

Navigating the Transition towards Bio-based Construction

Strategic Positioning of Value Chain Actors in the Dutch
Construction Sector

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"If nature could speak, would you listen?"
- Wubbo J. Ockels (1946 - 2014)

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the Dutch Construction Sector

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in Management in the Built Environment



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Preface

When architect Thomas Rau introduced me to the principles of the circular economy in a television broadcast in 2017, as a young student, my idea of how the world works changed completely. I was already fascinated by sustainability in the broader sense of the word. But what struck me most was that this went beyond technical applications – that was all I knew at the time – and brought me the recognition that we, as a global society, need to restructure our entire economic system to better care for our planet. It has stayed with me ever since.

Several years later, after “pausing” my master’s in architecture in Delft for a business opportunity and gaining a few years of professional experience, I decided to return to university to study management. I wanted to undertake a proper thesis trajectory at least once in my life, and I knew this was likely my last opportunity to do so. Looking back now, I am more than grateful for that decision, which wasn’t easy at the time.

Throughout the master's programme, I collected potential thesis topics and wrote them on the final page of my notebook. When I heard about timber construction again, I knew immediately this was the topic I was going for, as this was the perfect intersection of everything that I'm interested in: circular economy, real estate and architecture, sustainable finance, and of course, research. What I didn't fully anticipate was how enriching the research process itself would be. Speaking with professionals across the construction industry opened my eyes to the dedication, creativity, and determination of those working to transform how we build. My internship at Nederlands Vastgoed provided an especially welcoming environment where colleagues showed genuine interest in my work and offered generous support.

This thesis examines strategic positioning in the bio-based construction transition, but the deeper insight I've gained is about the power of collaboration. The pioneers I came across are not just working for their own benefit but for the world's future; they are actively building the networks, sharing the knowledge, and accepting the risks necessary to enable systemic change. Their work is absolutely inspiring.

I hope this research contributes, in some way, to supporting those efforts. Whether it helps stakeholders understand their roles in this transition more clearly or provides institutional investors with more confidence to deploy capital toward more bio-based projects.

As I’m completing this master's degree, I cannot wait to step into a new world where I can employ these fascinations more directly in practice. And maybe too, make a little difference.

Bram van Eersel
The Hague, December 2025

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First of all, I want to thank my main supervisor, Paul. From the moment I first joined his class in 2020, in a course that was given online due to the pandemic, he was at the top of my list of the professors I wanted as my thesis supervisor. He knows how to make you think and reflect on yourself like no one else can. He manages to give confidence and get you back on the right track but makes you find solutions yourself. On a personal note, I feel like we speak each other's language. It was a great pleasure to do my final project with him.

Besides, I want to thank Alex for accepting my request to supervise my project, especially given his tight schedule and limited time in the Netherlands. It is a great honour to have had him, as a great pioneer for timber architecture, on my graduation committee.

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A special word for my parents, Iris and Edgar, and my sister, Lieke, who have supported me unconditionally in every decision I have made throughout my studies and career. I cannot imagine a more supportive, loving family than mine.

And I want to thank Laura, for not knowing half the confidence she gives me in everything I do, by being my critical eye, my home and my future.

To end, I want to thank the inspiring professors throughout Amsterdam, Brisbane and Delft, and my friend Stephan.

Abstract

The Dutch construction sector faces a critical challenge: meeting ambitious housing targets while drastically reducing carbon emissions. Existing research identifies barriers to sustainable construction but offers limited insight into how actors coordinate their strategic positions to overcome them. This research examines how strategic positioning of value chain actors influences the socio-technical transition toward bio-based construction in the Netherlands.

Using semi-structured interviews with multiple stakeholders and a Delphi validation study, this research identifies critical coordination failures preventing transition acceleration. The findings reveal that strategic incentives often outweigh purely economic considerations, as timber construction costs more than conventional methods in traditional calculations. However, the answer is contingent: strategic positioning enables transition only through coordinated movement across multiple actor types.

The research delivers strategic recommendations on two levels. For value chain coordination: establish shared risk distribution mechanisms, create a transition *conductor* role, and develop contractual frameworks preventing pioneers from bearing disproportionate costs. For institutional investors: integrate sustainability impact measurement beyond financial returns, build network mechanisms connecting capital to capability development, and recognise that fiduciary obligations align with transition goals when prioritising long-term value creation. These recommendations demonstrate that successful transitions require coordinated repositioning across multiple value chain segments rather than isolated optimisation by individual actors.

Key words: bio-based construction | strategic positioning | socio-technical transitions | value chain coordination | institutional investment

Management Summary

Research Context and Objective

The Dutch construction industry is confronted with a pressing dual challenge: constructing sufficient dwellings to meet the country's acute housing shortage while adhering to the rapidly declining carbon budget. The limitations of the current system are evident given the 390,000 dwelling deficit and the fact that, using conventional materials and construction techniques, the sector will surpass its remaining CO₂ budget for a 1.5°C pathway well before 2030. Simultaneous crises, such as nitrogen emissions, make systemic change increasingly urgent. In this context, bio-based materials present a viable path for lowering emissions, relieving pressure on ecological limits, and advancing larger societal objectives. This research examines how the strategic positioning of value-chain actors shapes the socio-technical transition toward a bio-based building ecosystem in the Netherlands, with a particular focus on institutional investors whose capital allocation decisions influence the entire chain.

Research Approach

Through semi-structured interviews with multiple stakeholders across the construction value chain (architects, contractors, developers, investors, forest management, and more) and a three-round Delphi validation study, this research identified coordination failures preventing transition acceleration. The analysis employed a Business Model Canvas framework combined with transition management theory to map how actors position themselves strategically.

Key Findings: Four Strategic Positioning Types

Strategic positioning does not align with traditional actor categories but reflects two dimensions: value creation timeframe (short-term versus long-term) and strategic focus (internal capability versus external ecosystem change). This produces four distinct types:

System Optimisers (short-term + internal) dominate the market, prioritising cost efficiency and evaluating bio-based projects individually against strict financial benchmarks, and explain why bio-based construction remains below 3% market share.

Capability Builders (long-term + internal) invest heavily in factories, expertise, and skills, accepting short-term costs for future competitive advantage, including contractors investing millions in prefabrication facilities.

Market Developers (short-term + external) create demonstration projects proving commercial viability, absorbing pioneer costs to break perception barriers through tangible examples.

Transition Pushers (long-term + external) pursue structural change through policy advocacy, knowledge sharing, and mission-driven models operating at 3-5% profit margins.

Critical Dynamics

The main conclusion is that *coordinated movement* among various actor types is the main way that strategic positioning facilitates transition. Currently, when acting independently, each positioning type fulfils necessary but insufficient roles, resulting in structural interdependence whereby each actor's willingness to invest is contingent upon others acting first.

Transition Pushers build knowledge infrastructure but cannot scale without market demand. Market Developers demonstrate viability but bear costs that later entrants avoid. Capability Builders create scalability potential but require demand certainty to justify capital expenditure. System Optimisers enable volume adoption but wait for proven track records. This circular dependency produces collective standstill despite individual rationality, what participants describe as the transition "not going fast enough".

As pioneers produce public goods (knowledge, standards, and reliable ideas) that followers can utilise without sharing transition risks, *risk distribution asymmetries* continue to exist. Contractors stated that widespread adoption won't happen unless contract forms fairly allocate price increases and failure costs. Momentum is further undermined by *regulatory ambiguities*: the government creating investment uncertainty and additional requirements imposed on timber despite its comparable performance to concrete introduce structural cost penalties. There is still a *knowledge-action gap* as well; despite substantial training and demonstration projects, institutional investors require more convincing proof of long-term performance to support higher upfront expenditures. Fiduciary restrictions restrict experimentation, resulting in a dilemma where implementation is still too limited to collect performance data.

Strategic Recommendations

For value chain coordination: Create transition "conductor" roles by establishing integrated actors with profit motives who unify bio-based decision-making from project inception, coordinate technical disciplines, and demonstrate through commercial success that perceived risks are manageable. Architects are potentially the best fit through business model transformation from fee-for-service to risk-bearing development partnership. Simultaneously, build coordination coalitions to scale multi-stakeholder platforms, coordinate pipeline commitments providing demand visibility for factory investments, establish long-term supplier agreements, and create industry-standard contracts distributing innovation costs across value chains rather than penalising pioneers.

For institutional investors: Institutional investors can accelerate transition by shifting from passive capital allocation to ecosystem coordination. By pre-committing capital, publicly signalling allocation targets, and participating in industry platforms, they build market confidence, encourage contractors to scale production, and secure preferential access to emerging capacity. Investors should develop impact quantification methodologies monetising embodied carbon, health benefits, and educational outcomes. Strategic signalling of financing terms aligns market actors, addressing coordination failures. Educating clients on long-term portfolio benefits creates informed demand. Finally, applying the positioning framework enables exploration of non-traditional investment structures, diversifying risk-return profiles and distributing bio-based construction capital across multiple strategic quadrants rather than relying solely on conventional investments.

Limitations

This study has several methodological limitations. The sample's under-representation of important players, such as insurance providers, housing corporations, producers of engineered timber, and policymakers, restricts the ability to fully comprehend the value chain. The framework runs the risk of overinterpreting organisational features as general patterns because each positioning type only has one to three examples. Because actors show hybrid behaviours across quadrants based on project context, the four-quadrant structure may oversimplify positioning diversity.

Temporal constraints limit the findings: it is unclear whether patterns forecast future behaviour or only describe current states because the framework records positioning at a single point in time rather than dynamically repositioning over time. Consensus-building depth was constrained by the short Delphi period and by an imbalanced, small panel. Self-reported data raises the possibility of bias because participants might exaggerate their commitment to sustainability or defend previous choices. Converging storylines that reflect social pressure rather than independent opinions run the risk of creating "echo chamber" effects in the small but connected Dutch bio-based construction community.

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List of Abbreviations

AUM	Assets Under Management
BMC	Business Model Canvas
CBAM	Carbon Border Adjustment Mechanism
CLT	Cross-Laminated Timber
CSRD	Corporate Sustainable Reporting Directive
ESG	Environmental Social Governance
ETS	European Trading System
GtC	Giga Ton of Carbon
GWP	Global Warming Potential
LVL	Laminated Veneer Lumber
MPG	Milieuprestatie Gebouwen (Environmental Performance of Buildings)
NABB	Nederlandse Aanpak Bio-based Bouwen (National Approach Bio-based Building)
SFRD	Sustainable Finance Disclosure Regulation
TFC	Timber Frame Construction
WLC	Whole Life Carbon

1 Introduction

This chapter provides the context information needed to analyse the Netherlands' transition to bio-based building. The background and context are given in Section 1.1, which discusses the two pressures that the construction industry faces: the pressing need to address the housing shortage and the environmental requirement to drastically cut CO₂ emissions. The emerging innovation of bio-based construction is introduced, and the changing regulatory environment that increasingly influences market dynamics through carbon pricing mechanisms and ESG requirements is reviewed. The problem definition is stated in Section 1.2, which emphasises the basic conflict between satisfying housing demands and staying within global carbon limits. The knowledge gap about the strategic positioning of stakeholders during this transition is identified in Section 1.3. The research goal and questions, which centre on how strategic positioning facilitates socio-technical transitions, are presented in Section 1.4 and the conceptual framework in Section 1.5.

1.1 Context and Background

As demographic, environmental, and regulatory issues come together, the Dutch real estate and construction industry is under increasing pressure. The sector's disproportionate environmental impact, a severe housing shortage, and quickly changing European sustainability regulations are all combined to shift expectations and highlight the limitations of current building practices.

1.1.1 Pressure on the real estate and construction sector

The acute shortage of affordable housing is causing an unprecedented crisis in the Dutch housing market. The Netherlands has a 390,000 housing deficit as of 2023, and estimates suggest that this gap may widen further in the absence of significant changes (LEVS Architects et al., 2024). The ambitious goals of the national coalition agreement "Omzien naar elkaar, vooruitkijken naar de toekomst" (or: "*Looking after each other, looking forwards to the future*") include building 100,000 homes a year until 2030, for a total of 900,000 additional units (Rijksoverheid, 2021).

This housing crisis is worsened by the environmental effects of the construction industry. About 39% of energy-related CO₂ emissions and 36% of world energy demand are caused by building and construction activities (UNEP, 2017; Shrestha, 2021). 82–87% of these emissions are caused by the manufacturing of materials rather than operational energy, with the manufacture of concrete being especially accountable (Shrestha, 2021). By maintaining the current way of producing this volume of construction materials, the construction sector will be the single most polluting entity in the world by 2035 (VPRO, 2019). But as of today, the cement sector would be the third-largest emitter in the world if it were a nation, after the United States and China (Finch Buildings, 2025).

Carbon budget limits highlight the need for sustainable transformation in the building industry. Copper8 et al. (2023) warn that if current trends in the building industry continue, its cumulative CO₂ emissions could exceed the limit associated with the 1.5 °C warming threshold as early as 2028. The realistic prognosis of 742,500 homes is going to produce levels that are incompatible with climate commitments if building were to proceed as planned (Copper8 et al., 2023). This results in what the authors refer to as an "integrated challenge" that calls for both accelerating building *and* achieving drastic emissions reductions at the same time.

The Paris Agreement's target of limiting global warming to 1.5°C has already been exceeded, with projections now indicating a rise to 1.7°C or higher (Building Balance, 2023). At current construction

practices, the CO₂ budget allocated to the built environment until 2050 is rapidly depleting, making it impossible to meet climate targets while maintaining conventional building methods (Building Balance, 2023).

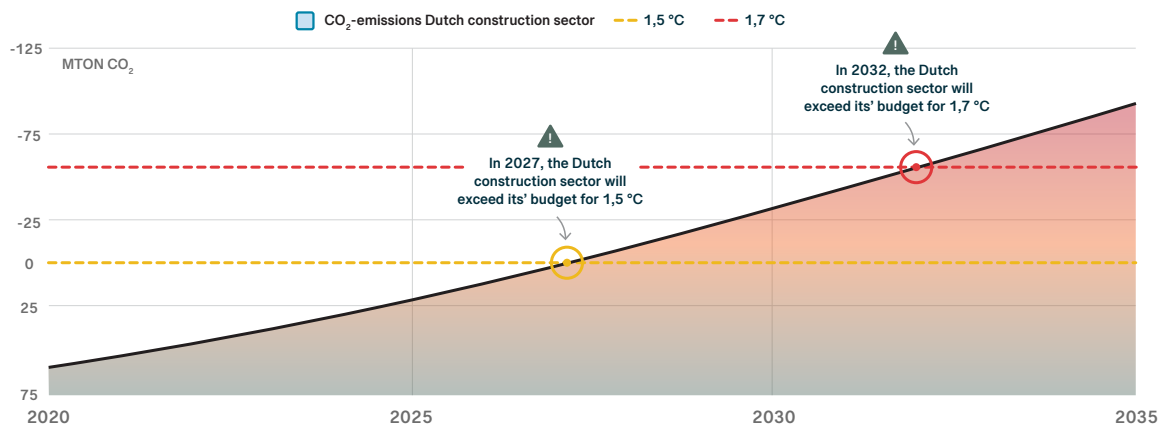


Figure 1: Exceeding the Dutch construction industry's CO₂ budget under contemporary circumstances
(Source: Copper8)

1.1.2 Bio-based construction as upcoming innovation

With its renewable qualities that can balance housing production with climate demands, bio-based construction offers the Dutch building industry a revolutionary opportunity. In contrast to limited resources (like sand, limestone, and iron ore), the term refers to materials that come from biological sources and can regenerate within reasonable timescales (Studio Marco Vermeulen, 2020). Primary bio-based materials include (Nationale Aanpak Bio-based Bouwen, 2023):

- Engineered timber products (cross-laminated timber, laminated veneer lumber)
- Agricultural fibres (straw, flax, hemp, and miscanthus)
- Biomaterials like composites

Bio-based materials offer far more environmental advantages than simply replacing materials. Plants absorb CO₂ from the atmosphere during photosynthesis and store it in their biomass, which contains about one tonne of CO₂ for every cubic meter of wood (Edzes et al., 2022). For decades or even centuries, this carbon is trapped in building structures, turning them from carbon sources to carbon storage facilities. According to research by Churkina et al. (2020), a global shift to timber construction could sequester 0.5–1.0 GtC per year. Furthermore, according to the substitution effect, every cubic meter of wood used instead of steel or concrete avoids the release of roughly 1.5 tonnes of CO₂ emissions (European Commission, 2016).

→ More about this can be found in Section 2.1.3 Environmental performance and CO₂ impact

“Building Balance” as governmental incentive

Building Balance, a key implementing organisation driving the Dutch bio-based transition, advocates for a "van land tot pand" (or: *From land to building*) system that integrates agricultural production with construction demands. They plan to break the current inactivity in which farmers are unwilling to grow fibre crops without a guarantee of demand and stimulate farms to pilots new forms of agriculture (Building Balance, 2023). The organisation wants to build strong value chains that can consistently supply the construction industry by scaling up from its current pilot projects to 4,000 hectares of fibre crop cultivation by 2030. Funding behind this organisation comes from the NABB and is worth around €200 million (NABB, 2023).

There are still major obstacles to market entry despite these benefits. Recent sector analyses indicate that the market share of bio-based construction is still around 3%, although it has increased from a baseline of less than 2% only a few years ago (NOA, 2025). Fragmented supply chains, a lack of standardisation, financial institutions' cautious risk assessments, and the lack of integrated design methodologies that optimise for bio-based materials from project inception are some of the obstacles (Horsting et al., 2024; Van Uden et al., 2024). It is evident how systemic the necessary transition is when these difficulties continue to exist in spite of obvious environmental and growing economic benefits.

1.1.3 (Inter)national regulations and financial impact

The European and national directives surrounding sustainable building is changing, which is increasingly affecting market dynamics. New environmental accountability standards are being established at the European level by significant frameworks. Environmentally sustainable economic activities are categorised by the European Taxonomy Regulation (EU 2020/852), and since March 2021, financial products have been required to report on sustainability under the Sustainable Finance Disclosures Regulation (SFDR, EU 2019/2088) (Timber Finance, 2025). With non-compliance turning into a governance risk, the Corporate Sustainability Reporting Directive (CSRD) now requires that businesses create and report on reduction targets across their operations and value chains (Copper8, 2023).

ESG-impact

With that, the behaviour of various stakeholders is changing as a result of these regulations. Instead of just lowering ESG risks, financial products are now only labelled sustainable if they are in line with particular sustainability goals (Federal Council, 2022). This change forces for instance Dutch pension funds and banks to support green building initiatives and give out higher loans for actors that have better ESG scores (Horsting et al., 2024).

Market and regulatory effects

There are several important market effects. Incentives for low-carbon alternatives will be created as CO₂ prices rise from the current €95 per tonne due to the expansion of the European Emissions Trading System (EU ETS) to include building operations and the Carbon Border Adjustment Mechanism (CBAM) for materials like steel and concrete (Copper8, 2023). In response, banks are offering certified sustainable projects interest discounts and green loans (Horsting et al., 2024).

Methodologies for assessments are changing too. Standardised comparisons between construction methods are now possible thanks to the addition of a Global Warming Potential (GWP) measurement tool for lifecycle CO₂ emissions to the Level(s) framework, taking over from the former MPG (*MilieuPrestatie Gebouwen*) (Copper8, 2023). Opportunities for industrialised bio-based systems are created by the government's emphasis on flexible housing, or "flexwoningen," which are short-term residences built using factory-produced modules.

→ More about this can be found in Section 2.1.2 Common bio-based materials and technologies

1.2 Problem Definition

Despite the clear environmental advantages of timber and bio-based construction alternatives, the transition toward these sustainable building systems remains slow. This sluggish adoption persists even though bio-based materials offer substantial carbon storage potential and lower embodied emissions (Nationale Aanpak Bio-based Bouwen, 2023). The resistance to change is partly attributed to "cultural embedment" within the Dutch construction sector, where traditional materials and methods are deeply entrenched in professional practices, regulatory frameworks, and stakeholder expectations (VPRO, 2019). Altogether, this manifests in risk perceptions, insurance challenges, financing hesitations, and a general

preference for familiar construction approaches despite mounting evidence of bio-based construction's viability (Horsting et al., 2024).

To conclude, the problem is a tension between contradicting objectives: the construction sector must simultaneously scale up housing production to address social needs while fundamentally transforming its material and system choices to remain within planetary carbon boundaries. Therefore, it is crucial to comprehend the strategic positioning of actors in the construction value chain during this transition, as these choices influence the adoption of innovations, risk distribution, and investment flows across interconnected networks. Complex sector transitions are rarely the result of isolated technological advancements; rather, they require concerted efforts from developers, suppliers, financiers, insurers, and regulators. Whether bio-based solutions stay niche or become mainstream depends on how each actor weighs trade-offs between short-term costs and long-term strategic advantages. Despite the obvious technical and environmental advantages, policy changes and market incentives run the risk of misaligning if these dynamics are not understood.

1.3 Knowledge Gap

There is already a considerable amount of research conducted on timber and bio-based construction, especially in regard to material characteristics, stakeholder-specific constraints, and technical viability. In addition to identifying obstacles like financial limitations, legal constraints, and knowledge gaps throughout the value chain, research has thoroughly documented the potential of engineered wood products, structural performance, and fire safety features (Wageningen University & Research, 2024; Horsting et al., 2024).

However, there is still a significant knowledge gap regarding the *strategic positioning* of various stakeholders in the ongoing transition to bio-based construction. Existing research outlines the obstacles that exist and the people who encounter them, but it offers not much knowledge about how actors deal with these difficulties, modify their methods, and generate change opportunities.

