication, uniform quality control, and a more cohesive and efficient operational environment.

However, standardization also carries potential downsides. As one interviewee cautioned, *"Doesn't reducing organizational and employee freedom risk boxing people in and negatively impact their willingness to innovate?"* This highlights the concern that excessive rigidity may suppress creativity and reduce employee motivation to drive change. Therefore, while standardization fosters clear communication and uniform quality control, it must be balanced with enough flexibility to maintain employee engagement and adaptability within the organization.

By adhering to standardized practices, organizations achieve a deeper understanding of workflows and enhance the effective use of data. **Data usage** in this context refers to the ability to organize, analyze, and leverage information to generate strategic insights and support informed decision-making. This approach goes beyond mere data collection, focusing on making data actionable for optimizing operations and identifying trends. Standardized data usage ensures accuracy and consistency, allowing the organization to process and utilize information in a reliable and impactful way.

Improved data usage contributes directly to **aimed innovation**, where innovation efforts are strategic, well-focused, and aligned with the organization's goals. Enhanced innovation, in turn, leads to more effective **resource allocation**, optimizing the deployment of finances, personnel, and tools to achieve the desired outcomes. Completing this feedback loop, the resulting improvements bolster the **current innovation capacity**, thereby narrowing the **innovation capacity gap**. Standardization emerges as a foundational practice for reducing uncertainty, fostering innovation, and driving sustained organizational growth.

4.2.9.Balancing loop 9: Agility

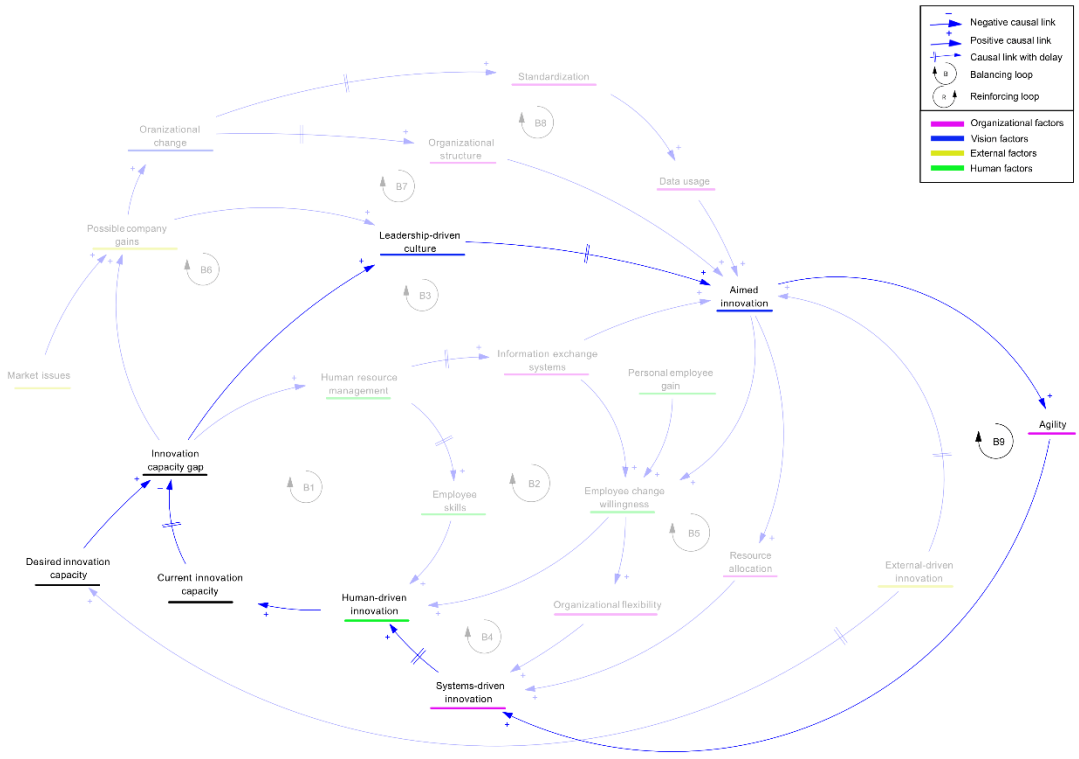


Figure 14: Agility loop

The ninth, and final, balancing loop is shown in Figure 14 and is built around the factor of agility, which reflects an organization's capacity to respond quickly and efficiently to unexpected changes and opportunities. **Agility** emphasizes dynamic responsiveness and resilience, enabling the organization to adapt to evolving market demands. As one interviewee noted, *"You need to adapt to subcontractors' needs, how they communicate, and how the client communicates with you. Each time, you must respond to those requests, making this an important aspect."* This highlights the importance of tailoring communication and collaboration to external stakeholders to maintain agility. Horizontally structured organizations, in particular, often demonstrate greater agility due to their broad understanding of products and applications, enabling them to identify and capitalize on opportunities more rapidly.

This organizational agility positively influences **system-driven innovation**, fostering structured processes and collaborative frameworks that enhance the organization's capacity for innovation. As detailed in previous loops, increased system-driven innovation leads to a reduction in the **innovation capacity gap**, underscoring agility's high impact role in driving sustainable progress and competitiveness.

4.2.10. Reinforcing loop 1: Leadership-Driven Innovation

Figure 15: Leadership-driven reinforcing loop

Figure 15 illustrates the first reinforcing loop focuses on the role of **leadership-driven culture** in shaping innovation efforts. When leadership prioritizes innovation as a core objective, it drives a cultural shift within the organization, aligning values, goals, and behaviors to support innovation. As one interviewee noted, “Our CEO has a vision of linking practical needs to aesthetic elements, creating needs that didn’t exist before,” illustrating how visionary leadership can inspire innovation by redefining customer expectations and creating new opportunities. This cultural transformation raises the **desired innovation capacity**, setting higher aspirations for what the company aims to achieve.

As the desired innovation capacity increases, the **innovation capacity gap** widens, signaling a greater need for innovation-driven efforts. This expanded gap further reinforces the leadership’s commitment to fostering an innovation-oriented culture, creating a self-reinforcing cycle where leadership influence continuously drives cultural and strategic focus on innovation.

4.2.11. Reinforcing loop 2&3: Decision Authority of Employees

Figure 16: Decision authority reinforcing loop 2

The second and third reinforcing loops are closely linked, both centered around the factor of **decision authority of employees**, which refers to the level of autonomy and freedom delegated to employees at all organizational levels, from managers to regular staff. This factor reflects the degree of organizational freedom employees have to make decisions and take initiative within their roles. This is backed by the following observation by one of the partitioners, *"I think there may be a correlation between organizational freedom and change willingness; if you are given more freedom, responsibility, and playing room, employees will, in my opinion, be more likely to actively participate in innovation processes."*

When **standardization** within the organization increases, it often leads to a reduction in decision authority, as rigid processes and guidelines limit employees' ability to exercise independent judgment. **employee change willingness**, as employees may feel disempowered and less engaged. This diminished willingness to embrace and support organizational changes further weakens human-driven innovation and is depicted in Figure 16.

Figure 17: Decision authority reinforcing loop 3

This effect in addition to the third reinforcing loop which visualizes that when employees' autonomy is restricted by rigid processes and standardized guidelines, their ability to contribute to structured innovation processes is hindered. This diminishes **system-driven innovation** by limiting participation in formalized mechanisms, such as R&D initiatives and collaborative frameworks. Additionally, the lack of decision-making freedom **suppresses human-driven** innovation by discouraging employees from proposing or implementing new ideas as shown in Figure 17.

This aligns with the insights from the "Organizational Flexibility Loop," which emphasizes the need to balance formal structures with adaptability. Therefore, empowering employees with decision-making authority is essential to maintaining a dynamic, innovation-friendly environment where both structured processes and individual creativity can thrive.

Ultimately, the combined negative effects of reduced employee authority contribute to a decline in innovative input, widening the innovation capacity gap. These interconnected reinforcing loops illustrate the critical importance of balancing standardization and autonomy to sustain a culture of innovation and drive organizational progress.

4.2.12. Reinforcing loop 4: Adaptation Lag

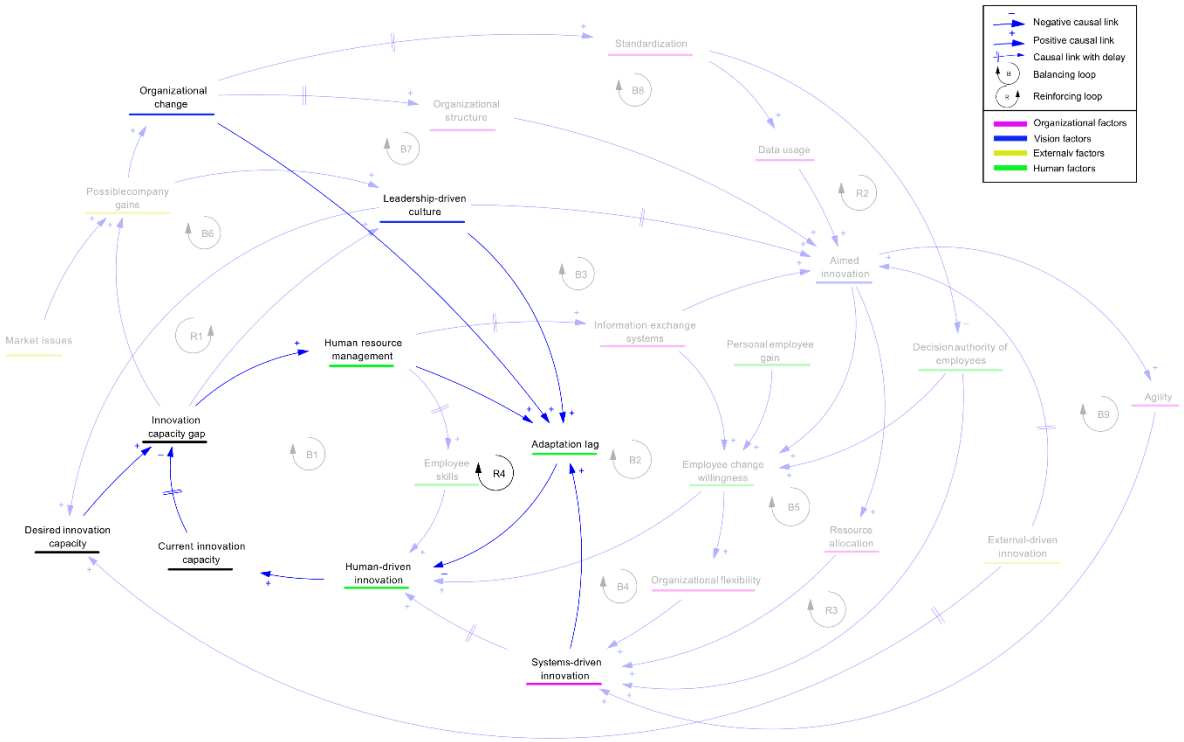


Figure 18: Adaptation lag reinforcing loop 4

The final reinforcing loop shown in Figure 18 addresses the concept of **adaptation lag**, which represents the time delay between the implementation of new skills, systems, or processes and their full realization in enhancing innovation capacity. During this period, there is often a temporary decline in employee productivity as individuals adapt, internalize, and learn to effectively apply new knowledge or workflows. This learning curve, marked by gradual adjustments, makes adaptation lag a critical factor to consider in the planning and timing of innovation-driven initiatives. As one interviewee highlighted, *"The biggest challenge is the old way of working versus the new way and adapting to this change."* This statement emphasizes that the shift to new practices often encounters resistance and requires time for employees to adjust.

Another challenge lies in convincing employees of the long-term benefits of additional upfront effort, especially when the immediate output appears minimal. One practitioner explained, *"For example, for prefab to work, someone must ensure early on that everything is properly designed, but people only focus on their own piece and have to be convinced of the added value for the process as a whole."* This example underscores the impact of adaptation lag on **leadership-driven culture** and **human resource management**, as effective communication and support are necessary to foster a collective understanding of the broader value of new practices.

In the short term, adaptation lag can reduce **human-driven innovation**, as employees may struggle to immediately integrate new methods or tools into their daily workflows. This temporary reduction in innovation output widens the **innovation capacity gap**, reinforcing the importance of effective leadership and structured support during adaptation periods. By managing this transition carefully, organizations can minimize disruptions and accelerate the integration of new practices, ultimately fostering sustained progress and higher levels of innovation.

4.3. General CLD summary

The components of the Causal Loop Diagram (CLD) primarily represent factors that companies can influence to drive innovation. However, there are three external components, which are market issues, company gains and external driven innovation that lie beyond the control of individual firms but still play a crucial role in shaping innovation dynamics. These components are included in the CLD because they affect decision-making, strategic alignment, and overall innovation capacity, despite being outside a firm's direct influence.

