

Master's Thesis – Master Sustainable Business and Innovation

Small wins triggering the sustainability transition of the Dutch construction industry



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Abstract

The Dutch construction sector has to deal with two great social issues. First, the Dutch government is increasingly emphasizing the transition to a more sustainable industry, that focuses on circularity and reducing the environmental impact. Secondly, there is a housing shortage in the Netherlands. In order to accomplish both tasks, the Dutch government is pushing for more innovation in order to achieve a sustainability transition. To analyze whether a sustainability transition is occurring and innovations are initiated to accelerate the transition, this research used the multi-level perspective and the small wins approach. Small wins are completed, concrete, implemented outcomes of moderate importance, and focus on incremental change to achieve sustainable results for large societal challenges. The research aims to systematically analyze innovative initiatives of small-scale, which are qualified as small wins, in the sustainability transition issue of the Dutch construction industry, by answering the following research question:

How can “small wins” amplify the sustainability transition of the Dutch construction industry?

To formulate an answer on this questions, a qualitative research design was used. Sixteen initiatives were studied that contributed to the sustainability transition as derived from desk research. The conducted interviews were coded using the constant comparative method in order to compare categories and identify patterns.

The analysis showed that moderate importance is experienced as valuable for small wins to achieve more radical change and transformations. Small wins should have concrete outcomes to eventually become positively judged by others, which stimulates the development of the small win. The market barriers small wins experience are causing technical and regulatory barriers small wins have to overcome. The risk averse nature of the construction industry is hampering the further development of the small wins. In addition, small wins should couple their initiatives to other problem areas in order to increase the energizing and logic of attraction mechanism. As a result, more imitation and competition could occur, which would amplify the sustainability transition.

Based on these results, it can be concluded that small wins should operate on a local and small scale, to develop radical innovations. By doing so, small wins will experience less resistance from the market. By being competitive on price and by complying with dominant standards and certification procedures, small wins can overcome existing barriers. The assumption is that when the right propelling mechanisms are activated, small wins can amplify the sustainability transition in the Dutch construction industry.

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1. Introduction

The Dutch construction industry is under great pressure to move towards sustainability (Klein Woolthuis, 2010). It is responsible for 5% of the national greenhouse gas (GHG) emissions in the Netherlands (Bijleveld et al., 2014). This is partly caused by the extensive use of mainly steel and concrete in the current way of working, which is responsible for 1,7% of Dutch national GHG emissions (Bijleveld et al., 2013). Globally, concrete and steel production account for approximately 17% of all the CO₂ emissions related to human activity (Schut et al., 2015). To improve their national environmental impact, the Dutch ministry of Economic Affairs and Climate Policy ('EZK') aims to cut the country's GHG emissions by 49% in 2030, rising to 95% in 2050, compared to 1990 (Ministry of EZK, 2019).

To achieve this, the Netherlands introduced in fall 2019 its 'Mission-oriented Topsector and Innovation Policy' (MTIP) strategy. The nine Topsectors that were chosen relate to R&D and export-intensive fields like AgriFood, Logistics, Life Sciences and Health, and High-Tech Systems and Materials (Janssen, 2020). The strategy is due to the attempt of the Dutch government to keep their nine innovative top sectors among the world's best and further strengthen their international position. Different ministries have set a total of 25 missions divided over four central themes, with the first theme being 'Energy Transition and Sustainability'. Part of this theme is the mission of cutting GHG emissions by 95% in 2050 compared to 1990. To achieve this, the mission is broken down into five sub-missions. To force a sustainability transition within the construction industry, two of those missions are relevant for the construction industry: 1) a carbon-free built environment in 2050 and 2) a carbon-neutral industry based on the re-use of raw materials and products in 2050 (Ministry of EZK, 2019).

However, two recent developments are not conducive to the desired sustainability transition and the achievement of the set missions. The Climate and Energy Outlook 2020 report of PBL Netherlands Environmental Assessment Agency (PBL), argues that the Netherlands is on its way to reduce the GHG emissions in 2030 by only 34 percent compared to 1990, instead of the target of 49 percent of the Climate Act (PBL, 2020). Additionally, the Netherlands is currently facing a housing shortage. A recently published report claims that 95,000 homes per year must be built to meet the housing demand in ten years' time (BMH, 2020).

To be able to cope with the housing shortage and at the same time achieve the reduction of GHG emissions, a sustainability transition in the Dutch construction industry is needed. To analyze sustainability transitions, the multi-level perspective (MLP) has emerged as an useful framework (Bui et al., 2016; Chang et al., 2015; Geels, 2011). MLP views transitions as non-linear processes that result from the interplay of developments at three analytical levels: niches, socio-technical regimes, and an exogenous socio-technical landscape (Geels, 2002). Niches are spaces where deviating practices take place, such as new technologies and initiatives, and new forms of culture and governance (Loorbach & Rotmans, 2006). Because niches provide the seeds for systemic change and therefore are crucial for transitions (Fagerberg, 2015; Geels, 2011), this research focuses on niches within the Dutch construction industry.

An analytical framework prominent in recent sustainability transition debates has been Strategic Niche Management (SNM) (Caniëls & Romijn, 2008; Kemp et al., 1998; Smith, 2006). SNM provides insight into the reasons why new technologies may fail in their development, including success and failure factors of radical innovations (Caniëls & Romijn, 2008). A general critique on SNM is that the approach puts too much emphasis on well-ordered, planned, and consensual processes (Farla et al., 2012). Instead, continuous transformational change is emergent and cannot be controlled by planned change efforts (Termeer & Metze, 2019). Therefore, a less researched theory in relation to sustainability transitions and in particular MLP, is "small wins" (Weick, 1984). Small wins are described by Weick (1984) as "concrete, completed, implemented outcomes of moderate importance" (p. 43), and focus

on incremental change to achieve sustainable results for large societal challenges. According to Termeer and Dewulf (2019) small wins are defined by four key characteristics: i.e., concrete outcomes, in-depth changes, moderate importance, and positive judgement. In this research, niche initiatives that develop radical innovations (i.e., practices representing a breakthrough in relation to the practices carried out in the conventional regime) to contribute to the sustainability transition of the construction industry are considered as small win if they meet the characteristics of a small win.

This research aims at introducing the combination of multi-level perspective and small wins to systematically analyze small-scale solutions in the Dutch construction industry, which are qualified as small wins. This research will do so by addressing the following research questions:

How can “small wins” amplify the sustainability transition of the Dutch construction industry?

To date, the small wins concept has not been applied to the domain of the construction industry. When larger problems are modified into smaller problems, people should be able to identify a series of manageable opportunities of modest size that produce visible results (Weick, 1984). These results can eventually be gathered into synoptic solutions, which could help niches to scale-up and create transformative change (Weick, 1984). By cherishing emerging change, this research identifies niche initiatives by the characteristics of small wins to form a strategy for other niche initiatives to scale-up. This research does so by addressing the following sub-question:

SQ1: How can “small wins” help niche initiatives grow in the construction industry?

As described by Weick (1984), “small wins are like miniature experiments that [...] uncover both resources and barriers” (p. 44). Following Termeer and Metze (2019), it is essential for small wins to overcome barriers and to face resistance in order to become an in-depth change. Specifically, initially facing barriers is characteristic of small wins, otherwise they could not be considered as such. Additionally, small wins have to create conditions to tolerate tensions with existing institutions to make a transition happen. To overcome these barriers, they need to be understood (Kirchherr et al., 2018). Although there is research done on barriers inhibiting the transition to sustainability (Martek et al., 2018), little research is done on barriers from the niche- and regime-level in relation to small wins. Therefore, this research aims to contribute to this gap in literature by answering the following sub-question:

SQ2: How do barriers influence “small wins” in the construction industry?

As single small wins will not result in transformations, it is important to examine which mechanisms make small wins accumulate (Termeer & Metze, 2019). For small wins to accumulate and scale up, broaden or deepen, the right propelling mechanisms have to be activated (Termeer & Dewulf, 2019). Propelling mechanisms are described by Termeer and Dewulf (2019) as “chains of events that reinforce themselves through feedback loops with an amplifying effect on an initial small change so that it becomes larger and stronger, or intensifies and escalates its consequences” (p. 305). Further success of new innovations is not only governed by processes within the niche, but also by developments at the existing regime, and it is the alignment of developments which determine if a regime will shift (Geels, 2002). This research examines whether the right propelling mechanisms are present in order to accelerate the sustainability transition by answering the following sub-question:

SQ3: How can propelling mechanisms accelerate “small wins” in the construction industry?

The aim of answering these questions is to identify and analyze small wins, with the focus on how a sustainability transition can arise from the niche-level. Furthermore, more insights are gained regarding what initiatives and small-scale solutions appear to be small wins, what barriers they had to

overcome, and which propelling mechanisms are present to start a sustainability transition. A deeper scientific understanding of how the small wins approach can analyze the niche-regime interaction from a MLP is gained with an empirical case study. The empirical case of the Dutch construction industry will contribute to deeper scientific understanding of barriers in relation to observed small wins and their propelling mechanisms. Insights are gained through understanding how small wins come about, so opportunities and conditions under which sustainability transitions develop can be applied in the future. These insights are derived from a bottom-up perspective and can support and complement the 'Mission-oriented Topsector and Innovation Policy' strategy of the Dutch government. Because the strategy is top-down, it can be interesting for the Dutch government how small-scale initiatives respond to the strategy (Mazzucato, 2018). With these insights, the government can then determine how it can better respond to the developments taking place at the niche-level and how these developments can be further stimulated for the benefit of the sustainability transition.

2. Theory

This chapter describes the theory and scientific literature used during the study. First, the MLP will be described to provide a theory for how sustainability transitions generally unfold. Second, the small wins approach is explained to characterize promising niche-innovations present at the micro-level. After that, possible barriers regarding small wins are described to examine how a sustainability transition could be hampered. Finally, a set of propelling mechanism accelerating small wins is discussed in order to scrutinize how small wins can accelerate the transition.

2.1 Multi-Level Perspective

The multi-level perspective (MLP) is a framework for understanding sustainability transitions, that provides an overall view of the multi-dimensional complexity of changes in socio-technical systems (Geels, 2002; Geels, 2004). The MLP is used to analyze transitions defined as processes of regime reconfiguration bringing about a shift from one socio-technical system (in this case, the conventional construction industry) to another (Bui et al., 2016). MLP views transitions as non-linear processes that results from the interplay of developments at three levels: niches as the micro-level, socio-technical regimes as the meso-level, and an exogenous socio-technical landscape as the macro-level (Fagerberg, 2015).

Socio-technical regimes are the rule-set or grammar, such as technologies, regulations, and user preferences, embedded in a web of institutions and infrastructures (Geels, 2004). Within socio-technical regimes, innovative activity towards incremental improvements is guided along trajectories, creating stability. In addition, lock-in mechanisms cause to result in changes and innovations on the regime level being mostly slow and incremental (Markard et al., 2012). Typical lock-in mechanisms include the fact that business network of corporations are difficult to change, ways of doing business are all deeply embedded in existing institutions and infrastructure, low costs are the norm because of economies of scale, and that government policies or technical standards may favor existing technologies (Chang et al., 2015; Geels, 2012).

Socio-technical trajectories are located in a socio-technical landscape which consists of a set of deep structural trends (Geels, 2002). The landscape is an external structure or context for interactions of actors and contains a set of heterogeneous factors. A socio-cultural development that can be considered as a landscape process, and which is questioning the performance of multiple regimes, is the growing environmental awareness (Smith et al., 2010).

The same applies to the incumbent actors with their current technologies, regulations, and infrastructures within the Dutch construction industry. With their linear and polluting practices, they are under great pressure to move towards sustainability and niche initiatives are believed to be of great importance in this transition by introducing sustainable products and business practices (Klein Woolthuis, 2010). Sustainability transitions in the MLP are crucially dependent upon activities within niches (Smith et al., 2010). Niches are the protected spaces of novelties and the incubation rooms that protect novelties against mainstream market selection (Grin et al., 2010; Kemp et al., 1998). Research on sustainability transitions emphasize the role of niches as a source for path-breaking innovation, both technological innovation as social innovation (Smith & Raven, 2012). However, such novelties, often a form of experimentation, are fraught with difficulties of various sorts and need to overcome the constraining influence of regimes (Smith et al., 2010; Fagerberg, 2015). In this research, the processes through which alternative niche initiatives can contribute to such a regime reconfiguration are analyzed. Niche initiatives are considered to be initiatives that introduce new products and business practices that are more sustainable than products and business practices carried out by the conventional regime.

Niches are believed to expand to a certain point where it is robust enough to break through and transform parts of the socio-technical regime (Smink et al., 2015). In addition, niches are supposed to break down some of the barriers limiting the adoption of alternative products and business practices in contrast to those of the regime and present some potential to overcome the lock-in effects involved in the conventional regime (Bui et al., 2016). This interaction between niche and regime has received insufficient attention within literature (Smith, 2007; Diaz et al., 2013). The analysis of such interaction between niches and the regime reveals the importance of processes by which practices translate between the very distinctive socio-technical situations in niches and the regime (Smith, 2007). Therefore, if applicable, it is emphasized if something takes place or arises from the socio-technical regime or from regime actors. For example, when niche initiatives are hindered or accelerated by a certain phenomenon, emphasis is placed as soon as this is caused by regime actors, so that a better overview is obtained of the interaction between the niche and regime-level.