This study's academic contribution focuses on analysing the behaviour of strategic stakeholders during the transition process, looking at how actors actively impact, resist, or accelerate the construction industry's transformation rather than what stops adoption. This entails being aware of how developers, contractors, financial institutions, and other players change their investment standards, business plans, and cooperative procedures in reaction to changes in the market and regulations. The way stakeholders manage regulatory uncertainty, strike a balance between short-term risks and long-term opportunities, and establish the legitimacy of bio-based solutions in a regime that is dominated by traditional materials is not adequately covered by current research.

1.4 Research Aim and Questions

1.4.1 Research objective

Despite the established technical viability of timber construction, institutional and financial obstacles continue to hinder its widespread adoption (Horsting et al., 2024). Understanding how value chain participants strategically position themselves in response to institutional pressures and financial incentives is crucial for the shift to bio-based and timber construction (Eikelenboom & Van Marrewijk, 2023).

This study examines how organisational dynamics and strategic decision-making are being used in the current Dutch construction industry to accommodate this transition, using the socio-technical transition theory by Loorbach et al. (2017). By recognising and understanding how these actors interact across

different phases of the transition, either facilitating or impeding the shift toward bio-based construction, this study aims to identify distinct positioning types that enable mapping stakeholders along a strategic spectrum. This mapping reveals where coordination failures occur and which actor combinations can accelerate transition acceleration, providing a foundation for targeted value chain interventions and investment strategies.

Strategic positioning as research tool

Understanding stakeholder behaviour from the standpoint of socio-technical transitions requires analysing how actors alter their practices, create new networks, and get past institutional obstacles within the established construction regime (Loorbach et al., 2017). Strategic positioning serves as an analytical lens to examine these dynamics: instead of abrupt changes, transitions take place gradually as actors strategically position themselves, build alliances, and make agreements that connect the old and new systems (Geels, 2002; Loorbach et al., 2017). By mapping how different actors position themselves relative to bio-based innovations and established practices, this research tool reveals how strategic stakeholder behaviour can turn critical intersections into opportunities between emerging bio-based innovations and established construction practices (Eikelenboom & Van Marrewijk, 2023).

The perspective of the investor: why it matters

Given the influential role institutional investors play within the construction value chain, this study prioritises their perspective. Institutional investors have the financial means and strategic incentive for driving change, but they are still generally cautious. This is due to their long investment horizons, sizeable capital pools, and fiduciary duties that are becoming increasingly linked to ESG performance. Because their capital allocation decisions have an impact on the entire value chain, it is crucial to understand what motivates or limits their positioning. For example, when investors commit to bio-based projects, they send a signal of market confidence that encourages developers to pursue timber portfolios, allows contractors to build capabilities, and incentivises suppliers to scale production.

Investors, however, cannot act in isolation. Their willingness to invest is fundamentally shaped by how other value chain participants position themselves. This interdependence makes a comprehensive understanding of the entire ecosystem essential for informing effective investor strategies. This research equips investors with the strategic insights needed for determining which partnerships speed up transition, where coordination issues lead to bottlenecks, and how their capital may promote systemic change instead of just funding discrete projects by mapping positioning types across all actors. The research will lead to two levels of strategic recommendations:

- Value chain coordination strategies that encourage cooperation among value chain actors
- Strategic advice for (institutional) investors concerning timber and bio-based construction projects, with an emphasis on how investors can use their positioning to enable transition dynamics beyond their direct portfolio decisions

1.4.2 Research questions

Main research question

How could strategic positioning enable the socio-technical transition towards bio-based building ecosystems?

Sub-questions:

SQ1: *How are the actors in the bio-based construction value chain currently positioned?*

By identifying important stakeholders and their strategic positions, this question maps the landscape of bio-based construction. It examines whether actors present themselves as change-making pioneers, cautious evaluators seeking broader acceptance, or established incumbents defending their positions. The variety of strategies used throughout the transition ecosystem is shown by this mapping.

SQ2: *How do actors define their strategy, and what influences them?*

This question investigates the reasoning behind positioning decisions. It reveals the factors that influence actors to invest in bio-based capabilities as opposed to sticking with conventional methods, including risks, financial expectations, regulations, competitive pressures, and resource limitations. It also shows how strategic decisions are made and justified.

SQ3: *What dynamics within the construction value chain accelerate or hinder the transition?*

This question determines the structural factors that either encourage or hinder the bio-based transition. This is to identify areas where coordination fails, identify interventions that could remove bottlenecks, and determine how strategic positioning affects transition speed overall; it looks at mechanisms such as economic tools, regulations, coordination patterns, and knowledge sharing.

1.5 Conceptual Framework

This research examines the relationship between “strategic positioning” and “socio-technical transitions” toward bio-based building systems. Strategic positioning is one of the primary ways that choices made by individual actors come together to change a system.

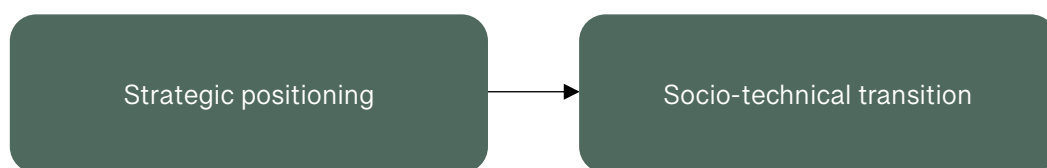


Figure 2: Conceptual framework

By altering core tasks like capital allocation, risk distribution, and innovation trajectories, actors are taking new roles, resulting in changes in the dynamics of the market (Geels, 2002; Loorbach, 2010). These decisions about positioning generally have a domino effect; for instance, when institutional investors shift their capital to bio-based projects, they encourage contractors to build timber capabilities, which in turn encourages developers to use sustainable materials. These interrelated choices create interactions that destabilise existing regimes and speed up the emergence of niches (Geels & Schot, 2007).

Demand-supply dynamics are reshaped and new network configurations are created when several actors simultaneously change their strategic positions along the value chain (Loorbach et al., 2017). Instead of optimising current structures, strategic positioning reconfigures value networks to facilitate transitions. By positioning themselves to anticipate future system states, actors provide space for the growth of emerging technologies (Geels, 2011).

This framework fills the knowledge gap in academia regarding how strategic choices at the stakeholder level result in changes in the value chain. The shift from concrete-steel dominance to bio-based construction systems is made possible by individual strategic decisions taken together, demonstrating that successful transitions necessitate coordinated repositioning across multiple value chain segments (Loorbach et al., 2017).

2 Literature Research and Theoretical Framework

The theoretical basis for understanding the transition to timber and bio-based construction is established in this chapter. After defining bio-based construction and clarifying important terms, it analyses the state of the market and stakeholder positions. After examining adoption-influencing factors such as technical factors, policy drivers, and economic advantages, the chapter applies sustainable transitions theory by Loorbach (2017) and Geels (2002) to frame the sector's systemic challenges. Additionally, the chapter draws on strategic positioning literature, particularly the work of Baines et al. (2005), which provides a framework for understanding how actors define their organisational boundaries and competitive positions within supply chain networks during periods of technological change. When combined, these elements offer the analytical framework required to create a foundation for the research methods and strategic suggestions that are discussed in later chapters.

2.1 Key Concepts of Bio-based Construction

The basic terminology and technical foundations required for understanding bio-based construction systems are established in this section. It starts by outlining the key differences between overlapping terms like 'timber', 'bio-based', and 'bio-enriched' materials, as well as what bio-based materials mean in the Dutch context. After that, the section looks at the main engineered wood products and construction technologies, such as CLT, glulam, and modular prefabrication systems. Lastly, it examines how bio-based materials perform in terms of the environment, especially their ability to store carbon and the substitution effects that distinguish them from traditional building materials.

2.1.1 Definition and scope

The term "*bio-based construction*" refers to construction methods that make use of materials that are sourced from biological resources that are renewable. The Nationale Aanpak Bio-based Bouwen (NABB) offers a clear definition in the Dutch context: "a bio-based building material is one that contains at least 70% renewable mass" (Nationale Aanpak Bio-based Bouwen, 2023). The ideal situation would see materials produced entirely of biological raw materials, grown regeneratively, and improving spatial quality while addressing regional issues like nitrogen emissions, biodiversity, and water quality (Nationale Aanpak Bio-based Bouwen, 2023).

"*Bio-enriched*" (or "*bioverrijkte*" in Dutch) materials are those that contain less than 70% renewable mass but are made from bio-based raw materials. In the field of civil engineering, where materials frequently cannot yet be applied without abiotic raw materials and additional substances (primarily mineral surface minerals like sand, gravel, and clay), this terminology is particularly applicable. Bio-enriched describes the substitution of a comparatively small quantity of biotic materials, such as fillers, glues, resins, and binders, for CO₂-intensive abiotic materials. According to Nationale Aanpak Bio-based Bouwen (2023), bio-enriched materials are especially noticeable in applications involving concrete and asphalt.

This research particularly focuses on *bio-based* construction materials.

The difference between timber and bio-based

Although timber is bio-based by nature, the terms are frequently used differently in practice. "*Bio-based*" frequently refers to a broader category of renewable materials, including insulation materials derived from agricultural products, whereas "*timber*" (or "*hout*" in Dutch) specifically defines wood-based structural and

construction materials (INBO, 2021). For understanding market segments in the construction industry, an understanding of this distinction is relevant.

Clarity of terminology

Several overlapping terms, such as bio-based, biogenic, natural, circular, and timber, are used to describe renewable building materials, according to the literature. Horsting et al. (2024) define bio-based materials as those that come from renewable (recycled or bio-based) sources, with wood products providing an element of this category. While "biogenic" highlights the material's biological origin, "circular" refers to the material's potential for reuse and recyclability at the end of its life. If wood is produced using sustainable forest management, it is a renewable resource that is inherently circular (Horsting et al., 2024).

2.1.2 Common bio-based materials and technologies

Engineered wood products

Structures that were previously only possible to design and construct using concrete and steel are now achievable because of the development of engineered wood products, which have significantly changed the possibilities for timber construction (Timber Finance, 2023). Value-added products known as "engineered wood products" are constructed from statically inhomogeneous timber raw materials, such as veneers, wood chips, and sawn timber, and then assembled and glued with a bio-based glue to create large, standardised, high-strength components like beams and columns (Timber Finance, 2023).

One of the most important developments in this field is *Cross-Laminated Timber* (CLT). CLT is a robust, multi-layered building material that is used for floors and walls. It is made up of at least three single-layer boards that have been glued crosswise and positioned parallel to one another (INBO, 2021; Horsting et al., 2024). Large timber panels that can support loads in three dimensions are produced by cross-lamination, which usually involves applying adhesive to join layers of timber planks that are 22 to 55 mm thick in five or seven layers (Brandforsk, 2024). CLT panels are a promising substitute for conventional materials because they provide roughly the same strength and range of applications as concrete (INBO, 2021). According to Horsting et al. (2024), CLT is especially well-suited for high-rise construction and provides particular benefits in buildings that are three to five storeys tall.

Other engineered wood products used for structural timber engineering include glue-laminated timber (glulam or GLT) and laminated veneer lumber (LVL) (Timber Finance, 2023). Following advancements in adhesive technologies, these products were created in the 1970s and 1990s and are now considered the industry standard for multi-storey timber construction (Timber Finance, 2023). Glulam consists of bonded wood laminations joined with durable adhesives, making it suitable for use as columns and beams in structural applications (Pau et al., 2024). LVL, developed later, uses veneer layers rather than solid laminations and can achieve higher strength properties, enabling larger spans when combined with traditional timber frame systems (INBO, 2021).

Timber Frame Construction (TFC), (or "houtskeletbouw" (*HSB*) in Dutch), is a building technique in which the structure of a house is constructed using timber joined together (Horsting et al., 2024). TFC components are insulated wooden frames that can be used as inner cavity walls, dwelling-separating walls, and structural walls (INBO, 2021). For residential buildings up to four storeys, TFC is frequently used. After that, it loses some of its cost-effectiveness (Horsting et al., 2024). Although HSB components are frequently far less expensive than CLT, buildings constructed with HSB may only have three layers because of their decreased stability (INBO, 2021).



Figure 3: Factory for 3D CLT modules in Vroomshoop, The Netherlands (Source: De Groot Vroomshoop)

Modular construction and prefabrication

An upcoming form of prefabrication is “3D-modular” construction. Those 3D modules are entirely custom-made in the factory until the level of a completely full-fledged kitchen is in place and tiles are in the bathroom (INBO, 2021). Faster construction times and less construction traffic are just two of the many significant advantages that come with prefabrication. Because CLT weighs 20% of concrete's weight, it requires fewer workers and lighter cranes on the job site, which leads to significantly quicker and less expensive demolition times (INBO, 2021). Due to its high repetition and small structural spans, modular construction is especially well-suited for hotels, student housing/studios, and social housing (INBO, 2021).
 → More about the advantages can be found in Section 2.3.2 Technical and design factors.

Industrial facilities

Contractors must make significant investments in prefabrication facilities in order to meet the demands of contemporary timber construction, especially mass timber techniques like CLT (Circulaire Bouweconomie, 2023). Some businesses are moving forward with industrialisation. For example, Plegt-Vos invested €20 million in a housing factory that specialises in timber, boosting productivity by combining prefabrication and digital design (Plegt-Vos, 2023). However, steady market demand for bio-based housing is necessary for this to succeed but such demand is still lacking (Van der Lugt, 2023).

Nieuwsuur (2025) recently published a news article revealing that Dutch prefab housing factories operate at critically low capacity levels, with some manufacturers running at only 30% utilisation despite significant investments in production facilities. The article reports that Startblock's factory in Emmeloord filed for bankruptcy, while VDL de Meeuw experienced a 30% revenue decline. Housing Minister Mona Keijzer advocates for industrial construction as both sustainable and cost-effective, setting ambitious targets with municipalities to achieve 50% prefab construction by 2030, though current prefab production represents only 20% of new housing developments.

2.1.3 Environmental performance and CO₂ impact

Climate benefits of timber

Through photosynthesis, plants (most notably trees) remove CO₂ from the atmosphere, separating carbon from oxygen. *Sequestration* is the process by which carbon is stored in the biomass and oxygen is released back into the environment.

1. The first benefit that trees and forests provide to the climate is their ability to remove and store carbon from the atmosphere. When wood is used as a building material, such as in the load-bearing structure of buildings, carbon is still bound in addition to this forest-based storage.
2. The second climate benefit is the potential for long-term carbon storage in durable wood products.
3. The third climate benefit comes from using wood to replace emission-intensive building materials or fossil fuels, in addition to the storage effects found in forests and wood products (Timber Finance, 2023).

Because timber products are generally less energy-intensive and have a smaller fossil carbon footprint than building components made of other materials, material substitution lowers fossil greenhouse gas emissions (Timber Finance, 2023). The European Forest Institute claims that for every kilogramme of wood used in place of a traditional mineral raw material, an average of 1.2 kilogrammes of CO₂ emissions are avoided (Leskinen et al., 2018, as cited in Bouwen met hout, n.d.). Because of this substitution effect, using wood on a large scale in place of traditional and fossil-based materials can prevent sizeable amounts of CO₂ emissions (Circulaire Bouweconomie, 2023).

Embodied carbon and avoided carbon

And not only timber, but also for each building component constructed with bio-based materials there are two significant environmental advantages: embodied carbon benefits and avoided carbon benefits. Bio-based materials absorb CO₂ from the atmosphere during their growth phase to facilitate development. This carbon remains captured as long as the materials maintain their form and are not incinerated (Scrown, 2022). Timber stores approximately 1 tonne of CO₂ per cubic meter, while insulation materials such as hemp store approximately one-fifth to one-sixth of this amount, though these crops grow considerably faster (Edzes, 2022).

The avoided carbon benefit arises because for each bio-based material applied, traditional materials need not be used. This avoids the use of materials that do not sequester CO₂ and whose production generates substantial emissions, thereby reducing operational emissions. Together, these factors create a dual environmental advantage (RVO, 2022).

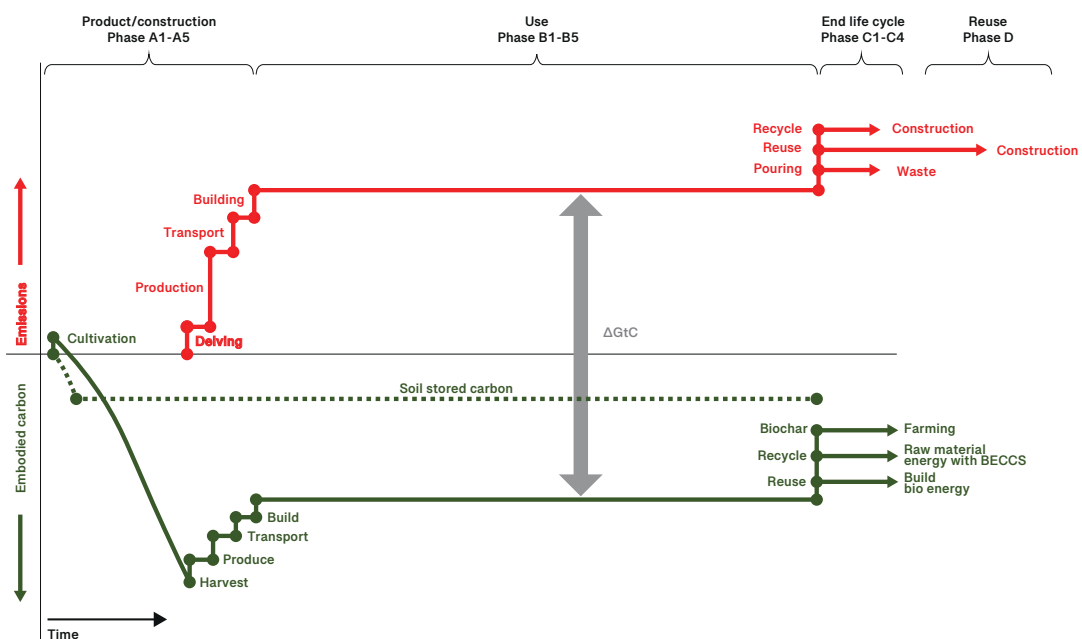


Figure 4: Carbon emissions and storage of conventional vs. bio-based construction materials
(Source: J.W. van de Groep)

2.2 Sustainable Transitions Theory

According to Markard et al. (2012), sustainable transitions are the result of fundamental changes in socio-technical systems towards more environmentally friendly forms of production and consumption. These shifts entail significant, protracted changes that go beyond advancements in technology and include modifications to actor behaviour, laws, infrastructure, industrial networks, and social meanings (Geels, 2002). Addressing enduring sustainability issues in industries like energy, mobility, agriculture and definitely construction requires an understanding of how such intricate systemic changes take place (Loorbach & Frantzeskaki, 2017).

In order to create frameworks for assessing and influencing system-level change, research in sustainability transitions research arose in the early 2000s, utilising knowledge from innovation studies, evolutionary economics, sociology, and governance theory (Geels, 2002; Loorbach, 2007). This multidisciplinary approach acknowledges that sustainability issues cannot be solved by making small, gradual changes alone because they are ingrained in the societal structures that currently exist (Rotmans et al., 2001). Instead, to overcome the limiting effects that define established socio-technical systems, fundamental system innovations or transitions are needed (Geels, 2002).

The theoretical foundations of sustainability transitions are examined in this section, along with the socio-technical nature of these transformations, how they develop through dynamic interactions across multiple levels, and methods for actively managing and quickening the transition processes towards sustainability.

2.2.1 Transition management and dynamics

Transition management is a governance approach that was created especially to address complex societal issues through system innovation processes (Loorbach & Rotmans, 2010). Transition management, which was created in the Netherlands in the early 2000s, covers the necessity of making significant, long-term changes to functional systems that might take a generation or longer to achieve (VROM, 2001).

Loorbach's transition theory

Transitions are defined by Loorbach (2007) as non-linear processes that evolve through shocks and not gradually. Four categories of governance activities that take place at various levels and time horizons are distinguished by transition management (Loorbach & Rotmans, 2010):

- Long-term (usually 25–50 years) societal systems are the level at which *strategic activities* take place. They concentrate on organising complicated societal issues and generating alternative futures through the creation of visions, such as CO₂ reduction targets and policy frameworks that last until 2050 (Loorbach & Rotmans, 2010).
- Through coalitions and policy initiatives like Building Balance and City Deals, *tactical activities* relate to the establishment and dismantling of system structures, including institutions, rules, and infrastructures, and operate at the subsystem level (5–15 years) (Loorbach & Rotmans, 2010).
- In *operational activities*, actors either recreate existing system structures or decide to restructure them through experiments and specialised projects, like bio-based construction initiatives (Loorbach & Rotmans, 2010). Operational activities are short-term, daily decisions and actions (0–5 years).
- *Reflexive activities* involve ongoing structuring, reframing, and learning through discussion, assessment, and research. These activities include evaluating subsidies and environmental

performance of buildings (MPG) as well as the current situation at different levels and how they relate to one another (Loorbach & Rotmans, 2010).

Through an iterative process, the transition management cycle operationalises these activities: (i) structuring the problem and creating a transition arena; (ii) creating sustainability visions and transition agendas; (iii) creating and implementing transition experiments; and (iv) tracking, assessing, and learning to adapt (Loorbach & Rotmans, 2010). New ideas and methods can co-evolve with practical changes thanks to this cyclical approach (Loorbach & Rotmans, 2010).