Market issues, making up the demand for a certain innovation therefore impact financial and strategic importance of an innovation. Heightened market uncertainties can hinder progress and erode stakeholder trust. However, recurring market challenges can also act as catalysts for innovation, driving the creation of new approaches that, over time, evolve into standard practices.

Potential company gains are another external factor, driven by the pursuit of competitive advantages such as increased market share, profit, and brand exposure. These anticipated rewards influence top management’s commitment to innovation, even though external rewards like market recognition cannot be directly controlled. The extent of potential gains also depends on the scale of the problem or risk being addressed by the innovation, further reinforcing its strategic importance.

The third external component is, as the name implies, externally driven innovation, where firms adopt advancements developed by suppliers, competitors, or regulatory bodies. Legal requirements and governance standards compel firms to innovate in compliance with industry regulations, while external advancements push firms to adapt and stay competitive.

By including these external components, the CLD provides a comprehensive view of systemic factors influencing innovation, encompassing both internal and external forces that shape strategic decisions.

The CLD framework uses the innovation capacity gap, the difference between desired and current innovation levels, as a starting point for driving change. However, innovation itself can originate from various sources. It may begin with a single individual championing an idea for diverse reasons, which, if recognized as having high potential, can grow into a company-wide initiative.

Ultimately, innovation can emerge from any component of the CLD. However, due to the interconnected nature of the feedback loops linking these components, the origin of an innovation is less significant than its overall impact on the company’s structure and innovation capacity. The CLD emphasizes how innovations, regardless of their source, contribute to reinforcing or reshaping organizational dynamics, underscoring their systemic influence on progress and transformation.

The formulation of the general CLD was aimed to answer the following sub-question: *“How can the critical organizational factors and their interrelations be mapped to effectively predict the impact of structural interventions on innovation capacity and overall performance?”*

The formulation of the general Causal Loop Diagram as depicted in Figure 5 addresses the integration of critical components, internal workflows, and influential factors to predict how structural interventions impact innovation capacity and performance within a construction firm. The validated CLD reveals that innovation dynamics are shaped by the complex interplay of the aggregate dimensions derived by the Gioia method; human factors, vision factors, organizational factors, and perceived gains. These factors interact across multiple feedback loops that highlight key drivers of adaptability, engagement, and strategic alignment.

Human factors, such as organizational freedom, employee well-being, and collaborative structures, are central to shaping innovation capacity. Greater autonomy enhances employee engagement and fosters adaptability, while rigid standardization, though useful for consistency, can suppress creativity and proactive decision-making. Ensuring employee satisfaction through well-being programs, recognition, and skill development strengthens their motivation to contribute to innovation. However, collaboration through specialized teams, if not aligned with organizational goals, can lead to fragmented efforts. To prevent this, strategies must balance team autonomy with unified innovation goals. Leadership and organizational flexibility play a critical role in bridging the innovation gap, ensuring operational efficiency while promoting long-term growth.

Gains, both personal and organizational, are integral to fostering a culture of innovation. Personal gains, such as skill development and job security, significantly influence employee willingness to support change. When innovations are perceived as threats to job stability, resistance increases. Clear communication of individual benefits and recognition of contributions enhance employee engagement and build a sense of accomplishment. The alignment between personal and organizational gains is essential to avoid friction. Demonstrating how company success translates into personal benefits fosters unity and proactive contributions. Leadership plays a key role in articulating organizational gains, such as competitive advantage and profitability, in ways that inspire and connect with the workforce. Leadership-driven innovation bridges the gap between company objectives and personal motivations, reinforcing a shared sense of purpose and driving sustained support for innovation.

A clear and proactive vision plays a crucial role in setting the strategic direction for innovation. Leadership-driven innovation aligns organizational efforts with long-term goals, preventing stagnation and fostering forward-thinking. Leadership must balance proactive innovation strategies with reactive responses to external pressures, such as competitor advancements or regulatory changes, to maintain both independence and responsiveness. Innovation goals must remain dynamic and evolve alongside organizational growth and external opportunities. Effective communication of this vision ensures organizational commitment and collective engagement in innovation initiatives, facilitating the seamless transition of innovations from project-level initiatives to company-wide processes.

External pressures such as regulations, market shifts, and competition are powerful drivers of innovation. Regulatory compliance and competitor successes compel organizations to innovate to remain competitive. Market dynamics, including client demands and economic fluctuations, necessitate innovative approaches to manage risks and capitalize on opportunities. Crises and sudden market changes often trigger organizational transformation, making external forces pivotal for adaptability. However, simultaneous vertical and horizontal integration can increase complexity and hinder innovation if not managed through clear communication, goal alignment, and a cohesive culture. A supportive

culture of autonomy enhances employee adaptability, aligning their efforts with broader organizational objectives and enabling organizations to turn external challenges into growth opportunities.

Organizational structures define how innovation is implemented and scaled. Standardization enhances efficiency but may stifle creativity if overly rigid. Therefore, organizations must create frameworks that maintain operational consistency while allowing for process adaptability. Effective information exchange systems ensure alignment between individual contributions and company objectives, maintaining autonomy within structured environments. Integration strategies further influence innovation capacity; horizontal integration simplifies coordination through specialization, while vertical integration offers greater control but may introduce complexity. Success in scaling innovation requires an adaptable structure that integrates both approaches without overwhelming organizational processes.

4.4. Specification of the CLD

The research presented in this report is structured according to the various sub-questions defined in the introduction. The last two sub-questions which are left to be addressed are:

"How do the distinct characteristics of the construction sector shape innovation mechanisms and the relative importance of influential factors in driving innovation?"

&

“How do vertical and horizontal organizational structures influence innovation capacity, and what practical insights can be derived to optimize organizational strategies in service-based construction firms?"

To answer these questions, additional interviews were conducted with informants who participated in the earlier phases of the study, as described in section 3.2. These interviews were designed to capture insights into the dynamics of both vertical and horizontal organizational structures within the construction industry, as well as their respective influences on innovation capacity. The interviewees are employed by either Group Jansen (a vertically integrated firm) or Bulsink (a horizontally integrated firm). Thereby providing a balanced perspective on these structural paradigms. In order to give a more targeted approach to the interviews the questions were centered around the general CLD while asking the following two core questions:

“*Are there variations in the model that arise because my research focuses on the construction industry rather than another sector?” **&** “What are the key points in the model where horizontal and vertical organizations differ, and how can these differences be represented within the model?”*

Through these discussions, participants were first encouraged to address the questions from the perspective of their own organizational type, which they found easier to articulate. Following this, they were prompted to offer their views on the contrasting organizational form. This process not only provided a richer understanding of the distinctions but also revealed shared perceptions of the broader industry context, ensuring that insights include the complete scope of the research question.

The feedback gathered through these interviews became the basis for the specification of the general CLD into three specialized variations. Although all three variations preserve the same core factors and interconnections as the original CLD, the interview data revealed different emphases and relative importances of those factors. The overview of the gathered data is illustrated in appendix III.

To capture these insights, all participant feedback was compiled and analyzed in Excel. Each individual's comments were organized into a color-coded matrix, offering a clear, comparison of how the factors were perceived. Hereby the following colors were assigned the following meaning for Table 5, 6 and 7:

- Core Strength and Differentiator (Green): Identifies areas where the organization excels or distinguishes itself.
- Core Challenge and Constraint (Orange): Highlights significant hurdles or bottlenecks that impede progress.
- High-Reward Complexity (Purple): Pinpoints complex issues that, while difficult, hold high potential for meaningful gains if addressed properly.
- Low-Impact Simplicity (Blue): Denotes straightforward or less complex factors, representing limited strategic upside which is more easily accomplished.

By aggregating participant perspectives in this manner, the matrix offers a concise overview of the core themes and priorities emerging from the interviews. This visual summary then underpins the development of each specialized CLD, showing where and how the factors shift in importance depending on context. In essence, each matrix-CLD pairing provides a foundation for deeper organizational analysis and improvement plans tailored to the company context.

4.4.1.Construction Sector Specific CLD

The first sub-model focuses on the context of the construction industry and its effect on the CLD. Within this model four factors - Human-driven innovation, Market issues, Standardization, and External-driven innovation - emerge as particularly significant for the construction industry. These variables signify greater influence compared to their impact in other industry contexts. These factors are visually emphasized in the CLD by assigning heavier line weights to their causal connections, illustrating their amplified effects. Table 5 illustrates the matrix collecting the feedback of the respondents on which the specification of the model is based.

Figure 19 provides a visual representation, where the high-impact factors and their directly associated variables are highlighted. In contrast, factors without relative significance within the construction industry are depicted with lighter, semi-transparent text. It is important to note that these lighter factors are less emphasized in the context of this chapter. This does not imply that these factors are insignificant. Instead, their importance is comparable to their role in the general CLD and does not increase specifically within the construction industry. Within Figure 19 the main take-aways for each of the variables assigned with increased importance are noted.

Table 5: Overview Construction sector specification CLD

	H1	H2	H3	H4	H5	H6	V1	V2	P1	P2	P3	P4	O1	O2	O3	O4	O5	O6	O7	O8	O9
Agent 1																					
Agent 2																					
Agent 3																					
Agent 4																					
Agent 5																					
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Agent 9																					
Agent 10																					
Agent 11																					
Agent 12																					
Agent 13																					
Agent 14																					
Agent 15																					
Agent 16																					
	0	3	3	1	5	1	0	1	8	1	0	2	0	1	6	1	0	3	10	1	0

Core Strength and Differentiator
Core Challenge and Constraint
High-Reward Complexity
Low-Impact Simplicity

Human Resource Management	H1
Employee Skills	H2
Personal Employee Gains	H3
Employee Change Willingness	H4
Human-Driven Innovation	H5
Adaptation lag	H6
Leadership-Driven Culture	V1
Aimed Innovation	V2
Market Issues	P1
Possible Company Gains	P2
Organizational Change	P3
Decision Authority of Employees	P4
Information exchange Systems	O1
Organizational Structure	O2
Standardization	O3
Data Usage	O4
Resource Allocation	O5
Organizational Flexibility	O6
External-Driven Innovation	O7
Agility	O8
Systems-Driven Innovation	O9

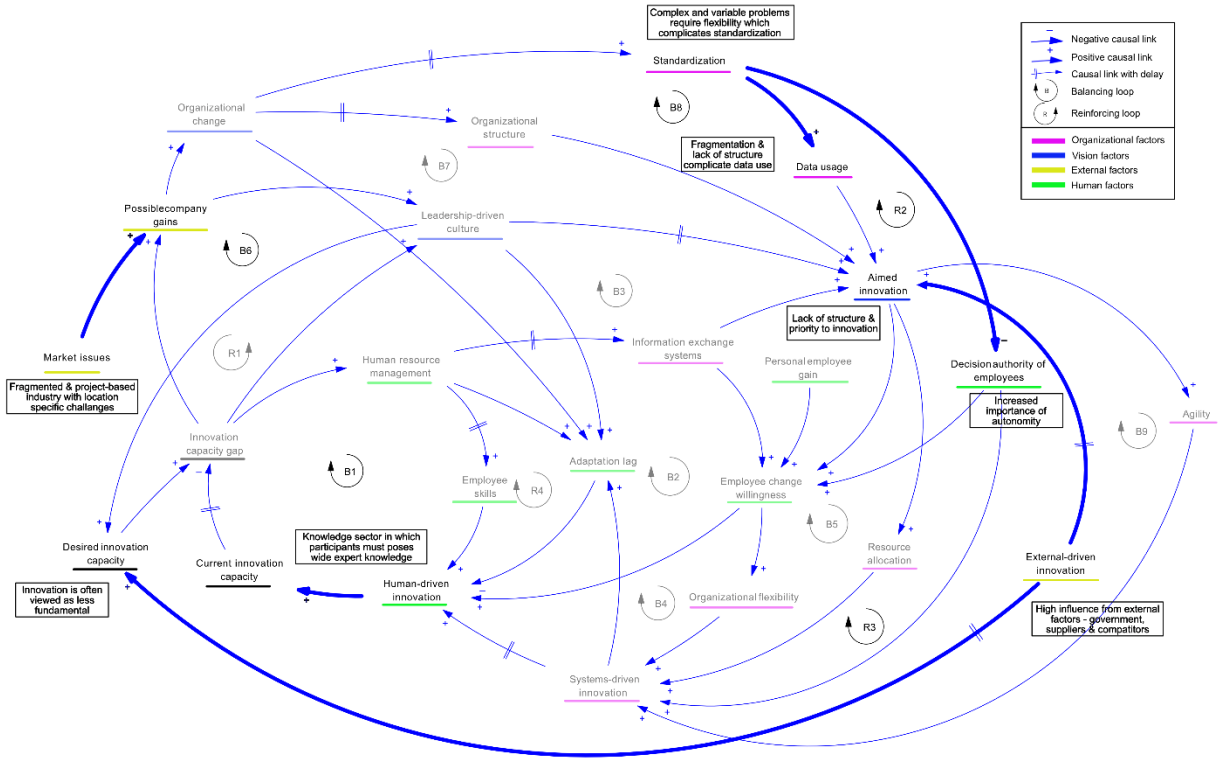

Figure 19: Construction industry specified CLD

Market issues

In the construction sector, market issues play a most significant role in shaping organizational strategies and innovation capacity. This strong emphasis, with 8 out of 16 participants specifically commenting on the significance of market issues, highlights how deeply these dynamics influence the construction sector, underscoring their critical role as both a challenge and a determinant in shaping the industry's capacity for innovation and strategic adaptation. This sector operates in a dynamic environment, where projects are often constrained by short timelines and location-specific challenges. Unlike production industries, where processes can be standardized and innovation systems established over time, the construction industry must adapt to projects that arrive suddenly and conclude before any structured innovation can take root. As one respondent put it, “A project simply comes in, and you have to start immediately, and before you’ve set up a certain structure, the project is already finished. In larger projects that take longer, it’s much easier to implement systems and innovations because you have the time for it.” It is market dynamics like this which often obstruct innovation within the building industry.