2.2 Small Wins

Despite the various hurdles and barriers novelties must face, transitions come about through interactions among the processes at the three levels of the MLP, starting at the micro-level. Instead of a simplistic intervention logic of listing barriers and developing targeted intervention, an in-depth knowledge on governance of the transition and an analysis of underlying mechanisms is necessary for better understanding of the sustainability transition in the Dutch construction sector (Biesbroek et al., 2014). For this purpose, to analyze the desired regime reconfiguration and to conceptualize mechanisms of transformative change, the small wins approach is used (Weick, 1984). The small wins approach can be used to address the importance of incremental or marginal change to achieve sustainable results for the sustainability transition. The fact that changes are relatively small does not mean that they are trivial on the long-term (Vermaak, 2013). Instead, they can amplify and cumulate into large-scale change (Weick & Quinn, 1999). As described by Weick (1984), “a series of wins at small but significant tasks [...] reveals a pattern that may attract allies, deter opponents, and lower resistance to subsequent proposals.” (p. 43).

2.2.1 Characteristics and indicators of small wins

For the identification and valuation of small wins, four characteristics of small wins and their indicators from Termeer and Dewulf (2019) are adopted. According to Termeer and Dewulf (2019), it can be hard to identify small wins, as most of them emerge under the radar of the public attention. Thus, it is important to not discard any small wins but valuing all of them (Termeer & Dewulf, 2019). Table 1 shows the four characteristics, including their indicators, adopted from Termeer and Dewulf (2019).

Table 1: Indicators for characteristics of small wins (Termeer and Dewulf, 2019)

Characteristic	Indicator
Concrete outcome	Visible result
In-depth changes	Second- and third-order change Radical new practices
Moderate importance	Micro or local level Intermediate
Positive judgement	Improvement Step forwards

The first characteristic is that small wins refer to *concrete results* and embody lived experiences that go beyond nicely framed creative ideas or promises (Termeer & Metze, 2019). This can be determined by visible results niche initiatives bring about. Secondly, small wins should include a change in routines, beliefs, or values by consisting of radical new practices; an example of *in-depth change* (Termeer & Dewulf, 2019). It is not sufficient for small wins to use existing rules and procedures fitting dominant mental frames to deal with well-understood issues (Vermaak, 2013). This is where small wins deviate

from existing regimes through radical innovations or second- and third-order changes. By reframing problems and practices and understanding them, second-order change breaks through mind-sets of the regime and opens them up for discussion (Termeer et al., 2017). Third order change aims to change the way we change, and refers to development of the capacity of the actors involved to reflect on the schemata fundamental to the system, of which they themselves are part (Bartunek & Moch, 1987). Thirdly, the steps are of *moderate importance*. To allow people to effectively meet complexity and turbulence, small wins are mostly located at a micro or local level, instead of at a larger level (Vermaak, 2013). Small wins are referred to intermediate because change is only small within a short time period, so they can accumulate. The final characteristic is its *positive importance*. Not all small steps qualify namely as small wins and rather constitute small losses (Termeer & Dewulf, 2019). This is one of the most difficult characteristics, because it depends on the value attached to the small step and most authors are not very explicit on this. Some relate it to general qualifications, such as improvements (Weick, 1984). Urpelainen (2013) labels them as positive if they contribute to limiting climate change. Following this, this research labels small wins as positively judged if the initiatives establish an improvement or step forward in terms of environmental impact relative to conventional alternatives.

2.2.2 Barriers regarding small wins

Niche initiatives are necessary but not sufficient to force a regime reconfiguration (Berkhout et al., 2011). Niche-regime interaction is another key process in transitions (Bui et al., 2016). Because the existing regime is stabilized by many lock-in mechanisms and niche initiatives may have a mis-match with the regime, because of their deviating radical innovations, conflicts and tensions between the niche-level and regime-level are likely to emerge (Geels, 2011; Vinnari & Vinnari, 2014). In this context, Loorbach (2010) argues that potential barriers to the transition should be considered. Additionally, the challenge remains to understand how to facilitate this transition when constrained by an institutional socio-technical regime that is aligned with the status quo of a linear oriented construction industry (Fischer & Pascucci, 2017). Therefore, more emphasis should be placed on identifying barriers to transitions.

Additionally, it is essential for small wins to overcome barriers, but to overcome them, these barriers must be understood (Kirchherr et al, 2018; Termeer & Metze, 2019). Vermaak (2013) observed that concrete obstacles, that seemed somewhat unimportant, regularly proved to be a systemic characteristic of an issue's underlying complexity. This insight embodies a door for further research. By identifying barriers and understanding them, people can learn to expect to run into trouble, appreciate finding out about it sooner, and get to know that initial adversity is part of a deeper change process, and may fuel change rather than disrupt it (Vermaak, 2013).

However, so far little research is done on barriers in relation to small wins. One of the few integrations of barriers into small wins literature, is that of Termeer and Metze (2019). They adopted the four characteristics of small wins of Termeer and Dewulf (2019) and added the characteristic of 'have overcome resistance and barriers'. Termeer and Metze (2019) derived from their empirical case technical, financial, and regulative barriers which had to overcome.

Barriers hampering sustainability transitions to happen are more often researched. Kirchherr et al. (2018) most recently established a framework of barriers that derail or slow down sustainability transitions, in particular transitions to a circular economy, distinguishing between cultural, regulatory, market, and technological barriers. As this research analyzes small wins in relation to a sustainability transition and due to the focus of the Dutch government on circularity through stimulating the re-use of raw materials and products, the different types of barriers of both the studies of Termeer and Dewulf (2019) and Kirchherr et al. (2018) are combined. Because both studies have technical and regulatory barriers in common, five different types of barriers are considered in this research, shown in Table 2.

Table 2: Types of barriers and their indicators (based on Kirchherr et al., 2018; Termeer & Dewulf, 2019)

Barriers	Indicator
Technical	Technical failures and developments Lack of data
Financial	Insufficient financial resources Deviant financing models
Regulatory	Institutional affairs Permits Safety measures
Market	Motivations to change Developed needs and beliefs
Cultural	Willingness to change Awareness

Due to the goal of the Dutch government to create a carbon-neutral industry based on the re-use of raw materials and products in 2050 (Ministry of EZK, 2019), it is assumed that the Dutch construction industry has to transition to a circular economy. Therefore, it is assumed that the barriers of Kirchherr et al. (2018) are applicable for this empirical case. Kirchherr et al. (2018) argue that technical barriers are emphasized as key barriers for transitions to the circular economy. As most experienced technical barriers they found the limited availability and quality of recycled materials, too few large-scale demonstration projects, and the lack of data to proof impact. Fischer and Pascucci (2017) argue in their research on circular economy transitions that due to the institutional system being aligned with the status quo of a linear economy, and decision factors behind financing models are based on linear business models, niche initiatives which come up with new business practices have to cope with obstructing legislation and the lack of adequate financing models. In addition to the former, Kirchherr et al. (2018) adds as regulatory barriers limited circular procurement and lacking of consensus on sustainability incentives. Regarding market barriers, Kirccherr et al. (2018) argues that the market in general lacks economic viability of circular business models. This is caused by lacking standardization, high upfront investment costs, and limited funding for circular business models. Finally, cultural barriers can be caused by the lacking awareness or willingness to change to a more circular sector (Kirchherr et al., 2018).

2.2.3 Propelling mechanisms and their indicators

Whether a small win accumulates and scale up, broaden or deepen, depends on whether the right propelling mechanisms are activated (Termeer & Dewulf, 2019). Termeer and Metze (2019) elaborate on this triad of scaling up, broadening, and deepening even more and describe upscaling as it becomes larger and more numerous, broadening as it escalates its consequences and effects on other areas, and deepening as it intensifies and becomes more radical. The six propelling mechanisms of Termeer and Dewulf (2019) are employed, including their indicators, and are shown in Table 3.

Table 3: Propelling mechanisms and their indicators (Termeer & Dewulf, 2019)

Propelling mechanisms	Indicators
Energizing	Energy and enthusiasm Empowerment
Learning by doing	More than one experiment Learning outcomes guide new experiments Experimenting also continues after disappointing and unexpected outcomes
Logic of attraction	Other communities know and value wins Additional resources
Bandwagon	Highlighting and celebrating wins Copying good practices
Coupling	Connection with problems or aims from other policy domains Connections across scales
Robustness	Numerous Non-stoppable Internalized behavioral change Examples of resisted opposition

The six propelling mechanisms are described in more detail according to whether they scale-up, broaden, or deepen small wins, following Termeer and Metze (2019). *Energizing* is based on motivational drivers, such as energy and enthusiasm, because when the excitement occurs that small wins are attainable, actors get motivated to look for other small wins. It increases the commitment to the initiative, as well as the mutual trust.

Learning by doing is based on the fact that each step results in an outcome, whether it is positive or negative, it uncovers new resources which can be learned from and applied in the future. This mechanism can be mainly activated through experimenting (Termeer & Dewulf, 2019).

The *logic of attraction* mechanisms is based on the fact that financial and human resources tend to flow towards success (Weick, 1984). Success can be derived from the acknowledgement of other actors. People want to work and new resources will be mobilized when certain positive outcomes appear.

The bandwagon effect is a psychological phenomenon (Behn, 2002), that is, people do something because other people are doing it. Positive outcomes may inspire other people to adopt or copy it when improvements are being highlighted and celebrated.

The fifth mechanism is *coupling*, whereby small wins may accumulate when they combine with other events across boundaries of areas and scales (Reay et al., 2006). Seemingly insignificant events in one area can set off chain reactions and generate cumulative effects in other areas (Termeer & Dewulf, 2019).

The final mechanisms, *robustness*, means that sustained change is more likely to occur when small wins become numerous. When initiatives become so numerous and legitimized, turning back to the initial situation is impossible (Termeer & Metze, 2019).

This thesis aims to bring the small wins approach with its propelling mechanisms closer to the MLP in order to be able to analyze sustainability transitions from a bottom-up perspective. For this reason, niches are qualified according to the characteristics of small wins. Kemp et al. (2001) highlight that successful processes within niches should be reinforced by changes at the regime and landscape level to let a regime shift occur. This thesis assumes that small wins, with their propelling mechanisms, can impersonate such reinforcements. As processes within niches seem to be successful, it may occur that

new resources will be mobilized for the niches as they may guarantee more chances of success, which may flow from the regime level. This is the logic of attraction mechanisms (Termeer & Dewulf, 2019). The same applies for the bandwagon effect; e.g. if niches show positive results and get publicly acknowledged and celebrated, the regime may get inspired to imitate or adopt it. Hence, although this research approaches the sustainability transition from a niche-level perspective, it focusses on interactions between the niche and regime-level as well to obtain a more comprehensive view of the sustainability transition.

3. Methodology

3.1 Case description

This study aims at initiatives and small-scale solutions which are qualified as small wins and contribute to lowering the GHG emissions of the Dutch construction industry. By doing so, the study aims to contribute to the mission of cutting GHG emissions by 95% in 2050 compared to 1990, set by the Dutch government. More specifically, the study aims to contribute to the two sub-missions related to this main mission, namely: 1) to create a carbon-free built environment in 2050 and 2) a carbon-neutral industry based on the re-use of raw materials and products in 2050 (Ministry of EZK, 2019). The mission for a carbon-free built environment in 2050 is also linked in the ‘Construction Agenda’ for driving public and private investments needed for innovation and cost reduction in the construction industry. The Construction Agenda is the program tasked with the Circular Economy transition agenda on construction (Janssen, 2020).

In March 2019, after the Dutch government realized that ambitious climate goals might require innovative solutions, the ‘Integrale Kennis- en Innovatie Agenda’ (IKIA; comprehensive knowledge and innovation agenda) was developed (Janssen, 2020). Part of the IKIA, is the ‘Kennis- en Innovatieagenda Circulaire Economie’ (KIA-CE; knowledge and innovation agenda circular economy), which has been drawn up in the context of the ‘Mission-oriented Topsector and Innovation Policy’ strategy at the request of the Dutch government, to stimulate and focus the development of knowledge and innovation on the circular economy (Taakgroep Innovatie, 2019). Within the KIA-CE two programmatic lines that connect the circular economy transitions agendas with the Topsectors seem relevant for the construction sector, containing themes the construction industry can respond to in order to contribute to a carbon-neutral industry. The first is the one focusing on designing for circularity with knowledge and innovation themes as ‘Design principles and design tools’, ‘Design for dismantling’, ‘Modularity and refurbishment’, and ‘Extend lifespan and smart maintenance’ (Taakgroep Innovatie, 2019). Secondly, the line focusing on circular materials and processes is relevant due to themes as ‘Optimization of reuse and recycling’ and ‘Recycling technology’ (Taakgroep Innovatie, 2019). When fossil and other non-renewable raw materials are replaced by alternative sources, such as biomass waste streams, or renewable sources, such as recyclate, this can mean a significant reduction in CO₂ emissions (Taakgroep Innovatie, 2019).