Geels' Multi-Level Perspective (MLP)

Transition management theory complements Geels' Multi-Level Perspective (MLP) (Geels & Schot, 2007). Both strategies have a design that combines several theoretical components, including future-focused visioning tools, a governance philosophy that promotes adaptation in the context of uncertainty, transition dynamics with periodic phases, and a multi-level analytical hierarchy (Loorbach & Rotmans, 2010). Geels (2002) conceptualises the multi-level perspective as a framework in which transitions result from dynamic interactions between three analytical levels, a foundation on which Loorbach later builds his transition management theory:

- **Niches** are innovative realms where radical innovations develop on the margins of established systems, serving as innovation rooms for alternatives that initially have low technical performance or high costs (Geels, 2004). Learning processes (learning by doing, by using and by interacting) and the development of social networks that foster innovation can be facilitated by those niches (Geels, 2002).
- **Regimes** are the prevailing arrangement of customs, laws, and networks that maintain the stability of current socio-technical systems (Geels, 2002). Systemic tensions result from regimes' path dependency, which is caused by sunk investments, economies of scale, and co-evolutionary dynamics that produce stability but ultimately render them incapable of changing beyond optimisation (Loorbach et al., 2017).
→ *An extensive explanation of the current regime is written in Section 2.4 Current regime and landscape developments*
- **Landscape** refers to the external socio-technical context that extends beyond the direct impact of regime and niche performers. This includes gradually shifting external factors that produce gradients for trajectories, such as political developments, economic trends, cultural values, and demographic shifts (Geels, 2002).

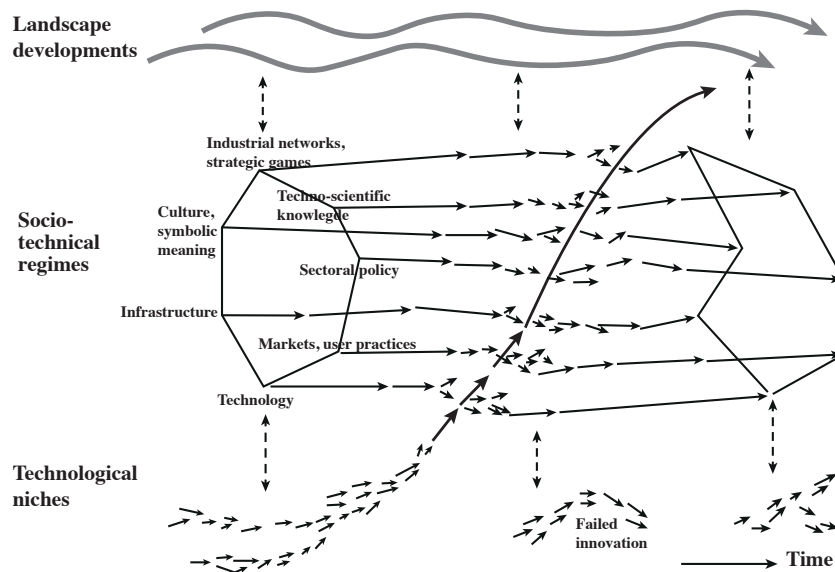


Figure 5: Multi-Level Perspective on socio-technical transitions: interactions between landscape, regimes, and niches (Source: Geels, 2002)

The intersection point of chaos and transition dynamics

Instead of gradual evolution, as Geels argues, Loorbach et al. (2017) state that transitions occur through shockwise, non-linear patterns. Regimes always experience elevated stress, internal crises, destabilisation, and systemic reconfiguration as broader societal contexts shift and radical alternatives arise (De Haan, 2010). Over decades, this process progresses through different but overlapping phases, involving iterative cycles of build-up and breakdown (Loorbach et al., 2017):

1. **Predevelopment phase:** While the established regime continues to optimise through small improvements, experimentation with alternative concepts, technologies, and practices starts.
2. **Phase of destabilisation:** As alternatives start to pick up speed and momentum, regime tensions and opportunities arise, putting more and more pressure on the regime to change.
3. **Acceleration phase:** The actual transition is brought about by disruptive and chaotic change, and it represents a crucial point of intersection for chaos where new combinations of elements of the transformative regime and emerging alternatives compete and come together.
4. **Phase of stabilisation:** While elements of the old regime that do not change are dismantled and phased out, new regime elements develop and institutionalise into a new configuration.

The chaos intersection point is the crucial moment at which the acceleration of specialised innovations and the destabilisation of the current regime coexist, resulting in fundamental uncertainty and swift, unpredictable change (Hebnick, 2022). Although the result depends on how various dynamics align across the landscape, regime, and niche levels, as this intersection signifies the point at which path dependencies are broken and new developmental trajectories become possible (Geels, 2002).

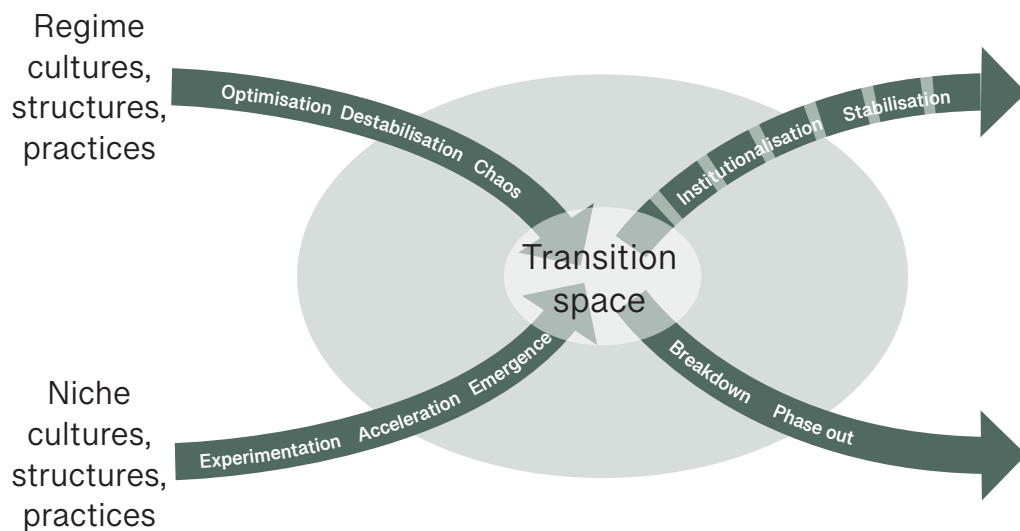


Figure 6: Transition space: interactions between regime and niche dynamics in socio-technical transitions (Source: Loorbach, 2017)

Pathways of transition

Regime shifts occur when successful niche developments align with reinforcing changes at the regime and landscape levels (Kemp et al., 2001). Because of fixed investments and co-evolutionary dynamics within regimes, transitions inevitably involve path dependency, according to Loorbach and Rotmans (2010). Over time, this leads to an inability to change beyond optimisation. Reorganisation towards a new balance becomes abrupt and unpredictable once it is disrupted by external crises, internal conflict, or better alternatives, resulting in a chaos of patterns (Hebnick, 2022).

Geels and Schot (2007) expanded on this knowledge by identifying several transition pathways depending on the state of niche innovations and the timing of landscape pressures. However, Loorbach et al. (2017) emphasise that while experimentation and acceleration were the primary focus of transitions research at first, processes of destabilisation, emergence, and institutional change are now receiving more attention. Any transition's particular course is determined by the circumstances of the situation, the tactics of the actors, and the ways in which various patterns and mechanisms of change propel nonlinear structural change in intricate social systems (Loorbach et al., 2017).

2.2.2 Socio-technical approach

The socio-technical approach acknowledges that sustainability transitions necessitate an integrated examination of the ways in which technology and society co-evolve rather than being viewed exclusively through technological or social lenses (Geels, 2004). The socio-technical perspective is one of three primary approaches to research on sustainability transitions, according to Loorbach et al. (2017), who highlight its emphasis on technology in social context and the examination of past innovation journeys.

Socio-technical systems are the connections between diverse components required to carry out societal tasks like construction, transportation, energy supply, and food production (Geels, 2004). Products and technologies, knowledge and competencies, actors and organisations, institutions and regulations, infrastructure networks, user practices, and cultural meanings are some of the interconnected elements that make up these systems (Geels, 2004; Quist, 2013). The socio-technical approach uses analytical lenses like path dependency and strategic niche management to comprehend transitions (Loorbach et al., 2017).

The dynamic process of co-evolution between technology and its user environment is a defining feature of socio-technical systems (Geels, 2004). Actors embedded in social groups, such as producers, users, policymakers, researchers, and civil society, reproduce and modify system elements through their actions; technology does not develop on its own (Geels, 2004). There is space for strategic action and innovation because these actors are guided and not forced by institutions and regulations (Geels, 2004).

The co-evolutionary perspective bridges multiple dimensions: technology and users, technology and policy institutions, science and markets, and technology and culture (Geels, 2004). According to Loorbach et al. (2017), system innovation and socio-technical interaction receive special attention in various governance approaches, which makes this viewpoint crucial for comprehending the dynamics of long-term transitions.

2.2.3 Acceleration theory (Diffusion of Innovation)

Understanding transition acceleration requires an understanding of how innovations move through social systems. Diffusion, according to Rogers (2003), is a process that follows an S-shaped adoption curve, with different adopter categories based on when they adopted innovations. Adoption begins slowly with early groups, picks up speed as more adopt, and then levels off as fewer non-adopters are left (Rogers, 2003).

Rogers (2003) distinguished five types of adopters: Despite a high degree of uncertainty, *innovators* (2.5%) are bold risk-takers with wide networks who adopt first. Respected opinion leaders who are sought after by others for guidance are *early adopters* (13.5%). Deliberate *early majority* (34%) adopt before the typical member. The *late majority* (34%) is dubious and needs peer pressure and proof of benefits. Traditional and last to adopt are laggards (16%) (Rogers, 2003). Figure 7 shows a this phenomenon in a conceptual graph.

In transition experiments, scaling up and diffusion are crucial components, according to Loorbach and Rotmans (2010). Since majority groups need social proof and proven benefits, while innovators and early adopters are willing to try new technologies, understanding adopter categories allows for targeted acceleration strategies (Rogers, 2003). Building broader networks of diverse actors fosters innovation and transition breakthroughs (Loorbach et al., 2017).

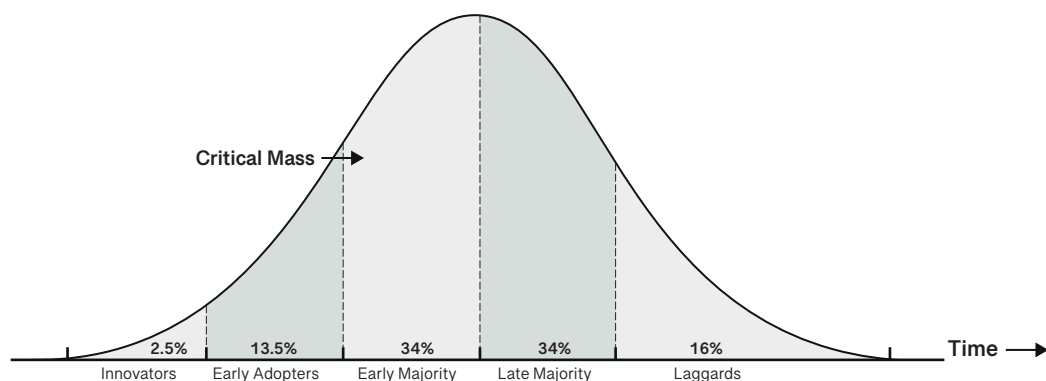


Figure 7: Diffusion of Innovation diagram (Source: Rogers)

2.3 Strategic Positioning in Transitions

The Dutch construction industry's shift from traditional to bio-based materials creates a serious challenge to the way value chain participants define their organisational boundaries and competitive positions. The

process of deciding which production-related tasks a certain actor should perform internally and which should be externally owned and controlled by suppliers, partners, distributors, and customers is known as strategic positioning (Baines et al., 2005). The strategic position itself represents the 'competitive space' or 'footprint' that an organisation adopts within supply chain networks (Baines et al., 2005).

Positioning choices become more difficult during material transitions because both the supply and demand sides change. While managing uncertainties regarding technological and market development, organisations must strike a balance between investments in developing, in this case, timber and bio-based capabilities and preserving competitiveness in traditional markets (Dombrowski et al., 2018). This section looks at how actors strategically position themselves during these (socio-technical) transitions. It explores the mechanisms by which actors create and capture value in transitioning markets, the value chain dynamics that shape competitive boundaries, and the theoretical frameworks that shape positioning decisions.

2.3.1 Definition and conceptual foundations

The intentional structuring of organisational boundaries and responsibilities within value networks is referred to as strategic positioning. It establishes which value-creating and production processes are carried out internally by a company and which are managed externally by partners, distributors, suppliers, and customers (Baines et al., 2005). According to Baines et al. (2005), who have done quite extensive research on this topic, a business' competitive space or footprint within supply chain networks is represented by this position. It includes dynamic decisions about resource deployment, capability development, and network relationships that change as market conditions and technological advancements do, in contrast to static make-or-buy decisions (Chandraprakaikul et al., 2010).

2.3.2 Actor roles and strategies in technological transitions

As organisational boundaries and responsibilities need to be redefined, socio-technical transitions cause confusion by fundamentally upending established actor roles within supply chains. Effective solutions to problems rely on the connections and interdependencies between various supply chain components rather than isolated adjustments to individual organisational units (Chandraprakaikul et al., 2010). Actors navigate through significant uncertainty regarding technological trajectories, market development, and institutional change while participating in search processes and learning activities during transitions (Geels & Schot, 2007). The lack of established institutional templates that normally direct learning and adaptation during times of change intensifies this uncertainty (Geels et al., 2016).

Successful actors show an in-depth knowledge of organisational dynamics, acknowledging that strategic positions need to change over time instead of staying constant (Baines et al., 2005). They recognise that their strategic position will need to evolve over time, and they understand how modifications to one supply chain connection affect others (Baines et al., 2005). Less successful businesses show the belief that positioning decisions are permanent rather than temporary, which stands in contrast to this awareness (Baines et al., 2005). Complementary processes of analysis, negotiation, and judgement can be used to reach decisions; the interaction of decision process, content, and context is crucial in determining results (Mintzberg et al., 1976).

Strategic positions in the value chain

During transitions, the relationship between positioning and competitive strategies becomes more clear. While actors looking for strategies for differentiation concentrate on innovation, brand development and unique products, those seeking cost leadership strategies prioritise production efficiency and minimising inputs for given output levels (Chang et al., 2015; Dombrowski et al., 2018). However, a lot of actors are adopting hybrid strategies in the transition to bio-based materials, lowering costs just to be able to compete with well-established traditional materials. Because competitive requirements can differ

significantly across various customer segments and application areas, this necessitates positioning decisions that are specific to the market and the product (Dombrowski et al., 2018).

Holistic thinking across four supply chain interfaces, as opposed to treating them separately, is a hallmark of more successful positioning decisions (Baines et al., 2005). Businesses can understand how a change in one supply chain affects others thanks to this "joined-up thinking" (Baines et al., 2005). Given that value chain initiatives handled locally typically have lower success rates than coordinated approaches, manufacturers need to take a collective and holistic approach to their value chain interactions (Baines et al., 2005). By taking into account the relationships between manufacturing operations and larger value chain networks connected to the company, this holistic approach goes beyond conventional ideas like make-or-buy, sourcing, and outsourcing (Chandraprakaikul et al., 2010). In times of fundamental technological change, this kind of coordinated decision-making is crucial for successfully managing niche transitions and striking a balance between short-term positioning decisions and long-term competitive strategy.

2.3.3 (Networked) business models, demand and supply

Value chains involving the forestry, wood products, building design, and construction sectors must be fundamentally reconfigured in order to make the switch from conventional to bio-based building materials (Horsting et al., 2024). Timber construction calls for value networks, as opposed to straightforward linear supply chains (Van Stijn et al., 2021). Forest-harvested timber travels via sawmills and manufacturing plants, creating engineered timber products before arriving at construction sites thanks to the concerted efforts of general contractors, architects, engineers, and timber builders (Circulaire Bouweconomie, 2023). Table 1 shows the differences in positioning in supply and demand in a transitioning market:

Table 1: Supply and demand in the market transitioning to bio-based

<i>Demand</i>	<i>Supply</i>
On the demand side, bio-based materials are becoming more and more required by green building certifications and climate targets; however, there are still beliefs that sustainable construction is a costly choice in a sector that prioritises cost and value for money. So, prefabricators must be involved early in the transition to allow for a thorough analysis of supply chains and company-specific solutions, which will improve early building sustainability assessment and optimisation (Horsting et al., 2024).	Supply-side dynamics in the timber and bio-based transition look very different from supply chains for traditional building materials. While architects, engineers, builders, and supplier-contractors work in local or regional markets, suppliers of engineered timber products usually target more global markets, posing unique coordination challenges across customer segments (Haisma et al., 2023).
Demonstrating that bio-based materials provide economic and environmental value by reducing expenses and material consumption, improving material performance, and developing new circular business models and revenue streams is essential for market expansion (ING, 2025; NVB, 2023).	Together with strong ties to suppliers and supplier-builders, collaborative contract procurement modes seem to be the most suitable for timber construction. Knowledge sharing is identified as essential and requires consistent collaboration (Mokhlesian & Holmén, 2012). In particular, mass timber makes it possible to utilise a greater variety of forest biomass, earning profits from forest restoration initiatives (Van der Lugt, 2023).
	However, because timber engineering is not taught in every civil engineering and architecture programme (Horsting et al., 2023), there is still a

shortage of skilled workers, leading to competition amongst businesses for qualified personnel (EIB, 2024).

2.3.4 Collaboration and knowledge sharing

In order to overcome coordination challenges and produce trustworthy sustainability assessments, operators along bio-based value chains must effectively collaborate. For circular economy approaches to be sustainable, circularity must be continuously considered and coordinated at every stage of value chains. This shifts from traditional linear business models to "regenerative" systems where biological resources retain economic value for longer (Van Stijn et al., 2021). For timber and bio-based construction in particular, knowledge sharing through ongoing collaboration seems essential, with tight relationships between suppliers and builders and collaborative contract procurement modes proving necessary (Eikelenboom & Van Marrewijk, 2023). In emerging bio-based markets, for instance attending industry conferences (like Houtbouw XL in the Netherlands, see Figure 8) is a useful tool for building relationships.



Figure 8: Houtbouw XL conference in October 2025 (Source: Maurice Verkerk via LinkedIn)

2.4 Current Regime and Landscape Developments

This section maps the established regime structures and new landscape pressures that shape the bio-based construction transition in the Netherlands. Finding opportunities and obstacles for scaling bio-based construction requires an understanding of the current actor layout, market dynamics, and institutional arrangements.

2.4.1 Development of the market

Despite increased industry interest and policy attention, the Dutch market for bio-based building materials is still in its early stages. The market even hardly exists at the moment, according to Nationale Aanpak Bio-based Bouwen (2023). Approximately 2% of building materials used in Dutch construction are made of timber, whereas only 0.1% are made of other bio-based materials (not including wood) (NIBE, 2019, as cited in Nationale Aanpak Bio-based Bouwen, 2023). In the sample from the fourth quarter of 2024, the mass percentage of bio-based material for new residential construction was less than 3% (NOA, 2025).

ING stated in January 2025 that timber accounted for no more than 2% of the Dutch housing market, confirming the small market share of timber construction (ING, 2025). Ongoing perceptions of bio-based construction contribute to this limited market penetration, even in the face of growing expertise and the availability of appropriate materials (ING, 2025).

Only about 2,000 hectares of fibre crops are grown for building products, which is still a small amount of land (Building Balance, 2023). There is an obvious standstill: when demand is low, suppliers are averse to creating new products, and when supply is limited, demand for new products will not materialise rapidly. Developing value chains, where long-term agreements are made regarding supply and demand, is the main intervention for breaking through this barrier. This gives parties certainty regarding delivery and revenue, allowing them to invest in building materials, industrial processing, agriculture and research for proof of safety. According to Nationale Aanpak Bio-based Bouwen (2023), the first 13 production chains were already set up within a year, in 2024.

Market demand

The demand for timber-based housing has increased significantly in recent years, and public awareness of the product has helped to break down barriers to motivation and remove unfavourable perceptions about timber as a building material (Horsting et al., 2024). Specialised departments committed to timber construction, specifically CLT, have been established by more than 60 construction companies. These departments' relative youth (the majority are under four years old) indicates a rapid and enthusiastic shift towards wood as a building material (Horsting et al., 2024). MRA (2025) set an ambition for the Metropole Region of Amsterdam for 20% of new-built buildings to consist completely of timber constructions until July 2025. The actual numbers were lower, just reaching 5%. Some examples of the projects in this region are shown in Table 2:

Table 2: Examples of bio-based/timber projects in Metropolitan Region of Amsterdam (MRA, 2025)

Image	Information
	Name: Xylino Developers: Synchroon & De Alliantie Architect: Arons en Gelauff architecten Location: Almere Poort Delivery: 2025-2026 (Source image: Delta L)
	Name: De Houten Leeuw Developer: Stadgenoot Architect: Heren 5 Architecten Location: Amsterdam Delivery: 2024 (Source image: Stadsgenoot)



Name: GROEI!
Developer: VORM
Architects: de Architekten Cie., Flux
 Landscape Architecture and Raumplan
Location: Amsterdam
Delivery: t.b.d.
 (Source image: VORM)



Name: Amstelwood
Developer: Being
Architects: Team V Architecture
Location: Amstelveen
Delivery: 2026
 (Source image: Being)

2.4.2 Key actors and regime context

Stakeholders can be divided into discrete actor groups that collectively make up the socio-technical regime through their behaviours, according to Geels' (2002) multi-level perspective framework. To understand the systemic limitations and possibilities for scaling bio-based construction in the Netherlands, it is crucial to comprehend these stakeholders and their interactions. For categorisation of the stakeholder groups, Geels' (2002) theory is followed.

→ *More about Geels' theory in Section 2.5 Sustainable transitions.*

1. Producer network

The actors in the business of creating, building and manufacturing bio-based structures make up the producer network. Because it converts designs into built reality, this network is essential to the *regime*.

Developers: Since they must guarantee capital availability and generate adequate returns, or buildings will never be built, real estate developers bear the highest risk in the construction process. They mainly take direct costs and returns into account in the short term. Timber products such as CLT often have material costs that are 5–10% higher up front than conventional concrete and steel (van der Lugt et al., 2020; Cromwell, 2022). However, these expenses are somewhat offset by significant time savings during construction. On average, timber projects can be completed in roughly 15 months as opposed to 21 months for standard structures, which is about a 30% reduction (Cazemir, 2017).