The fragmented nature of the industry exacerbates these challenges. Each stakeholder often operates under their own business model, prioritizing their margins over collaborative gains. This fragmentation creates barriers to integrated innovation efforts. As one respondent noted, “The construction sector is so fragmented that everyone has their own business model for their part… A ceiling with integrated functions is hard to sell because different parties want to maintain their margins on individual components.”

Moreover, the rigidity of the construction market limits its ability to embrace innovations fully. While clients increasingly demand sustainable and innovative solutions, they are often unprepared to pay the additional costs these changes entail. One participant highlighted, “A significant challenge is that clients often want sustainable solutions or innovations but are not willing to pay extra for them. This limits potential gains if efficiency improvements or cost reductions cannot be implemented to make innovation affordable.” This illustrates the need of a financial impulse in addition to a solely sustainable improvement of the building process.

External-driven innovation

External-driven innovation plays a pivotal role in the construction industry, with 10 out of 16 interviewees highlighting its significance compared to other sectors. Unlike industries where innovation is largely internally driven, construction relies heavily on external factors, primarily through supplier-driven innovation, competitor-driven collaboration, and government regulations as explained in section 2.3.8.

Suppliers and subcontractors are key sources of technological advancements. Without their innovations in products and methods, construction firms struggle to offer new solutions. As one respondent noted, *“Construction companies are highly dependent on external product innovations and methods. If others don’t innovate, you cannot offer innovative products either.”* This underscores the relation of construction firms and their supply chain in fostering technological innovation.

Collaboration with other entrepreneurs and contractors also serves as an external driver for innovation, particularly for smaller firms or start-ups. By pooling expertise and resources, these companies can achieve outcomes that would otherwise be unattainable. This form of innovation is less about rivalry and more about cooperative advancement. As one participant noted, “For a start-up or contractor, external-driven innovation is much more important. You involve another entrepreneur and get it done.” This

dynamic stresses the collaborative nature of innovation in construction, where competitors can also act as partners in progress.

Government regulations are perhaps the most influential external driver, setting agendas for sustainability and safety. As one interviewee observed, “External factors such as regulations and sustainability play a major role. Think of CO2-neutral construction requirements for 2050.” While these requirements push the industry toward progress, they can also induce barriers. As one participant observed, “Procurement legislation can hinder innovation because standard solutions are often required that multiple parties must be able to deliver.” This highlights a critical limitation: the enforcement of standardized solutions to include all parties can stifle creativity and restrict the adoption of unique or advanced innovations, as companies are constrained to align with broadly acceptable, less specialized options.

In summary, external-driven innovation in construction is shaped by supplier contributions, collaborative efforts among firms, and government regulations. While these factors drive progress, they also introduce constraints that must be navigated to maximize innovation potential.

Flexibility & Standardization

In the construction industry, flexibility and standardization play critical yet often conflicting roles. Flexibility enables organizations to adapt to diverse project demands, driven by factors like regulations, weather conditions, and site-specific challenges. As one participant noted, “Flexibility and quick decision-making are important due to the variability of projects.” This adaptability is not just reactive but serves as a competitive advantage, allowing firms to operate across different contexts and regions.

While flexibility is critical, standardization offers substantial benefits, including cost reduction, faster processes, and more efficient resource utilization. Modularization and the integration of standardized components are recognized as key drivers of innovation and profitability in the sector. One respondent highlighted, “Standardization, modularization, integration; that is the only way to make money in construction… Successful innovations in construction often stem from standardizing and modularly designing products to reduce costs and speed up processes.”

However, the inherent variability of construction projects poses significant barriers to achieving widespread standardization. Factors such as differing soil conditions, site accessibility, and project orientation ensure that every construction project is unique. “In construction, there is always something different: different soil conditions, different orientation, accessibility... Standardization in construction often means working with standard blocks, but the context of the project always differs.” Similarly, the industry often relies on adaptable methodologies rather than fixed standards to address these challenges. “Every construction site and project is different, so methodologies are used instead of standards.”

Balancing flexibility and standardization remain a challenge in construction. While flexibility helps firms navigate dynamic project environments, strategic standardization in processes and modular designs can enhance efficiency and foster innovation.

Human factors

Flexibility in the construction industry is closely tied to employee decision-making authority and proactive approach of employees to innovation. This in combination with the sector's dependence on individual initiative and specialized expertise sets it apart from other industries. Thereby stressing the importance of empowering employees and cultivating a culture of adaptability. This is reflected in participant feedback, with one noting, *"In construction, specialized knowledge from craftsmen is essential due to the project-based nature and complex regulations."*

In the construction sector, decision-making often requires significant reasoning, as solutions are rarely clear-cut. Employees frequently navigate multiple viable options, with the best choice depending on context, practicalities, and project goals. Unlike product industries, where processes are rigid and standardized, construction relies heavily on the flexibility, skills, and autonomy of its workforce. One respondent highlighted this by stating, "In the construction sector, decision authority has a different character since the solution is often not black and white. There are often multiple solutions possible, each of which can be the best for different reasons." Another emphasized the critical role of employees in driving innovation, noting that "The construction industry places a significant emphasis on the flexibility, skills, and autonomy of employees to drive innovation." These insights underscore the importance of the human factor, demonstrating how employee input and adaptability are central to fostering innovation within the construction industry.

This autonomy fosters adaptability but requires trust and expertise. As one participant observed, "… you manage more with the human factor and agility, by giving people more freedom." Motivation also plays a vital role, with personal engagement driving the adoption of innovations. One respondent noted, "In construction, activities are highly influenced by individuals, making it essential to better motivate employees to carry out certain tasks and embrace innovations, even if an adjustment may not initially seem beneficial." However, resistance can arise when innovations seem to demand more effort without immediate personal benefits. As another participant explained, "When we improve and innovate, in their perception, you need more time to solve problems. But in reality, you're investing more time in the process, while the overall value of the project is higher." Clarifying the broader benefits of innovation, such as enhanced workflows, is essential for reducing resistance and promoting sustained employee engagement.

The dynamic nature of the construction industry underscores the importance of employee autonomy, motivation, and expertise. Human-driven innovation is essential, with success relying on empowering employees, aligning innovations with their motivations to drive continuous improvement.

4.4.2. Vertical Organization CLD

The second sub-model focuses on the dynamics of vertical organizational structures. As shown in Table 6 tree factors - Leadership-driven culture, Organizational structure, and Standardization - emerge as particularly significant for vertical organizations. Thereby demonstrating greater influence compared to their impact in general organizations. These factors are visually emphasized in the CLD by assigning heavier line weights to their causal connections, illustrating their amplified effects. Table 3 illustrates the matrix collecting the feedback of the respondents on which the specification of the model is based. These factors are visually emphasized in the CLD shown in figure 20.

Table 6: Overview matrix Vertical specification CLD

	H1	H2	H3	H4	H5	H6	V1	V2	P1	P2	P3	P4	O1	O2	O3	O4	O5	O6	O7	O8	O9
Agent 1																					
Agent 2																					
Agent 3																					
Agent 4																					
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Agent 7																					
Agent 8																					
Agent 9																					
Agent 10																					
Agent 11																					
Agent 12																					
Agent 13																					
Agent 14																					
Agent 15																					
Agent 16																					
	4	0	3	4	4	1	8	2	3	2	2	4	2	6	9	2	1	2	3	2	4

Core Strength and Differentiator
Core Challenge and Constraint
High-Reward Complexity
Low-Impact Simplicity

Human Resource Management	H1
Employee Skills	H2
Personal Employee Gains	H3
Employee Change Willingness	H4
Human-Driven Innovation	H5
Adaptation lag	H6
Leadership-Driven Culture	V1
Aimed Innovation	V2
Market Issues	P1
Possible Company Gains	P2
Organizational Change	P3
Decision Authority of Employees	P4
Information exchange Systems	O1
Organizational Structure	O2
Standardization	O3
Data Usage	O4
Resource Allocation	O5
Organizational Flexibility	O6
External-Driven Innovation	O7
Agility	O8
Systems-Driven Innovation	O9

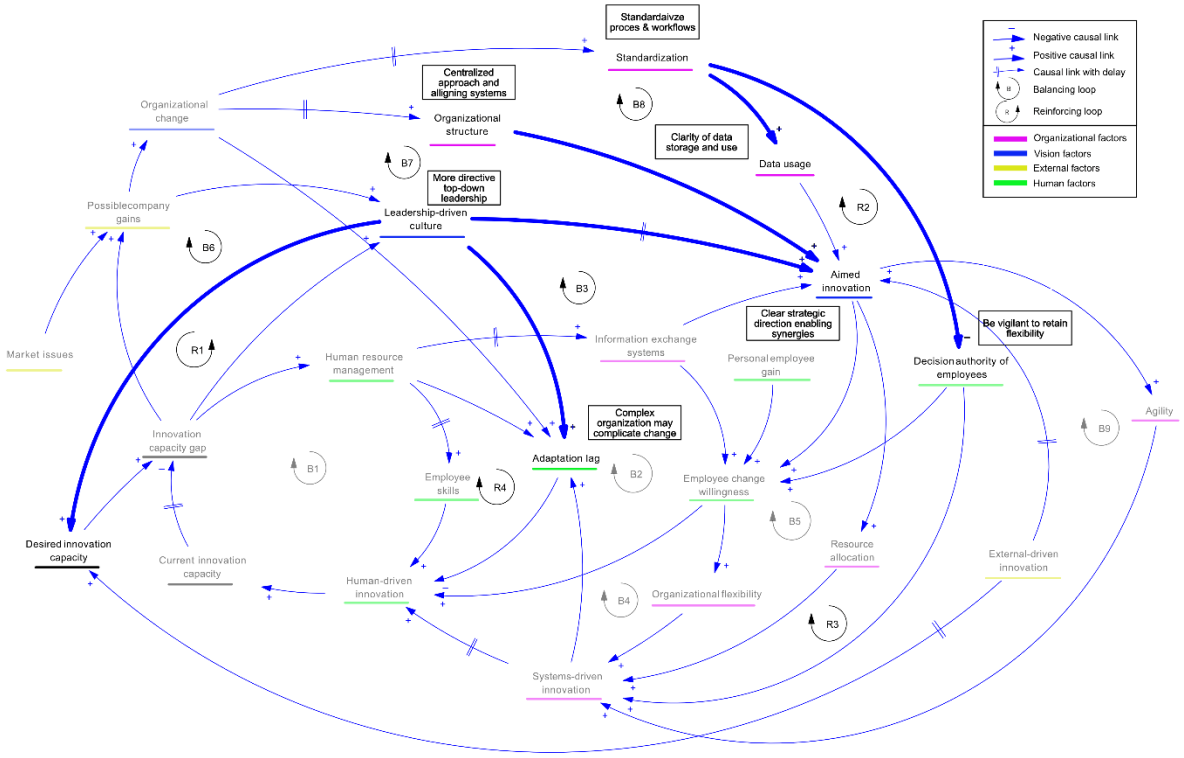

Figure 20: Vertical Organization CLD

Leadership-driven culture

In vertically structured organizations, leadership plays a central role in driving innovation through a hierarchical, top-down approach aligned with the strategic vision of upper management. As one interviewee noted, “In a vertical organization, leadership is often hierarchical and more directive.