Additionally, there is a great discussion within the Dutch government about how to deal with the housing shortage (PBL, 2021). There are therefore many plans to build large numbers of houses, but this conflicts with other social issues and the limited territory of the Netherlands (PBL, 2021). Due to both developments of the KIA-CE and the housing shortage, a sustainability transition will have to be initiated that takes both issues into account. Because few initiatives will be able to contribute to all the different themes within the KIA-CE and the housing shortage, this research will focus on four different types of initiatives that together do contribute to both issues.

First, the selection of sustainable buildings materials has been identified as easiest way for building professionals to begin incorporating sustainable principles in building projects (Akadiri & Olomolaiye, 2012). Mandili et al. (2019) emphasized the importance of particular ecological building materials, due to their renewability and therefore low environmental impact. Due to this, and with their potential contribution to the two programmatic lines of the KIA-CE, *ecological building materials* and *sustainable building materials* are the first two types of initiatives considered in this research. Although the two types seem very similar, there is a clear distinction. Initiatives regarding the first type consists of supporting a bio-based material, while the second type consists of initiatives supporting non-ecological products, such as a sustainable concrete mixture. Reddy (2004) stressed the need for optimum utilization of raw materials and available energy resources to produce simple, environment friendly, energy efficient, and sustainable building alternatives and techniques to satisfy the increasing demand for houses. To capitalize on different themes such as modularity, design for dismantling, and the

housing shortage, the third type consists of *sustainable building concepts*. Finally, construction and demolition waste is a major challenge for the construction industry due to the increasing volume of waste produced and its associated environmental impacts (Ruiz et al., 2020). Due to this, and to respond to the themes focusing on recycling, *demolition initiatives* are the forth type of initiatives this research considered.

3.2 Research design

The aim of this study is to identify barriers, small wins, and propelling mechanisms on the niche- and regime-level of the MLP, which could amplify the sustainability transition in the construction industry. Therefore, a qualitative research design is used in this research to obtain detailed data and in-depth insights (Bryman, 2012). Following Ketokivi and Choi (2014), qualitative research is described as an examination of concepts and their meaning and interpretations in specific contexts of enquiry.

The small wins approach as described in theory forms the theoretical basis of this research and different initiatives and small-scale solutions are analyzed according to this theory. This research namely uses the barriers, characteristics of small wins, and the propelling mechanisms based on which an initial coding scheme and relationships between codes are determined. This approach has often been referred to as deductive category application (Mayring, 2000). Moreover, new phenomenon, which are not covered by the used theory or the initial categories, will be included in the coding scheme by open inductive coding.

3.3 Sampling and data collection

The sample of initiatives is based on a purposive sampling strategy, which was used to identify and select the initiatives solutions for further analysis. Purposive sampling aims to sample cases in a strategic way, so that those sampled are relevant to the research questions (Bryman, 2012). First, the scope of the research was narrowed by identifying potential initiatives and small-scale solutions. Additionally, these initial initiatives were then used to establish contacts with other relevant small wins, which is a form of snowball sampling (Bryman, 2012). By doing so, more general conclusions can be drawn for niche-level actors and increases the external validity. The scope of the research was limited to bottom-up innovations which contribute to lowering the GHG emissions of the Dutch construction industry. The focus was chosen because of the mission-oriented innovation approach of the Dutch government and the knowledge and innovation themes of the KIA-CE, for which small-scale solutions can be relevant to achieve the goals set out in the strategy.

After limiting the scope, desk research was used to identify relevant initiatives. Data sources such as Google, Google Scholar, and Nexis Uni were used to find initiatives. Because of the empirical case of the Dutch construction industry, search terms in Dutch were used such as ‘duurzaam bouwmateriaal’, ‘duurzaamheid AND bouw AND start-up’, ‘ecologisch bouwmateriaal’, ‘recycling AND bouw’, and ‘modulair AND bouw’. As a result of this, a set of 42 initiatives were found which could become potential small wins.

As a second step of data collection, qualitative semi-structured interviews were conducted. By combining the desk research and the interviews, data triangulation could be ensured to increase the validity of this study and to provide multiple perspectives of the phenomena under study (Renz et al., 2018). Data collection was finished when theoretical saturation was reached (Bryman, 2012). This meant that similar or even repetitive answers were given by the interviewees in regards to the experienced characteristics, barriers, and propelling mechanisms.

As a result of this sampling and data collection process, detailed data on sixteen niche initiatives was acquired. The initiatives are shortly characterized in Table 4. Important for the interviews was that all the interviewees were the founders of their initiatives or innovations, or had sufficient knowledge

about the initiatives or innovations to give information on their growth and development. In this way, the most comprehensive view on the development of the initiatives was obtained. The abbreviations in Table 4 are used to refer to each initiative in the results section.

For the interviews, an interview guide was established based on the theory on small wins, barriers, and propelling mechanisms. The interview guide is shown in Appendix 1. The questions were asked in a semi-structured way, which allowed the interviewer to vary the sequence of questions. In addition, it provided the interviewer some room to ask further questions in response to what were seen as significant replies. An iterative process was applied through the open-ended, discursive nature of the interviews, whereby specific topics identified by earlier interviews were able to be adopted and used in later interviews.

Table 4: Initiatives under study

Type	Abbreviation	Short description of initiative
Ecological building materials	A1	Construction company which developed a insulation materials made of cattail.
	A2	Production company which produces insulation material and façade panels made of cork.
	A3	Start-up which developed an insulation materials made by fermenting agricultural biomass with mycelium.
	A4	A design studio which focuses on biobased materials and which developed a material for 3D-printing made out of a residue from sewage and drinking water treatment.
Sustainable building materials	B1	Start-up which developed a paving element made out of recycled plastic.
	B2	Production company which produces a lead substitute for roofing made out of recycled polyvinyl butyral.
	B3	Production company which produces lignin from miscanthus for the substitution of bitumen in asphalt.
	B4	Company which developed a geopolymmer technology and produces a binder made out of mineral residues as alternative for cement in concrete.
Sustainable building concepts	C1	Construction company which applies an ecological construction philosophy within their building concept.
	C2	Construction company which focuses on modular building concepts and applies recycled materials.
	C3	Organization which serves as a knowledge center for construction with straw.
	C4	Construction company which focuses on modular housing modules made out of primarily CLT.
Demolition initiatives	D1	Demolition company which focuses on recycling through urban mining ¹ .
	D2	Company which developed a new technique to recover sand, gravel, and cement from concrete rubble.
	D3	Demolition company which focuses on recycling and produces different products from recycled material.
	D4	Consultancy company which counsels on reusability and recycling.

To make the concepts discussed in Chapter 2 observable, an operationalization of the characteristics of the small wins, the types of barriers, and the six propelling mechanisms was established. The indicators are derived from theory and were used to guide the coding of the interviews. Niche-regime

¹ Urban mining is the process of reclaiming compounds or elements from any kind of anthropogenic stocks, including buildings, infrastructure, industries, products (in and out of use), environmental media receiving anthropogenic emissions, etc. The stocked materials may represent a significant source of resources, with concentrations of elements often comparable to or exceeding natural stocks (Cossu & Williams, 2015).

interaction in regards to the MLP is translated in whether or not the other concepts are influenced or derived from one of the two levels. The operationalization of the small wins, barriers, propelling mechanisms, and on which levels these occur is shown in Table 5. A clear operationalization is necessary to increase the external validity and replicability of this research, and which can measure the investigated concepts (Bryman, 2012).

Table 5: Operationalization of main theoretical concepts

Level	Concept	Characteristic	Indicator
Niche-level	Small wins	Concrete outcomes	Visible result: e.g., tangible new product; implemented idea
		In-depth change	Radical new practice: e.g., change in routines, beliefs or values
		Moderate importance	Small-scale: e.g., start-up, existing only five years
		Positive judgement	Improvement of GHG emissions: e.g., lower GHG emission than conventional material/practice
	Barriers	Technical	Technical failures: e.g., technical developments to be made
		Financial	Need for subsidies Failure to qualify for financial resources Deviant financing models
		Regulatory	Policy interventions: e.g., refusal within procurement process; restrictions due to existing regulations
		Market	Motivations to change Developed needs and beliefs
		Cultural	Willingness to change Awareness
	Propelling mechanisms	Energizing	Energizing others Increase of trust
		Learning by doing	Multiple experiments Guided by previous experiments Multiple pitfalls
		Logic of attraction	Mobilization of resources
		Bandwagon	Application and imitation News acknowledgement Copying good practices
		Coupling	Connections across scales Collaboration with other actors
		Robustness	Numerous Non-stopable Internalized behavioral change Examples of resisted opposition
Regime-level			

3.4 Data analysis

All interviews were recorded and transcribed in order to analyze the data. The interviews were held in Dutch, because the interviewer and interviewees were all native Dutch speakers. The translation from Dutch to English was made during the coding process. The transcriptions were still in Dutch, but when coding started in the qualitative data analysis program ‘NVivo’, the codes were in English.

Qualitative content analysis was used to analyze the data derived from the interviews. Qualitative content analysis (QCA) is defined by Hsieh and Shannon (2005) as “a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns” (p. 1278). For qualitative content analysis it is the objective to systematically transform a large amount of text into a highly organized and concise summary of key results (Erlingsson & Brysiewicz, 2017). For this research, a directed approach of content analysis was used. A directed content analysis starts with a theory or relevant research findings as guidance for initial codes, with the goal to validate or extend conceptually a theoretical framework or theory (Hsieh & Shannon, 2005). The aforementioned operationalization represented the guidance for the initial coding. This has been described as the deductive component of this research (Potter & Levine-Donnerstein, 1999; Mayring, 2000). Any data that could not be categorized along the operationalization was given a new code; this is a component of inductive research (Hsieh & Shannon, 2005). In this regard, codes made inductively may have changed as more data became available and the study progressed (Bengtsson, 2016).

During the data analysis, a coding scheme based on the interview guide and the operationalization table was developed. By having the coding process guided by the coding scheme which included explanations of the codes, cognitive changes during the process of analysis was minimized, resulting in an improvement of the internal reliability (Bengtsson, 2016). During the coding, the constant comparative methods (CCM) was used. CCM is a procedure for evaluating qualitative data in which the information is coded and compared across categories, patterns are identified, and these patterns are refined as new data are obtained (Boeije, 2002). The analysis was conducted in several steps: first, the comparison of codes and categories was conducted within one interview. The consistency of the interview as a whole is examined by the comparison of different parts of the interview, with the aim to develop categories and to label them with the most appropriate code. By doing so, it is possible to formulate the core message of the interview (Boeije, 2002).

After this initial comparison, second, the interviews are compared with each other. By comparing fragments from different interviews that were interpreted as dealing with the same category, it is important that they have been given the same code, which is a form of axial coding (Boeije, 2002). Based on this comparison, the researcher was able to describe and further define the concepts. The aim of these comparisons is to further develop the conceptualization of the different categories. This cycle of comparison and reflection was repeated several times, until new interviews did not bring any new information to light that categories were described as saturated. Comparisons which were highly regarded and were often observed increased the internal validity (Boeije, 2002). An overview of all the categories and indicators observed from the coding, including how often an indicator is observed and referenced to, is showed in Table 6 in Appendix 2.

4. Results

In this section, the outcomes of the desk research and interviews are elaborated extensively. Desk research was used to identify niche initiatives by the characteristics of small wins to form a strategy for other niche initiatives to scale-up. Therefore, the characteristics of the small wins are described in section 4.1. The outcomes of the sixteen interviews that were held result in the observed barriers and propelling mechanisms. For niche initiatives to understand which barriers small wins had to overcome in order to create tensions with existing institutions and to eventually make a transition happen, the observed barriers are described in section 4.2. Finally, to examine whether the right propelling mechanisms are present to enhance the sustainability transition, the observed propelling mechanisms are described in the following section.

4.1 Description of the small wins under study

In this section, the small wins are described by their characteristics following Termeer and Dewulf (2019) as mentioned in Table 1. Per characteristic is described how the characteristic is observed in the empirical data by discussing the most observed indicators. The main results are concluded for each of the characteristics. Differences and similarities will be discussed in a conclusion at the end of each characteristic.

4.1.1 Concrete outcome

Weick (1984) argues that when people work for something concrete and experience a visible result from which they draw confidence, it heightens their interest in attempting a second victory. For that reason, it is important for small wins to go beyond ideas and promises.

The visible results of the various small wins can mainly be categorized as technical and process innovations. *Technical innovations* encompass the development of new building materials or the improvement of existing building materials by substituting one of the components, all with a focus on lowering the environmental impact. This is achieved through the small wins by either focusing on the application of biobased materials (A1, A2 and B3) or the application of waste streams (A4, B1, B2 and B4) or even a combination of both (A3). New tangible building materials are being produced, such as insulation materials made from cattail and fermented agricultural biomass with mycelium, facade panels and insulation material made from cork and paving alternatives made from recycled plastic. Additionally, existing materials are improved by the substitution of cement with mineral residues in concrete and are bitumen in asphalt being replaced by a biobased binder such as miscanthus. Consequently, the visible result of the technical innovations are tangible building materials which are already produced and offered to the market, with the concrete outcome of a proven lower impact on the environment compared to conventional building materials.