Developers are increasingly taking regulatory resilience and long-term retained value into account as strategic considerations (INBO, 2021). Buildings with lower embodied carbon are expected to hold their value better as regulatory demands rise. ESG factors are encouraging Dutch banks and pension funds to invest in environmentally friendly projects, which increases the attractiveness of timber developments for financing agreements (Van Uden et al., 2024). Developers who adhere to ESG trends may benefit from lower interest rates or simpler access to institutional financing, depending on their approach and whether they choose to build and hold, sell or use (Van Uden et al., 2024).

Additionally, demand-side factors are changing. The circular economy is viewed favourably by the majority of Dutch consumers, demonstrating the growing significance of environmentally friendly decisions (Koch & Vringer, 2023). Developers have promoted buildings consisting of timber as healthier, more

aesthetically pleasing, and environmentally responsible due to the wood's ability to regulate moisture and act as insulation (INBO, 2021; Van der Lugt, 2023).

Contractors: Contractors must make significant investments in, amongst other things, prefabrication facilities in order to meet the demands of contemporary timber construction, especially mass timber techniques like CLT (Circulaire Bouweconomie, 2023). Some businesses are moving forward with industrialisation; for example, Plegt-Vos is investing in a housing factory that specialises in timber (Plegt-Vos, 2023). The builders must train their employees in new skills as a result of the transition from traditional construction to timber. Bio-based materials such as CLT and LVL require special assembly methods, fire safety precautions, and moisture protection procedures (Osvaldová & Hasburgh, 2024). Specialised subcontractors need to be trained in areas that are typically outside of their area of expertise, such as connection detailing, sealing, and dry construction techniques (Circulaire Bouweconomie, 2023).

Architects: Architects play a crucial role in early design decisions that determine material selection. Architects are often educated with a focus on conventional materials, and the lack of emphasis on wood means that many architects may not be familiar with its potential or how to incorporate wood effectively into their designs (Horsting et al., 2024). Stakeholders emphasise that other materials cannot simply be replaced by wooden materials, as the design should be centred around wood instead (Horsting et al., 2024). It is essential to involve engineers with timber expertise as early as possible in the project, as retrofitting a traditional design to timber is not cost-efficient.

It often occurs that architects are the progressive push behind innovative, more sustainable building principles if clients are able to be convinced of making larger investments for long-term benefits.

2. Suppliers

A relevant portion of the value chain is made up of suppliers who supply the required elements and materials to support bio-based construction.

Timber supply and forestry: The main source of timber resources at the start of the value chain is provided by European forestry operations, as well as national organisations like Staatsbosbeheer in the Netherlands. Sustainable forest management frameworks regulate the supply of timber in Europe, and ethical harvesting methods are ensured by certification programmes like the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC) (AMS Institute, n.d.). In order to meet climate targets while upholding sustainable forest management, the European Commission unveiled the EU Forest Strategy, which prioritises wood products, particularly those with long-lasting uses in buildings (Eurostat, n.d.).

Farmers: In an effort to create a lucrative business model that advances societal objectives, agricultural entrepreneurs pilot with fibre crops like hemp and flax for bio-based building materials (Nationale Aanpak Bio-based Bouwen, 2023). Especially given the nitrogen crisis, this 'new' form of agriculture could function as an alternative to excessive bioindustry.

Industrial processors and component manufacturers: In the fibre-processing industry, industrial processors are striving to set up adequate production capacity for scaling bio-based raw materials. However, the business case for growing fibre crops is still not compelling enough for many farmers, and the acreage dedicated to fibre crops for building products is still marginal at about 2,000 hectares (Nationale Aanpak Bio-based Bouwen, 2023; ING, 2025). While capacity for other crops still needs to be developed, limited capacity is already available for hemp and flax (Nationale Aanpak Bio-based Bouwen, 2023). Harvested logs are processed by sawmills, and producers of engineered wood products produce

products with added value like glulam and CLT (Timber Finance, 2023). For these actors to defend investments in production capacity, steady demand and long-term agreements are necessary.

3. User groups

The actors who eventually occupy and use bio-based buildings are known as user groups and are generally tenants and end-users. Market demand is influenced by their willingness-to-pay. Timber structures are becoming more and more popular as healthier and more comfortable living spaces because of their ability to regulate moisture and act as insulation and lower sickness absence (INBO, 2021; Van der Lugt, 2023).

4. Research network

The research network produces and shares information on bio-based construction, including best practices, performance data, and technical advancements. Early design choices that affect the choice of materials are heavily influenced by architects and construction engineers. But decades of using conventional materials have led to a lack of knowledge at every stage of the value chain, from planning to implementation (Horsting et al., 2024). According to Horsting et al. (2024), one of the main reasons professionals are unprepared is due to outdated educational curricula that do not incorporate a focus on timber.

5. Financial network

Construction projects are made possible by the financial network's capital and financing mechanisms. This network functions independently of the producer network within Geels' framework but has some crucial overlap.

Banks: Despite not being investors themselves, banks are essential to the funding of environmentally friendly building projects. Since the EU Taxonomy and ESG reporting requirements are pressuring institutions to incorporate more thorough sustainability criteria, this financing activity also improves their ESG scores (Horsting et al., 2024). Some banks now provide green loans or interest discounts for certified sustainable constructions, and timber is being repositioned as an innovative rather than risky asset (Horsting et al., 2024). The Nederlandse Vereniging van Banken (2024) even pleads towards the national government for drastic shifts in the Dutch economy by arguing the following points:

1. Establish a level playing field through pricing mechanisms and regulatory standards.
Clear price incentives and standards can boost demand for circular products, giving financiers more confidence to invest in innovation and new market entrants.
2. Explore a tax shift at both European and national levels: from labour to raw materials.
Taxing raw materials instead of labour promotes labour-intensive circular models like repair, reducing fixed costs and making financing more attractive.
3. Increase public sector demand for circular products.
With an annual purchasing power of €80 billion, the government can drive the market by requiring circularity in tenders, improving financing options.
4. Support temporary financial bridging through public-private partnerships.
Risk-bearing capital from public funds or new PPPs can lower the need for loans, reduce bank risks, and help circular businesses grow.

The financial component for banks and lenders depends on evaluations of returns, risk, and viability. One of the primary financial issues is the tendency for finance decision-makers to prioritise initial costs and budget control over upfront capital costs (Dams et al., 2023). The long-term advantages of timber, such as lower operating costs and potential carbon tax savings, are overlooked by this short-term perspective. Timber building loans are evaluated using traditional lending standards, which are often applied more

rigorously. Lower loan-to-value (LTV) ratios result from this, such as 50–60% versus 70–80% for concrete, which limits financial leverage and calls for higher borrower equity (Cazemir, 2017).

Institutional investors: With longer investment horizons, institutional investors, like pension funds, are increasingly integrating ESG factors into their investment strategies. Dutch banks and pension funds are committing capital to green projects due to ESG considerations (Van Uden et al., 2024). They make it able to build affordable dwellings in large amounts due to their large capital.

Insurance companies: One unique and significant barrier in the value chain is insurance companies. Despite mounting evidence that engineered timber can withstand fire conditions, many insurers still view wood as having higher risks of fire, mould growth, and structural degradation (Osvaldová & Hasburgh, 2024).

In general, timber construction results in more coverage limitations and higher insurance premiums (Pettersson, 2020; Arup, 2024). Developers are frequently unable to obtain acceptable financing terms for timber buildings because banks typically offer smaller loans when insurance premiums are high or coverage is limited. This forces them to either demand more equity up front or accept lower margins (Cazemir, 2017). The insurance industry's conservatism in adjusting standards has been worsened by the lack of data on extensive timber projects. As more reference projects are completed and post-occupancy assessments become available, a more precise risk profile may become apparent (Osvaldová & Hasburgh, 2024; Scius, 2020). Regarding warranty insurers terminating coverage for timber homes because of alleged poor performance and quality (Schouten, 2025; Verbond van Verzekeraars, 2025).

6. Public authorities

Government agencies create policies, offer subsidies, and mould the regulatory landscape to affect the uptake of bio-based building. Each level of government (European, national, and local) has its own set of priorities and policy tools. Through a number of strategies, such as buyer groups for the purchase of bio-based materials, subsidies like the NABB programme, and financial incentives like MIA/Vamil for low-impact building, the government encourages market participants to use bio-based materials (Nationale Aanpak Bio-based Bouwen, 2023; Ministry of BZK, 2023). City Deals, Green Deals, and provincial covenants are examples of cooperative tools used to promote bio-based building.

→ See Section 1.1.3 (Inter)national regulations and financial impact for more information on this topic

7. Societal groups

Societal groups shape cultural meanings surrounding bio-based construction, advocate for policy changes, and impact public discourse. Industry associations can raise awareness and support for bio-based construction initiatives among their members by promoting their objectives and activities (Nationale Aanpak Bio-based Bouwen, 2023). Examples of these include *Centrum Hout* for timber construction and *Bouwend Nederland* for the larger construction sector.

3 Methodology

The Methodology chapter describes the research methodologies used to examine how the socio-technical transition is influenced by strategic positioning. Through a qualitative study that captures the nuance and complexity of actor behaviour, the methodology aims to provide answers to the research questions.

The study uses a two-phase methodology: (1) *semi-structured interviews* with key actors to learn about their personal positioning in the value chain, factors that influence their decision-making, and perceived obstacles; and (2) a *Delphi validation study* to test results using scenario-based open questions. This combination makes it possible to validate and gain a deeper understanding of emerging patterns throughout the value chain.

In Section 3.1, the overall research design is lined out, and the qualitative approach is justified. The methods used to collect the data are described in Section 3.2; the sampling plan and participant selection are described in Section 3.3. In Section 3.4, the procedure for data analysis is explained. Research integrity and quality are covered in Section 3.5, and limitations are noted in Section 3.6.

3.1 Research Approach

3.1.1 Exploratory-descriptive research design

The exploratory-descriptive design used in this research is suitable for examining new concepts about which not much is known (Blaikie & Priest, 2009). In situations where established theories need to be tested and refined in new contexts, exploratory research is particularly suitable to investigate "how" and "why" questions (Blaikie & Priest, 2009). A good example is the shift to bio-based construction, since this contains a niche innovation that challenges long-standing regimes where actor behaviours and strategic patterns are not well documented.

Mainly sub-question 1 (*how are the actors in the bio-based construction value chain currently positioned?*) is addressed in the exploratory component. By recording the opportunities, obstacles, and financial incentives influencing strategic choices throughout the value chain, the descriptive component addresses sub-questions 2 and 3. Followed by applying transition theory management frameworks, this design allows theory elaboration rather than theory testing while remaining open to contextual variations and unexpected findings.

3.1.2 Justification of qualitative research

This research employs qualitative methodologies because semi-structured interviews allow participants to make the trade-offs between conflicting priorities, explain the reasoning behind investment decisions, and discuss the challenges of coordination across organisational boundaries. Making room for longer answers and follow-up questions will help to better understand how actors perceive transition dynamics and formulate their tactical reasons.

By examining whether patterns found in individual conversations are consistent when actors react to shared scenarios, the Delphi validation component enhances interviews. This mixed-method approach preserves the depth of qualitative inquiry while enhancing credibility.

3.1.3 Conceptual framework integration

In line with *Section 1.5 Conceptual framework*, the methodology operationalises the conceptual framework that connects “strategic positioning” to “socio-technical transitions”. Three analytical dimensions taken from transition theory served as the framework for the interview questions:

1. *Niche-regime dynamics*: In line with Geels' (2002) multi-level perspective, questions examined how actors place themselves in relation to established construction practices versus alternatives and innovations.
2. *Value chain reconfiguration*: In line with Loorbach et al. (2017)'s focus on value chain reconfiguration during transitions, the questions looked at modifications to actor roles, upcoming technologies, innovative partnerships and business models.
3. *Economic incentives and barriers*: Questions examined the economic aspect of strategic positioning by examining how market dynamics, financing methods, and regulatory frameworks influence investment choices.

3.2 Research Collection Methods and Design

This study employs two complementary data collection methods: semi-structured interviews and a Delphi validation study. A conceptual overview of the research design is given in Figure 8, which also shows how these techniques relate to the research questions and add to the final conclusions. The main source of empirical data is the interviews, which collect viewpoints on strategic positioning along the value chain. As a deepening and validation tool, the Delphi study examines whether interview patterns hold true for actors' reactions to hypothetical future situations.

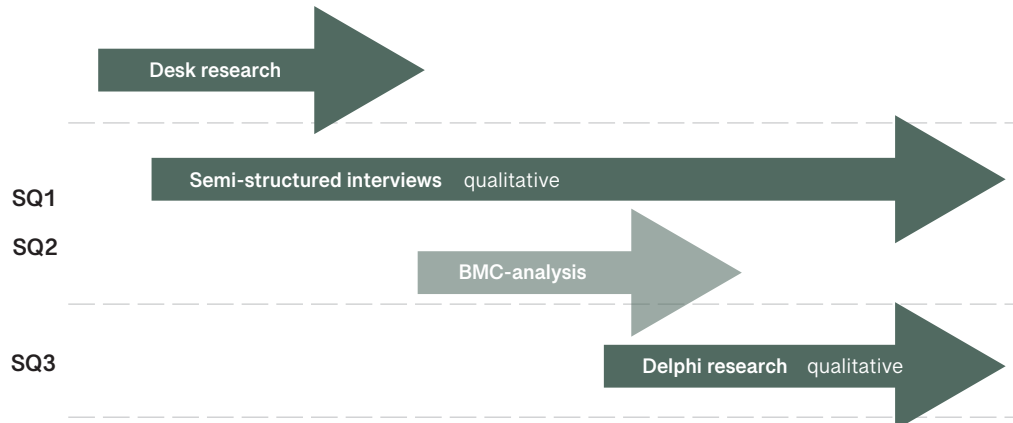


Figure 8: Research design

3.2.1 Semi-structured interviews

Because semi-structured interviews create a balance between consistency and flexibility, they were chosen as the main technique for gathering data (Brinkmann & Kvale, 2015). While allowing for exploratory follow-up questions provided to the unique experiences and expertise of each actor, this format ensures that all participants address core themes in line with the research questions.

The interview protocol was developed through an iterative process. Initial questions were derived from the theoretical framework and organised around three sub-questions: actors' positioning, definition (SQ1+2), and dynamics (SQ3). Both actor-specific questions that reflected various roles within the value chain and standardised questions that were asked of all participants were part of the protocol. For instance, contractors were questioned about supply chain collaborations and technical skills, while developers were questioned about project funding and risk assessment.

The questions are based on the participants' degrees of experience with timber construction too. Actors with extensive bio-based project portfolios received more detailed questions about operational challenges, cost optimisation strategies, and partnership structures. More basic issues concerning adoption barriers and the prerequisites for their entry into bio-based construction were posed to actors with less experience.

→ For participant composition, see Section 3.3.2 Interviews: sample overview and characteristics

Collection software

With participant consent, all interviews were recorded. "Goodtape.io" was used to transcribe each one properly. This software is able to separate speaker turns in transcriptions, which made it possible to separate participant responses from the researcher's questions during analysis. Interview recordings and transcripts were stored securely in password-protected servers, with access limited to the researcher.

→ More on data security in Section 4.3 Data Management and Security

3.2.2 The Delphi approach

The Delphi method is an established technique for building expert consensus on complex issues characterised by uncertainty, involving structured iteration of questionnaires interspersed with controlled feedback (Linstone & Turoff, 2002). This study adapted the Delphi approach to serve two integrated purposes: achieving convergence on strategic positioning patterns and testing how actor strategies influence transition outcomes under varying future scenarios.

Participant composition

Eleven participants engaged in the Delphi study, representing key actor types across the bio-based construction value chain: contractors (n=3), developers (n=1), architects (n=1), institutional investors (n=4), insurers (n=1), and public forest management organisations (n=1). This composition ensured diverse perspectives over production, design, financing, risk management, and resource supply. Participants were recruited from the interview sample based on their expressed interest in scenario-based discussions and their organisational roles enabling strategic decision-making authority, and from the researchers' network.

Scenario development process

Through desk research, two future scenarios were created by combining market dynamics, regulatory trends, and the idea that stakeholders are solely able to get into movement by either regulatory- or market-driven incentives. For detailed scenario descriptions, see Appendix A. The scenarios were represented as the following:

- Scenario 1: *Regulatory-driven transition* – Mandatory CO₂ regulations, strict MPG thresholds, and fiscal incentives force rapid adoption of bio-based materials.
- Scenario 2: *Market-driven transition* – ESG investor pressure and consumer demand create market pull despite weak policy support.

Participants were able to formulate ideas on strategic responses under various structural conditions because each scenario included implications for costs, supply chain dynamics, demand certainty, and the regulatory environment.

Three-round structure

The Delphi study followed a three-round system, conducted via email over a 9-day period. Respondents had 48 hours to give their inputs. The content of the rounds is shown in Table 2:

Table 3: Delphi rounds explanation

<i>Round 1</i>	- Participants received all three scenarios simultaneously and had 48 hours to provide written responses of at least 150 words per scenario. - They were asked to describe strategic positioning choices, identify bottlenecks, and explain what conditions would enable or constrain their participation in bio-based construction under each scenario.
<i>Round 2</i>	- After compiling and anonymising every response from Round 1, the researcher gave them back to the participants. - Insights from other value chain actors could help participants refine their own positions, find areas of agreement or disagreement, and respond to other people's points of view.
<i>Round 3</i>	- Following Round 2, the researcher presented the participants with a summary of the themes and areas of convergence and divergence that had emerged. - Participants were asked if they agreed with the synthesis and if they had any last thoughts on the implications for strategic positioning. - This is the final round, so this outcome will be considered the result of the research.

Anonymity procedures

All correspondence took place through email, which the researcher mediated. Anonymity was maintained since participants never spoke to one another directly. When responses were shared between rounds, statements were never related to a person but stated as a general remark, making it impossible to identify particular companies or people. Because of this anonymity, open communication regarding organisational limitations, risk assessment, and competitive strategy was encouraged.

Criteria for consensus

According to Hasson and Keeney (2011), consensus is not universal agreement on all issues but rather convergence around important strategic themes. When at least six out of eight participants (>75%) recognised the same challenges, articulated similar positioning logic, or offered similar solutions within a scenario, the researcher determined that there was consensus. Instead of being pushed towards artificial consensus, areas of enduring disagreement were documented as reflecting true strategic diversity across actor types.

3.3 Sampling Strategy and Participant Selection

3.3.1 Purposive sampling justification

Purposive sampling was used for both methods to guarantee that important players from the bio-based construction value chain were represented (Blaikie & Priest, 2009). A broad range of participants was selected to ensure that the insights would reflect the diversity of perspectives in practice and provide a representation as realistic as possible.

Three selection criteria were given attention in the sampling strategy. First, *value chain coverage* made sure that players from midstream (contractors, architects), downstream (developers, investors), and upstream (forestry, material suppliers) positions were included. The way that strategic positioning changes based on an actor's location within production and financing networks is reflected in this horizontal diversity. Second, rather than having operational staff carry out decisions made elsewhere,

decision-making authority directed selection towards people who have strategic influence over bio-based construction investments (senior managers, directors, and founders) who shape organisational positioning. Third, *experience variation* purposefully included traditional actors focused on conventional materials to specialised pioneers who were totally dedicated to timber and bio-based construction. This spectrum shows what promotes early adoption and what prevents wider diffusion.

3.3.2 Interviews: sample overview and characteristics

Eleven semi-structured interviews were conducted with actors representing diverse organisational types, scales, and timber construction experience levels. Table 3 provides an overview of participant characteristics using anonymised codes to protect confidentiality while enabling readers to assess sample diversity.

Table 3: Actor codes and characteristic element descriptions

Actor code	Actor type	Scale organisation	Experience timber/bio-based	Key activities
A1	Architect-developer	Small	Specialist pioneer	Integrated design-development, timber-only portfolio
A2	Architectural practice	Medium	Established pioneer	Design services, multiple timber projects
C1	Contractor	Very large	Established pioneer	General contracting, factory investment strategy
C2	Contractor	Large	Active experimenter	General contracting, selective timber projects
C3	Contractor	Large	Active experimenter	General contracting, modular systems exploration
D1	Developer	Small	Specialist pioneer	Mission-driven development, profit-capping model
D2	Developer	Very large	Selective explorer	International portfolio, premium segment focus
F1	Bank	Very large	Active evaluator	Construction sector financing, ESG integration
I1	Institutional Investor	Large	Active evaluator	Real estate investment, long-term portfolios
S1	Material supplier	Very large	Traditional incumbent	Concrete/cement production, alternatives exploration
S2	Forest management	Medium	Potential pioneer	Public forestry, timber supply coordination

Organisational scale categories

- Small: <€5 million annual revenue / <50 staff
- Medium: €5-20 million revenue / 50-200 staff
- Large: €20-500 million revenue / 200-2,000 staff
- Very Large: >€500 million revenue / >2,000 staff OR >€10 billion assets under management for investors

Timber construction experience categories

- Specialist pioneer: Majority (>50%) of activity in timber; strategic commitment; often mission-driven
- Established pioneer: Multiple completed timber projects (5+); systematic approach; capability building
- Active experimenter: Several projects (2-4); learning phase; developing internal knowledge
- Selective explorer: Limited projects (1-2); testing feasibility; evaluating strategic fit
- Active evaluator: Serious interest and analysis but limited/no execution yet
- Hesitant explorer: Nominal interest but significant barriers preventing action
- Traditional incumbent: Focused on conventional materials; timber as potential threat or Opportunity
- Potential pioneer: Driven to join transition, but reliant on value chain dynamics

Multi-stakeholder coverage across all important value chain segments was accomplished by this sample composition, which also captured scale diversity from small, mission-driven businesses to large, multinational corporations. Comparative analysis of the factors that promote early adoption versus those that limit wider market entry is made possible by the inclusion of both specialised pioneers and established incumbents.