Innovation is stimulated more top-down and depends on the vision of higher management." This centralized control fosters coherence and consistency across the different subsidiaries.

The importance of leadership in this context extends beyond only directive control, it is instrumental in maintaining employee engagement, managing resistance to change, and ensuring that team members understand and align with organizational objectives. As one respondent emphasized *"Effective leaders act as innovation champions who provide clarity and direction, minimizing uncertainty and encouraging focused efforts."*

However, this centralized approach to innovation also has its limitations. While it allows for greater control and alignment, It can unintentionally hinder bottom-up innovation, creativity and responsiveness to spontaneous opportunities. A respondent highlighted this potential drawback, remarking, *"When you focus too much on a high-level vision, on-the-spot opportunities may be overlooked."* This highlights the inherent tension in vertical organizations between maintaining strategic focus and fostering flexibility.

It is important to note that not all interviewees agree with the view that leadership should always drive innovation from the top. Some emphasized that innovation is often market-driven, with leadership serving a supporting role by setting strategic boundaries and making key decisions rather than directly driving the creative process. As one interviewee explained, *"Innovation is driven by an impulse from the market. Leadership then chooses a direction, gives a kind of go/no-go decision, after which the initiative must come from the people."* This perspective suggests that, in some cases, successful innovation relies on empowering teams to take the initiative within the broader strategic framework, highlighting the importance of balancing directive leadership with bottom-up creativity.

Aimed innovation

The concept of "aimed innovation" is intrinsically linked to a leadership-driven culture. In vertically structured organizations, innovation typically follows a deliberate and well-coordinated path, guided by strict planning within established frameworks. This structured approach helps ensure that changes are implemented consistently and align with long-term strategic objectives. By providing clear guidelines, this approach can enhance execution efficiency and ensure that innovations align seamlessly with the organization's operational priorities. However, this strong emphasis on control and formalization can limit the organization's flexibility, making it more challenging to adapt during the implementation process.

Despite these challenges, the focused nature of aimed innovation in vertical organizations ensures that resources are directed toward well-defined priorities, fostering incremental yet consistent improvements. Leaders play a critical role in evaluating whether emerging ideas fit within the larger strategic framework and determining whether they merit investment. This evaluative role reinforces the organization's commitment to its strategic objectives while mitigating the risk of pursuing initiatives that deviate from the established vision.

Vertical organizations emphasize a leadership-driven culture with clear roles, expectations, and a focus on long-term strategic innovation. As one respondent put it, *"It's clear: This is how we want you to work."* This clarity fosters alignment toward collective goals and enhances collaboration across departments. However, this structured approach often reduces employee autonomy and decision-making authority, leading to standardized workflows where personal contributions may feel overlooked.

As one interviewee noted, limited recognition and autonomy can weaken motivation, slow innovation, and disengage employees from the broader innovation process.

Organizational factors:

Apart from leadership, the organization structure is an essential tool in shaping innovation capacity in vertically integrated organizations. As this is closely linked to standardization, the hierarchical nature of vertical organizations relies heavily on clearly defined roles, centralized decision-making, and structured workflows to maintain efficiency and alignment. While this structure ensures consistency and reduces uncertainties, it can also limit flexibility and reduce decision-making autonomy at the individual level. One interviewee highlighted the impact of this by stating that *"the more vertical you become, the heavier the organizational structure and human resource management weigh."*

Standardization within vertical organizations aims to reduce complexity by streamlining processes and clarifying responsibilities. This simplification is crucial in larger organizations where complexity can otherwise become a barrier to efficiency and innovation. The integration of interconnected departments within a vertical structure can strengthen collaboration across projects, as long as processes are well-aligned. Another interviewee emphasized this interconnectedness, noting that *"if everything works together in a vertical structure, you can achieve higher gains."*

In vertical organizations, the structured approach reinforces a project management system where tasks are passed sequentially from one department to the next. While this system provides clarity and predictability, it can foster silos, as departments may focus on their specific roles rather than collaborative problem-solving. This can make innovation more system-dependent and less spontaneous compared to horizontal organizations, where creativity tends to arise more naturally. At the same time, this structured workflow is crucial for ensuring consistency, coordination, and efficiency across complex processes. As one respondent noted, *"You want the workflow to be as structured as possible so that you can expect consistency at every step."* Standardization, in this sense, acts as a "funneling tool" that streamlines operations and creates an efficient, direct pathway for completing tasks, minimizing delays caused by inconsistent approaches.

The reliance on formal communication channels reinforces top-down decision-making, ensuring data-driven, strategic alignment but often at the cost of agility. This can slow response times to unexpected challenges. Additionally, vertically integrated firms face the dual challenge of balancing product innovation, often through dedicated R&D departments, with continuous process optimization. As one interviewee observed, "Vertically organized companies are more likely to have an R&D department because they are product-focused, but they also need to prioritize process improvement." This dual focus adds strategic and operational complexity unique to vertical structures.

Standardization and decision authority:

By establishing clear frameworks and guidelines, standardization can accelerate decision-making and improve performance. This approach was likened to a cultural example where standardized systems allow companies to function with speed and precision once the frameworks are in place. *"If you look at German culture, once those frameworks are in place, those companies can accelerate."* In this way, standardization enables vertical organizations to avoid unclarities and delays, particularly in industries that require consistent output across various departments and teams.

Nevertheless, standardization also introduces significant challenges, particularly in terms of flexibility and inter-departmental communication. In organizations with diverse functions, it can be difficult to create a standardized system that meets the varied needs of each role without causing friction. One interviewee captured this complexity by stating, *"It's just a nightmare if you have to keep an installer, a carpenter, and a modeler happy in one organization."* In addition to complexities in terms of capturing diverse needs. Standardization may possibly lead to dissatisfaction among employees who may feel restricted by rigid processes and less empowered to operate freely within their roles. As another respondent noted, "Standardization can limit employee autonomy and reduce their willingness to change." Balancing the efficiency of standardized processes with the flexibility needed to support diverse roles is crucial for maintaining both operational effectiveness and employee engagement.

Moreover, effective standardization requires robust information exchange systems to support decision-making and maintain alignment across multiple levels of the organization. More than half of the interviewees emphasized that vertical organizations place increased reliance on data-driven insights to guide innovation and validate decisions, highlighting the critical importance of standardization in these companies. This data-centric approach helps to ensure that changes align with the organization's long-term objectives but can slow the responsiveness of decision-making processes.

In summary, the organizational structure in vertically integrated companies provides the foundation for maintaining consistency, streamlining operations, and aligning departments toward shared goals. However, this structure can also create silos, reduce individual autonomy, and slow decision-making due to its reliance on formal processes and data-driven validation. To maximize innovation capacity, it is essential for leadership to foster collaboration across departments and implement frameworks that balance standardization with flexibility. By doing so, vertical organizations can reduce complexity, improve integration, and enhance overall performance.

4.4.3.Horizontal Organization CLD

The third sub-model focuses on the dynamics of horizontal organizational structures, again in a similar way as applied for previous specification CLD's. Within the context of a horizontal organization, four factors - Human-driven innovation, Agility, Leadership-driven culture, and Organizational flexibility - emerge as particularly significant, demonstrating greater influence compared to their impact in general organizations. These factors are visually emphasized in the CLD shown in figure 21.

Table 7: Overview matrix Horizontal specification CLD

	H1	H2	H3	H4	H5	H6	V1	V2	P1	P2	P3	P4	O1	O2	O3	O4	O5	O6	O7	O8	O9
Agent 1																					
Agent 2																					
Agent 3																					
Agent 4																					
Agent 5																					
Agent 6																					
Agent 7																					
Agent 8																					
Agent 9																					
Agent 10																					
Agent 11																					
Agent 12																					
Agent 13																					
Agent 14																					
Agent 15																					
Agent 16																					
	2	1	3	2	9	0	8	3	4	1	1	5	0	5	3	2	2	6	0	9	1

Core Strength and Differentiator
Core Challenge and Constraint
High-Reward Complexity
Low-Impact Simplicity

Human Resource Management	H1
Employee Skills	H2
Personal Employee Gains	H3
Employee Change Willingness	H4
Human-Driven Innovation	H5
Adaptation lag	H6
Leadership-Driven Culture	V1
Aimed Innovation	V2
Market Issues	P1
Possible Company Gains	P2
Organizational Change	P3
Decision Authority of Employees	P4
Information exchange Systems	O1
Organizational Structure	O2
Standardization	O3
Data Usage	O4
Resource Allocation	O5
Organizational Flexibility	O6
External-Driven Innovation	O7
Agility	O8
Systems-Driven Innovation	O9

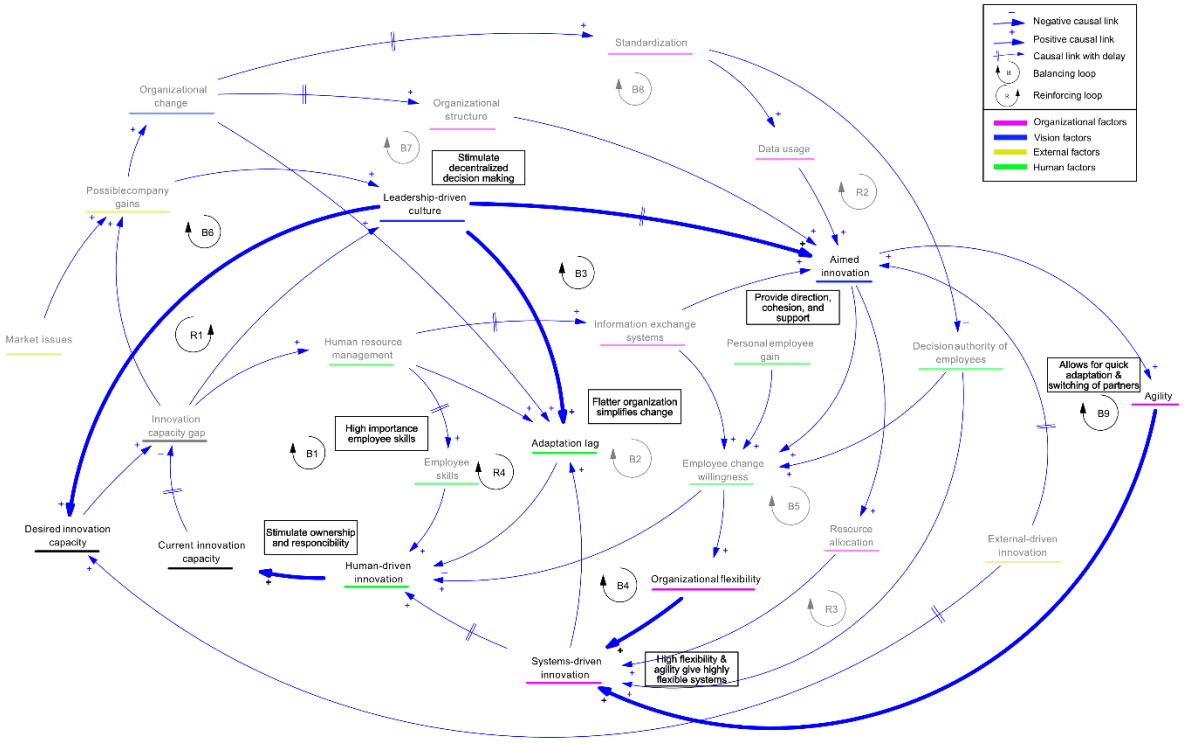

Figure 21: Horizontally specified CLD

Human-driven innovation

Human-driven innovation is a defining element in horizontal organizations, where success is largely determined by the contributions, agility, and motivation of individuals and teams. Horizontal organizations rely heavily on their people to initiate and sustain innovative efforts. Therefore, decision-making in horizontal organizations is often decentralized, giving employees the opportunity to actively contribute to innovation efforts. This fosters a stronger sense of ownership and responsibility, as highlighted by one interviewee: “Decision-making is bottom-up, and employees feel more involved in innovation.” This active involvement requires not only technical proficiency but also a sense of purpose and alignment with organizational goals. Clear and transparent communication is key to fostering this alignment. As noted by another respondent, “Communication is essential... People need to know why they are doing things, how they should do them, and what they need to do... Ultimately, innovation comes from the teams themselves”.

Authority of employees

However, granting employees this level of autonomy also requires a strong foundation of trust and effective human resource management. Leaders active in horizontal organizations must ensure that their teams understand and are capable of handling the freedom they are given. “If you give people freedom, you also need to trust that they understand their work... Horizontal leaders understand what conversations they need to have, and whether their people understand the freedom they have and can handle it”. This demonstrates that successful human-driven innovation is not only about granting autonomy but also about supporting employees through guidance, feedback, and opportunities for professional growth.