Process innovations are aimed at improving the environmental impact of the construction process or the demolition process of buildings. All small wins regarding the construction process focus on the integration of more sustainable building materials in their constructions such as biobased materials or waste streams as well. Additionally, in order to meet the housing shortage sooner and more simply, emphasis is also placed on efficient and modular construction of housing (C2, C4). For example, a modular floor plan is used so that it is easier to meet the different types of households with different expectations and requirements (C2). The visible results of these initiatives are building concepts made out of biobased materials such as cross laminated timber (CLT) or straw and recycled concrete. In addition to initiatives that solely produce a product, initiatives that construct focus on educating other organizations and parties as well. Certain initiatives provide advice on how to build with biobased materials, for example, and they share their expertise in this regard. As a result, the concrete outcome of this type of initiative, which is always aimed at reducing the environmental impact, is not always immediately visible. In addition to the visible results of their business practices, their advices and

knowledge sharing of their expertise on sustainable constructions is less visible, but has the same concrete outcome of reducing the environmental impact of constructions. The same applies to initiatives aimed at the demolition process. They develop visible new processes to make waste flows reusable and supply products made from recycled material (D1, D2 and D3), but also alternate this with advising other companies on how to deal with demolition projects or waste flows (D1, D3 and D4).

Sustainable building materials and building concepts are the main visible and tangible results of the small wins. These technical and process innovations have led to providing building materials and construction and demolition processes alternative to conventional products and processes, with the concrete outcome of their improved environmental impact. In addition, the sharing of knowledge of the initiatives aimed at the construction and demolition process also ensures that knowledge is disseminated in order to allow other actors to act more sustainably.

4.1.2 In-depth changes

When a change can be effectively realized with an approach that is already known to organizations, there is no point in keeping the change small. Instead, ambitious change should address tough issues requiring adaptation of existing cultures, dominant rationalities and customary practices (Vermaak, 2013). Therefore, the small wins have to be of second- or third-order change.

For the category of initiatives regarding ecological building materials the in-depth change is more visible than the other categories. Since the construction industry still mainly uses non-renewable raw materials, ecological building materials by definition already have a lead in terms of sustainability. The small wins try to distinguish themselves from each other by using ecological building materials that have not been used before or at least only on a small scale. *Radical innovations* are developed by developing products that have hardly been experimented with as building materials, such as cattail, cork or fungi for insulation material (A1, A2 and A3). These innovations can be seen as radical, as they break the routines of conventional manufacturers of building materials with the use of such materials that are hardly used or not used in the construction industry. Other radical innovations occur within initiatives which focus on non-ecological building materials through the application of unused waste streams. For example, a waste stream of car windows is used for the extraction of polyvinyl butyral to produce a lead substitute for roof applications (B2). Therefore, the in-depth change lies in the experimentation and subsequent application of alternative raw materials that can have a lower environmental impact. The initiatives move away from the ever more efficient production of certain products such as concrete and asphalt in order to create a lower environmental impact. The initiatives actually produce alternative products that contain a different composition and in which sustainable materials are given a more prominent role.

The in-depth change activated by small wins of sustainable building concepts is observed in multiple ways. A change that all have in common in contrast to traditional construction companies is that there is a focus on the use of more sustainable materials within their constructions. Nevertheless, an attempt is made to still be unique by applying a material that is not widely used in the entire construction such as straw (C3). However, what all try to distinguish themselves on is the process of constructing and the *change in beliefs* related to that. For example, an initiative that aims to create social housing and mid-rental housing focuses on the producers of semi-finished products within the construction process. They place the responsibility on these producers that they have to ensure that a semi-finished product should last approximately 50 years before they also have to recycle the product themselves, resulting in more sustainable semi-finished products (C2). This is a completely different way of working compared to traditional builders, where semi-finished products are mass-produced and the producers do not think about how to recycle them in the end. A completely different view and a change in beliefs about the production process of housing which goes beyond the application of ecological building

materials. Despite the fact that these kinds of initiatives are already running larger projects, it is observed that this has not yet achieved the intended in-depth change. Their clients remain less influential actors who recognize the change in beliefs, but the beliefs are still far from being shared by all regime actors.

Such a change in beliefs has also been observed in the initiatives that focus on the demolition process. All demolition initiatives have in common that they all clearly focus on promoting circularity within the demolition process. However, multiple initiatives endorse a change in beliefs within the process itself and in its relation to other processes in the construction industry (D1, D2 and D3). For instance, the construction process and the demolition process are still too often seen as two separate processes. While if the demolition process is already taken into account during the construction process, the demolition process can take place much more efficiently. Several initiatives try to spread such ideas within the industry:

"Those demolition companies know exactly when and why something can and cannot be reused. That knowledge should actually already be applied in the design phase of buildings, so that you can construct things now that can be reused in the future." (D4)

In-depth change is observed through radical innovations in product development that aim to have a lower environmental impact than current products. In addition, in-depth change is observed through the change in beliefs that are attempted in the field of construction and demolition of buildings, which are aimed at the integration of both processes to increase the reusability of materials. However, the in-depth change does not appear to have the desired impact yet.

4.1.3 Moderate importance

For people to effectively meet complexity and turbulence, small wins are mostly located at a micro or local level and should be moderate (Vermaak, 2013). Small wins should therefore take place at micro or local level and be of an intermediate nature.

The moderate importance of the initiatives focusing on building materials lies in the fact that when *local production* is applied or a *local product* is used, it is more likely to be taken up by the market. To apply materials relatively unknown for the construction industry as cattail, miscanthus or fungi, it involves a higher risk for potential clients when they use them. By producing locally or applying a local well-known material initiatives create a different incentive for clients to adopt the building material (A1, B3). The same applies for improving existing building materials. When just a minor element of an existing material is being replaced by a more sustainable alternative, the magnitude and risk of the change is less, so it is accepted sooner. This is observed by the initiatives that replace the binder of asphalt or concrete with miscanthus and mineral residual, respectively (B3, B4). The original binder is not immediately replaced in its entirety, but the share of the sustainable alternative is *gradually* increased so that acceptance is smoother. By doing so, the moderate importance of the small wins related to building materials thus ensures that the more radical and complex innovations of the initiatives can first be adopted on a small scale and then scale up and increase in impact.

More in general, moderate importance is observed through the *tests and experiments* initiatives have to perform before applying their products and ideas on a larger scale. Since the ideas of certain initiatives differ a lot in material choice or process compared to the traditional construction industry, a lot of testing and experimentation is needed to build a certain form of credibility. For example, first model houses or pilot projects are carried out in which the application of recycled materials for the structure or the modular construction platform can be demonstrated on a small scale to show that it is reliable before it can be applied in larger projects (C1, C2 and C4). The same applies for a technique for the processing of concrete in such a way that the raw materials become available again and can

then be used to make new concrete. Before a significant investment was made to deploy the technique on a large scale, tests were conducted on a smaller scale to see if the technique was feasible (D2). This shows that the moderate importance of such initiatives is mainly in the start-up phase, but is rather important to be able to scale up.

As observed, moderate importance gives niche initiatives the opportunity to breed on learning processes which allow them to develop new rules and practices, and protects them from market selection. The analysis shows that by focusing on local materials or local production, the relatively radical developments of niche initiatives are more easily accepted and yet protected from influences from the socio-technical regime. As soon as the sphere of influence is entered, as the initiative with the innovation on concrete showed, it can be advantageous to introduce the radical innovation gradually in order to create as little resistance as possible and stimulate the adoption of the innovation. Frequent testing and experimentation can also help in eventually being able to apply the innovations on a larger scale.

4.1.4 Positive judgement

People tend to accumulate positive traits and processes (Termeer & Metze, 2019). Moreover, positive results lower existing resistance in all its forms and usual opponents become discouraged by them (Weick, 1984). This research builds on Urpelainen's (2013) argument to label small wins as positive if they contribute to limiting climate change by formulating it more precisely as contributing to the reduction of GHG emissions compared to the conventional product or process. No distinction is made here in whether an initiative directly or indirectly contributes to it. Logically, this should further improve the sustainability of the construction industry.

In general, ecological building materials already contribute to lowering GHG emissions because they are biobased, which means they have a short growth time compared to fossil materials and they retain CO₂ instead of emitting it (A2). In addition, it is possible to produce certain biobased materials locally (A1) or to produce them using residual biomass flows (A3). An indirect way of contributing to the same positive results, is providing room for the development of such biobased building materials (A4). Small wins that the initiatives regarding sustainable building materials contribute directly to happen to be positive because of their decrease of environmental impact as well. In some cases this is achieved by using undefined waste streams (B1, B2) or by replacing the most polluting part of an existing product with a sustainable alternative (B3, B4). For these small wins it is clear that they are positively judged for their *improvement on the environmental impact* compared to conventional building materials.

For both the sustainable building concepts and the demolition initiatives, because they are positively assessed, more companies want to go along with their sustainability vision. And why they are rated positively is because they view the building process significantly differently from current methods. For example, responsibilities are shifted during the construction process where the producers of semi-finished products are responsible for their products over a longer time period (C2). By doing so, these producers are made more aware of the sustainability of their products, resulting in an improvement of the sustainability of the construction itself. In addition, attempts are made to link the design and demolition phases so that the material circle is closed (D1, D4). Many different parties are involved in achieving this, which must adopt this philosophy. These initiatives are positively judged because their *impact on sustainability can be of great value*. By making not only themselves more aware of sustainability, but also the related companies within their process, the sustainability of the entire construction increases even more.

The small wins under study are often described as positive as they often emphasize in their marketing that they are more sustainable than conventional building materials or concepts. Nevertheless, this is confirmed by the fact that competitions and awards are being won. It is observed that these prizes and

awards are increasingly made available from actors from the regime. In addition, it has been showed that this is a method for small wins to bring in further resources. In that sense, being positively judge can be crucial for small wins to gain interest.

4.1.5 Overview of observed small wins characteristics

A few important interlinkages between the characteristics of the small wins became clear. Moderate importance is experienced as important to come to innovations which are very different in composition and beliefs to the products and business practices of conventional actors. By operating at a local or small scale, the small wins stayed protected from market influences and could therefore develop changes from a higher order. Besides that, concrete outcomes are important to eventually become positively judged. Therefore, small wins have to go beyond ideas and show visible results. To summarize the observed indicators and examples regarding the characteristics of the small wins, a summarizing figure is presented in Figure 1. In this, the observed indicators from the empirical data are described with a concrete description, so that it is easier for other niche initiatives to adopt these characteristics.

Characteristics	Observed indicator	Empirical example
Concrete outcome	Technical innovation	Tangible material and product innovations regarding building materials
	Process innovation	Innovation on the construction and demolition process through a focus on biobased materials and circularity
In-depth change	Radical innovations	Material innovation through application of unknown biobased materials and unused waste steams
	Change in beliefs	Persuading the use of biobased materials and shifting responsibilities within the construction process.
Moderate importance	Local product(ion)	By producing locally or applying a local product, risk can be taken because there is another incentive
	Change gradually	Making a small adjustment or allowing a change to take place gradually can accept the change more easily
	Tests and experiments	Credibility can be gained by first testing and experimenting with the ideas before application on large scale
Positive judgement	Improved environmental impact	Material and product innovation leading to improved environmental impact relative to conventional building materials
	Influencing others	Include others in their beliefs about sustainability so that a greater impact can be made

Figure 1: Observed characteristics of small wins

4.2 Analysis of barriers

Following Amabile and Kramer (2011), positive experiences can easily become overshadowed by negative ones. Deep change requires therefore as well problematizing of that which hinders change as reinforcing that which facilitates it. It is essential for small wins to face resistance, understand the

resistance, and eventually to overcome the resistance (Termeer & Metze, 2019). Resulting from the empirical analysis, the experienced barriers are described per type of barrier. First, the most crucial and substantial barriers will be discussed such as the technical, financial and regulatory types. Next, the barriers observed to a lesser extent will be discussed, the market and cultural barriers.

4.2.1 Technical barriers

Technical barriers are experienced by almost all initiatives. The most often experienced technical barrier is the *dominant market conditions and requirements* for building materials. The initiatives related to the production or development of building materials all experience this barrier. This is due to the existing standards and certification procedures for building materials set by the market. For example, initiatives focusing on ecological building materials argue that most of the standards and certification procedures are not compliant with ecological or biobased materials. These are often based on and developed for the already existing, often linear materials, and it becomes difficult for the more sustainable and circular materials to pass the associated tests:

"You have to go through a circus of certification before you can use your products. Existing standards are often been developed for fossil-based products and behave a little differently than biobased products." (A1)

An additional example is the initiative which produces a paving alternative based on recycled plastic which competes with existing paving methods such as asphalt (B1). They argue that existing standards and certification procedures are mainly focused on the testing of the durability, deformation and hardness of asphalt methods. Their product, which is made from recycled plastic, reacts very differently, but that does not mean that the quality is not sufficient or that it does not last for 50 years. The way of testing for such materials does not yet exist in that context, which delays the marketing of such products. The same applies to more initiatives that come onto the market with a new and unknown product, which means that they have to adjust the standards themselves or even set them up completely:

"You have to look closely at regulations, that can be an obstacle for your innovation. Because, for example, I am launching a completely new product on the market that companies are not familiar with in the construction industry. Well, then there is no test standard for that either, so you can set it all up by yourself." (B2)

The *quality of circular materials* is an additional observed barrier. This is observed in initiatives that focus on circularity, where waste streams are used for the production of new products or materials (A3, A4, D2 and D3). Market actors still have doubts about building materials obtained from waste streams. For example, certain building materials are not well taken up by the market because there are doubts about the quality of the product or whether the technical specifications are not the same as those of a completely new product. This applies, for example, to timber obtained from urban mining:

"Timber from urban mining has the lowest carbon footprint you can have, because it has already been produced, it can be de-nailed and then reused. So you and I understand it is better than linear timber. But the regulations say you cannot quantify that yet. Timber from urban mining cannot be traced, where does it come from? Is it FSC² certified? Because all building decrees state it must be FSC certified timber. (D1)

² FSC certification ensures that products come from responsibly managed forests that provide environmental, social and economic benefits.