3.3.3 Delphi sample

To choose participants who could offer knowledgeable viewpoints on strategic positioning under various transition scenarios, the Delphi study used criterion-based sampling (Blaikie & Priest, 2009). The selection criteria for the eight participants were their experience with bio-based construction and diversity across the value chain, ensuring representation from contractors, developers, insurers, architects, investors, and forest management.

Two of the Delphi participants (C1, S2) had previously taken part in interviews, which allowed for deeper exploration of themes that surfaced during the initial data collection. To broaden viewpoints beyond the interview sample, the remaining participants were specifically chosen to target actors from under-represented industries like insurance and institutional investors. Opposed to the interviews, this method will not code participants and will be fully anonymous.

3.4 Data Analysis

3.4.1 Coding framework

The qualitative data analysis program ATLAS.ti, which facilitates the methodical coding, retrieval, and comparison of textual data, was used to examine interview transcripts. The Business Model Canvas (BMC), created by Osterwalder and Pigneur (2010) and modified for the analysis of networked business models in the bio-based construction value chain, served as the foundation for the coding framework.

As the analytical framework, the BMC was chosen because it offers a framework for comprehending the creation, delivery, and capture of value across organisational boundaries (Osterwalder & Pigneur, 2010). Business models in transitional environments do not function independently; rather, they create interdependent networks in which the value proposition of one actor is dependent on the essential resources or partnership arrangements of another (Boons & Lüdeke-Freund, 2013). The BMC framework made it possible to systematically examine how strategic positioning appears in a variety of contexts, including value propositions provided to clients, essential tasks needed to complete timber projects, the resources and skills required, collaborations that facilitate coordination, cost structures, and revenue streams.

The framework included eight of the nine code categories from the BMC (Osterwalder & Pigneur, 2010):

- `value propositions`: Advantages that participants' statements provides (health benefits, cost savings, speed of construction, sustainability credentials)
- `customer segments`: Target markets and clientele (public sector, commercial, luxury residential, and social housing)
- `key activities`: Design, engineering, prefabrication, assembly, and financing are examples of core operations that support bio-based projects.
- `key resources`: Strategic assets (capital, supply chain relationships, factory capacity, and timber expertise) are needed.
- `key partnerships`: Value chain collaboration agreements (financing consortia, design-build teams, and supplier agreements)
- `cost structure`: Investment requirements and economic barriers (costs of capability development, risk premiums, and material premiums)
- `revenue streams`: Financial gains and methods of capturing value
- `customer relationships`: Market positioning and client engagement

BMC component "channels" (distribution and communication pathways) proved not applicable to construction value chains where projects are site-specific rather than distributed through retail or digital channels. This category was excluded from the coding framework.

Inductive codes

Beyond BMC categories, inductive codes were added during the process to capture the full width of the theme:

- `policy` (fire safety standards, building codes, MPG methodology),
- `awareness` (green loans, carbon credits, subsidy programs),
- `bias` (statements that were subjective to their position and unjustified).

3.4.2 Step-by-step analysing process

Deductive coding (using the BMC framework and inductive additions) and inductive theme development (letting positioning types emerge from patterns within codes) were combined in a methodical five-step process for data analysis:

Step 1: Initial coding

Line-by-line coding of all ten interview transcripts was done using ATLAS.ti, allocating text passages to appropriate BMC categories and transition-specific codes. Every statement was assessed for its applicability to strategic positioning – the ways in which actors explain their present strategy, justify their choices, or express their goals for the future. An emergent code for supply chain control strategy was attached to a contractor's description of investing in factory capacity, for instance, which was coded under `key resources` and `cost structure`.

Step 2: Code observation and pattern identification

In order to find reoccurring patterns, the researcher went over every text segment in each code category after initial coding. For example, within *key partnerships*, some actors described project-specific collaborations, while others stressed long-term supplier relationships to secure capacity. Different logics developed within *cost structure*: for example, where a contractor states they cannot reduce the costs of a timber building, an architect says they stopped using doorframes as they are unnecessary in CLT structures to save costs. This shows interesting contradicting perspectives and therefore valuable outcomes for the research.

Step 3: Comparing cases among actor types

Organisational types (developers vs. contractors), scales (small vs. very large), and experience levels (pioneers vs. evaluators) were all systematically compared with coded data. This comparison revealed that positioning strategies did not align neatly with actor categories. For example, both architects and developers pursued business model innovation, while both contractors and investors grappled with supply chain control challenges.

Step 4: Theme development and positioning type emergence

Four different types of strategic positioning emerged as patterns firmed up, each of which embodies a logical logic for facilitating the transition to bio-based construction. Two clear parameters were discovered: internal and external strategic focus, and value creation in the long term or short term.

→ For detailed analysis, see Chapter 5

Step 5: Verification and deepening using Delphi study answers

The same framework was used to code the responses from the Delphi study, and the results were compared to positioning types derived from interviews. The purpose of this validation step was to determine whether actors would actually use these tactics in response to particular scenarios. Confidence that positioning types represent true strategic logics rather than spontaneous justifications was reinforced by the convergence of Delphi responses and interview statements.

3.5 Limitations

3.5.1 Missing actor types

The depth of value chain coverage is limited by the under-representation or absence of several critical actor types in the sample, despite systematic recruitment efforts.

1. *Housing corporations* represent a significant gap given their dominant role in Dutch residential construction and potential for volume scaling of bio-based projects. Several efforts to recruit social housing providers failed, with organisations citing internal strategic uncertainty about bio-based approaches, time constraints, or a lack of established timber expertise that made them feel unqualified to contribute. Because of their absence, the perspectives of housing corporations are only indirectly captured in this research through the contractors and developers who collaborate with them, possibly missing the particular difficulties faced by affordable housing providers who must adhere to tight cost controls and regulatory oversight.
2. Even though *insurance companies* are essential to the system, it was very challenging to get in touch with them. Their premiums have the power to make or break a project. It became evident from the interviews that while other value chain actors can frequently reach insurers, this is not always the case for research. One insurer could be involved by the end of the process, at the

Delphi study stage. Although their opinions were insightful, it would have been especially beneficial to involve them sooner to find out how they see their own role in the transition.

3. *Engineered timber product manufacturers* (CLT factories or glulam producers) are not directly represented, though forestry (S2) and general building materials suppliers (S1) provide partial supply-side coverage. The absence of manufacturers limits understanding of production capacity constraints, pricing strategies, and their positioning toward the Dutch market relative to other European markets. Contractor C1's description of vertically integrated supplier partnerships provides indirect insight but lacks the supplier's direct strategic perspective.
4. Another significant absence is that of *regulatory and policy makers*. National-level policy makers from ministries (Infrastructure and Water Management, Interior and Kingdom Relations) or regulatory bodies (Building Quality Assurance) did not take part, although municipal officials offered insight into local policy experimentation (D1). Because of this gap, regulatory viewpoints are mainly expressed through practitioners' descriptions of the effects of policies rather than firsthand accounts of the justifications for policy design, difficulties in implementing policies, or coordination amongst levels of governance. Given that practitioners frequently discuss policy dysfunction, the absence is especially noteworthy. "I'm disappointed in our politics... they work with covenants. Negotiate long time. Becomes covenant. Evaluate after five years. Nothing happened" (C1), which suggests policy makers' own accounts of constraints and decision-making processes would provide valuable counterpoint.

These absences are a reflection of both real market gaps, where certain actor types have limited timber exposure, and access issues, where organisations are possibly declining participation because of perceived lack of relevant experience, time constraints, or competitive sensitivity. Other actors' reports of their interactions with these stakeholders were used, whenever feasible, to identify missing perspectives; however, this introduces potential bias because secondary accounts record perceptions rather than firsthand dialogue.

3.5.2 Methodological constraints

Potential *biases* are introduced through self-reported data. Interviewees may rationalise past decisions, overstate commitment to bio-based construction to appear progressive, or present organisational strategies in more coherent or sustainability-orientated terms than complex realities allow. The situations used in the Delphi study might cause idealistic positioning instead of practical behaviour in real-world market circumstances.

Despite being justified for exploratory research (→ see Section 3.3.4 *Interviews sample overview and characteristics*), *sample size* still restricts how robustly positioning type classifications can be made. There is a chance that unique organisational characteristics will be overinterpreted as generic strategic patterns when there are only one to three examples per positioning type.

Delphi study limitations include the relatively compact panel (eight participants) and compressed timeframe (nine days in total). Traditional Delphi studies often involve larger panels (15-30 participants) and longer periods, enabling deeper reflection between rounds (Linstone & Turoff, 2002). The abbreviated format was inevitable due to thesis timeline constraints and participant availability, potentially limiting the depth of consensus-building and scenario exploration.

3.5.3 Delphi research alterations

Artificial answers

The researcher added deliberately simulated responses for under-represented actor types to the real participant responses because of the shortened timeframe and insufficient stakeholder representation in Round 1 responses. These hypothetical answers were created using:

1. Straightforward quotations and reasoning from the interview data with comparable actor types
2. Recognised trends in the way particular actors present opportunities and challenges

Two goals were achieved by the simulated responses: (1) making sure that all important stakeholder viewpoints were covered in the Round 2 feedback given to participants, and (2) determining how participants would respond to these positions.

The researcher knows that simulated responses may not fully capture the authentic reasoning of missing stakeholders, and participants may have responded differently to real input. Nonetheless, this modification was required to keep the Delphi study's primary purpose of identifying agreement and disagreement.

Participant imbalance

Contractors and institutional investors were disproportionately represented in the Delphi sample, while architects, developers, and material suppliers were under-represented. Due to this imbalance, opinions on design integration, market acceptance, or capacity investment that are more important to under-represented actor types may be underweighted in the emerging consensus, which may disproportionately reflect execution risk, supply chain coordination, and fiduciary concerns typical of over-represented groups. Rather than intentional sampling bias, this resulted from practical limitations within the small Dutch timber construction community.

4 Research Ethics and Data Management

This chapter addresses the ethical considerations and data management protocols that guided this research. It explains how participant protection, confidentiality, and research integrity were maintained throughout the study and reflects on the researcher's positionality within the investigation of the Dutch timber construction transition.

4.1 Ethical Framework and Approval

The ethical standards for qualitative social research and TU Delft's guidelines for responsible research practice were followed in the conduct of this study. Throughout the entire research process, the study complied with the fundamental guidelines of informed consent, confidentiality, data protection, and participant safety.

Clear explanations of the goals of the research, their voluntary involvement, their right to withdraw at any time, and the use and storage of their data were given to each participant. Before every interview, participants gave their verbal informed consent after being fully informed about the anonymisation process and the duration of data retention. Participants in the Delphi study were provided with written information regarding the three-round process, the anonymity of response sharing, and the reporting of the findings. All participants are able to read the definitive report and are allowed to retrieve information.

The study's design placed a high priority on reducing participant risk and optimising the amount of knowledge produced. Protecting participants from possible professional or reputational risks resulting from open discussions about competitive dynamics, strategic positioning, and policy critiques within the Dutch construction industry was given priority. The methodology was created to strike a balance between ethical responsibility and academic integrity, allowing participants to share delicate insights without worrying about negative consequences.

4.2 Participant Protection

Because strategic positioning discussions are sensitive to competition and the Dutch timber construction industry is small and interconnected, participant confidentiality was protected strongly. This section outlines the justification for complete anonymisation, the particular strategies used, and the recognised drawbacks of anonymisation in a small professional community.

4.2.1 Justification for anonymisation

Complete anonymisation was used for all interview and Delphi data, even though some participants said they had no issues with being identified. Three main arguments supported this decision.

1. Strategically sensitive information that was shared through the interviews. This included partnership dynamics, investment decisions, competitive evaluations, and direct criticism of other market participants. Assigning such content to companies may have an impact on competitive positioning, harm business relationships, or pose reputational hazards.
2. There is a relatively small and well-connected construction community in the Netherlands. According to one supervisor, "bio-based construction is not a big world" because most professionals work together on different projects, know one another, and attend the same

conferences. Industry insiders may be able to identify certain participants even after formal anonymisation due to organisational traits or unique strategic positions. On the other hand, anonymisation lowers the risk of direct attribution and offers plausible deniability.

3. Maintaining transparency was crucial to the quality of the research. Several participants offered critical viewpoints on supplier dependability, client behaviour, policy failures, and competitive dynamics that were insightful from an analytical standpoint. These insights were preserved through anonymisation, which also protected participants from any unfavourable outcomes, just in case.

4.2.2 Anonymisation method

Organisations were coded by actor type and number (e.g., C1, C2 for contractors; A1, A2 for architects; D1, D2 for developers; I1 for institutional investors; F1 for financial institutions; S1, S2 for suppliers; M1 for municipality). Although organisational names were not disclosed, general organisational characteristics were given, such as scale categories (small, medium, large, and very large), timber construction experience levels (specialist pioneer, established pioneer, active experimenter, and selective explorer), and primary activities. All quotes were ascribed solely to these codes, and no names of specific participants were provided.

In the Delphi research, all responses were sent to the researcher so that participants were never in contact with each other directly. Therefore, names and organisations could remain anonymised.

4.2.3 Limits

It is impossible to guarantee complete anonymity in a small professional community. Industry insiders may be able to identify some participants by their organisational traits, recognisable quotes, or distinctive strategic positions.

4.3 Data Management and Security

Only the researcher (and supervisory team on request) had access to the password-protected, encrypted devices where the interview recordings were kept. Complete transcripts, produced with Goodtape.io, were kept apart from consent records to avoid associating answers with specific people. In line with TU Delft policy, all data will be kept for five years, after which transcripts and recordings will be safely erased.

Only coded samples with all identifying information eliminated are available in the ATLAS.ti analysis database. Since there are no confidentiality concerns, this anonymised database may be kept for longer than the usual retention period in case it is used for secondary analysis.

The same access restrictions applied to the safe storage of email responses. The research took place on a highly encrypted and secured email address. Also, data may be kept for longer than the usual retention period but is inaccessible for others besides the researcher.

5 Results

In this chapter, the results of the semi-structured interviews and Delphi research with stakeholders from the value chain are examined, using the Business Model Canvas framework. The results are based on two dimensions: the timeframe of value creation (short-term versus long-term) and strategic focus (internal capability versus external ecosystem change). The analysis identifies four different types of strategic positioning.

The four positioning types are *System Optimisers* (short-term + internal), who focus on cost efficiency within existing structures; *Capacity Builders* (long-term + internal), who invest in expertise for future competitiveness; *Market Developers* (short-term + external), who chase immediate ecosystem change through demonstration projects; and *Transition Pushers* (long-term + external), who work towards structural value chain reconfiguration.

These types cross traditional actor categories. The fact that architects, contractors, and developers come in a variety of forms suggests that strategic positioning is not a reflection of sectoral identity but rather reflects variations in business model thinking. Each positioning type is examined in detail in the following Sections 5.2–5.5, which are followed by cross-cutting tensions, such as the ongoing trend of actors attributing bottlenecks elsewhere in the value chain (5.6).

5.1 Framework for Strategic Positioning

Figure 9 presents a two-dimensional framework that maps how actors position themselves in the bio-based construction transition.

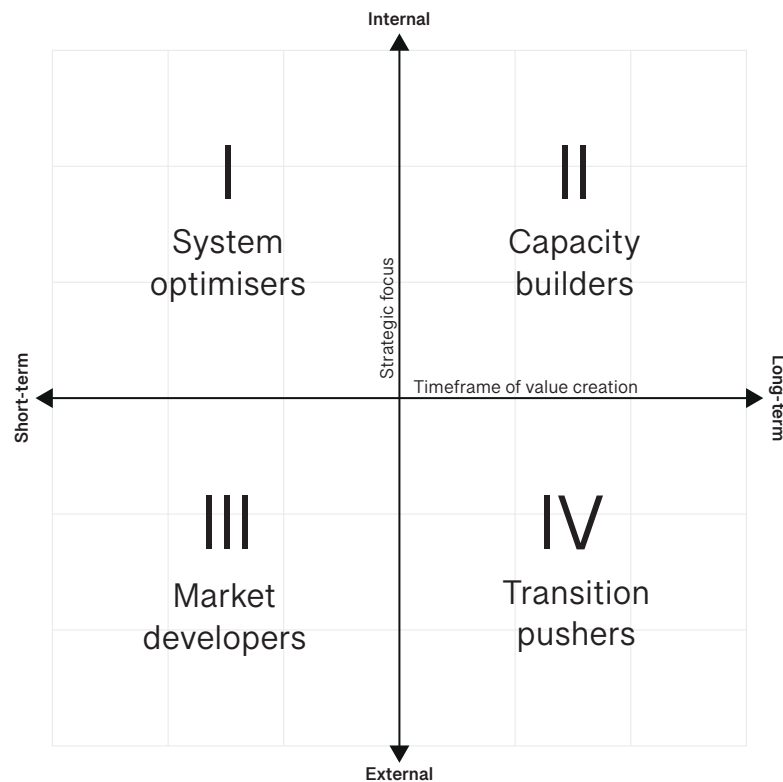


Figure 9: Strategic positioning framework in the bio-based construction transition

The X-axis: Value creation timeframe

Whether actors invest in long-term transformation or optimise for short-term returns is captured by the horizontal axis. When comparing, for instance, contractor strategies, this dimension becomes very obvious: C1's timber factory accepts current cost premiums in order to develop future competitive advantage, whereas another contractor's concrete factory investment prioritises immediate volume efficiency (C1, S1). Decisions about partnerships, risk tolerance, and investments are all significantly influenced by temporal orientation.

The Y-axis: Strategic focus

The vertical axis makes a distinction between changes in the external ecosystem and the development of internal capabilities. Some actors make investments in infrastructure and specialised knowledge; for example, A2 self-funded prototype buildings to gather data. Others concentrate on the “outside world” by managing training programmes, carrying out demonstration projects, or advocating for policies to change the state of the market. Actors' perceptions of transition bottlenecks in their own organisations or in larger system dynamics are revealed by this axis.

The framework produces four different typologies by cutting the map into four quadrants. Contractors (C2, C3) seeking specific efficiency gains without restructuring are included in the System Optimisers quadrant (short-term + internal). Long-term and internal capability builders invest heavily in infrastructure, such as C1's factory. Market developers (both external and short-term) produce showcase projects that demonstrate their commercial viability (D2, A2). Long-term and external transition pushers use advocacy and mission-driven models to work towards structural change, usually without seeking commercial benefits.

In the following paragraphs, the four quadrants, or types, will be explained.

5.2 Type I: System Optimisers (Short-term + Internal)

5.2.1 Positioning logic and actor examples

System Optimisers minimise risk and stay away from long-term capability investments by targeting gradual efficiency gains within pre-existing market structures. Many kinds of actors exhibit this positioning:

- Contractors (C2, C3) who assess the viability of timber projects individually without making a systematic commitment
- Material suppliers (S1) optimising traditional materials
- Financial institutions (F1) require extensive track records to be examined before making changes to risk assessments
- Conservative developers
- Government of the Netherlands (as of 2025)

The guiding principle is *pragmatic conservatism*: use bio-based materials when there are clear, immediate benefits, but fall back on proven methods when in doubt. As C3 put it:

“I think it's a good development, but we're not blind to it either. Every project is tested for viability, and we also use traditional methods when it appears that we must wait too long.”

5.2.2 Key BMC Findings

Cost Structure: Because timber projects are somewhat unfamiliar to many organisations, System Optimisers frequently fall back to risk premiums. D2 explained the behaviour of conservative contractors as follows:

"Let's proceed as usual. No new suppliers. And the contractor returns with a half-million-dollar risk surcharge if you force that through. And this while developers and suppliers are usually eager to try new technologies."

Because of this risk-loading, the idea that bio-based construction is costly becomes inevitable.

Key Resources: These actors maximise current capabilities rather than developing timber expertise. S1, for instance, focuses on "using less concrete" and incorporating "secondary raw materials", a strategy of improving what you know.

Revenue Streams: Developers maximise immediate returns using conventional materials because there are no rent premiums for timber buildings. According to D2's financial calculation:

"A tenant is not willing to pay extra euros per square metre for a timber building".

The adoption of timber lacks business case justification in the absence of price premiums, which makes that link extremely annoying.

Customer relations: F1 argued that "*developers are often those who give the first push*" before financial institutions modify lending criteria, acknowledging that banks "can't take risks" without market validation. Pioneer disadvantages result from early adopters having to pay more for financing, and banks are not responsible for that.

5.2.3 Strategic tensions

Financial conservatism and environmental commitments present a basic conflict for System Optimisers. Although they acknowledge the need for a transition, they are still structurally limited by:

1. Metrics for short-term performance that discourage experimentation
2. Organisational conditioned behaviour that favours reliable suppliers and techniques
3. Misalignments in which the time-value benefits of timber are not recognised by decision-makers or there are not enough incentives present

5.3 Type II: Capability Builders (Long-term + Internal)

5.3.1 Positioning logic and actor examples

Capability Builders invest heavily in organisational knowledge, physical infrastructure, and proprietary expertise to position themselves for future market leadership. For establishing competitive advantages and capturing learning economies, this positioning accepts short-term costs and execution risks. Among the key players are:

- Builders (C1) building timber factories to increase prefabrication capacity
- Integrated architect-developers (A1) using self-funded projects to develop specialised skills in timber engineering

- Architects (A2) are establishing ownership frameworks that facilitate learning from multiple projects
- Developers creating internal portfolios for timber projects

The strategic reasoning reflects long-term optimisation: make investments in capabilities that will yield higher returns once bio-based construction scales. C1 stated:

"We will prefabricate our own building elements ourselves. The factory in its entirety, requiring us to assemble only on the construction site."