Moreover, horizontal organizations benefit from flexible team structures that allow them to quickly adapt to project needs by bringing in external specialists when necessary. As one respondent noted, “Horizontal organizations can hire specialists for specific projects, while vertical organizations often try to build all expertise internally”. This ability to adapt and collaborate externally reinforces the notion that innovation in horizontal structures is fluid and responsive, shaped by collaboration and the dynamic integration of diverse expertise.

In summary, human-driven innovation in horizontal organizations relies on the empowerment and active participation of individuals and teams. The decentralized nature of these organizations places emphasis on communication, trust, and adaptability. By prioritizing people over processes, horizontal structures create an environment where innovation is nurtured from within, driven by the collective efforts of motivated individuals.

Leadership

In horizontal organizations, agility and adaptability are essential, consequently they place considerable pressure on individuals to be both highly skilled and flexible. As one interviewee pointed out, “A single person cannot be infinitely agile and innovative, making employee skills even more crucial.” While individual initiative plays a significant role in fostering innovation, effective leadership is crucial to provide direction, cohesion, and support to ensure that innovation efforts remain focused and productive.

Leadership in horizontal organizations plays a crucial role in creating an environment of trust, empowerment, and psychological safety. Leaders must ensure that employees feel supported in taking

initiative and learning from their mistakes. One interviewee noted, “It’s the support that people receive from the board or the management team... In horizontal organizations, it’s really about freedom, trust, and support. So, it’s more about the human factor”. This indicates that effective horizontal leadership is not about micromanaging but about nurturing an innovation-friendly culture that encourages experimentation.

Fostering a leadership-driven culture is often simpler in horizontal organizations due to flatter hierarchies, where leaders are more accessible and can directly influence team dynamics. Leadership, combined with effective human resource management, are key to shaping organizational outcomes.

While horizontal structures emphasize individual initiative and autonomy, strong leadership is crucial for strategic direction, collaboration, and a culture of trust. Without it, innovation can become fragmented, thereby stressing the need to balance freedom with guidance.

Organizational factors

Effective communication and coordination are crucial in horizontal organizations due to the complexity of cross-disciplinary collaboration. Horizontal organizations favor informal, direct channels, enhancing agility but risking clarity as they scale. As one respondent noted, “Vertical organizations have formal communication flows from top to bottom, whereas horizontal organizations use more informal and direct communication channels.” This reliance on informal communication channels can enhance agility and responsiveness but also presents challenges in maintaining clarity and consistency, especially as the organization grows.

Horizontal organizations rely on various external partners, which enhances agility but can challenge efficiency and consistency. As one respondent noted, *“The agility within a horizontal company is more critical because you work with various parties that frequently change. You need to adapt to subcontractors’ and clients’ communication styles.”* This constant need to adjust requires horizontal companies to maintain structured yet adaptable communication systems to prevent misalignment as they scale and engage with diverse partners.

In addition to that horizontal companies have to focus more on alignment across diverse teams and projects. In horizontal organizations, different teams or units often operate autonomously, which can make it difficult to optimize resource allocation and maintain cohesion. One interviewee described this complexity: “In a horizontally oriented organization, you have different organizations or structures that stand next to each other but must still form a whole... Sometimes it’s harder to optimize that, for example, through the allocation of your personnel”. This suggests that while horizontal organizations excel at flexibility, strong leadership and coordination mechanisms are necessary to ensure that agility at the team level aligns with broader organizational goals.

Ultimately, horizontal structures thrive on flexibility, but strong leadership and structured coordination are essential to align team-level agility with broader organizational goals. Flexibility both enables and results from the agility that defines horizontal organizations, with leadership playing a key role in fostering supportive communication and a culture of trust.

Agility and Flexibility

Agility and flexibility enable horizontal organizations to adapt quickly to changes, foster innovation, and collaborate effectively across multiple sectors. A key strength of horizontal organizations is their ability to collaborate flexibly with external partners, selecting the most competent party for each project. Their streamlined structure facilitates quick knowledge transfer and flexible partnerships. As one interviewee noted, *"Horizontal partners need less time and energy to transfer things properly"*, highlighting their ability to adapt fluidly to innovations and changes. This fast pace of work is further enhanced by decentralized decision-making by enabling swift choices without lengthy approval processes

Flexibility enables horizontal organizations to pivot quickly when partners underperform, reducing risks by easily switching subcontractors or suppliers. As one interviewee noted, "If one supplier can't deliver, we get it from somewhere else." This adaptability also extends to operating in different countries with varying regulations, where horizontal firms can rapidly form partnerships with local companies to manage projects efficiently. As one participant described, "We just call up a subcontractor in Switzerland: 'Let's do this together,' with permits already in place." This ability to leverage external partnerships reinforces the organization's agility, enabling it to maintain continuity, adapt to market demands, and remain resilient amid external dependencies and regulatory changes.

In summary, agility and flexibility are key enablers of innovation and adaptability in horizontal organizations. Agility allows these companies to quickly respond to changes and make decentralized decisions, while flexibility provides the structural capacity to reconfigure resources and partnerships as needed. By leveraging these strengths, horizontal organizations can operate effectively in dynamic and competitive environments, positioning themselves as resilient and responsive players in their respective industries.

5. Discussion and Conclusion

In response to the absence of research on the interplay between organizational structures and innovation capacity within the service-based construction industry, this study aims to explore the dynamic mechanisms that connect the two. It aims to identifying possible leverage points to positively influence and enhance the relationship between organizational structure and innovation capacity. This chapter evaluates the research by summarizing key findings, strengths, limitations, and areas for improvement. The developed Causal Loop Diagram and its specifications are analyzed for their theoretical and practical relevance, with a focus on their implications regarding strength and weaknesses in the various contexts. Finally, the chapter bridges theoretical insights with practical implications, offering recommendations for enhancing innovation strategies and fostering sustainable growth in the case study companies.

5.1. Discussion

The findings of this research have significant implications for construction firms seeking to enhance their innovation capacity. Initially, this study examined the impact of organizational structures on innovation capabilities in construction firms. Vertical integration supports systemic innovation by streamlining workflows and improving efficiency but requires significant investments, leadership, and collaboration to manage risks. In contrast, horizontal structures enhance specialization and agility, fostering incremental and modular innovations, but often lack the integration necessary for large-scale systemic changes. Both structures offer distinct strengths and limitations, requiring strategic alignment to optimize innovation outcomes.

The following section is based on the categorization of innovations in construction into systemic, incremental, modular, and architectural types. Systemic innovations involve transformative changes, reconfiguring workflows and relationships across the value chain. These innovations demand high resource allocation, collaboration across disciplines, and the use of advanced digital tools like BIM to facilitate integration. Incremental innovations, on the other hand, focus on refining existing processes, offering more immediate and practical improvements within traditional project models. Modular and architectural innovations address specific system components and their relation to each other, balancing adaptability with efficiency (Yusof et al., 2022; Hall et al., 2019).

Vertical organizational structures are particularly effective in driving systemic and architectural innovations due to their centralized control, streamlined workflows, and consistent knowledge retention across project phases. This integrated approach allows for efficient coordination, resource consolidation, and long-term planning, all of which are critical for large-scale, transformative innovations. By enabling centralized decision-making and early stakeholder involvement vertical structures promote shared accountability and enhance knowledge alignment, increasing the potential for systemic change (Hall et al., 2018). However, these benefits come with the need for significant investments in leadership and resource management to mitigate risks associated with complexity and resource intensity.

Horizontal organizational structures are well-suited for driving incremental and modular innovations due to their emphasis on specialization, adaptability, and agility. Their decentralized nature enables quick responses to evolving market demands and client needs. Thereby, fostering continuous improvements and tailored solutions. This flexibility allows for efficient alignment with customer requirements or new methods, making horizontal organizations particularly fit for modular innovations. Additionally, tools like multiparty contracts enhance collaboration by distributing risks and rewards equitably among stakeholders, aligning project goals with client needs (Chen et al., 2024). However, horizontal structures can face challenges in knowledge transfer and cross-functional collaboration, which may limit the scalability of innovations.

In addition to organizational structure, innovation output is significantly influenced by firm strategy. Companies that excel as both creators and adopters of innovation typically invest strategically in research and development, employee training, and collaboration networks. Strong inter-organizational relationships and trust among stakeholders further enhance innovation outcomes by fostering higher levels of collaboration and knowledge exchange (Zhao et al., 2023). Moreover, the integration of digital tools amplifies innovation capacity by bridging organizational fragmentation and supporting both systemic and incremental advancements. However, the effectiveness of digital adoption relies heavily on a supportive organizational culture and leadership that prioritizes digital transformation (Papadonikolaki, 2018). Therefore, companies must align their organizational structures with strategic initiatives to identify and leverage their strengths while addressing potential weaknesses, effectively enhancing their capacity for sustained innovation.

When conducting the semi-structured interviews, contrasting perspectives between Bulsink and Group Jansen employees concerning their views on structural factors were noted. This possibly indicates how organizational culture and personal experiences shape their perception. While there was general agreement on factors relevant to the construction sector and horizontal organizations, notable differences emerged regarding vertical structures (see Appendix III for detailed response distribution). For example, 4 out of 9 Group Jansen participants emphasized the importance of the human component

in vertical structures, compared to none from Bulsink. Conversely, standardization was prioritized by 6 out of 7 Bulsink respondents, compared to 3 out of 9 from Group Jansen. Leadership was recognized as a critical factor by participants from both companies.

Existing literature found that leadership is a variable fostering adaptability, trust, and collaboration while aligning strategic objectives with innovation efforts (Gunduz & Alfar, 2019; Pham et al., 2022). Effective leaders promote knowledge sharing, open communication, and team empowerment, helping organizations overcome structural barriers and enhance innovation capacity. This is particularly important in decentralized networks, where distributed leadership supports bottom-up innovation through collaborative problem-solving (Papadonikolaki, 2018). As such, leadership is essential in horizontally structured organizations, where autonomy, cross-functional collaboration, and agility drive sustained innovation as well as in vertical structured organization where centralized control and streamlined workflows are essential. In line with findings of existing literature the importance of leadership in the context of innovation is in both structures undeniable but significantly different in nature.

Additionally, innovation in construction is influenced by factors such as firm size, employee capabilities, and resource allocation. An significant claim which is made by other researcher is the following. Larger, often older firms tend to pursue systemic innovations due to their greater investment capacity but may face challenges related to entrenched routines. While in contrast, smaller, typically younger firms are more flexible and open to adopting innovations, focusing on incremental improvements driven by their adaptability and resource constraints (Barata & Fontainha, 2017; Kamal et al., 2016). However, firm-specific factors like workforce demographics, company culture, and organizational size were excluded from the research scope to maintain focus and avoid overly broad conclusions.

5.1.1. Vertical specific complications

Vertically integrated organizations like Group Jansen can offer significant advantages in control, cost efficiency, and internal resource management, but these benefits come with inherent risks. While the structure enables greater autonomy over processes and fosters specialized innovation, it introduces rigidity. Thereby making the organization less agile in responding to market fluctuations. In addition to that, high fixed costs tied to personnel, equipment, and facilities increase vulnerability during economic downturns. Additionally, the complexity of managing diverse operations can lead to adaptation lags, where changes in systems or processes take longer to yield results due to hierarchical decision-making and interdepartmental dependencies.

This can be illustrated using the example of Group Jansen's acquisition of Vinitex. Despite strategic aims to scale Vinitex to the Jansen Labs & Cleanrooms (JLC) primary supplier, the company’s reliance on manual processes clashed with new automation efforts. This mismatch led to operational inefficiencies, underutilized equipment, and employee dissatisfaction. The case underscores the importance of aligning integration strategies with existing capabilities and culture, emphasizing the need for gradual change management, leadership-driven adaptation, and human resource support to support successful innovation within vertical structures.

While the Vinitex case highlights challenges related to adaptation lag in vertical integration, the integration of SUMI into Group Jansen illustrates a contrasting scenario, emphasizing the importance of leveraging two-way synergies. SUMI, specializing in advanced building automation, has thrived with significant autonomy, leveraging Jansen's support while maintaining independent operations. This

autonomy has stimulated exposure and pleasant cooperation. However, unexploited potential remains in fostering deeper collaboration between SUMI and other Jansen entities. By establishing stronger interconnections, Group Jansen could enhance operational efficiency, promote cross-entity synergies, and amplify SUMI's value within the group. Together, these cases demonstrate that successful vertical integration requires both careful adaptation to new systems and the strategic integration to achieve synergies across the organization.