In addition to the fact that the initiatives ultimately have to ensure that the doubts about the quality of their delivered product are cleared for the market actors, they have to deal with the varying quality of the waste streams they use. For example, an initiative that uses a mineral residual as a binder in concrete experiences a wider bandwidth of the quality of the waste stream, which means that it has to be checked with each batch whether the desired quality of the end product is achieved (B4). The same applies to initiatives that use biomass, a residue from sewage and drinking water treatment or recycled plastic (A3, A4 and B1). This means that initiatives aimed at circularity or applying circularity within their process must have a flexible production process and continuous checks must be carried out on the quality of their end product.

Finally, a barrier experienced by specifically the initiatives regarding the building concepts and demolition process is the *status quo* of the construction industry. A construction company specialized in timber and modular constructions experiences that people who are now trained in the construction process are all trained in the traditional process, while they force people to switch to a different work process (C4). They argue that there is a lot of intrinsic resistance and very few people are willing to adapt the current building process and the current work process to the new work process that is necessary. The same applies to a construction company that focuses on housing for housing associations and a construction company that focuses on constructions with straw, their production process are hard to adopt for traditional construction companies (C2, C3). Something similar is experienced by the initiatives aimed at the demolition process because contractors and architects do not think enough about the demolition process in the design phase. It turns out that parties of this kind do not yet have a need for the knowledge and the working method that should make it easier for demolition companies to demolish a structure in such a way that all materials can be reused again (D1, D4).

The dominant market conditions and requirements including the status quo within the construction industry are observed as developments caused by the socio-technical regime and make it harder for niche initiatives which focus on sustainability to enter the current market. Therefore, some initiatives have developed their own ways to meet dominant standards and certification procedures (B2, B3, and D2). For an industry, such as the construction industry, in which many processes are boarded up with standards and certificates, it is shown that it is crucial for niche initiatives to invest a lot of time and energy in obtaining such burden of proof for an innovative product to successfully market it. To prevent the current way of working within an industry having to change too much for the adoption of an innovation, niche initiatives must ensure that their production process or supply chain is as similar as possible to that of the current way of working. In addition to niche initiatives aimed at circularity, it is important that the quality of the end product can always be guaranteed independent of the quality of residual flow that is used.

4.2.2 Financial barriers

Financial barriers would mainly focus on being unable to proceed with the initiative or development of the ideas due to insufficient funding or that the adoption of the initiative is hampered by financially related reasons. However, only two of the initiatives experienced financial uncertainty in relation to the survival of their initiative due to high *costs to scale* (A3, D2). One initiative is mainly dependent on subsidies and prize money earned through competitions while still in the development phase of their innovation of a biobased insulation material (A3). They argue that it is not desirable for the long term to depend on this type of revenue and that larger-scale production requires investment as their production technique is quite new within the construction industry. The other initiative, which developed a new technique for processing concrete, experienced a similar barrier related to scaling (D2). Since they wanted their concrete to be competitive with traditional concrete and to reduce costs, production had to be as efficient as possible, which led to the need for large investments in new

machines. They eventually found such investments, but it does show that niche initiatives that require completely new production techniques must look for investors in good time.

A barrier of a financial nature much more often experienced is that the *cost price of products or processes* of different initiatives is higher than their conventional alternative. For years, products and processes from the socio-technical regime have been produced more efficiently and effectively, which means that they have been able to significantly reduce the cost price. More sustainable alternatives that have only been conceived, developed and actually produced in the past few years are relatively expensive because efficiency has not yet been achieved. This applies, for example, to the insulation material of one of the initiatives, which is made from cattail (A1). Because the cattail is merely cultivated on a small scale by a number of farmers, the cost price of the cattail itself is already considerable. The same applies to the production and cost price of miscanthus, which is used by an initiative as a replacement for bitumen (B4). In contrast, bitumen is a residual product from the oil industry and has been used for years, resulting in a significantly lower cost price. A more process related observation of the barrier is that of the initiative developing a paving alternative (B1). While the asphalt industry has been optimized for decades on the basis of efficiency and more recently also in the field of sustainability, the production process of the paving modules made of recycled plastic is still in full development. This is one of the reasons why the initiative is not yet able to compete on price with traditional paving methods. It turns out that the cost price of many initiatives is a crucial barrier to compete within the socio-technical regime and this is emphasized several times:

"The biggest barrier you have is just purely the price." (D1)

"The price has to drop drastically to make it more competitive with existing alternatives." (B1)

Additional to that is the *price-oriented nature* of the socio-technical regime. The traditional construction industry is very price driven and as one of the demolition initiatives claims is that if they want to compete they must first focus on price and duration of their products (D1). After that, sustainability eventually becomes important. Furthermore, one of the construction companies which focuses on timber constructions argues that the short-term focus on cost still seems more important than the long-term focus on health and climate (C4). Timber constructions still appear to be more expensive than traditional concrete and steel constructions, for example due to the large fluctuation in the price of timber. Since costs play such an important role within the construction industry for the further adoption of innovations, certain small wins consider it as crucial and try to counter it by continuously benchmarking their own costs with those of traditional alternatives (C2, D1).

However, cost price evolution is characteristic of any innovation where the costs are higher at the beginning, but the more efficient production can be and the higher sales, the cost price will decrease. The same applies to innovations related to sustainability, but it is partly up to the government how quickly sustainable alternatives are adopted within the socio-technical regime. Based on this, another barrier is identified, namely a *lack of governmental directionality*. Multiple initiatives have their own ideas on how the government can intervene. Most ideas boil down to the idea that sustainable innovations should have some financial advantage over traditional alternatives. It is suggested, for example, that if something is not circular, a heavier financial burden should be imposed (B2). The initiative regarding straw constructions cites the example with the mandatory gas connection in Dutch homes, where it was also decided from one moment to the next that new homes may no longer have a gas connection (C3). They propose that the same thing happens in relation to the construction method desired by the government. Finally, two initiatives also believe that their products should benefit from the fact that they store CO₂ due to the application of biobased materials, which could be achieved with carbon accounting (A1, B4). This shows that, according to several initiatives, financial benefits are necessary for the faster adoption of their innovations.

The most crucial observed financial barrier for niche initiatives is the cost price of their products and processes which can hamper the uptake of their innovations. This barrier becomes even more crucial in a cost-driven socio-technical regime, such as the Dutch construction industry. Initiatives try to overcome these barriers by focusing on the minimalization of the cost price (A3, B1), or by benchmarking their cost price to conventional alternatives (C2). In general, it is important for niche initiatives to have a low cost price so that a possible threshold as cost price can in any case be eliminated or prevented. It can therefore be important to make a good inventory of what competing products have for costs, which can serve as a guideline as well. Nevertheless, the government can take a more supportive role in achieving its sustainability goals by offering financial benefits to small wins related to sustainability.

4.2.3 Regulatory barriers

The transition from a linear economy to a circular economy requires the development of new regulations which need to be aligned to circular and sustainable principles and practices (Fischer & Pascucci, 2017). The empirical data shows that the Dutch construction industry is lacking at this domain. For example, there are still *too minimal sustainability requirements* set within the legislation and regulations related to the construction industry. the Dutch Building Decree³ and the Concrete Agreement⁴ have a major impact on the Dutch construction industry. Many initiatives note that these documents encourage little to no innovation in the field of sustainability and are considered as the minimum that structures must meet and therefore do not impose high requirements (C1). As an example of why the Concrete Agreement does not stimulate innovation, the three concrete-related initiatives cite the same example (B4, D1 and D2). The Concrete Agreement states that a minimum of five and a maximum of 30 percent concrete granulate may be used for new concrete, while all three initiatives can do more than 30 percent without this being at the expense of the quality of the concrete. But because the Concrete Agreement still has to be complied with in every construction project, they cannot use an even more sustainable concrete mixture. The Building Decree is not very innovative because it always prescribes minimum requirements. So as soon as it requires that a certain minimum amount of CO₂ must be stored in every construction, there is no incentive to store more CO₂ than is required. This is especially experienced by sustainable construction companies that lack the incentives from legislation, which give their sustainable constructions an advantage over traditional builders (C1, C2). A more concrete example of a demolition company is that of the constantly changing prescribed heights of frames and doors, resulting in old frames and doors not being reused (D1).

An important process within the Dutch construction industry is that of public procurement based on the amended Dutch Public Procurement Act. To stimulate the market for sustainable products the Dutch government set up the Dutch Sustainable Public Procurement Programme, which encompasses the guidelines and criteria for taking into account environmental and social aspects in all public procurement or tendering processes (Melissen & Reinders, 2012). However, the empirical case shows that the *incentives within the procurement process* to increase sustainability are still perceived as too limited. For example, a timber builder experiences that as soon as they compete with traditional builders, little value is given to aspects such as circularity, CO₂ storage and biobased materials (C4). Decisive criteria are often still price and efficiency. The initiative that uses miscanthus in asphalt experienced a similar case in which high sustainability requirements were set in a tender, but the municipality in question subsequently opted for CO₂ compensation via solar panels (B3). Several initiatives experienced similar cases within tenders (B1, B4 and C2), considering the barrier as

³ If you plan to refurbish, build, demolish or occupy a building, you must comply with the Building Decree 2012. This decree contains the technical regulations that represent the minimum requirements for all structures in the Netherlands.

⁴ The Concrete Agreement is an agreement between market parties, public and private clients and the government to make the concrete sector completely sustainable within ten years.

significantly hampering the uptake of small wins. The Dutch government should consider reviewing their approach to public procurement to see if it is delivering the desired result.

Subsequently, it is important for the Dutch government to clarify how sustainability is measured. It is experienced by many different initiatives that there is no unambiguous *way of measuring sustainability*. It mainly comes down to the fact that there is still a lot of uncertainty about how sustainability is measured and that there are currently many contradictions in the various measurement systems. At the moment, the MPG⁵ and the MKI⁶ score are often considered important, which base much of their data on the Dutch National Environmental Database⁷ (NMD). However, the database is assessed as incomplete and in some cases incorrect by various initiatives (B3, D3 and D4). For example, an initiative claims that the reuse scenario for CLT is now incineration, while this can also be included as reuse (C4). And that timber derived from urban mining cannot be applied because the environmental impact cannot be quantified (D1). As a result, there is still a lot of uncertainty about what sustainability is and about the ratio of sustainability. If this is made more clearly, it can also be better substantiated by governmental actors why they prefer one approach over the other. Subsequently, construction companies can respond better to this.

These regulatory barriers are crucial for determining the timeframe in which the government wants small wins focused on sustainability to scale and have more impact. Since the government, according to the observed small wins, can be such a determinant for them by paving the way for a more sustainable construction industry, they could do more by setting higher sustainability requirements. For example, more attention should be paid to the functional requirements of materials instead of material types. By focusing on the functional requirements of their products, some initiatives try to overcome such barriers (A1, A4, and B4). Sustainability transitions create conditions to reshape the way property rights, regulations, and laws are conceptualized, and ultimately to support and promote sustainable solutions (Fischer & Pascucci, 2017).

4.2.4 Market barriers

In line with the previously mentioned barriers are those related to the current market. For example, the current socio-technical regime is regarded as *conservative* and *risk averse* by the initiatives. Initiatives claim that there is sometimes too much emphasis on safety (A1), known materials are often preferred over unknown improved materials (B2), and the incumbents are very reluctant to innovate (A3, C4). One initiative argues that this is the basis for getting their innovation accepted only after two years (B2). According to a number of initiatives, the *lobbying of incumbents* plays a role in this, such as the concrete sector (B4, C1 and D2). They have invested for years in making their products and market as efficient as possible and it is therefore logical that they resist change. It is therefore important for niche initiatives to gain good insight into which aspects within a market are considered important, so that they can respond more precisely and directly.

4.2.5 Cultural barriers

To a lesser extent, a cultural barrier also contributes to the risk averse nature of the construction industry. According to some initiatives there is in a more general sense a notion of *trusting the present* in Dutch society. They claim that despite the socio-cultural development of the growing environmental

⁵ The Determination Method for Environmental Performance of Buildings and civil engineering works (Milieuprestatie Gebouwen) indicates the environmental impact of the materials used in a building and is mandatory for every application for an environmental permit.

⁶ The Environmental Cost Indicator (milieukostenindicator) is a single-score indicator expressed in euros and unites all relevant environmental impacts into a single score of environmental costs, representing the environmental shadow price of a product or project.