This commitment is a well-considered gamble on the continued demand for timber.

5.3.2 Key BMC Findings

Key Activities: Capability Builders restructure core operations around timber expertise. In order to create experiences that are not possible in traditional "fee-for-service" models, A1 pursued systematic capability development:

"We bought an old building, demolished it and started developing a small timber building ourselves. We learned a lot from that project. That was an investment that was manageable for us, so we invested in that ourselves. And it's still in our ownership. We rent them out now too."

Key Resources: These actors invest in knowledge and infrastructure over a period of years. A2 acquired technical knowledge through factory visits, prototype projects, and methodical documentation, treating each project as research and development rather than a single execution. C1's factory investment amounts to "tens to hundreds of millions in capital expenditure, multi-decade commitments that cannot be reversed without massive write-offs."

Key Partners: Instead of focusing on project-specific procurement, Capability Builders foster long-term relationships with (timber) suppliers. C1 collaborates with "vertically integrated partners who understand timber systems deeply" in order to accomplish performance goals that aren't achievable through transactional partnerships.

Cost Structure: Learning expenses are covered by initial projects. Although D1 admitted that their Rotterdam project *"was complex and expensive"*, they were ultimately able to *"build cheaper than we would have done traditionally."* A1 detailed a door mounted directly to the CLT, instead of using interior door frames for financial optimisation.

5.3.3 Strategic tensions

Capability Builders must balance short-term financial constraints with long-term goals.

1. Factory utilisation risk: in order to justify capital expenditure, C1's timber factory needs a consistent project volume, which puts pressure on the pipeline to be secured before capacity is put online.
2. Knowledge capture challenges: learning is limited by project-based delivery models, even in dedicated organisations. "We find it difficult to go look at a colleague to see how he makes his mistakes," as one contractor put it.
3. First-mover disadvantages: Pioneers create capabilities that rivals can later replicate without having to pay for development.

5.4 Type III: Market Developers (Short-term + External)

5.4.1 Positioning logic and actor examples

By means of demonstration projects and showing the validity of bio-based construction, Market Developers change ecosystem dynamics. These actors create immediate market pull instead of waiting for favourable conditions. Important players consist of:

- Architect(-developer)s (A1, A2) pioneering and finding solutions to build the first timber/bio-based buildings on the market
- Developers (D1, D2) producing well-known projects that demonstrate their commercial viability
- Contractors (C2) using timber capability and demonstration as competitive advantage
- Institutional investors (I1) making selective investments in timber buildings for portfolio positioning
- Forest management organisations (S2) trying to show that they are prepared for supply
- Stakeholders being more selective in their client list (A2, C1, D1, and more)

By using concrete examples, the strategic logic aims to break down barriers of perception. This was clearly stated by C2: "We wanted to show this to our clients from a business perspective. Look, we're capable. You've come to the right place if you're looking for someone who wants to build timber."

5.4.2 Key BMC Findings

Customer Segments: Market Developers focus on customer segments where premiums are justified by marketing and sustainability benefits.

Value Propositions: Rather than focusing on cost reduction, these actors present timber as a means of market advantage. D2 admitted:

"Sometimes timber is not used because it's more expensive. And because the business case doesn't allow it. That's certainly a deliberate choice made against timber. Which is unfortunate. But yes, the other choice was not building the building at all."

Value proposition becomes a *proof of concept* instead of a quick profit.

Customer Relations: Although it causes conflict, Market Developers actively educate their clients. Developers "*certainly need a financing bank that gives somewhat better financing conditions for the fact that you build sustainably*," according to D2, which emphasises that building bio-based needs broad value chain support. More and more actors are becoming increasingly selective with their client base, prioritising customers who are open to building with bio-based materials. However, this largely depends on the number of requests an organisation receives.

Key Resources: Supply-side demonstration issues were disclosed by S2. Even though Dutch forests could "*load 200 trucks every working day*," industrial infrastructure is the limiting factor:

"We've had conversations with market parties who approached us, but at this moment it's not quite the right time to invest in CLT factories,"

they said. S2 makes an effort to show supply readiness, but it is unable to change more local forest resources into building materials due to the absence of national willingness.

5.4.3 Strategic tensions

Market developers deal with basic conflicts between profitability and demonstration:

1. The trap of credibility: When reality becomes more complicated, overstating timber's present capabilities undermines long-term trust. (D1 had several experiences that challenged its viability.)
2. First-mover expenses: Higher costs are absorbed by demonstration projects, which allow competitors to later undercut them.
3. Value chains that are not complete: Despite the availability of timber, S2's failure to demonstrate integrated supply highlights infrastructure gaps that cannot be filled by individual actors.
4. Investor timing paradox: I1's conditional enthusiasm, interested but cautious, reflects holding off on making a financial commitment until others have demonstrated viability.

5.5 Type IV: Transition Pushers (Long-term + External)



5.5.1 Positioning logic and actor examples

Instead of optimising within current constraints, Transition Pushers seek structural reconfiguration of market mechanisms, regulatory frameworks and industry practices. Instead of following the rules, these actors dedicate organisational resources to altering them. Important players consist of:

- Mission-driven developers (D1) operating with profit-capping models
- Knowledge platforms like Building Balance and Built by Nature facilitate and fund training programs for all stakeholders from farmers to developers and contractors (or: "van-land-tot-pand")
- Architects (A2, i.e., Finch Buildings, Thristleton Waugh Architects) engaging in policy advocacy and free, open-source knowledge-building for other stakeholders
- Research programs and stakeholder dialogues without direct commercial returns

A theory of change is reflected in the strategic logic: actors must work together to reshape institutional environments because systemic misalignments cannot be resolved by individual project optimisation. D1 articulated this explicitly:

"We develop for shared values and not so much for shareholders' value. We don't have profit maximisation as an objective... we cap profit at 3 to 5 per cent... And everything above that automatically goes back into the project to develop based on those social values."

5.5.2 Key BMC Findings

Value Propositions: Transition pushers push for systemic change. In order to "get things moving", Building Balance was given 200 million in government funding and trained "130 architects" to use bio-based materials in their designs (F1, A2). Market transformation itself is their value proposition; the platform is "meant to dissolve" once markets operate on their own (F1).

Key Activities: These actors participate in standard-setting, policy engagement, and knowledge sharing. In order to develop systemic solutions rather than sector-specific fixes, A2 explained Building Balance's work that connected "problems you must solve in agriculture and problems you must solve in construction". Architecture studio Thristleton Waugh's core business is not designing but providing other architects open-source knowledge on how to build with timber (VPRO, 2019).

Key Partners: Transition Pushers form coalitions with a variety of stakeholders. However, A2, C1, D1, D2 noted the lack of government and European standardisation. C1 stated:

"The government was conspicuously absent. I found that so frustrating... the government simply doesn't actively think along."

Actor in this quadrant generally organise conferences, get-togethers and even games to stimulate dialogue and break barriers.

Revenue Streams: Instead of passing costs on to customers, D1's profit-capping model allows for the absorption of timber premiums within compressed profit (3–5% vs. typical developer margins of 15–20%). This radically different revenue logic trades achievement of goals for financial optimisation, which is only feasible when impact-orientated capital is willing to accept below-market returns.

5.5.3 Strategic tensions

There are conflicts for Pushers between advocacy and implementation:

1. Disillusionment with policy: According to C1, there are "*covenant disappointment cycles*" in which the government negotiates voluntary agreements, assesses them years later, finds non-compliance, and then negotiates again. "*Just delay behaviour that avoids legally binding regulations.*" C1 concluded that "*we can wait forever in this political climate,*" and it recommended industry self-organisation.
2. Knowledge versus incentives: A2 recognised that these "*repeatedly run into structural barriers that knowledge diffusion alone cannot overcome*" despite the training of 130 architects and undertaking substantial demonstration efforts.
3. Mission-market misalignment: D1's profit-capping strategy is effective with aligned investors on a small scale, but the question is if it can grow without needing more general financial expectations.

5.6 Recurring Patterns of Bottlenecks

Across all positioning types, there is a noteworthy trend: actors consistently find bottlenecks outside of their own organisations, elsewhere in the value chain. This "pointing finger" dynamic reveals underlying conflicts regarding phasing and transition obligations. The patterns that occurred are as follows:

1. The question of leadership

Various actors put up conflicting ideas about who is in charge. Investors pointed to contractors and developers as bottlenecks, with one institutional investor stating that "*the bottleneck lies with partners, dependent on supply*" while presenting themselves as the "early majority" awaiting tested products. C1 contended that "institutional investors should take the lead in the transition... because they have a long-term vision and they usually have money."

Although they acknowledged their reliance on ecosystem support, developers positioned themselves as catalysts. D2 said,

"We certainly can't do it alone. We certainly need a financing bank... an investor willing to pay a bit more... developers are often those who give the first push, but then also the collaboration and support from the rest of the chain."

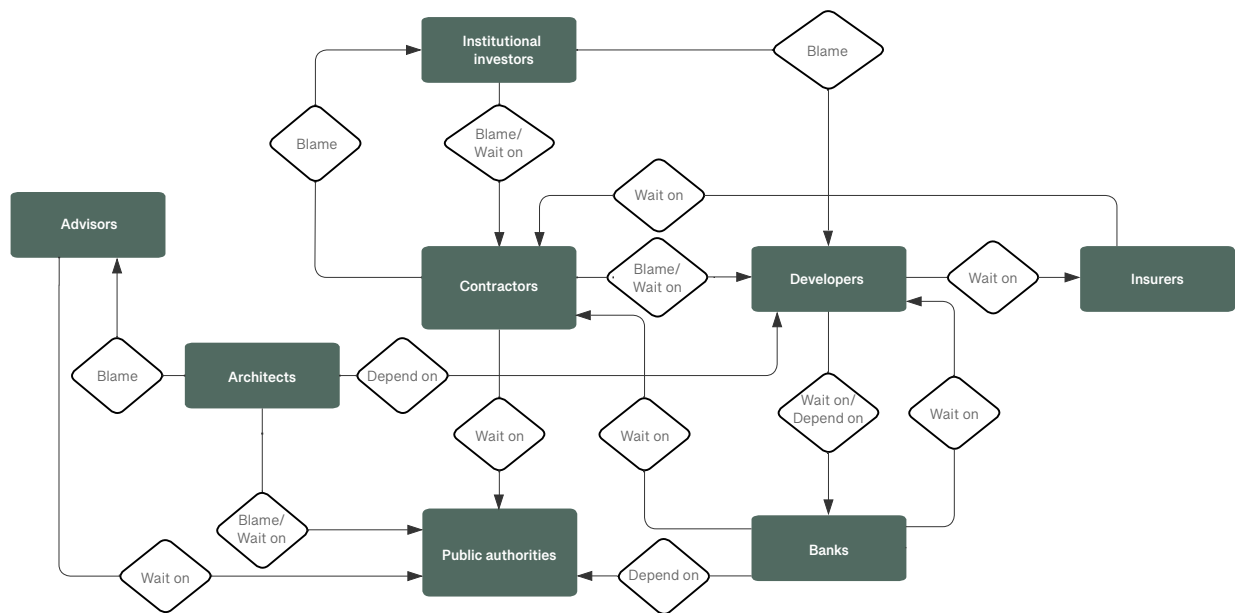


Figure 10: Interorganisational relations hindering transition

Blame	=	Actors identify other parties as the primary bottleneck preventing transition progress
Wait on	=	Actors delay their own positioning decisions until another party moves first
Depend on	=	Actors require specific inputs, capabilities, or conditions from others to execute their strategy successfully

Policymakers and advisors were noted by architects as limitations. A2 stated that the "*bottleneck lies with advisors (structural engineers, fire advisors) – not with architects*" while emphasising "*top-down pressure needed via politics/municipalities*." Meanwhile, contractors cited clients. "*The bottleneck lies with clients, since knowledge transfer is difficult,*" and "*from the SO phase (sketch design), a project must be initiated as bio-based/timber or not,*" according to Delphi participants, emphasising the importance of early client commitment.

2. Architects' changing business

Architects reclaiming integrative responsibility created a key dynamic that weakened over many years. A2 explained how, while technical complexity significantly increased, "*the architect has in principle had a very large part of their work and role taken away,*" reduced to "*designing a facade*" in conventional housing (A2). However, the architect is still "*uniquely suited to connect all disciplines*", like structural engineering, building physics, and lifecycle design – exactly what is required for implementing timber construction.

There are several ways in which this role reclamation appears: By teaching 130 architects to design competently with bio-based materials, A2 assisted Building Balance by improving their educational courses. More architects start developing real estate themselves, like A2 and D2, or in R&D, like A1. As written in paragraph 5.4, other architectural offices share knowledge for free to inspire and teach others. What connects all these side activities is that they're all mission-driven rather than strictly commercial.

Crucially, by actively "pushing" resistant stakeholders, they are increasingly taking more risk than as a designing consultant. *"The architect should really take their role as a 'classical conductor'"* that unites disciplines, as A2 pointed out. This signifies a fundamental shift in the business model from fee-for-service design to transition leadership.

5.7 Conclusion

The four positioning types show essentially distinct theories of change in the transition to bio-based construction. System Optimists believe that markets will develop organically as costs drop due to learning curves, necessitating only gradual incrementalism. Capability Builders wager that concentrated investment will yield future returns by using proprietary infrastructure and expertise to gain a competitive edge. Market developers think that visibility and demonstration projects can change attitudes and lead to wider adoption. Transition Pushers argue that individual optimisation is still insufficient in the absence of structural change, such as financing mechanisms, regulatory frameworks, and group coordination.

These positioning types are not mutually exclusive stages; they coexist, creating both complementarities and frictions. To support factory investments, Capability Builders rely on Market Developers to demonstrate demand. System Optimisers profit from lower costs without initial costs for development by taking benefit of pioneers' risk-taking. Transition Pushers build the knowledge infrastructure that Market Developers and Capability Builders use, but their systemic advocacy necessitates a long-term commitment that is rarely rewarded with quick results.

Deeper coordination failures are revealed by the cross-cutting dynamics as universal bottleneck attribution and architects reluctantly becoming integrators. Transition is "not going fast enough" because, as F1 admitted, reasonable individual caution combines to create collective standstill. Although no mechanism coordinates simultaneous movement, each actor's willingness to invest depends on others moving first.

This interdependence means transition pace depends less on technical capability and environmental awareness than on organisational authority and incentives. The bottleneck is not what the industry knows but how it is organised.

5.7.1 Delphi's results

The positioning framework was validated by the Delphi study, which also revealed important implementation barriers. Identifying coordination gaps that prevent transition acceleration while acknowledging their perspectives within the typology, participants on average gave the consensus statement a score of 4 out of 5. Across all positioning types, three recurring tensions surfaced.

1. Participants agreed that "risk must be shared," but there are no contractual frameworks outlining how pioneers' costs are allocated across value chains. As a result, risk distribution mechanisms are still unclear. It is unlikely that scaled adoption will occur "without clear contract forms where price increases and failure costs don't fall entirely on us," according to one contractor.
2. Pilots are hindered by regulatory inequalities, and that must change. According to one participant, "additional requirements are imposed on timber construction that are technically unnecessary," resulting in systematic cost penalties, even though concrete and timber perform similarly on almost every aspect (INBO, 2021).
3. Financial justification is hindered by knowledge gaps. If given "knowledge expansion on long-term performance effects to ultimately express this in willingness to pay higher prices", institutional

investors indicated that they would be willing to accept higher initial costs. Regardless of environmental commitments, fiduciary constraints hinder adoption in the absence of proven operational benefits.

Participation in Delphi significantly changed viewpoints of the participants: several actors acknowledged the importance of "coalitions with investors and clients" and stated that they have "more faith in the market", since they were able to agree on many levels.

6 Discussion

The strategic positioning framework and empirical results from Chapter 5 are interpreted in this chapter, and their implications for comprehending how actors promote or hinder the socio-technical shift towards bio-based construction in the Netherlands are examined. While the Results chapter identified four distinct positioning types, this Discussion chapter uses these findings to answer the research questions, explores their theoretical significance and acknowledges the limitations inherent in this analysis.

The chapter is structured as follows. To explain how actors position themselves (SQ1), what influences their strategic choices (SQ2), and which dynamics accelerate or impede transition progress (SQ3), Section 6.1 directly addresses each research sub-question by combining insights from interviews and the Delphi study. The theoretical contributions of this study are examined in Section 6.2, with special attention to how the positioning framework builds upon the body of knowledge already available on business models and transition management. In Section 6.3, the framework's boundaries and applicability are critically examined. The research revealed some unsettling facts, which are presented in Section 6.4. These facts contradict the conventional wisdom regarding the transition but are nevertheless worthy of candid recognition. Lastly, Section 6.5 discusses the limitations of the study, such as gaps in stakeholder representation and methodological restrictions.

6.1 Answering the Research Questions

This section addresses each research sub-question, using the results from the interviews and Delphi study to build towards answering the main research question: *How could strategic positioning enable the socio-technical transition towards bio-based building ecosystems?*

6.1.1 SQ1: How are the actors currently positioned?

→ *This chapter is largely a summary of Chapter 5; please read this chapter for more information.*

According to the research, traditional actor categories are not consistent with strategic positioning in the bio-based construction transition. Positioning reflects deeper organisational decisions about orientation and focus, rather than, i.e., developers uniformly adopting one strategy and contractors another. The four-quadrant framework demonstrates that actors across different sectors can occupy the same positioning type when their underlying logic converges.

Positioning across strategy types

- Although **System Optimisers (Type I)** make up the majority in the Dutch construction industry, their representation in this study was purposefully under-sampled to capture pioneer viewpoints. Most conventional developers, mainstream contractors without specialised timber divisions, conventional product-focused material suppliers, and financial institutions using standard risk assessment frameworks are all included in this positioning. Their combined dominance explains why, despite increasing technical feasibility and environmental urgency, bio-based construction still only accounts for about 3% of the market (ING, 2025).
- **Capability Builders (Type II)** are a smaller but strategically important group. The study found that developers were creating internal portfolios to gain knowledge, architects were gaining proprietary timber expertise through self-funded projects (A1, A2), and contractors were investing in prefabrication facilities (C1). When bio-based construction scales, these actors are willing to pay short-term costs in the hope of gaining a competitive edge. Their positioning necessitates significant

patient investment or capital reserves; C1's factory represents "tens to hundreds of millions" in expenditure that requires multi-year utilisation to justify.

- **Market Developers (Type III)** serve as a link between commercialisation and demonstration. This positioning was seen in the creation of prominent demonstration projects by architect-developers, the use of timber capabilities by contractors to differentiate themselves in the market, the positioning of portfolios by selective institutional investors for ESG alignment, and even the efforts of forest management organisations to indicate supply readiness. Instead of waiting for advantageous market conditions to naturally arise, their common reasoning focuses on breaking down perception barriers through tangible examples.
- **Transition Pushers (Type IV)** use essentially different success metrics: mission over financial profits. A prime example is D1's profit-capping model, which caps profits at 3–5%. Instead of being commercial entities, knowledge platforms such as Building Balance, which trained 130 architects and received €200 million in government funding specifically "to dissolve once markets operate independently" (F1), are examples of temporary institutional scaffolding (NABB, 2023). In a similar vein, individual architects who advocate for policies and share open-source knowledge commit resources to systemic change without expecting immediate financial gain.

Variation in positioning and hybrid approaches

Importantly, positioning is not as rigid as the framework indicates. Several actors display flexible or hybrid strategies. Both C2 and C3 demonstrated traits of Capability Builders (selective skill development) and System Optimisers (project-by-project evaluation), indicating movement along the temporal axis as timber experience builds up. With its willingness to feature timber in high-end markets and its need for well-defined business cases that frequently favour traditional materials, D2 stood on the line between Market Developer and System Optimiser positioning.

This versatility suggests that positioning types are not fixed organisational identities but rather strategic moments. As internal capabilities grow, leadership priorities change, or market conditions change, actors can adjust their positioning. Therefore, rather than capturing fixed actor characteristics, the framework captures strategic logic at a specific moment in time. The Delphi research indicates that several stakeholders believe that on the short term it would be best to apply an external strategy and in the long term an internal one.

→ See Section 5.7.1 Delphi's results for complete reference

Geographic and sectoral differentiation

Geographically, pioneer positioning (Types II, III, and IV) is concentrated in urban areas with progressive building policies, like Rotterdam, Utrecht, and especially the Metropolitan Region of Amsterdam, where building regulations and municipal procurement procedures provide more conducive environments for bio-based experimentation. In areas with less regulatory pressure and less difficulty for conventional construction techniques, System Optimiser positioning is dominant.

Different building typologies have different sectoral positioning. More Capability Builder investment in prefabrication systems is drawn to residential construction, especially ground-level (or low-storey) residential housing with recurring designs. Because of tenant conservatism and longer lease structures that make lifecycle value capture more difficult, System Optimisers continue to dominate commercial and office construction. Also the technical requirements for offices are way harder to meet, as a more open construction is more sustainable due to the flexibility most corporates expect from their office.

6.1.2 SQ2: How do actors define their strategy, and what influences them?

Strategic positioning decisions emerge from the interaction of four primary influence categories:

1. Economic factors,
2. Institutional pressures,
3. Mission orientation and organisational identity, and
4. Perceived risk and knowledge gaps

1. Economic factors (short-term costs versus long-term value)

The trade-off between short-term project economics and long-term strategic value is the primary economic tension influencing positioning decisions. System optimisers assess each project separately against specified benchmarks, giving priority to short-term financial performance. The revenue constraint that motivates this positioning is encapsulated in D2's statement that "a tenant is not willing to pay extra euros per square metre for a timber building" – without rent premiums, timber's 5–10% material cost premium directly lowers developer margins.