Furthermore, Group Jansen's JLC branch illustrates a key challenge in vertical organizations: recruiting suitable personnel. The complexity and broad functional scope of vertical structures demand diverse, specialized skills, making talent acquisition more difficult compared to horizontal organizations. JLC's struggle with finding skilled employees, exacerbated by a tight labor market, directly limits its innovation capacity. This highlights the need for strategic human resource management, focusing on specialized training, talent pipelines, and internal development to support innovation and operational resilience.

5.1.2. Horizontal specific complications

Horizontal organizations thrive in dynamic industries like construction due to their adaptability, decentralized structures, and flexible partnerships. This agility allows them to respond swiftly to market fluctuations, regulatory changes, and external disruptions by reallocating resources and adjusting project priorities with ease. Their diversified operations across various sectors and revenue models also help mitigate risks, providing resilience during economic downturns. However, this broad focus can lead to limitations in resource allocation, as horizontal firms often face constraints within specialized domains, lacking the cross-departmental resource flexibility found in vertically integrated organizations.

Additionally, horizontal firms rely heavily on outsourcing to external partners, reducing the burden of maintaining extensive in-house operations. While this strategy minimizes risks related to internal resource constraints, it requires robust supplier relationships to ensure operational stability. Strong partnerships help secure consistent service quality, even during crises, and foster long-term collaboration with suppliers who value reliability over short-term gains. Despite these strengths, the reliance on external networks can introduce vulnerabilities, particularly when supplier performance fluctuates or market conditions strain partnerships.

To overcome these challenges, Bulsink could prioritize process standardization and knowledge management to strengthen operational stability and reduce its dependence on external partners. By establishing clear workflows and systematically documenting best practices, Bulsink can enhance internal collaboration, ensure consistency across projects, and minimize the risk of errors that often arise from ad-hoc decision-making.

Horizontal organizations often rely heavily on individuals and ad-hoc changes. While this approach empowers employees, it has created confusion around roles, responsibilities, and communication lines. This can hinder the full realization of innovative potential. At Bulsink, this is evident in the BIM department, where promising initiatives are not fully realized due to a lack of sustained commitment and strategic alignment. Progress frequently depends on the efforts of Innovation Champions, whose impact is limited by competing priorities and insufficient organizational support. Without clear leadership, defined goals, and integration into broader company strategies, these innovations risk remaining underdeveloped or partially implemented. To fully capitalize on its investments, stronger direction and long-term objectives must be defined.

5.1.3. Practical Alignment of Innovation Research

To assess the practical relevance of this thesis, articles from McKinsey & Company were reviewed. This analysis revealed a strong alignment between the research findings and McKinsey & Company's insights. Thereby stressing the practical relevance of the thesis by demonstrating significant overlap in the factors critical to fostering innovation. McKinsey emphasizes that companies excelling in structured innovation achieve up to 2.4 times greater economic profit than their peers (Cohen et al., 2019), reinforcing the importance this study aimed to enable companies to identify and stimulate drivers of innovation in service-based construction firms.

Key factors stressed by McKinsey are visionary leadership, resource allocation, organizational agility, collaboration, and employee engagement. All of which can be linked to identified variables within my own model. Both sources emphasize the centrality of leadership-driven culture, which empowers teams, creates trust, and drives alignment between innovation strategies and organizational goals (Cohen et al., 2019; Gunduz & Alfar, 2019). Similarly, both highlight flexible organizational structures as enablers of adaptability, allowing firms to respond effectively to evolving market needs (Furstenthal et al., 2022).

The importance of strategic resource allocation, as emphasized by McKinsey, matches this research's findings on optimizing investments to prioritize high-value initiatives. McKinsey's insights into dynamic portfolio management, which reallocates resources to amplify impactful projects, align with this study's recommendations for refining resource use in innovation processes (Banholzer et al., 2019; De Jong et al., 2015).

Collaboration and cross-functional integration are critical components in both McKinsey's frameworks and this research. In both contexts highlighted as essential for overcoming barriers and enhancing creativity. McKinsey refers to the added value of practices such as "collision sessions" and open communication which foster diverse perspectives and innovation. This can be closely linked to a theme central within the presented study emphasizing open communication and bottom-up innovation (Cohen et al., 2019; Papadonikolaki, 2018).

Additionally, both McKinsey and this research underline the importance of embedding innovation into organizational culture. Leaders play a crucial role in creating a safe environment for experimentation, encouraging employee engagement, and driving change, even during uncertainty (Cohen et al., 2019; Furstenthal et al., 2022). The resilience of companies maintaining their commitment to innovation during crises, such as COVID-19, aligns with the study's emphasis on sustaining innovation capacity through strategic alignment (Furstenthal & Roth, 2021).

The similarity in these frameworks underscores the relevance of this research by bridging theoretical insights with practical realities. The shared focus on leadership, strategic alignment, flexibility, and collaboration demonstrates the practical applicability of the study's findings, reinforcing its value as a roadmap for service-based construction firms seeking to enhance their innovation strategies and achieve sustainable growth.

5.2. Theoretical Contributions

This study contributes to the literature by exploring how vertical and horizontal organizational structures in service-based construction companies influence the mechanisms of process innovation. It provides insights into how these structures shape innovation dynamics, identifies key factors that impact

innovation capacity, and offers a framework based on system dynamics models to identify possible leverage points and optimize organizational strategies for optimizing innovation.

More specifically this study exploits the potential Causal Loop Diagrams (CLDs) to visualize the complex interrelationships among organizational structures, innovation drivers, and external factors (Figure 5). Through the analysis of company documents, extensive literature reviews, and semi-structured interviews which were analyzed using the Gioia method, key leverage points were identified. By specifying CLDs tailored to specific operational and market contexts, firms can identify critical leverage points, refine strategies, mitigate risks, and enhance their innovation capacity. This research represents the first attempts to apply qualitative system dynamics to explore the impact of organizational structures on innovation within the service-based construction industry. Making this study an unique contribution to the field of organizational construction management.

The findings of this study have multiple theoretical implications. Firstly, the application of a CLD as a dynamic tool to analyze innovation capacity and identify key factors influencing the adoption of new innovations. The CLD provides a structured framework to assess the impact of past innovations, anticipate challenges, and enhance innovation strategies. In this research the CLD is contextualizing within the construction industry, highlighting how industry-specific dynamics shape innovation processes.

The first key finding of this thesis is the identification of the most influential factors across different contexts. In the construction-specific CLD (Figure 19), four critical factors stand out: Human-driven Innovation, Market Issues, Standardization, and External-driven Innovation. These factors reflect the unique characteristics of the construction sector, where employee empowerment, external and market-driven pressures, and the challenges of standardization play highly significant roles in shaping innovation capacity. The model emphasizes the universal importance of these variables when accounting for the sector's inherent complexity.

The CLD further distinguishes the differing impacts of vertical and horizontal organizational structures. Vertical firms rely on leadership-driven culture, formal organizational structures, and standardized processes to drive systemic innovations (Figure 20). In contrast, horizontal firms benefit from human-driven innovation, agility, and flexibility, fostering incremental and modular innovations (Figure 21). By integrating these organization-specific factors, the CLD offers a framework for understanding how organizational structures interact with industry-specific variables to shape innovation capacity. In section 5.3., practical implications are given based on the application of this theoretical lens to the case study companies and their past developments.

Second, this research underscores the critical importance of aligning organizational structures and innovation strategies to optimize innovation outcomes in service-based construction firms. Hereby stressing that vertical and horizontal structures offer distinct yet complementary pathways to fostering innovation. Vertical structures, with centralized control and streamlined workflows, effectively drive systemic and architectural innovations. In contrast, horizontal structures foster incremental and modular innovations by emphasizing specialization, flexibility, and quick market responsiveness.

By strategically combining the stability and efficiency of vertical integration with the agility and adaptability of horizontal models, organizations can create dynamic environments conducive to a wide range of innovative activities. This integration is further enhanced through the effective use of digital

tools and collaborative practices like multiparty contracts. Strategic partnerships also play a key role in facilitating knowledge exchange and expanding the firm's innovation ecosystem.

The third and final key theoretical contribution of this study is the significance of the leadership component which emerges as a central factor in fostering this structural and strategic alignment. Transformational leadership is shown to be a significant driver in both vertical and horizontal contexts. Due to its effect on promoting a culture of adaptability, trust, and continuous improvement. In vertically structured firms, strong leadership supports centralized decision-making and ensures the efficient management of complex projects. In horizontally structured firms, leadership empowers teams, encourages bottom-up innovation, and fosters cross-functional collaboration. Although existing literature acknowledges the importance of leadership in driving innovation, it lacks a clear connection between leadership style and organizational structure, particularly in the context of service-based construction companies. This study bridges that gap by demonstrating how different leadership approaches interact with vertical and horizontal structures to stimulate innovation capacity. Ultimately, the study contributes to the theoretical understanding of how leadership shapes the organizational climate, thereby enhancing a firm's overall innovation potential.

5.3. Practical Implications

Based on the study's findings, several managerial implications are proposed. These are categorized as Group Jansen-specific and Bulsink-specific. These suggestions aim to provide case study companies with insights from the comparative analysis. Applying these implications, derived from the application of the CLD and its specifications, will enhance organizational understanding and guide effective innovation strategies. Grounded in past, particularly unsuccessful, innovation efforts. These tools help identify underlying causes of failure, enabling companies to refine strategies and turn past shortcomings into future successes. Thereby, enabling organizations to leverage their strengths, identify risks, and address complications early in the process.

5.3.1.Group Jansen

Building on the insights from the integration Vinitex and SUMI as well as general vision and company background, the following recommendations aim to enhance Group Jansen's strategic performance. Drawing from the analysis presented in sections 3.1.2., 4.4.2., and 5.1.2., these recommendations focus on strengthening integration, standardization, and strategic alignment within the organization. By improving shared systems, centralizing purchasing processes, and streamlining communication across entities, Group Jansen can foster stronger connections between disciplines, leading to greater efficiency across its vertically integrated structure. Figure 22 shows the main take-aways at the respective locations of the vertically specified CLD.

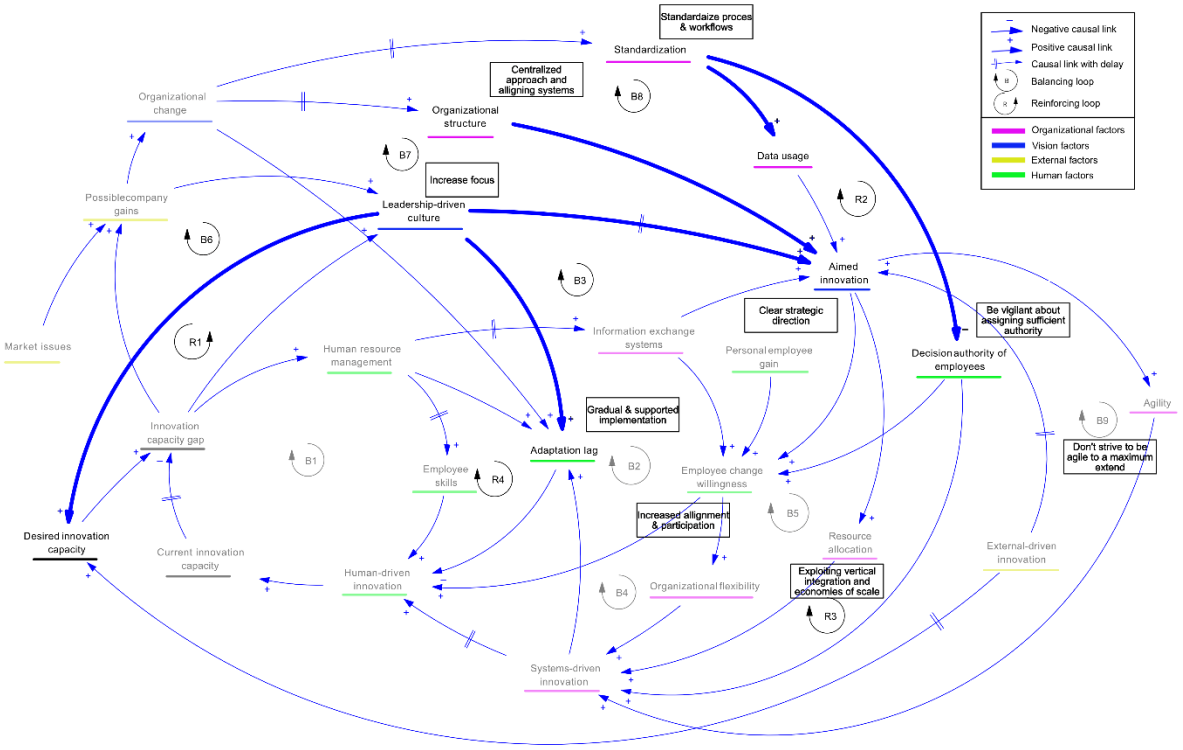

Figure 22: Practical implications - Group Jansen

Lessons from Vinitex highlight the need for thorough due diligence and gradual change management to mitigate adaptation lag. A hybrid approach, balancing manual processes with automation while addressing skills gaps, can smoothen transitions and maximize current and future potential. This case also emphasizes the importance of thorough due diligence to identify risks early, ensuring acquisitions align with Group Jansen's strategy and goals. By applying these lessons, future integrations can achieve greater success.