⁷ The National Environmental Database (Nationale Milieudatabase) was set up to provide a uniform calculation of the environmental performance of buildings and civil engineering works in the Dutch context.

awareness, many people still prefer the familiar, such as concrete and brick-finished houses (C1, C3 and C4). The *wrong image* of timber construction, for example, contributes to this. Initiatives argue that some people are still convinced that timber construction is not fireproof, and wonder whether there are enough trees and whether there is sufficient soundproofing. Educating society can therefore also be an important development in the adoption of niche initiatives.

4.2.6 Overview of barriers experienced by small wins

It turns out that the different types of barriers cannot be seen separately from each other. For example, it becomes clear that market barriers can lead to barriers from other types. The risk averse nature of the market can have caused the dominant market conditions and requirements, which means that small wins have to test and experiment a lot to meet standards and certifications. In addition, the too few sustainability requirements and incentives lead to the disadvantage of small wins in term of cost price, or to the fact their innovations are not applied yet on large-scale projects. On the other hand, various initiatives have used their creativity and flexibility to overcome some barriers.

To get a better overview of all the experienced barriers and examples regarding the small wins, a summarizing figure is presented in Figure 2. In this, the experienced barriers from the empirical data are described and are listed in order of importance in regard to the small wins. By doing so, other niche initiatives have better insight into what can await them in similar sectors and they can better respond to this.

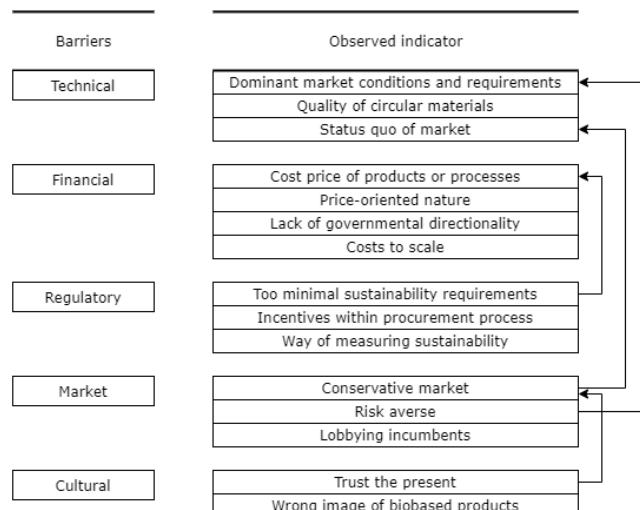


Figure 2: Overview of experienced barriers by the small wins and their interlinkages

4.3 Propelling mechanisms

This section describes the propelling mechanisms observed by the empirical analysis that caused the appropriate small wins to be triggered. To assess the involvement of the small wins to progress in the sustainability transition of the Dutch construction industry, it is vital to analyse whether they are accumulating and scaling, broadening or deepening (Termeer & Dewulf, 2019). Per propelling mechanism it is described how the mechanism is observed in the empirical data by discussing the most observed indicators. The same applies here as for the section on the characteristics of small wins that differences and similarities are discussed at the end of each mechanism in the form of a conclusion.

4.3.1 Energizing

Energizing is the first propelling mechanism and is directly linked to the first characteristic of small wins, namely the concrete outcomes of them. The concrete outcome of a single small win ensures that people become enthusiastic and positive. The excitement this creates that a small win is achievable

makes people immediately look for the next small win, which can result in a positive virtuous cycle (Weick, 1984; Termeer & Dewulf, 2019).

The most obvious way for the niche initiatives from the empirical case is to *emphasize the sustainability benefits* of their innovations. The initiatives therefore emphasize in their communication how sustainable they are compared to traditional alternatives. For example, various small wins show that they emit a percent less CO₂ compared to a traditional material (B3, B4 and D2), emphasis is placed on the application of biobased materials (A1, A3 and C3) and circularity is often mentioned in external communication (D3, D4). They do this to show the advantages of their product or process compared to alternatives and to convince people and organization to work with them.

More generally, *increasing trust* is a commonly observed mechanism to energize others. Trust can be important to attract more customers for your product or to enter into partnerships with different parties (D3). In addition, the trust of local authorities and recognition of your work can also ensure that trust in an initiative increases, which has positive consequences (C1). Trust can also be gained in unusual ways. As soon as there is little confidence in a product in the Dutch construction industry, you can go to other markets or sectors where there is less doubt about the quality of your product and then return to the construction industry with an achieved track record (B2). A channel that is experienced by several initiatives as important for energizing others and increasing trust are trade fairs (A3, B1, B2, C3 and C4). For example, scaling was even experienced by a small win when there was little interest in their ideas at the first participation on a trade fair, but two years later there was not enough room for all interested parties at the same fair (C1). Increasing trust can eventually lead to other companies accepting the small win and new small wins can arise through collaborations or interactions.

A lesser known indicator for the mechanism of energizing in the existing literature is *educating others*. It is experienced through various initiatives that as soon as people or organizations are taught something about an innovation, they can better understand the innovation and only then become enthusiastic. In some cases, the initiatives experienced this as a crucial step for increasing enthusiasm. As an example, two construction companies, one focused on timber and the other on straw, noted that many private individuals, contractors and architects have too little knowledge about building with such materials (C1, C3). They could therefore not become enthusiastic before they knew more about what is possible, what advantages it has and how they can apply it. Another initiative focused on construction also experienced this with its subcontractors, where they first had to be taught a little more about sustainability before they wanted to collaborate with the initiative (C2). Demolition companies also have certain knowledge that they have to share with construction companies and architects about making structures reusable before getting them energized (D1, D4). Educating other companies therefore leads in some cases to enthuse those companies, so that the small win can potentially accumulate or scale.

An additional way to educate others is shown by some initiatives through *leading by example*. Initiatives regarding ecological building materials try to distinguish themselves and energize others by showing what can be done with relatively unknown biobased materials such as cork and biomass in combination with mycelium (A2 and A3). The initiative that uses cattail for insulation material emphasizes as well that with their product they want to show what is possible with relatively unknown biobased materials, in the hope that other companies will try out other unknown materials (A1). For the construction company, which gives subcontractors new responsibilities, such as being able to guarantee that their semi-finished products last longer, they also try to take the lead and encourage the subcontractors to become more sustainable (C2). So by taking the lead and acting as a source of inspiration, other niche initiatives can be energized to become a small win as well.

In this empirical case, the initiatives mainly use the benefits of sustainability and trust as means to energize others. By emphasizing those sustainability benefits, the initiatives show that things can actually be more sustainable in various areas within the construction industry. This confirms the existing literature on small wins, where for example Termeer and Metze (2019) argue that the energizing mechanism implies increased commitment to the initiative and increased mutual trust. An additional instrument to create trust or energize others that has not been described in detail before in literature on small wins is educating others. Educating others is considered a necessity in the empirical case for being able to enthuse the ignorant. For niche initiatives that come with innovations, it is often the case that new knowledge has been gained. In order to convince people that their innovation is a positive development, they must first be able to acquire this knowledge.

4.3.2 Learning by doing

Whether a small win is successful or not, each attempt will result in new ideas (Termeer & Metze, 2019). This is called the learning by doing mechanism and is abundantly discussed in literature as crucial in transition processes (Hekkert et al., 2007). Small wins test the resistance and opportunities they experience and while doing that they expose both resources and barriers that were not visible before.

Technical development is crucial for the material related initiatives. In order for the product to meet the requirements of the market, the production process and technological properties must be continuously adapted and improved. This is reflected by various initiatives that, through *testing, lab tests and pilots*, find out what the quality of their product or construction is and whether improvements still need to be made (A3, C2 and C4). For a number of initiatives, the quality of their product also depends on the waste stream they use. Because the waste stream is not consistent in quality, the initiatives must continuously test and iterate their product or production process (A4, B1). Some initiatives have the facilities to perform such product tests in-house:

"Yes, we have been testing extensively. Not only in the climate chamber, but also fire tests, for example. And mock-ups of complete walls have also been made, well they can't go in and that is at the back of the company's premises, so we did all that in-house." (A1)

For building concepts or demolition related initiatives, testing and pilots have an impact on the success or failure of the initiative because they deal with new forms of constructing or demolishing and collaborations within these processes. Whether constructions based on recycled materials or CLT and demolishing methods based on circularity are feasible or not can be decisive for whether or not the initiatives succeed (C2, D1, D3 and D4).

One way to learn from your product or process and to test whether it is satisfactory is by generating feedback from various organizations. For multiple initiatives it is observed that *feedback guides the development* of the initiatives. Feedback is obtained in several ways by the initiatives. To accelerate learning, the initiatives of all categories generate testing through pilots and field labs (A3, B1, B4, C2 and D2). In certain cases, this is facilitated by means of competitions and contests in which resources can be won to allow initiatives to develop further (A3, B1). This is often set up and funded by actors who come from the socio-technical regime, such as large construction companies or government agencies with whom they want to stimulate innovation within the construction industry.

For some initiatives it is difficult to find such organizations that are willing to give feedback or even difficult to find their first customers because their product is not yet considered good enough. These initiatives let themselves be *guided by previous experiments*. It has proven to be a solution for them to first present their product in another sector or market, build a track record and then return to the construction industry (A4, B2). In the early stage of development some initiatives experience this as

well. These initiatives therefore seek like-minded organizations which dare to take risk by trying out their products so the initiatives can test their product (A4, C1 and C3). Such organizations can have several reasons for choosing to do so:

"And that means from our perspective that you really have to look for the early adopters. Just be the first parties to say we are willing to give up some of the certainty we now have in order to be able to do more to bring in work, to be able to comply with future legislation or to be a leader because that is what we think we should be." (A3)

By continuing to experiment with the help of tests and pilots, the quality of the small wins continues to increase. In this way, the small wins can accumulate and deepen. There is an important role observed for actors from the regime to stimulate the learning by doing mechanism. On the one hand, it is a way to provide initiatives with resources of various forms and thereby stimulate the further development of small wins. On the other hand, it is a way of accelerating the small wins in such a way that they can be incorporated earlier in existing and saturated processes and markets. Despite Bulkeley and Castán Broto (2013) claiming that projects labeled as pilots or experiments that are limited in scope and time cannot lead to iterative processes of experimentation, this empirical analysis shows that such pilots and experiments are used to experiment extensively and are least an attempt to set up such iterative processes.

4.3.3 Logic of attraction

Because visible positive results of small wins guarantee more chances of success, resources tend to flow towards them, so that slightly larger wins can be attempted (Weick, 1984). Before initiatives can attract additional resources, they first have to be assessed as positive. This is done when influential actors, such as in this empirical analysis local governments or well-known construction companies from the established order, advocate a small win which creates credibility (Hekkert et al., 2007).

An important factor within the logic of attraction mechanism is gaining recognition through winning *contests, awards and competitions*. Many initiatives have participated during various development phases. However, it can have a different meaning or value for each initiative. For certain initiatives, winning a competition turned out to be of great importance to win financial resources since they were still in the start-up phase (B1, B2), for others it was important that a field lab could be acquired (A3), or even to win an entire construction project (C2). Winning such contests is, in addition to gaining credibility, a direct way to receive additional resources.

What can contribute even more is recognition by *influential actors*. Most of the contests and awards observed were set up by actors from the socio-technical regime, such as large established construction companies, Rijkswaterstaat, ProRail and various government agencies. Several initiatives claim that the recognition of such organizations brought more media attention to their initiatives (B1, C1, C4 and D2). Influencing actors can be of value not only through competitions or awards. Collaborations with leading organizations with an interest in an initiative (B1, D4) or by carrying out assignments for municipalities can also accelerate the initiative (B3, C4). Due to such developments, it is observed that initiatives receive public acknowledgement and gain credibility.

One way that has proven to be successful in obtaining material resources has been observed by responding to *predictable volume* and by *valuing unused waste streams*. By gaining insight into the fact that a large and predictable volume of certain materials or products will always be available, you can build a business case in which there will always be sufficient material resources. As an example the initiative which a waste stream of car windows uses for the extraction of polyvinyl butyral to produce a lead substitute for roof applications (B2). That polyvinyl butyral is hardly recycled or used in other products, but that waste stream is continuously producing. By showing that a new product can be

made, more organizations with the same or similar waste stream will come to the initiative. The same is observed for the initiatives producing products from recycled timber (D3), residues from sewage and drinking water treatment (A4) and recycled plastic (B1).

A less commonly observed way of obtaining resources, but which has proven to be effective, is to *build a track record* in another sector or country. What applied to a number of initiatives for the learning by doing mechanism is that they had difficulty finding organizations where they could test their product or process. However, for this mechanism it is also important to find such organizations to set up a track record and thereby create credibility for your initiative. One initiative first presented their product made out of a waste stream as a work of art in order to demonstrate the functionality of the innovation, before it was used in a construction (A4). Or what was experienced by another initiative was when there were doubts about the product in the Dutch construction sector because it consists of a residual flow. Subsequently, a track record was built up in other countries because the quality of the product was considered much more important there (B2). Therefore, it can be of great value for niche initiatives to look for other markets or sectors that accept and adopt the products or processes at an early stage, in order to build a track record and create credibility for the initiative so that it can still be applied in the desired industry (A4, B2 and D4).