In order to gain future competitive advantages, Capability Builders are willing to pay short-term cost disadvantages. This calculus is demonstrated by C1's factory investment logic: long-term cost leadership is promised by accumulated learning and future economies of scale, even though current projects might not fully utilise capacity or achieve cost parity with concrete. Either significant capital reserves that offset learning costs or patient investors prepared to take below-market returns during capability development stages are needed for this positioning.

Market Developers take the middle route, agreeing to project-level cost premiums when the investment is warranted by client relationships, ESG positioning, or reputational advantages. Their approach relies on determining which clientele have sustainability credentials that are valuable enough. Interestingly, a number of actors reported becoming "increasingly selective with client base" (A2, C1, D1), suggesting that as demand from aligned clients increases, Market Developer positioning becomes more feasible.

2. Institutional pressures (regulations, standards, certification)

Regulatory frameworks have a significant but unequal impact on location choices. Three different regulatory dynamics were identified by the study. First, bio-based materials are given quantifiable incentives by performance-based regulations such as MPG and its successor, GWP(_2). "When MPG requirements tighten enough that concrete becomes difficult, timber becomes competitive" (C2) is one example of a decision trigger cited by several actors. Nonetheless, System Optimisers and Capability Builders that concentrate on compliance-driven markets are the main targets of these regulations. They may even annoy pioneers who believe that regulatory minimums are insufficient and that they have little impact on actors who are already dedicated to bio-based construction (Types III and IV).

Second, systematic barriers that disproportionately restrict bio-based materials are created by prescriptive requirements pertaining to insurance, structural performance, and fire safety. A2 pointed out that "additional requirements are imposed on timber construction that are technically unnecessary". For example, sprinkler systems are required for timber buildings even though concrete buildings with comparable fire resistance are exempt. These regulatory disparities artificially raise the cost of timber, which frustrates Capability Builders who have already overcome technical obstacles and reinforces System Optimiser caution.

Third, by establishing demand certainty, provincial and local procurement laws facilitate the positioning of Market Developers and Transition Pushers. Although only 5% of the Amsterdam Metropolitan Region's 20% timber construction target was met, it shows that municipalities are open to accepting bio-based

proposals, which lowers pioneer risk. On the other hand, System Optimisers who use traditional materials with established supply chains and low learning premiums are routinely disadvantaged by procurement frameworks that only choose based on building costs.

3. Mission orientation and organisational identity

Organisational identity, or how actors define their success and purpose beyond financial returns, is arguably the most underappreciated factor influencing strategic positioning. This is the most obvious way that Transition Pushers differ from other kinds.

The developer identity of D1 was clearly defined as "developing for shared values, not shareholder value". Essentially redefining their core business from project delivery to sector transformation, A2's architectural practice branched out from fee-for-service design into knowledge platform development. These positioning decisions are a reflection of deeply held beliefs about organisational purpose and professional responsibility, and they cannot be fully explained by economic calculus alone.

Even among System Optimizers and Capability Builders, identity influences positioning largely. C1 attributed the difference, in part, to leadership vision when comparing their investment in a timber factory to competitors who were more concerned with concrete optimisation: "Our CEO believes construction must change fundamentally." According to F1, banks' readiness to modify lending standards is contingent upon whether they view ESG integration as a "compliance burden or strategic opportunity".

Some actor types' resistance to repositioning in the face of obvious financial or legal incentives can also be explained by organisational identity. S1's concrete supplier positioning, which emphasises "using less concrete" and using secondary materials instead of investigating timber alternatives, is a reflection of decades of material-specific expertise and identity investment in well-established product lines. In addition to new capabilities, repositioning would necessitate a fundamental redefinition of the organisation's mission, which is a barrier separate from financial limitations.

4. Perceived risk and knowledge gaps

Knowledge limitations influence strategic decisions across positioning types, although in different ways for each quadrant. System Optimisers justify risk premiums and conservative specifications by pointing to inadequate performance histories. F1 positioned lending criteria as inherently reactive rather than proactive, claiming that "banks don't take risks" in the absence of market validation. Circular dynamics result from this: mainstream actors wait for cost reductions that rely on scale that can only be achieved through mainstream adoption, while pioneers pay higher financing costs simply because they are pioneers.

Capability Builders treat early projects as R&D rather than profit centres, investing specifically to close knowledge gaps. While C1's factory partnerships sought to develop "deep timber system understanding" that would enable performance guarantees that competitors cannot provide, A1's self-funded prototype building produced experiential knowledge "not available in traditional fee-for-service models." Their positioning is predicated on the idea that accumulating knowledge generates competitive moats that offset the initial costs of learning.

Through industry discussions, open-source knowledge platforms, and training initiatives, Transition Pushers systematically close knowledge gaps. A2's involvement in European knowledge networks and Building Balance's architect training are prime examples of positioning that prioritises sector-wide capability building over proprietary advantage. Even if this lessens competitive differentiation, this

approach makes the assumption that the diffusion of collective knowledge speeds up transition more successfully than the expertise of individual firms.

6.1.3 SQ3: What dynamics accelerate or hinder the transition?

Value chain coordination failures, regulatory ambiguity and enforcement gaps, and knowledge-action disconnects were found to be the main factors influencing transition pace.

1. Value chain coordination failures

The most obvious consequence of value chain coordination failures is asymmetries in risk distribution. In order to create public goods (knowledge, standards, and proven viability) that eventually become inexpensively available to followers, pioneers bear the costs of development, including capability building, supply chain establishment, and regulatory navigation. In the absence of mechanisms to share transition risks across value chains, this produces systematic disincentives for early adoption.

This tension was validated by the Delphi study. Participants acknowledged that "risk must be shared," but they also noted that there were no contractual frameworks dividing pioneer costs among several actors. Scaled adoption is unlikely, according to contractor C3, "without clear contract forms where price increases and failure costs don't fall entirely on us." The design-bid-build and fixed-price contracting project delivery models currently in use systematically shift innovation risk to the parties carrying out the project rather than dividing it among clients, financiers, and suppliers who profit later.

2. Regulatory ambiguity

Most participants of this research agreed on the fact that regulatory ambiguity hinders acceleration. Systematic governmental aversion of legally binding commitments is described by C1's annoyance that "government was conspicuously absent" and the description of "covenant disappointment cycles" — voluntary agreements negotiated, assessed years later, found non-compliant, and renegotiated. Because of the uncertainty this produces, actors are unable to confidently invest before demand.

Specific regulatory disparities were noted by Delphi participants: "additional requirements imposed on timber construction that are technically unnecessary" result in systematic cost penalties even though concrete performs similarly. This asymmetry is best illustrated by fire safety regulations, which require costly testing to prove engineered timber's performance while granting concrete presumptive compliance based on historical precedent.

Economic signals that would support low-carbon materials are eliminated in the absence of significant carbon pricing on embodied emissions. Although it offers information, the current MPG methodology lacks monetary consequences or legally binding thresholds that could influence investment choices. Beyond voluntary sustainability commitments, System Optimisers have no business case for adoption as long as high-embodied-carbon materials are not subject to cost penalties.

3. Knowledge-action disconnects

Despite widespread information dissemination, knowledge-action disconnects continue to exist. A2 recognised that despite Building Balance's training of "130 architects to design competently with bio-based materials" and facilitation of multiple demonstration projects, its efforts "repeatedly run into structural barriers that knowledge diffusion alone cannot overcome". As a participant of Delphi recognised, also in current educational curricula, building with timber and bio-based materials is still totally absent.

The Delphi study made this clear: institutional investors' willingness to pay higher initial costs is contingent upon their "knowledge expansion on long-term performance effects to ultimately express this in willingness to pay higher prices." Regardless of environmental commitments, fiduciary constraints hinder adoption in the absence of demonstrated operational benefits. Even when embodied carbon is known, financial justification is hindered by knowledge gaps regarding lifecycle performance.

Conservatism in the insurance industry is a prime example of how systemic bottlenecks are caused by informational barriers. According to several interviewees, insurers continue to impose "higher premiums and coverage limitations" on timber construction despite growing evidence that engineered timber performs adequately in fire situations. The absence of actuarial data from long-term timber building performance makes risk assessment difficult and results in financial penalties, which deters adoption and prevents the collection of performance data that is required.

6.2 Theoretical Reflection

6.2.1 Missing link between micro-decisions and macro-transitions

By showing how strategic positioning fills the analytical gap between individual organisational decisions and system-level transformation, this study advances the theory of transition management. Although Loorbach et al. (2017) characterise transitions as arising from interactions at the niche, regime, and landscape levels, it is still unclear how micro-level business decisions translate into macro-level regime shifts. The positioning framework partly reveals this missing link: actors' strategic choices about timeframe and focus create coordination patterns that either enable or hinder transition pathways.

Nonetheless, the study reveals a crucial detail that calls into question predictable interpretations of positioning types. When research shows greater variability and inconsistent behaviour, the four-quadrant framework runs the risk of implying that actors have fixed positions. At the same time, C1 demonstrates System Optimiser behaviour (adoption of timber for a project based on client demand) and Capability Builder logic (factory investment). Through demonstration projects, D2 illustrates Market Developer positioning while showing System Optimiser's financial discipline, which rejects timber when "the business case doesn't allow it".

Depending on the project's context, the state of the market, and internal decision-making procedures, actors move between quadrants. While maximising short-term returns in commercial work, a contractor may pursue long-term capability building for residential projects. This makes Loorbach's phase-based transition model more difficult to use because it makes it harder to predict transition acceleration than theory would imply if actors don't maintain consistent positioning. Where the transition truly begins can only be explained once the transition has reached its end.

6.2.2 Discussing transition management theory

Loorbach's (2017) literature on transition describes how niches put regimes under pressure from the landscape, but it hardly ever looks at the strategic decisions that actors make in these interactions. This study shows that actors actively assess the risks and opportunities for value creation before positioning themselves appropriately, rather than merely responding to transition dynamics.

Concrete incumbent material supplier S1, who often appears as a regime defender, characterises bio-based development as "parallel advancement rather than substitution" and "innovation advances both timber and concrete at the same time". Loorbach's emphasis on "regime destabilisation" is contradicted by this viewpoint, which suggests that transitions might involve less creative destruction than theory suggests. S1 envisions coexistence rather than displacement, with different materials serving distinct

purposes. For example, concrete is optimised through a lower clinker content and secondary materials, while timber targets particular market segments. "When gas came to be seen as a better form of energy provision, it was assumed that coal use would decline. But, we are still using it today."

Other theoretical questions are raised by this: is the bio-based transition less disruptive than promoters claim? "Transition" turns into regime evolution rather than transformation if current actors are able to successfully modify traditional materials while selectively embracing alternatives. This ambiguity is revealed by the positioning framework, which complicates predictions about transition endpoints. System Optimisers and Capability Builders can both succeed if markets segment rather than completely switch to bio-based solutions.

6.3 Framework Reflection

Major strategic differences between actors were effectively captured by the two-dimensional positioning framework (value creation timeframe and strategic focus). However, considering the framework's exclusions highlights alternate possibilities in presenting results of the research. The following dimensions are missing but could enhance the explanatory effect:

1. **Scale and resource availability:** How organisational size limits positioning options is not specifically taken into consideration by the framework. While D1's profit-capping model only functions at boutique scale, does a factory investment require capital that most contractors cannot afford? Similar strategic intentions may result in different positioning outcomes, which could be explained by a third axis that separates "resource-constrained" from "resource-abundant" actors.
2. **Risk tolerance and organisational governance:** Although the framework views risk appetite as implicit rather than explicit, mission-driven pioneers and public institutions have essentially different risk constraints because of governance structures. The distinction between "shareholder accountability" and "fiduciary flexibility" could help explain why some actors are able to pursue long-term positioning despite short-term losses while others are unable to.
3. **Market power and value chain position:** Developers who are in charge of starting a project have a different impact than contractors carrying out other people's designs. The "external focus" of the framework fails to differentiate between those who advocate without direct market authority and those who use procurement power to shape markets.

Justification for chosen dimensions

The timeframe and strategic focus dimensions were chosen because they directly address transition dynamics. According to Loorbach et al. (2017), transitions necessitate both short-term action and long-term change; this tension is captured by the temporal axis. In line with Baines et al. (2005), whether actors believe bottlenecks are in their organisations (requiring capability development) or in larger systems (requiring ecosystem change) is reflected in the internal/external distinction.

6.4 Research Limitations and Implications

6.4.1 Framework limitations

Besides dimensional choices, the capacity for explanation of the framework is limited by three constraints.

1. Temporary versus dynamic positioning

While actors continuously adapt to changing circumstances, the framework records positioning at a particular point in time. It is unable to differentiate between short-term tactical reactions to current events and long-term organisational strategy. Therefore, it's harder to pinpoint the current state of the transition.

2. Quadrant structure viability

Positioning diversity may be oversimplified by using four distinct quadrants. Actors behave in a hybrid manner; C1 maximises project returns (Quadrant I) while concurrently developing capabilities (Quadrant II). It is still unclear if these are true hybrid types or context-dependent transitions between types.

3. Descriptive or predictive relevance

Does positioning describe the present state or forecast future behaviour? The framework is not temporally validated; it would be difficult to tell if actors who were identified as System Optimisers in 2024 would still be so in 2026.

6.4.2 Research bias

Several sources of bias should be acknowledged because they have the potential to influence results.

1. Commercial positioning bias

Instead of displaying real strategic reasoning, participants may have purposefully crafted their answers to fit market opportunities. Developers highlighting sustainability credentials may be positioning for ESG-conscious investors, while contractors highlighting timber capabilities may be marketing to prospective clients. Because actors create narratives to business interests, making it challenging to discern between idealistic self-presentation and true positioning.

2. Echo chamber effects

The Dutch bio-based construction community is small and cohesive, with professionals working together on various projects, attending the same conferences (like Houtbouw XL), and taking part in common initiatives (like Building Balance). This puts actors at risk of repeating similar framings without independent verification, leading to convergent narratives. Especially in the Delphi research, it seemed like many participants answered somewhat similarly to certain situations.

3. Social desirability bias

In order to conform to professional norms or perceived research expectations, participants may have exaggerated their dedication to sustainability and bio-based materials. Beyond cautious System Optimisers, the lack of openly transition-sceptical voices in professional discourse may be more a reflection of social pressure than of the distribution of opinions.

4. Bias in sampling for involved actors

Actors with experience or interest in bio-based construction were given preference during the selection process, and organisations that were completely disengaged from the transition were absent (besides actor S1). Having more bio-based-sceptical actors would probably have given a different view on how stakeholders strategically position themselves, as the transition is less relevant to them.

7 Conclusion

This research examined how the Netherlands' socio-technical shift to bio-based construction is influenced by strategic positioning. Four different positioning types that influence transition dynamics were identified by semi-structured interviews and a Delphi study that established recurring patterns. This chapter synthesises findings by (1) answering the main research question, (2) outlining academic and practical contributions, (3) providing strategic recommendations for value chain actors and institutional investors in particular, and (4) reflecting on why the transition seems organisationally stuck.

7.1 Answering the Main Research Question

“How could strategic positioning enable the socio-technical transition towards bio-based building ecosystems?”

The answer is contingent: strategic positioning enables transition only through coordinated movement across multiple actor types. Current positioning patterns create a situation where individual, rational decisions lead to collective confusion. The four positioning types each play necessary but insufficient roles when acting independently.

- Transition Pushers use research, demonstration projects in the market, policy advocacy, and training programmes to build knowledge infrastructure, but they are unable to scale bio-based construction on their own without market demand
- Market Developers use showcase projects to demonstrate their commercial viability, but they also pay pioneer costs that later entrants do not
- Capability Builders invest in factories and expertise that create scalability potential, but require demand certainty to justify the capital expenditure
- System Optimisers collectively postpone what they are waiting for by enabling widespread adoption through volume but waiting for demonstrated viability

Every positioning style relies on other people moving at the same time. For System Optimisers to adopt at scale, Transition Pushers require Market Developers to show demand that warrants the investments made by Capability Builders. However, the willingness of each actor to invest is contingent upon the actions of others, resulting in structural interdependence that cannot be achieved by a single organisation.

When actors of all four types reposition in a coordinated manner, strategic positioning facilitates transition by building a cascade of momentum that overcomes coordination failure.

7.1.1 Conditions for transition acceleration

The simultaneous movement required for transition acceleration could be made possible by three different mechanisms. These are synergistic rather than mutually exclusive, as shown in Figure 11, with maximum potential happening where all three come together.

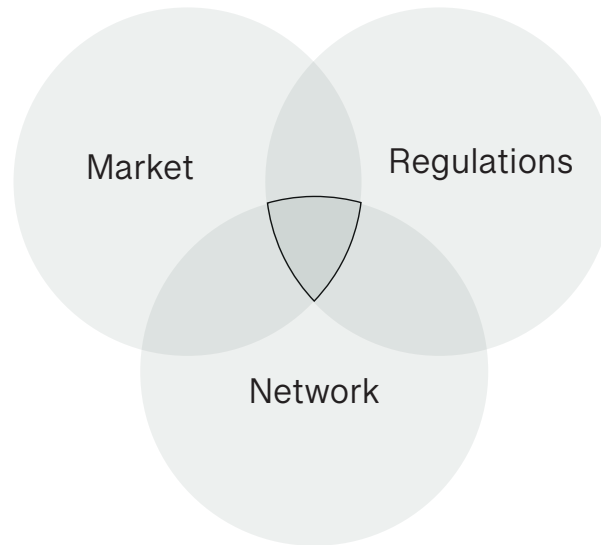


Figure 11: Venn-diagram showing the intersecting area of mechanisms with largest potential for transition acceleration

Market mechanism: economic incentives that are powerful enough to compensate for a lack of coordination. Cost structures would be drastically altered by carbon pricing that makes bio-based materials more cost-effective than traditional substitutes. Also, examples like better loan conditions, like significant interest rate differentials, and ESG-driven capital flows may generate financing advantages. However, the low green financing premiums and current carbon prices are still insufficient to encourage coordinated action among risk-averse actors.

Regulatory mechanism: Optimising within traditional construction regimes would be unnecessary by building codes which require embodied carbon limits. In order to achieve acceleration, the government must be on board and cooperating. A same-level playground is basically the starting point.

Network mechanism: Repositioning is coordinated by voluntary coalitions. The Building Balance model and other value chain agreements show how multi-stakeholder platforms can match factory investments with pipeline commitments. Industry self-organisation could establish the frameworks for risk-sharing and trust required for coordinated action. These mechanisms, however, call for governance frameworks and contractual innovations that are not yet widely used.

None of these mechanisms currently operates at sufficient scale, explaining why the transition is "not going fast enough" despite wide knowledge, technical capability, and environmental urgency.

7.2 Key Contributions

7.2.1 Academic contribution

This research makes several contributions to transition management theory:

1. *Using strategic positioning as an analytical lens*

This study connects macro-level system change with micro-level organisational decisions by applying BMC analysis to socio-technical transitions. The framework bridges the gap between system-level transition theory and firm-level strategy literature by demonstrating how individual strategic decisions add up to form transition patterns.

2. Four-quadrant positioning framework

Architects, developers, and contractors are found in all four quadrants, indicating that organisational type is less important in predicting transition engagement than strategic orientation.

3. Coordination failure mechanism

The study shows how multi-actor systems experience collective delay because of logical individual decisions. This mechanism helps to understand transition dynamics beyond technical or knowledge barriers by explaining persistent transition gaps, where all actors recognise necessity but movement remains restricted.

7.2.2 Practical contribution

Several stakeholder groups can benefit from the research's practical insights.

For participants in the value chain: In order to assess transition participation and coordination needs more realistically, the framework assists organisations in determining their own positioning and strategic dependencies on others. The framework gives them the opportunity to think about their strategy in a way they did not realise could also be effective, by placing themselves in a different quadrant.

For policymakers: The findings show why voluntary covenants and knowledge are not enough. Market, regulatory, or network coordinating mechanisms that get past structural interdependence are necessary to prevent coordination failure.

Regarding industry partnerships: The results show that investing in long-term, multi-stakeholder platforms and risk-sharing frameworks is justified because coordinated repositioning throughout the value chain is a prerequisite for effective acceleration.

8 Recommendations

According to this research, the shift to bio-based construction is not hampered by technical issues but rather by coordination breakdowns that result in a collective deadlock due to sensible individual caution. The following recommendations address this fundamental challenge at two levels: value chain coordination strategies that enable collective action and investment strategies for institutional investors who possess unique leverage to catalyse systemic change. These recommendations acknowledge that a successful transition necessitates strategic repositioning to capture value from market transformation that is inevitable due to regulatory and environmental pressures, rather than sacrificing financial returns or waiting for ideal policy conditions.

8.1 Value chain recommendations

8.1.1 General value chain advice

The following suggestions create mechanisms for collective action that distribute risks, align incentives, and allow for coordinated movement between value chain segments that are currently isolated from one another.

1. Create a transition “conductor” with profit motive

Integration failures caused by the dispersion of expertise among most stakeholders raise perceived risk and actual expenses. A transition conductor, who unifies bio-based decision-making authority and reaps the benefits of successful integration, is required as a new actor type.

From the beginning of the project, this role entails bringing together all technical disciplines around bio-based solutions and making financial investments, particularly by removing the coordination risks that presently constrain other actors. Crucially, instead of acting as a facilitator dependent on subsidies, this conductor must act with a profit motive. This actor shows through commercial success that the risks associated with bio-based construction are manageable by betting against perceived risks and accepting performance guarantees that conventional actors deem too uncertain. Every successful project creates a record that lowers industry-wide perceived risk.

The best candidates for this conductor position are architects, but this is a fundamental change in the business model from fee-for-service design to risk-bearing development partnership.

2. Create coalitions for transition that go beyond demonstrations

Although it needs to be scaled, the Building Balance model has potential. Demand visibility that supports factory investments is produced by multi-stakeholder platforms that coordinate pipeline commitments. In addition to guaranteeing supply for Market Developers' showcase projects, long-term supplier agreements would give Capability Builders the assurance they require.