While SUMI has retained operational autonomy, further integration into Group Jansen's structure could unlock additional synergies and enhance its contribution to the group's overall objectives. Monthly alignments and focused collaboration on relevant projects are steps in the right direction, but deeper integration would amplify SUMI's strategic impact. For example, upselling could be normalized further by encouraging group entities to actively promote services from other companies within the group when interacting with potential customers. While this practice already exists, increasing its intensity and frequency could enhance the group's ability to capitalize synergies. Therefore, SUMI's case emphasizes fostering inter-entity synergies through closer collaboration.

A recurring theme across Group Jansen's innovation efforts is the lack of focused direction, often resulting in the widespread allocation of resources and diluted impact. This is illustrated in section 3.2.1. which showcases the wide spread of developments and focus of Group Jansen. To achieve better performance, it is crucial for high-level management to set clear strategic priorities, concentrating efforts

on a select number of high-impact initiatives aligned with the group's long-term vision. Strong leadership is essential in providing this focus, guiding resources effectively, and balancing innovative projects with operational demands. By fostering "aimed innovation" through specific goals and improved communication, employees can better understand the organization's objectives, enhancing their engagement and willingness to drive bottom-up innovations. This clarity not only maximizes resource efficiency but also strengthens Group Jansen's capability to deliver meaningful, sustainable innovations across its entities.

Prioritizing "aimed innovation" with focused strategic goals and clearer leadership direction will help concentrate resources on high-impact initiatives. Additionally, reassessing the investment-heavy approach in favor of optimizing current structures through standardization and integrated data systems can improve decision-making and performance. Moving towards a unified profit pool and consolidating leadership roles will drive collective success, enhancing Group Jansen's competitive advantage and long-term growth.

To further support Group Jansen's growth and competitive advantage, prioritizing "aimed innovation" with focused strategic goals and strong leadership direction is essential. Concentrating resources on high-impact initiatives aligned with the group's long-term vision will enhance performance while minimizing resource diffusion. Optimizing current structures through standardization, integrated data systems, and improved decision-making processes will also drive operational efficiency. A shift towards a unified profit pool, coupled with consolidating leadership roles and reducing executive layers, will promote cross-entity collaboration, reduce inefficiencies, and reinforce the group's collective success. This centralized approach and a stage of consolidation is necessary to refine strategy and streamline operations. By transforming into a well-oiled machine through focused integration, leadership and standardization, the group can increase efficiency, unlock its full potential, and achieve sustained growth and success.

5.3.2.Bulsink

Similar to the previous section, this following builds on the current context of Bulsink to explore the managerial implications of strategic choices, emphasizing the lessons learned and the opportunities for leveraging these insights to guide future actions. This analysis and recommendations are guided by sections 3.2.2., 4.4.3. & 5.1.2. resulting in several key conclusions and recommendations to address the identified challenges and exploit future potential. Figure 23 shows the main take-aways at the respective locations of the horizontally specified CLD.

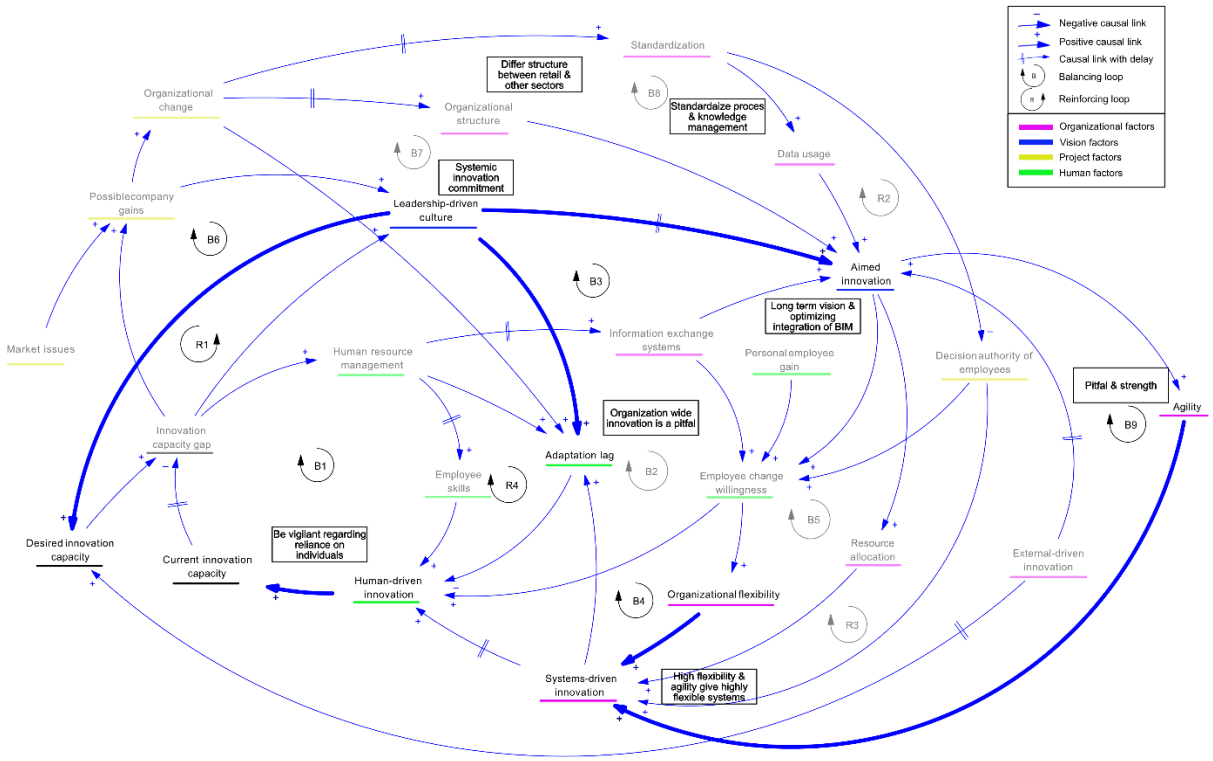

Figure 23: Practical implications - Bulsink

Bulsink's leadership has successfully driven agility and operational efficiency, particularly in the fast-paced retail sector. However, its reactive approach often prioritizes short-term demands over strategic innovation, limiting the company's ability to fully exploit both incremental and systemic innovations. To address this, dedicated leadership roles are needed to oversee key initiatives in order to ensure consistent focus and alignment with broader organizational goals. Thereby putting emphasis on the importance and need for innovation.

The flat and flexible organizational structure which characterizes Bulsink supports agility, which is especially critical in the fast-paced retail sector. However, this flexibility often comes at the expense of standardized processes and effective knowledge management, leading to inconsistent documentation and operational inefficiencies. These challenges become more pronounced as the company takes on larger, more complex projects. To address these issues, Bulsink should prioritize the development of clear workflows, centralized knowledge repositories, and best practice guidelines. This approach will enhance collaboration, improve efficiency, and ensure consistency across teams. A possible and more radical change could be for Bulsink to restructure its organization into two distinct units to balance the demands of different project types. One unit could focus on larger, complex projects, emphasizing detailed planning, standardization, and operational structure. The other unit could maintain the flexibility required for fast-paced retail projects, which gave the company its identity. This dual approach would allow Bulsink to match its structure and processes to the specific needs of each project type.

Consequently, enabling the company to perform effectively in both fast-moving and complex project environments.

While the BIM department represents an interesting step toward vertical integration and independence in otherwise mainly horizontal approach. The full adoption of advanced BIM applications, such as 4D and 5D modeling remains off. This kind of innovations remain underutilized due to resource constraints and a lack of consistent support. To fully capitalize on its BIM investments, Bulsink needs strong leadership focus and commitment to integrate advanced applications into its workflows. Appointing dedicated leaders and prioritizing investments in technologies such as mobile scanners and BIM printers will ensure consistent progress and long-term value.

Finally, implementing a dedicated R&D function would ensure systematic innovation efforts. Thereby reducing reliance on ad-hoc initiatives and individual champions. Providing resources, clear objectives, and cross-team collaboration opportunities will help strengthen the drive for innovation into the company's core operations, supporting sustainable growth and competitive advantage in the evolving construction industry.

Understanding the strengths and weaknesses by applying the developed CLD to its respective context Bulsink, Group Jansen, and similar firms are enabled to modify their organizational strategies more effectively. By leveraging these insights, companies can identify possible leverage points and align their structures with innovation goals to stay competitive.

5.4. Limitations and Further Research

In conclusion, while the research effectively establishes a foundation for understanding how organizational structures influence innovation in service-based construction companies, various significant opportunities for refinement and broader application are to be explored. Addressing these limitations through follow-up studies and further development of the model could enhance its utility, applicability, and impact, making it a valuable tool for fostering innovation across diverse organizational and industry contexts.

5.4.1. Limitations and Related Further Research

Despite its analytical potential the use of system dynamics may overwhelm users unfamiliar with this method. The complexity of the CLD can hinder practical accessibility, as it can overwhelm users unfamiliar with its structure. While introducing loops gradually has been an effective approach, the formulated CLD fails to be self-explanatory. Future research could focus on streamlining the model by classifying innovations or challenges and developing simplified versions tailored to specific contexts. This modular approach would improve practical use for those who require straightforward tools.

The study's small target group, consisting of 16 participants primarily in management roles at Group Jansen and Bulsink, introduces potential bias and limits the generalizability of findings. Participants also tended to evaluate their own organizations favorably, influenced by alignment with company culture. To compensate for these biases, future research could expand the participant pool to include a broader range of functions and hierarchical levels, incorporating both management and operational staff. Combining semi-structured interviews with large-scale questionnaires would provide more diverse perspectives.

Additionally, cross-referencing interview data with inputs from participants with cross-organizational experience could reduce familiarity bias. Expanding the scope to include a larger sample of companies, such as 40 firms evenly split between vertically and horizontally integrated organizations. could enhance the robustness of comparisons and offer deeper insights into structural dynamics. Further research could also aim to validate the CLD's interconnections, as the limited sample may have led to the underrepresentation of commonly addressed links.

5.4.2. Broader Future Research Directions

Future research could enhance the current model by developing a quantitative version, assigning measurable values to variables to quantify the innovation gap and simulate the impact of interventions. This would offer actionable insights, support precise resource allocation, and improve strategic decision-making. Additionally, incorporating performance metrics such as EBITDA, revenue, profit per full-time employee, and cash flow could provide a deeper understanding of how organizational design impacts performance.

Unanswered questions remain regarding the origins of impactful innovations within the CLD, warranting further study. Innovations may arise from top-down directives, employee-driven initiatives, or external pressures such as market demands. As stated before, innovation may find its origin in any point of the model. Future studies could investigate which of these origins tends to produce the most effective and sustainable innovations in different organizational contexts. Consequently, understanding the motivations behind initiating innovations could reveal how these motivations influence the likelihood of successful integration and support from employees and management.

In vertically integrated companies, profit and loss (P&L) conflicts between subsidiaries and the broader group can create structural tensions absent in horizontal organizations. Future research could expand on the "Possible Company Gain" factor to address these complexities.

Cultural factors also shape the model's applicability. Variations in values, such as the emphasis on autonomy in the Netherlands versus hierarchical norms in countries like China, suggest the potential for culture-based model adaptations to enhance relevance. Additionally, company-specific factors like workforce demographics, size, and geographic reach should be considered to better understand their influence on innovation dynamics.

Lastly, the study focusses on innovation in service-based construction firms thereby excluding the dynamics of production-based organizations. Production environments often involve more standardized workflows and different organizational priorities. Future research could adapt the model to include these contexts, providing a more holistic understanding of innovation across the construction industry and possibly full context of vertical organizations.