As observed, receiving awards and winning competitions can ensure that small wins receive public acknowledgement and gain credibility. Influential actors are important in this regard, as they determine whether niche initiatives may be regarded as winners. More deviant ways of attracting additional resources are those of responding to predictable volume and by valuing unused waste streams, emphasizing the creativity small wins have to advantage. In addition, small wins can use their flexibility to build a track record in a different market or country than the desired one.

4.3.4 Bandwagon

The bandwagon effect resonates elements of the diffusion curve of Rogers (1983), including different types of adopters and the early majority. Because when small wins develop arrangements that circumvent barriers, they become example for other stakeholders and may inspire others to see what alternative products and processes can look like (Fischer and Pascucci, 2017; Reay et al., 2006).

It has been observed that the bandwagon effect is closely related to both the mechanisms of energizing and logic of attraction. Educating and enthusing others ensures that other initiatives are becoming energized. Receiving recognition from influential actors plays an important role in this as well. Partly because of this, other initiatives will start doing the same as those small wins. This is observed in different ways within the empirical case.

A number of initiatives have now noticed that their ideas are being adopted by other organizations on the basis of *imitation*. Two initiatives aimed at timber construction notice that through the fact that they have won several awards and are recognized by government agencies that they are seen as specialists in their area of expertise. They claim that partly because of this, various actors come to them to gather knowledge so that they can set up similar practices themselves (C1, C4). However, imitation does not have to mean literally producing the same product or performing the same process. It can also imitate the mindset or ideas of small wins. For example, small wins aimed at the application of residual flows experience that organizations where the residual flows come from want to improve their residual flow qualitatively as soon as it appears that this can improve the small win. Instead of considering the residual flow as waste, such companies imitate the idea of considering the waste as a raw material for new products (A3, A4 and B1). It is therefore important for small wins to be open to sharing their knowledge and experiences, so that other parties such as niche initiatives and actors from the socio-technical regime can adopt their ideas and beliefs.

While small wins focused on the demolition process also experience imitation, because many more demolition companies are focusing on circularity, some experience it more as *competition* (D1, D4). They claim that this is because demolition companies realize that there can be a revenue model for processing and selling products derived from demolition projects, with small wins as an example. Since this can be at the expense of their turnover, they see it more as a hazard. However, competition is not always perceived as a negative phenomenon. Small wins that come up with a relatively new product or development notice that they still have insufficient support to be able to apply their innovation on a larger scale (B3, B4). As soon as there are more companies with a similar product, awareness increases as well as the potential market. For this reason, competition can also be considered as stimulating for small wins, as it is also a form of the bandwagon effect.

With several small wins it has been observed that in the initial phase of their initiative they went looking for like-minded organizations to enter into their first collaborations or to make their first sales, these organizations are also called the *early adopters*. This often concerns companies that already have the same intrinsic motivation as the small wins to opt for a sustainable alternative (A1, B4 and C1). Certain small wins are therefore specifically looking for organizations that dare to take risks by trying their product (A3), or organizations who want to act as a launching costumer (B1), or who already see that it is necessary for the survival of their organization due to sustainability (B4, D2). Therefore, it can be advantageous for small wins to coop with like-minded organizations at an early stage of their initiatives.

What has not been observed is that the government plays a leading role within the bandwagon effect. The Dutch government can play a major role by setting the stage for more sustainable procurement or regulations. In this way, the small wins could have had more acknowledgment and credibility from the government as an influential actor. Despite that, the empirical case shows that the bandwagon effect can be a result of the energizing and logic of attraction mechanisms. Due to that, imitation and competition take place and sufficient organizations are found that adopt the beliefs and ideas of the small wins. It is therefore important for niche initiatives to seek recognition and then share their acquired knowledge with interested parties. After all, the small wins can benefit from it themselves as well.

4.3.5 Coupling

The coupling mechanism can increase the durability of small wins and can increase the chance of more radical change small wins potentially can create (Termeer & Metse, 2019). Even though the actions connected to small wins are often brief, specific, and localized, they can have a deterministic effect on many problem areas (Weick, 1984). Therefore, small wins can accumulate when they combine with events, scales or actors other than the initial ones (Reay et al., 2006).

Coupling appears to be important when niche initiatives try to make the greatest possible impact by *coupling with other problem areas*, within the domain of sustainability or even other social problems. Two initiatives aimed at modular timber construction mainly focus on a lower environmental impact on the one hand, but on the other hand also on solving the housing shortage by designing practical homes (C2, C4). While they focus on another problem in addition to sustainability, other initiatives emphasize that their initiative has an impact on various aspects within sustainability. For example, not only a reduction in CO₂ emissions is mentioned, but the problem surrounding poly- and perfluoroalkyl substances (PFAS), the shortage of raw materials or energy efficiency are included in their marketing as well (A1, A3 and C1). One initiative claims that they have also specifically focused on this in order to respond to as many different problems as possible and have also experienced immediate results due to this. Their paving alternative was focused on water storage, on the application of recycled plastic, they used sensors for testing, and wanted to make the replacing of pipelines easier (B1). Due to this broad focus, they received media attention and public acknowledge from actors regarding all these

different domains. Even resources were offered from such actors from which they could not have imagined beforehand that these actors were also interested. That is why it can be beneficial for niche initiatives as soon as several problem areas are addressed.

Other initiatives make *connections across scales* for diverse reasons. They do this mainly for their own benefit, for example to attract additional resources. For example, a number of initiatives work closely with the agricultural sector, as they apply biobased materials within their initiative (A1, B3 and C3). By entering into discussions with possible suppliers of their raw material, it turned out that small wins found out that they had similar problems. A concrete example is that farmers also have to deal with developments in the field of sustainability and have to respond to them. If they can help the small wins by growing building materials on their land, they would immediately respond to their own sustainability. Thus, by making connections with different sectors and supply chains, it can have mutual benefits and several small wins can benefit from it.

More generally, small wins can benefit from various *collaborations with other actors*. For example, knowledge institutions are considered important for many different small wins. Universities and colleges can share crucial knowledge with the small wins by doing research and experiments (A1, A3, B1 and D1). Because niche initiatives often have a relatively unknown innovation, these types of actors are interested in their knowledge. Other initiatives use knowledge institutions to carry out certain tests, since these kinds of actors have certain machines that are too expensive for the initiatives to purchase themselves (B3, B4). Institutions are also considered important that make the sustainability of products or processes of initiatives measurable and insightful by performing life cycle assessments, so small wins can distinguish themselves in that area from more traditional alternatives (B1, B3 and D2). By entering into well-considered partnerships, small wins can obtain additional resources, support other small wins and broaden themselves further.

In general, it is observed that coupling can be a supportive mechanism to energizing and the mechanism of logic of attraction. Small wins must collaborate with the right actors and have the right goals in mind with their initiative in order to receive more public recognition and additional resources. When small wins from different sectors and problem areas find each other at the right time, the chance increases that radical change can be achieved.

4.3.6 Robustness

When initiatives have become so numerous and legitimatized that returning to the initial situation is impossible, they are more likely to result in sustained change and that is referred to the robustness mechanism (Termeer & Dewulf, 2019; Termeer & Metze, 2019). When this point of no-return is reached, it is harder to dismantle. In this empirical case, that point can be reached as soon as biobased and circular products and processes are the norm within the construction industry. However, this will be difficult as barriers will increase the closer this point comes (Hekkert et al., 2007).

Based on the empirical data, it can be concluded that a point of no return has not yet been reached for the sustainability transition. Despite the fact that many initiatives are experiencing an increasing interest in sustainability, it is still only small developments that are being carried out. Many initiatives are still *struggling to win large-scale projects* (A2, B1 and B3). For example, initiatives aimed at sustainable building concepts still struggle to compete with traditional construction companies in all major construction projects (C2, C3). They argue that there are still too many barriers, such as price, and too few incentives regarding sustainability requirements to give more sustainable initiatives an advantage over traditional construction companies. For some initiatives, it also remains to the early adopters and prestige projects (A4, B4).

In addition, some initiatives claim that sustainability is not the *only urgent social problem*. Some initiatives think that, for example, the housing shortage is considered more urgent by the government and that sustainability is therefore not taken into account to the extend it should be (B3, C3 and C4). They claim that by wanting to build houses at a rapid pace, there is even more reliance on existing and much more efficient building concepts. And this is not always possible in combination with the most sustainable solutions.

Generally, the empirical case shows that sustainability is still not the norm within the Dutch construction industry. Niche initiatives which focus on the improvement of the environmental impact of building materials or construction processes experience too many barriers to fully compete within the socio-technical regime. There are still too few incentives for the full adoption of these types of small wins. It depends on the actors within the socio-technical regime how urgent they find the problem and what tools they will use to accelerate the transition.

4.3.7 Overview of activated propelling mechanisms

It becomes clear that one propelling mechanism can be of great importance to activate other propelling mechanisms. For instance, small wins coupling their innovation to other problem areas can activate or trigger the energizing and logic of attraction mechanisms. The activation of these mechanisms can activate the bandwagon effect, which can increase the imitation or competition of a certain innovation.

Compared to other papers on small wins, such as Termeer and Metze (2019), both similar and different indicators are observed. Energizing and learning by doing within the Dutch transition to a circular economy are observed as important as well. Termeer and Metze (2019) found that enthusing others and testing can accelerate small wins, which is also the case in the Dutch construction sector. The bandwagon effect is differently observed than in the empirical case of this study. For the transition to a circular economy it was found that other actors and initiatives followed the focus on circularity, once some key actors had signed a covenant on circular economy (Termeer & Metze, 2019). Such showcasing of good examples still lacks in the construction industry, where the Dutch government should set an example of. Similar to the construction industry, was how coupling was observed within the empirical case of Termeer and Metze (2019). Small wins were stimulated when they coupled with other societal problems. In addition, the transition to a circular economy was not yet observed as robust due to a lack of internalized behavioral change, which is similar to the construction industry as well.

Regarding the niche-regime interaction, it is observed that for the energizing mechanism, it is important that niche initiatives educate actors from the regime. In order for regime actors to become convinced of the need to apply more sustainable products and business practices, they must first be able to acquire knowledge on more sustainable alternatives. For the learning by doing and the logic of attraction mechanisms, it appears that regime actors can use these mechanisms to influence the timeframe in which niche initiatives are further developed and incorporated. By making the right resources available, niche initiatives can scale up faster. The Dutch government can also play a greater role in this within the construction industry.

To get a holistic view of which propelling mechanisms were activated to accelerate the investigated small wins, Figure 3 is presented below. By doing so, an overview is given of whether the right propelling mechanisms are present in order to accelerate the sustainability transition.

Propelling mechanisms	Observed indicator
Energizing	Educate others Emphasize sustainability benefits Increase of trust Leading by example
Learning by doing	Tests, labs and pilots Feedback guides development Guided by previous experiments
Logic of attraction	Contests and awards Influential actors Predictable volume Value unused resources Build up track record
Bandwagon effect	Imitation Competition Early adopters
Coupling	Coupling with other problem areas Collaboration with other actors Connection across scales
Robustness	Large-scale projects Other urgent social problems

Figure 3: Observed activated propelling mechanisms

5. Conclusion

Achieving the targets set by the Dutch government to have a carbon-free built environment and a carbon-neutral industry based on the re-use of raw materials and products by 2050 requires a more intensive approach to actually realize a sustainability transition. This study analyzed the sustainability transition within the Dutch construction industry through the MLP and zoomed-in on the micro-level of small-scaled niche initiatives with the application of the small wins approach. This study introduced the combination of MLP and small wins into the construction industry field to systematically analyze small-scale solutions, which are qualified as small wins, in the sustainability transition issue of the Dutch construction industry by answering the following research question:

How can “small wins” amplify the sustainability transition of the Dutch construction industry?

To develop an answer, a qualitative research strategy was used by conducting desk research and interviews with niche initiatives that focus on improving the sustainability of the Dutch construction sector. The initiatives were selected on the basis of the characteristics of small wins. By doing so, this study scrutinized the niche-regime interaction by identifying niche initiatives that contribute to the sustainability transition by the characteristics of small wins, distinguishing which barriers were hampering the sustainability transition, and discovering the activated propelling mechanisms which accelerated the transition.

To achieve this, three sub-questions were proposed. The first sub-question concerned how small wins can niche initiatives help to grow in the construction industry. By identifying small wins by their characteristics, a strategy is formed for other niche initiatives to grow. The results show that niche initiatives seem to meet certain expectations in order to be described as small win. They have to realize technical or process innovations that are actually developed and lead to visible results. It has been observed that by producing product innovations or by applying sustainable building concepts, and by disseminating their knowledge in order to allow other actors to act more sustainably, more environmental friendly products and business practices are being taken up by within the Dutch construction industry. This case study shows that in order to meet the characteristic of in-depth change, moderate importance is essential. Niche initiatives must be of moderate importance by operating at a local level or on a small scale to be able to perform radical innovations. Because they remain protected from influences from the socio-technical regime, they can more easily realize second- and third-order changes. The last characteristic is crucial for small wins in regards to the sustainability transition. Niche initiatives must contribute to the sustainability transition and be positively assessed in that sense. Once this happens, it can have positive effects on other niche initiatives. Small wins can help other niche initiatives to grow by setting an example of how to become positively judged and how to perform radical innovations by being of moderate importance. Small wins must share their knowledge with other niche initiatives in order to subsequently also see the joint impact on the long term.