3. Establish risk-sharing contractual frameworks

Existing contracts assign all risk to individual actors, particularly to pioneers who bear the costs of learning that are saved by later entrants. Experimentation would be made possible without penalising early adopters by industry-standard contracts that spread these costs throughout the value chain. Incentives for innovation rather than risk avoidance would be aligned by developer-contractor-supplier partnerships with shared upside and downside.

8.1.2 Value chain repositioning pathways

Pathway 1: System Optimiser → Capability Builder

<i>What this involves</i>	<u>Long-term</u> investment in biobased-specific infrastructure, expertise, and production capacity
<i>Implementation</i>	Partner with specialists on multiple projects to build experiential knowledge, hire personnel with biobased expertise, and commit capital to either factory investments or long-term supply partnerships that guarantee capacity access
<i>Business case</i>	Future competitive advantage when carbon regulations tighten and biobased construction reaches cost parity through learning economies
<i>Risk profile</i>	High capital requirements and execution risk, but creates defensible competitive advantages
<i>Resource requirements</i>	Large capital reserves, patient ownership structures tolerating multi-year payback periods, and organisational capacity to manage capability development alongside ongoing conventional operations

Pathway 2: System Optimiser → Market Developer

<i>What this involves</i>	Selective biobased project execution for market positioning and learning, maintaining conventional methods for remaining portfolio
<i>Implementation</i>	Target specific client segments valuing sustainability credentials (ESG-driven organisations, progressive municipalities), accept margin reduction, and build reference portfolios demonstrating your capabilities.
<i>Business case</i>	Access to premium market segments, preferential positioning for future ESG-linked financing, and reduced regulatory risk as carbon limits tighten.
<i>Risk profile</i>	Moderate - pioneer costs absorbed on limited project share while maintaining conventional revenue streams
<i>Strategic precedent</i>	Moderate capital, willingness to accept learning costs on subset of portfolio, and access to clients willing to partner on demonstration projects

Pathway 3: System Optimiser → Transition Pusher

<i>What this involves</i>	Organisational restructuring around impact metrics rather than profit maximisation, accepting smaller margins to advance systemic change
<i>Implementation</i>	Adopt profit-capping models (max 5%, rather than usual market-rate margins), prioritise knowledge sharing over your own advantage, and participate actively in industry coordination platforms without immediate commercial return expectations
<i>Business case</i>	Mission alignment and long-term market development
<i>Risk profile</i>	Requires mission-driven structures or cooperative ownership models incompatible with conventional shareholder expectations
<i>Strategic precedent</i>	Organisational structures that allow below-market returns and leadership that prioritises transition over financial performance.

8.2 Value chain recommendations

8.2.1 General institutional investors advice

Institutional investors face a fundamental dilemma: their fiduciary duties require competitive returns, but the coordination flaws found in this study hinder markets from operating effectively. By putting institutional investors in a position to profit from transition acceleration while upholding their obligation to beneficiaries, the following recommendations resolve this conflict.

1. Engage in network mechanism building

Institutional investors must shift from passive capital allocation to active ecosystem coordination. This entails engaging directly with architects, contractors, and developers to signal credible demand for bio-based construction that justifies their capability investments. By publicly committing to biobased allocation targets and participating in industry coordination platforms, investors can break the collective bottleneck where each actor waits for others to move first. This visible engagement demonstrates to the value chain that capital will be available for bio-based projects, encouraging contractors to invest in factories, developers to pursue timber portfolios, and suppliers to scale production. By establishing this market confidence before competitors recognise the opportunity, institutional investors secure preferential access to emerging bio-based capacity. This network engagement will be particularly valuable in the coming years as the biobased market scales and early relationships determine access to quality projects. Currently, institutional investors remain largely absent from pioneer events and industry coordination efforts.

2. Investigate impact quantification methodologies

Current financial models systematically undervalue bio-based construction because they fail to monetise non-market benefits. Institutional investors ought to create in-house methods for measuring embodied carbon storage, healthcare benefits from improved indoor air quality, and enhanced educational outcomes in timber learning environments. An example of a quantifying method for embodied carbon is, for instance, carbon credits, which adds a unique new layer to the business case. Three strategic goals are served by this analytical capability: (1) it supports investments that seem insufficient by traditional standards, (2) it puts investors in a favourable position for new true pricing mechanisms that internalise environmental costs, and (3) it enhances ESG reporting by proving quantifiable effects that go beyond carbon accounting. Early development of these measurement methodologies creates strategic option value, positioning investors advantageously as regulatory frameworks increasingly monetise environmental externalities through carbon pricing mechanisms.

3. Use strategic signalling to accelerate market development

Institutional investors need to understand that addressing bio-based construction strategies in public has an impact on the entire market in addition to their own portfolios. The announcement of allocation targets or preferential financing terms for bio-based projects by a major insurance company or pension fund signals to developers that financing will be available, to contractors that demand warrants capability investments, and to other institutional investors that competitive positioning is changing.

The coordination failure at the core of transition reluctance is addressed by this signalling mechanism, which causes actors to move in response to credible commitments from others. By enhancing market conditions for future investments, strategic communication of investment theses, partnership announcements, and pilot project commitments serves as a transition acceleration tool that benefits the entire portfolio.

4. Stimulate client awareness of long-term benefits

Institutional investors provide services to pension funds and other beneficiaries who may not fully comprehend the risk-return profile of bio-based construction, but who are demanding sustainable investment strategies. The ways that bio-based allocations improve long-term portfolio resilience through regulatory compliance, decreased exposure to carbon pricing, and alignment with beneficiary values should be made explicit by investors.

This entails converting technical sustainability metrics into outcomes that are relevant to beneficiaries, such as illustrating how embodied carbon reductions support climate stability, which safeguards long-term asset values, and illustrating how ESG leadership draws funding from allocators that prioritise sustainability. Institutional investors establish competitive advantage in transitioning markets and provide the governance space required for strategic positioning that may momentarily underperform based on traditional benchmarks but will generate more stable assets in the future.

5. Apply the positioning framework to explore non-traditional investment structures

Instead of just characterising existing positioning, the four-quadrant framework should be used as a strategic tool to find opportunities for unconventional value creation. In order to methodically investigate options in each quadrant that deviate from conventional practice, institutional investors should integrate this framework with their industry knowledge.

For instance, financing for contractor factory investments (Capability Builder), co-development of flagship projects with architectural practices (Market Developer), or catalytic capital for supply chain coordination platforms (Transition Pusher) are alternatives to passive equity stakes in completed buildings (System Optimiser default). Different risk-return profiles, timeline expectations, and value capture strategies are represented by each quadrant. In addition to increasing transition dynamics that improve overall portfolio performance, institutional investors diversify their portfolios within the bio-based sector itself by purposefully distributing portions of bio-based construction capital across several quadrants rather than focusing on well-known structures.

8.2.2 Institutional investors repositioning strategies

Currently, institutional investors generally present themselves as *System Optimisers*, waiting for proven track records before adjusting underwriting criteria. To go beyond wait-and-see methods, three repositioning strategies provide various risk-return profiles.

Strategy 1: Investor → Capability Builder

<i>What this involves</i>	Direct investment in bio-based production infrastructure rather than only completed buildings
<i>Implementation</i>	although institutional real estate investors cannot invest in factory enterprises, they could co-invest in contractor factory real estate, fund CLT production capacity expansion, or support integrated supply chain projects that reduce dependence on foreign manufacturers
<i>Business case</i>	As biobased building expands, investments in production capacity yield profits through exclusive access to future project pipelines and asset development
<i>Risk profile</i>	Higher risk and higher potential return compared to traditional real estate investment, offering portfolio diversification into construction industrialisation

<i>Strategic precedent</i>	Similar to infrastructure investment models where investors fund capacity that generates long-term cash flows, applied to biobased construction production
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Strategy 2: Investor → Market Developer

<i>What this involves</i>	Portfolio-level allocation of 10-20% to biobased projects, signalling market commitment rather than project-by-project evaluation
<i>Implementation</i>	Develop distinct funding criteria that account for construction time savings, accept 2-3% lower initial yields for regulatory resilience
<i>Business case</i>	Slight yield reduction in early years offset by long-term value retention as carbon regulations tighten, plus enhanced ESG compliance that attracts sustainability-focused limited partners.
<i>Risk profile</i>	Moderate - diversified across multiple biobased projects in proven building typologies (low-rise residential, prefabricated housing).
<i>Strategic precedent</i>	Similar to early renewable energy investments where first movers accepted lower returns to position portfolios ahead of regulatory shifts.

Strategy 3: Investor → Transition Pusher

<i>What this involves</i>	In order to improve systemic market conditions, capital deployment accepts below-market returns. Actively lobby for equal regulatory grounds.
<i>Implementation</i>	Fund industry research, training programs, standards development initiatives, and multi-stakeholder coordination platforms that stimulate information alignment and reduce coordination costs across the value chain.
<i>Business case</i>	Indirect returns through improved market infrastructure that benefits entire future portfolio, plus alignment with impact investment mandates.
<i>Risk profile</i>	Highest risk as returns depends on successful ecosystem development, suitable only for impact-oriented capital, and not for fiduciary optimization
<i>Strategic precedent</i>	Like market-building investments in emerging economies or venture donations, where initial capital builds the infrastructure for later commercial improvement.

8.2.3 Further research

This study identifies a number of areas that need more research to accelerate the transition to bio-based construction.

1. Innovative fiscal tools for circular construction

Although many studies look at financial incentives for circular construction, there are still a lot of unanswered questions about which fiscal tools can best address coordination issues. Future studies should look into depreciation schedules that take circular value retention into account, tax structures that shift costs from labour to raw materials, and carbon border adjustment mechanisms that influence material choices. Examining tax changes at the national and European levels could significantly change the economics of bio-based construction, as suggested by the Nederlandse Vereniging van Banken (2023).

2. Missing actor analysis

There are significant knowledge gaps in the value chain. Systematic analysis of capacity planning, pricing strategies, and geographic market positioning across Europe is necessary for CLT factories and manufacturers of engineered timber products. Given their purchasing power and potential to ensure pipeline certainty, housing corporations should be thoroughly investigated in order to justify capability investments. Their exclusion from this study is indicative of broader market reluctance, necessitating an analysis of procurement requirements and decision-making procedures unique to providers of affordable housing.

3. Comparative transition analysis

The Dutch context was the sole focus of this study. Comparative research analysing the variations in strategic positioning patterns among European markets would yield results that are context-dependent rather than generalisable. Germany and France provide intermediate cases, while Sweden and Austria, with their long-standing timber traditions, provide natural comparisons.

4. Studies of positioning development over time

Positioning was captured in a single moment by cross-sectional design, but changes take place over decades. Monitoring how companies switch between positioning types would reveal repositioning triggers and transition pathways, offering dynamic insight not possible with static typologies.

9 Reflection

It was a great experience that I had long looked forward to, and I am genuinely grateful to have undertaken it. I learnt an enormous amount and discovered the urgency of this transition even more profoundly than I had anticipated. That said, not everything went seamlessly, and there are aspects I would approach differently next time. In the following sections, I reflect more deeply on those (based on the requirements outlined by TU Delft).

9.1.1 Relation to Master Track and Programme

This study is strongly related to both Architecture and Building Technology because it investigates a new way to build that will change the construction sector forever. Architects and engineers need to plan and figure out how to build buildings all over again in a completely new way. This is a challenging position that requires a lot of knowledge. You must think about a building's structural system at the very beginning of a project. This is something that all actors in the construction sector need to keep in mind, from developers and contractors to architects and forest managers.

The research is also directly related to the idea of a circular economy, which is part of the MBE curriculum and getting more important in different sorts of areas. Biobased construction is an example of circular economy thinking because materials are reusable, buildings can be designed to be demountable, and timber parts keep some value so they can be reused.

Restructuring value chains so that actors strategically position themselves during this material transition and keeping materials in productive use across multiple lifecycles connects different fields. It is important for architects who plan with flexibility in mind, engineers who figure out material efficiency, developers who think about long-term value, and contractors who must know what to do with reusing materials.

Looking at the perspective of Management in the Built Environment in my research, it's most related to the construction process from initiative to use. The study connects technical progress with economic factors, organisational behaviour, and institutional dynamics. This is exactly the kind of integrated view that MBE promotes.

9.1.2 Research-Recommendations Interaction

The strategic suggestions that were formed over time during the project are connected to my empirical research. At first, I thought I would find quite obvious patterns of adoption and resistance. But the interviews showed something more complex: actors weren't simply "for" or "against" bio-based construction, they were taking a range of positions at the same time and had good arguments for it.

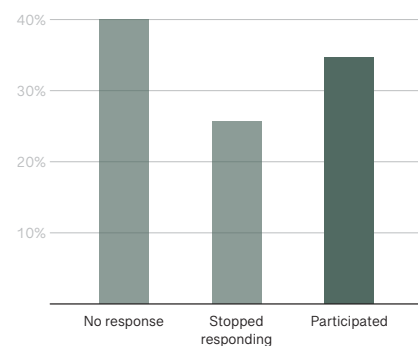
The work I did for NLV (Nederlands Vastgoed) as an intern helped me build a relationship with the activities of an institutional investors. This greatly influenced how I did this research and set up a system that allowed me to get feedback from multiple sources. That experience gave a real insider's view of how investment committees work, what risk frameworks they use, and why they hesitate even when they seem to be on board with sustainability goals. I saw that at NLV, experts keep their minds mostly on the limitations of biobased construction, like higher initial costs, uncertain insurance, and difficulties with valuation, instead of thinking about the long-term benefits. But they were really willing to learn, which gave me the chance to talk to them about it during my research. I was able to informally test ideas, ask about financial mechanisms, and find out why some suggestions could be put into action but others would face governance problems.

The back-and-forth dialogue between the researcher and the practitioner added a lot to the analysis. The positioning types came from the idea that institutional investors should be the ones to lead the transition because they have long-term views, a lot of money, and ESG mandates. But these investors face structural issues like benchmarking pressure and fiduciary conservatism that make it impossible for them to do so. So, the recommendations chapter can talk about what investors should do as well as what changes in the system would let them follow their beliefs.

9.1.3 Methodological Assessment

The qualitative multi-stakeholder interviews and Delphi methods turned out to be very important for showing how complicated strategic positioning is during transitions. Speaking to contractors, developers, architects, investors, suppliers, and more showed how dependent each group's choices are on the others, and no one group can make the transition happen by itself. Even though it was a somewhat complicated process, I think the methods really showed some results. People shared very important views on how the rules failed, how clients acted, and how competition worked.

But some significant issues were found too. The Netherlands' bio-based construction industry is small. This made it often hard to get people to participate. Over 60% of invitees never replied or at some point stopped replying to (reminder) emails. I also would have liked to interview more people with a lot of practical experience, but the specialisation of the field made that impossible. Also, I saw that bio-based construction isn't taken quite seriously in many parts of the industry yet; it's seen as an unimportant issue rather than a key focus, which impacted the recruitment process and the level of some responses.



Also the Delphi validation research had some very specific problems. My original plan was to get stakeholders to start a focus group meeting in person and give them specific situations to respond to. But as an alternative, I have to design the Delphi method, with three rounds of email, so that some participants could still come to a consensus. It was still hard to recruit people, response times were slow, and participants lost interest over the rounds even though I tried to keep them excited and show them how important the research was. In the end, the process had to be done more quickly, and fewer people stayed involved than I would have hoped. I still believe a focus group might have worked better. Meeting in person could have led to more lively conversation and kept things moving better than email exchanges that weren't sent and received right away.

Altogether, these aren't just technical problems; they are real characteristics of the transition. Some actors are more involved than others, and it's naturally hard to work together in a new sector that isn't fully formed yet.

9.1.4 Academic and Societal Value

I think that right now, any research into biobased construction is useful, especially because it brings more people into contact with the topic and involves more people through interviews. The subject needs to be seen and taken seriously, and academic work helps with both.

Academically, this research fills a genuine knowledge gap. Existing research on biobased construction has a lot of information about how possible it is to do technically, material properties, and what makes it challenging to use. My positioning types framework adds to the transition management literature by showing that strategic positioning isn't the same for everyone. Instead, actors use different strategies, such as knowledge-building, market-making, business model innovation, regulation-focused, or supply

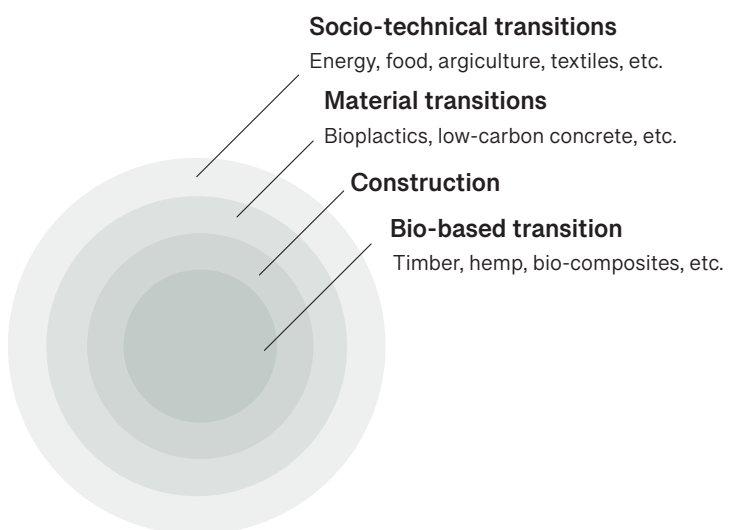
chain control, based on their value chain position, resources, and willingness to take risks. This goes beyond describing what stops adoption and starts to look at how changes can be made through coordinated strategic repositioning.

Societally, the research offers practical value for many sorts of audiences. Regulators learn about the areas where they may benefit or hinder the transition, like how carbon pricing might change economic incentives or how fire safety standards unfairly target wood. Investors learn about the valuation-appraisal gap that explains why they are hesitant even though they agree with timber's sustainability credentials in theory. People in the industry can make better decisions about where to place themselves by knowing how their choices affect other people along the value chain.

9.1.5 Transferability Assessment

I've designed a framework that can be used in a lot of different areas, not just bio-based construction. Basically, it looks at how actors think about their businesses and the future, or how they think about their own capabilities. This analytical approach can be used in other situations where actors have to deal with major changes while not being sure of the outcome. Stakeholders in any industry can use the same strategy types as general strategic responses to conflicts between niches and regimes.

And the framework can be used for more than just construction and materials. Any sector that is going through a major (socio-technical) transition has the same kind of developments happening, like the energy and mobility transition. In each case, established actors face new options, and the positioning types framework helps to understand how they respond strategically. Do energy companies focus on lobbying for favourable regulation, invest in building renewable energy expertise, and develop new service-based business models rather than commodity sales? The analytical categories are used in other sectors because they deal with basic strategic decisions that can be made when the government is destabilising.



The reason this framework works across such diverse contexts is that it captures generic mechanisms of systemic change rather than sector-specific technical details. The transitions theory came from cross-sectoral comparison, which noted that changes in energy, mobility, food, and environment have features in common even though they are technically different. My framework adds to this by identifying strategic positioning as an important way that transitions happen. Strategic positioning means making decisions about value capture, risk management, resource allocation, and forming partnerships. These choices are common for organisations that face uncertainty, no matter if they're agricultural cooperatives, building contractors, energy utilities, or car companies.

Multidimensional investment streams (financial, knowledge, infrastructure, relational) are similar in different situations. Anyone who wants to make a change has to commit resources across these dimensions, and knowing the trade-offs between them shows why transitions don't always go as planned. Some people can afford to invest in infrastructure while others can't, and some people focus on knowledge building while others focus on regulatory change.

9.1.6 Reflection Questions

Question 1: How did the tension between maintaining academic neutrality and advocating for biobased construction influence my research design, data interpretation, and recommendations?

I entered this research as a committed advocate for timber and bio-based construction. This topic was selected because I believe deeply in its environmental necessity and have followed developments in the sector with genuine enthusiasm for years. Whilst I approached the research with sincere intentions to maintain an open perspective, I undoubtedly leaned towards optimism at times. I recognise that many parties still face substantial difficulties and that pioneers sometimes reason too simplistically about how quickly change can occur. I may have been guilty of this myself.

This advocacy position shaped the research in subtle ways. When coding interview transcripts, I unconsciously may have emphasised statements supporting transition feasibility whilst downplaying expressions of scepticism. There are probably some critical questions that should have come to mind or even should've been asked, but weren't. When developing positioning types, I might have framed them as strategic opportunities rather than desperate adaptations to an uncertain future. When writing recommendations, I assumed goodwill and capacity, something that absolutely does not exist. The line between analysing strategic positioning and advocating for positions is finer than I initially appreciated. If conducting the research again, I would implement more systematic checks on my own interpretative bias. This might include having a critical review of coding decisions, more explicitly seeking out counter-evidence to emerging hypotheses or structuring the Delphi research to surface sceptical perspectives more deliberately.

Question 2: How did the compressed timeline of a master's thesis affect the depth of analysis possible, and what would I prioritise differently if given more time?

There were some tight deadlines in the graduation phase (about five months from proposal to defence). This made it harder to get to know each group of stakeholders really well. If I had had more time, I would have done follow-up interviews to see how actors' positions changed as the market did, what would've added an extended aspect that would have made the claims about transition dynamics stronger. I also would have put in more work to get balanced representation, especially by bringing in housing corporations and insurance companies, since their absence shows a real limitation. The Delphi study deserved more time to build relationships and be refined over and over again, instead of being shortened when participation decreased.

The limitation, on the other hand, forced me to prioritise, which ultimately made the research stronger. I didn't try to cover every angle briefly. Instead, I focused on really getting to know the different types of positioning. The question for future research is whether depth within a narrower scope (strategic positioning) or breadth across multiple dimensions (technical, financial, regulatory, cultural) will lead to more useful discoveries. I think it does, but I know that was only partly because of a methodological choice that had to be made.

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