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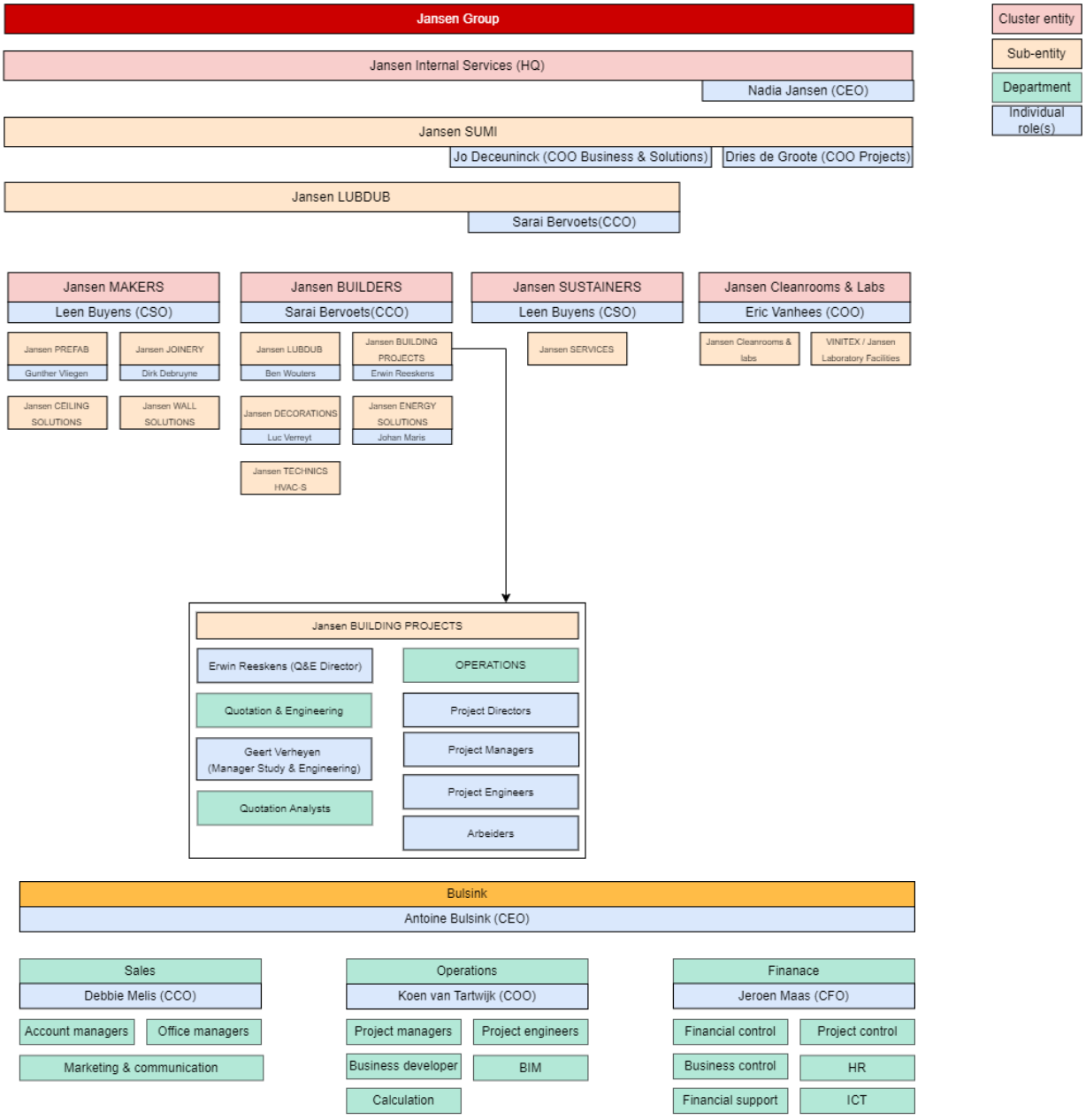
Appendix I: Organizational diagrams



Appendix II: definition 2nd order themes

Adaptation Lag	Refers to the time delay between implementing new skills, systems, or processes and achieving their full impact on innovation capacity. In the short term, this factor often leads to a temporary decrease in employee productivity as they adjust, internalize, and learn to effectively apply new knowledge or ways of working. Adaptation lag accounts for the learning curve and gradual adjustment required to realize measurable improvements, making it a significant factor in planning and timing innovation-driven initiatives.
Agility	Agility is an organization's ability to quickly and efficiently respond to unexpected changes and opportunities. It emphasizes dynamic responsiveness and resilience, with more horizontal organizations often identifying and exploiting opportunities faster due to their deeper understanding of products and applications.
Aimed innovation	Aimed Innovation represents an organization’s commitment to strategically focused and mission-driven innovation that is embedded into its culture, goals, and long-term strategy. This vision directs the organization to prioritize well-defined, forward-thinking initiatives that leverage specialized expertise and address industry trends.
Current innovation capacity	The current ability of a firm to realize and drive innovation within the company, across its scope of works
Data usage	data usage referes to an organization’s ability to organize, analyze, and leverage its data to generate strategic insights and drive informed decision-making. This moves beyond data collection to making data actionable for optimizing operations and identifying trends.

Decision authority of employees	Decision authority of employees indicates the amount of authority and freedom which is delegated to employees within the organsation this inludes managers of different levels but also regular employees. Thereby, indicating organizational freedom.
Disired innovation capacity	The desired ability of a firm to realize and drive innovation within the company, across its scope of works
Employee change willingness	Employee change willingness is the collective readiness of employees to embrace and adapt to organizational changes, driven by a mindset that supports change from both the top-down and bottom-up.
Employee skills	Employee skills refer to the combined expertise and adaptability of a workforce, blending new talent with experienced staff to drive innovation, integrate new technologies, and support continuous improvement.
External-driven innovation	External sources-driven innovation is an approach where a company leverages the innovations and advancements developed by its suppliers and competitors, aligning its own products and processes accordingly. In addition to that law and governance set by authorities drives companies to innovate and work conform standards.
Human resource management	Human resource management is the strategic alignment and adjustment of employee roles, skills, and resources. Aiming to maximize organizational expertise and support innovation. This involves elevating employee skillsets as a core focus and efficiently allocating roles to leverage in-house expertise.

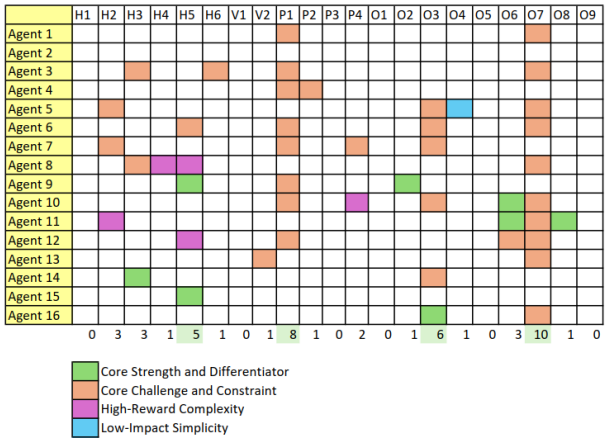
Human-driven innovation	Human-driven innovation refers to the process where employees contribute ideas and input that shape the organization's innovation efforts, often through practical, ad-hoc suggestions. Supporting a bottom-up flow of innovation that complements top-down strategy.
Information exchange systems	Information exchange systems are structured processes designed to facilitate the effective exchange of information, foster collaboration, feedback & communication, and support continuous improvement within an organization.
Innovation capacity gap	The gap between the disired innovation capacity and the current innovation capacity
Leadership-driven culture	The role of top management, particularly the CEO and key leaders, in actively shaping and promoting a culture of innovation within the organization. Leadership can inspire teams to think creatively and address both existing and emerging needs.
Market issues	Market issues refer to challenges affecting financial and strategic clarity in project-driven industries, influenced not only by project-specific factors but also by broader macroeconomic conditions, such as economic cycles, labor market dynamics, and regulatory environments. These issues impact project funding, resource availability, and stakeholder confidence, shaping the number and scope of new projects. Greater uncertainty undermines progress, disrupts stakeholder trust, and complicates sustainable planning, while effective management of these issues supports well-defined budgets, alignment with client expectations, and resilience in project execution.

Organizational change	Organizational change captures a company’s structural change due to adjustment in its structure, strategies, and workflows. Aiming to increase adaptability and certainty. The main components of this factor are horizontal and vertical adjustments.
Organizational flexibility	Organizational flexibiltiy refferes to the ability to implement new processes or systems within an organization. In this context established practices, diverse needs, and varying systems are deeply ingrained. Therefore, change could prove difficult
Organizational structure	Organizational structure refers to the ability to align and effectively manage interconnected processes, stakeholders, and specialized roles within diverse and sometimes fragmented market environments. Enabling clear communication, synchronized decision-making, and careful resource allocation to ensure smooth project execution.
Personal employee gains	Personal gains represents the "what is in it for me" factor employees may require in order to cooperate in a pro-active manner in relation to new innovations.
Possible company gains	A big factor in the commitment of top mangement to achieve innovative goals is to acuire compative advantage. Thereby being able to increas things such as marketshare, profit, exposure, etc.
Resource allocation	Resource allocation refers to the strategic distribution of resources, including finances, personnel, and support, to optimize organizational outcomes and support growth initiatives.

Standardization	Standardization is the practice of implementing consistent processes, tools, and systems to ensure clear information flow, quality control, and accessibility across an organization. Communication & documentation flows according to set standards.
System-drivin innovation	Systems driving innovation refer to internal structured processes, strategies, and collaborative environments within an organization that foster idea generation and innovation. These systems include dedicated R&D departments, adaptable group strategies, and open channels for employees to propose ideas.

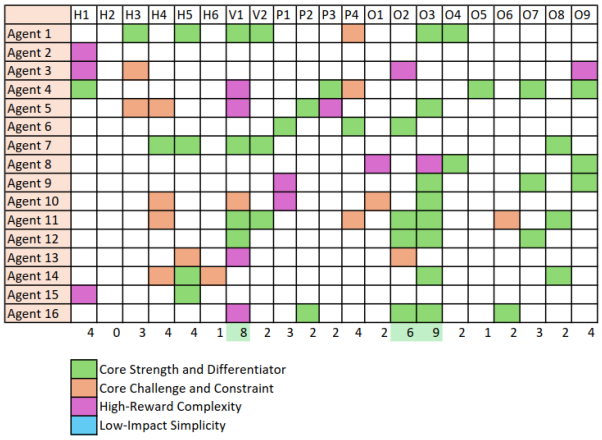
Appendix III: Analysis interviews round 2

Construction industry



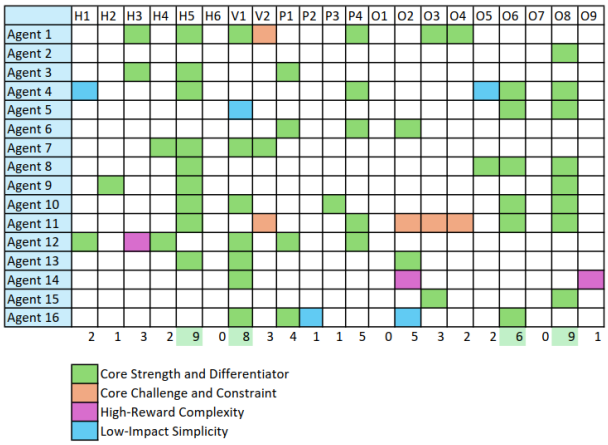
Human Resource Management	H1
Employee Skills	H2
Personal Employee Gains	H3
Employee Change Willingness	H4
Human-Driven Innovation	H5
Adaptation lag	H6
Leadership-Driven Culture	V1
Aimed Innovation	V2
Market Issues	P1
Possible Company Gains	P2
Organizational Change	P3
Decision Authority of Employees	P4
Information exchange Systems	O1
Organizational Structure	O2
Standardization	O3
Data Usage	O4
Resource Allocation	O5
Organizational Flexibility	O6
External-Driven Innovation	O7
Agility	O8
Systems-Driven Innovation	O9

Vertical organization specific



Human Resource Management	H1
Employee Skills	H2
Personal Employee Gains	H3
Employee Change Willingness	H4
Human-Driven Innovation	H5
Adaptation lag	H6
Leadership-Driven Culture	V1
Aimed Innovation	V2
Market Issues	P1
Possible Company Gains	P2
Organizational Change	P3
Decision Authority of Employees	P4
Information exchange Systems	O1
Organizational Structure	O2
Standardization	O3
Data Usage	O4
Resource Allocation	O5
Organizational Flexibility	O6
External-Driven Innovation	O7
Agility	O8
Systems-Driven Innovation	O9

Horizontal organization specific



Human Resource Management	H1
Employee Skills	H2
Personal Employee Gains	H3
Employee Change Willingness	H4
Human-Driven Innovation	H5
Adaptation lag	H6
Leadership-Driven Culture	V1
Aimed Innovation	V2
Market Issues	P1
Possible Company Gains	P2
Organizational Change	P3
Decision Authority of Employees	P4
Information exchange Systems	O1
Organizational Structure	O2
Standardization	O3
Data Usage	O4
Resource Allocation	O5
Organizational Flexibility	O6
External-Driven Innovation	O7
Agility	O8
Systems-Driven Innovation	O9