The second sub-question addressed the barriers influencing small wins. The results indicate that barriers are caused by different actors, and interlinkages between types of barriers are found. Market barriers play an important role for small wins in the construction sector. Because the market is regarded as conservative and therefore risk averse, small wins on technology are made difficult to enter the market due to dominant market conditions and requirements and the status quo of the construction industry. This makes it important for small wins to provide timely insight into what the innovation that is applied must meet in relation to standards and certification procedures. Some initiatives have overcome such barriers by doing so, and used their creativity to meet such standards and certifications to increase their credibility. In addition, the market barriers lead to regulatory barriers such as a lack of incentives within the procurement process so that sustainability-related initiatives receive benefits. More in general, the results show that too minimal sustainability

requirements are set within the construction industry, which creates resistance to scaling small initiatives. This is observed as necessary for small wins to overcome other barriers as well. Additionally, the price-oriented nature of the industry is seen as a barrier leading to a resistance due to the high cost price of sustainable alternatives. The observed barriers are therefore hampering the scaling and accumulation of small wins in multiple ways.

The third sub-questions focused on whether the right propelling mechanisms were activated to accelerate the small wins. The case study shows the importance of the coupling mechanism. By trying to make the greatest possible impact with an initiative by linking different problem areas to it, this can have positive consequences for the energizing and logic of attraction mechanism. This means that the initiative receives recognition from various domains and because of that potential resources. For example, certain small wins focus on various social problems, such as flooding, shortage of raw materials and waste reduction. These developments then, are shown by the empirical case as cause for the bandwagon effect. As soon as certain innovations or developments in the same area receive more attention and resources, imitation and competition are more likely to occur. The logic of attraction is considered important as it accelerates small wins in such a way that they can be incorporated earlier in existing and saturated processes and markets. By receiving additional resources from influential actors within the regime, the small wins increase in credibility, stimulating the potential uptake. Robustness is the least activated mechanism which results in the fact that sustainability is still not the norm within the Dutch construction industry.

These insights provide the substantiation for answering the main research question. It appears to be advantageous for small wins to operate on a local and small scale, which helps them introduce concrete radical innovations aimed at improving the environmental impact in the construction industry. Staying small seems initially beneficial for the innovations to be more radical and remain protected from regime influences. However, also in that phase small wins already experience sufficient barriers that come from the socio-technical regime. One way for small initiatives to overcome these resistances seems to be the aim to create the greatest possible impact by activating the coupling mechanism. This could also activate other mechanisms such as energizing and the bandwagon effect. The idea of activating multiple propelling mechanisms is that actors from the socio-technical regime can be convinced sooner to achieve more incentives for the small wins. Hence, small wins should also enthusiastically share their knowledge and experiences with other niche initiatives, so that mechanisms such as the bandwagon effect are activated. This ensures that the need to become more sustainable is becoming increasingly clear and obvious within the Dutch construction sector.

This qualitative research has shown that small wins can amplify the sustainability transition within the Dutch construction industry to a large extent. However, there are still abundant barriers to overcome to take the transition even further. It is in fact up to various regime actors to determine how quickly the influence of small wins will increase and the objectives regarding sustainability set by the Dutch government will be achieved.

6. Discussion

6.1 Theoretical implications

This research identified and analyzed small wins, the barriers they experienced, and the activated propelling mechanisms for accelerating a sustainability transition in the Dutch construction industry. This is done by presenting an analysis of how niche initiatives became small wins and try to start a sustainability transition, including the barriers they experienced which hampered the transition, and the mechanisms which propelled their impact on the transition. Based on the empirical study, several theoretical contributions were made to existing literature on small wins and sustainability transitions.

First, in-depth insights are gained in how niche initiatives can start a process of transformative change. By linking the characteristics of small wins to niche activities of the MLP, it has become clear which characteristics are required for niche initiatives to bring about incremental or marginal change, by attracting allies, deterring opponents, and lowering resistance to subsequent proposals. Niche initiatives must have concrete outcomes that contribute to making the construction industry more sustainable. They can achieve this by realizing visible results such as innovations on the field of building materials and construction and demolition practices. In addition, they can also achieve concrete results by sharing knowledge and sharing their expertise with actors from the regime. By sharing their radically different beliefs on how to deal with different types of building materials and sustainable business practices, they can change the way in which actors within the socio-technical regime think about change. In addition, the moderate importance of niche initiatives has been observed as crucial. By focusing on local client, radical new practices can be adopted more easily and their impact can only be greater as a result. In addition, the moderate importance represents the breeding spaces of the MLP. This is at odds with what the Strategic Niche Management framework tries to facilitate, where more emphasis is placed on well-ordered, planned, and consensual processes (Farla et al., 2012). However, this empirical case shows that small wins can create more radical practices if the right characteristics are present. These results show that the literature on the small wins approach as described by Weick (1984) and Termeer and Metze (2019) complements the literature on niche activities in relation to the MLP as explained by Kemp et al. (1998) and Geels (2011). This strengthens both the streams of literature on how sustainability transition can be derived from developments on the micro-level.

Secondly, two theoretical contributions were made on barriers regarding sustainability transitions. The first contribution is in regards to the barriers small wins have to overcome. For a more comprehensive approach to analyze barriers that small wins have to overcome in order to achieve in-depth change, it is useful to supplement the three types of barriers identified by Termeer and Metze (2019) with cultural and market barriers. This complements the fact that Vermaak (2013) emphasizes the identification and understanding of barriers, so people can learn to expect to run into trouble and fuels change rather than disrupt it. Another contribution regarding barriers are the illustrated interlinkages among types of barriers. It was visualized that barriers from one type can cause or are caused by barriers from another type. This builds on the literature of barriers hampering sustainability transitions (Kirchherr et al., 2018). For future research on interlinkages among barriers regarding small wins and sustainability transitions, this can be an example to other areas which are under great pressure to move towards sustainability, such as the food sector and the automotive industry. Also, when initiating and stimulating small wins in future research, the analysis should be incorporated to obtain an all-encompassing insight on both mechanisms that explain impasses of a transition and mechanisms that explain acceleration.

Thirdly, the thesis contributed to a deeper scientific understanding of developments that contribute to propelling mechanisms. Hence, various interlinkages have been presented between the different propelling mechanisms. If a combination of the energizing and the logic of attraction mechanisms arises, for example when a small win gets acknowledged through increasing trust, imitation and competition can take place, which adds to the bandwagon effect. Additionally, when small wins couple

with other problem areas, coupling becomes a supportive mechanism to energizing and logic of attraction, because the potential impact increases. These interlinkages and the effects on the different propelling mechanisms should be considered when introducing and accelerating small wins.

6.2 Limitations

In addition to the insights and implications that this analysis offers, there are some important limitations that should not go unmentioned which might influence the dynamics in other contexts or settings. The reader should keep in mind a limitation in regards to the sample. Since a number of selected initiatives were not open or did not have the opportunity to participate in an interview, while the researcher already started doing interviews, snowball sampling was used to find additional initiatives. Because there is a possibility that interviewees have recommended a competitor or initiative that developed something similar, this may have influenced the functioning of the bandwagon effect. By doing a background study on each selected initiative, the researcher was able to rule out whether there were too many similarities between the various initiatives in terms of the product or business practice they developed.

An additional limitation regarding the sample is that some initiatives have only recently been set up. What therefore could not be observed from the initiatives and is presumably not being taken into account, is that it is difficult to determine in advance what practices will turn out eventually to be bad wins. Because some initiatives have been established recently, it is not yet possible to say with great certainty whether they will also deliver the desired results. A possible consequence of this is that for certain mechanisms this can create undesirable outcomes, such as bad practices being copied, which can influence the bandwagon effect. Although in such cases the bandwagon effect is not yet visible and has therefore not been considered, it is important for the reader to be aware of this.

In regards to the niche-regime interaction it should be addressed the solely niche initiatives were studied. For more comprehensive insights on the developments on the socio-technical regime of the MLP and the resulting interactions with the niche-level, it could have been interesting to include regime actors, such as governmental organizations and incumbent construction companies. This research only highlights and focusses on one side of the interaction.

Regarding the generalizability of the results derived from this study, the research has specifically studied small wins, the barriers the faced, and the experienced propelling mechanisms within the Dutch construction sector. It is possible to find similar results in other empirical cases which are forced in a sustainability transition. However, the context of this research should always be considered and results can not be reproduced to other contexts. The theoretical contributions of the relations between the characteristics of the small wins, the interlinkages between the types of barriers, and the interlinkages between some propelling mechanisms can be employed in other contexts, if the specific context of this study is kept in mind. For example, it can be assumed that the enthusing effect of energizing and the logic of attraction can also trigger the bandwagon effect in other contexts. More future research may confirm this type of interlinkages.

A very practical limitation to the study refers to the interviews being held in Dutch. The researcher is a native Dutch speaker and so were all the interviewees. By translating the results from Dutch to English, to apply them in the research, it could have occurred that the purport of certain statements have not been fully preserved due to the translation into English. As soon as doubt arose about whether or not certain statements were misinterpreted, they were checked with the relevant interviewee. In order to minimize the possibility of losing important data as much as possible, the translation from Dutch to English was only made during coding by coding the Dutch transcripts with English terms.

Another limitation regarding the interviews held, is regarding the setting they were held. Due to the Corona virus, the interviews were held online via Microsoft Teams. As non-verbal communication is very important during interviews, this can have hampered the interviewee as well as the interviewer in speaking freely in multiple kind of ways. To be able to receive as much as verbal and non-verbal information from the interviewees, the interviewer always asked if cameras could be turned on. As some interviewees were not able or allowed to use the camera for various reasons, it can have been occurred that some information was not received to the full extend. This limitation could not be overcome due to the fact that this is outside the interviewer's sphere of influence.

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Appendix 1: Interview guide

Introduction

My name is Bram Reijnders and right now I'm finishing my Master programme Sustainable Business and Innovations by doing my Master's Thesis on the sustainability transition of the Dutch construction industry. In particular, I am doing research on niches in the construction sector which are already growing. I want to find out which mechanisms and stimuli triggered the growth or accelerated you or others to become stronger and larger. I also want to find out the barriers which hampered the growth or the acceleration at first. For that reason, it is important for me that you elaborate on both the positive elements of your initiative's journey and the negative ones.

The interview will last around 60 minutes and I would like to record it to be able to analyse it at a later moment during my research. I ask you for your permission to do so. If you change your mind afterwards, you are still able to let me know. Also, you may at any time refuse to answer a question. Nevertheless, your answers are confidential.

General questions

1. Can you give an description of what your initiative/innovation/solution ("initiative") entails?
2. What has been your role within the initiative the past years?
3. In terms of sustainability, what is in your opinion the problem of the construction industry?
4. How does your initiative contribute to the improvement of the sustainability of the construction industry?

Development of initiative

5. How did the initiative start?
6. Which activities or events were crucial for your initiative?
7. What have hampered the growth of the initiative until now?
8. How does the current way of working within the construction sector have hampered the development of your initiative?
9. How has the initiative changed from the start to now?
10. How do you see your initiative in the future?
11. What has to happen or what does your initiative need, to become where you want it to be in the future?

Propelling mechanisms

12. How do you share your achievements or developments with the public?
13. In what way did you get support from others for the development of your initiative?
14. What competition have you experienced during the development of your initiative?
15. What changes created by your initiative do you already notice in the construction sector?
16. With what organizations do you collaborate or have you started partnerships?
17. Did the initiative inspire other organizations or initiatives?

Appendix 2: Coding scheme

Table 6: Results of coding process in Nvivo

Category	Sub-category	Observed indicator	Interviews	References
Small wins	Concrete outcome	Technical innovation	8	21
		Process innovation	6	15
	In-depth change	Radical innovations	6	11
		Change in beliefs	5	12
	Moderate importance	Local production	3	8
		Change gradually	3	9
		Tests and experiments	5	14
	Positive judgement	Improved environmental impact	13	22
		Influencing others	5	12
Barriers	Technical	Dominant market conditions and requirements	8	21
		Quality of circular materials	7	20
		Status quo of market	5	13
	Financial	Cost price of products or processes	6	17
		Price-oriented nature	4	15
		Lack of governmental directionality	4	13
		Costs to scale	2	4
	Regulatory	Too minimal sustainability requirements	10	26
		Incentives within procurement process	6	11
		Way of measuring sustainability	8	11
	Market	Conservative market	6	8
		Risk averse	5	9
		Lobbying incumbents	3	5
	Cultural	Trust the present	7	8
		Wrong image of biobased products	3	4
Propelling mechanisms	Energizing	Educate others	7	19
		Emphasize sustainability benefits	8	14
		Increase of trust	9	12
		Leading by example	5	5
	Learning by doing	Tests, labs, and pilots	9	16
		Feedback guides development	7	18
		Guided by previous experiments	6	7
	Logic of attraction	Contests and awards	6	7
		Influential actors	8	12
		Predictable volume	4	6
		Value unused resources	4	4
		Build up track record	5	6
	Bandwagon effect	Imitation	6	15
		Competition	4	8
		Early adopters	6	9
	Coupling	Coupling with other problem areas	8	16
		Collaboration with other actors	7	11
		Connection across scales	5	7
	Robustness	Large-scale projects	7	14
		Other urgent social problems	3	5