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The Business Model for Sustainability from a System Dynamics Perspective

A Multiple Case Study in the Architecture Industry

by

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Abstract

Title: System Dynamics Perspective on the Business Model for Sustainability: A Multiple Case Study in the Architecture Industry

Purpose: The primary purpose of the study is to explain how the system dynamics between the Value Configuration, Partner Network, and Capabilities work in a Business Model for Sustainability of small and large architecture firms

Methodology: We followed an abductive, qualitative research strategy with a multiple case study of ten participating firms. In two steps we analysed the firms. First, we categorised them alongside two dimensions, the degree of sustainability and the firm size, resulting in four quadrants. Second, we performed an in-depth analysis, using Causal Loop Diagrams for each firm of every quadrant.

Theoretical Perspectives: The Business Model for Sustainability provides the foundation of the research. It explains the logic behind a firm that achieves economic value through environmental and social measures.

Empirical Foundation: We base our findings on ten architecture firms from Germany and Denmark and complement the findings with voices of experts from industry and academia.

Conclusion: The findings show that the Value Configuration, Partner Network, and Capabilities are working interdependently, whereas the Value Configuration acts as a connector between the other two. There are little differences in small and large firms in terms of their underlying dynamics. In order to design sustainably, architecture firms need to integrate their partner closely, build their brand rapidly, invest in their internal competences, and learn from partners. Because of the interdependency between the elements, each measure that the firm takes acts as a catalyst for the other.

Keywords: Business Model for Sustainability, System Dynamics, Value Configuration, Partner Network, Capabilities, Infrastructure Management, Sustainability, Strategic Management, Business Models, Construction Industry, Architecture Industry

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1   Introduction

1.1   Background

> *"We shape our buildings; thereafter they shape us."*
>
> *– Winston Churchill*

The construction industry consumes 40% of all energy and emits 35% of all greenhouse gas emissions in the EU (European Commission, 2017; Ofori & Kien, 2004). This has a negative climate impact and causes an increasing resource scarcity. Architects are in the special role of any construction project, since they design the blueprint and coordinate the building project. Therefore, architects have a significant impact on whether the buildings around us are sustainable or not. Decision makers in architecture firms are progressively integrating sustainable building solutions in their business models in order to counter the traditionally unsustainable development (DGNB, 2017a). When architecture firms decide to make sustainability an integral part of their business, this may come with fundamental changes in how the firm operates (Ahn & Pearce, 2007). Consequently, sustainable construction may alter the logic of doing business (Mokhlesian & Holmén, 2012), which entails a transformation of the business model (Weber, 2008; Sommer, 2012; Schaltegger, Lüdeke-Freund, Hansen, 2012). Scholars termed this new logic *Business Models for Sustainability (BMfS)* (cf. Stubbs & Cocklin, 2008; Lüdeke-Freund, 2009). This research field attempts to understand how a firm works, when sustainability becomes a driving force (Stubbs & Cocklin, 2008). In opposed to a traditional business model that seeks merely profit maximisation, a BMfS aims to achieve economic profit through environmental and social measures (Lüdeke-Freund, 2009). Thereby, a BMfS is crucial to advance and realise novel, sustainable solutions, as well as it may be the catalyst of superior performance (Bocken, Short, Rana, & Evans, 2014).

Research in BMfS is often grounded in the Business Model Ontology developed by Alexander Osterwalder (2004). Osterwalder's works (c.f. Osterwalder, 2004; Osterwalder, Pigneur & Tucci, 2005; Osterwalder & Pigneur, 2010) have received wide attention and the Business Model Ontology is frequently applied among academics and managers alike (cf. Mokhlesian & Holmén, 2010, 2012; Sommer, 2012; Abuzeinab & Arif, 2013; Umbeck, 2014). According to Osterwalder (2004) a business model consists of nine business model elements. The nine elements are Value Proposition, Target Customer, Value Configuration, Customer Handling, Customer Interfaces, Capability, Partner Network, Cost Structure, Revenue Model (Osterwalder, Pigneur, & Tucci, 2005 cited in Mokhlesian & Holmén, 2012). Key to understanding the Business Model Ontology is that Osterwalder views a business model as a nexus that "contains a set of elements and their relationships" and thereby emphasises the inherent interrelations not only inside any firm, but also spanning external market actors such as suppliers, rivals, or customers (2004).

Managers of architecture firms need to deeply understand how the elements of their business model interrelate (Ackoff, 1994 b; Wilms, 2001; Casadesus-Masanell & Ricart, 2010; Vester, 2015), to be able to successfully drive sustainability in their organisation. Only then, synergies between the elements can be achieved (Ackoff, 1994 b; Wilms, 2001; Forrester, 2009; Vester, 2015). After all, it is the synergies that give superior companies the competitive edge over rivals (Porter, 1996; Casadesus-Masanell & Ricart, 2010; Sanchez & Ricart, 2010). First, because a set of interlocking activities is more difficult to imitate by competitors (Porter, 1996), and second, mutually reinforcing business model elements "help a business model to gain strength over time" (Sanchez & Ricart, 2010).

"Good (strategic) management rests on the analysis of the interaction of variables" (Wilms, 2008, p. 1). Lüdeke-Freund goes even further by stating that "at the end of the day strategic management is nothing but causal loop diagrams" (2017, Appendix G). Sommer emphasises that System Dynamics (SD) is a valuable concept to scrutinise the complexities that prevail in management (2012). A system is a whole that consist of at least two elements, each of which can affect its behaviour or its functionalities (Ackoff, 1994 a). All elements have to fit in order to function together (Ackoff, 1994 b). Against this background, SD explains the underlying interrelations of systems, such as the BMfS, by revealing causal interdependencies within a system (Sterman, 2000; Mathews & Jones, 2008; Williams & Hummelbrunner, 2011; Habernfellner, Fricke, de Weck & Vössner, 2015). It allows identifying and visualising the

cause-and-effect relationships between the elements (Meadows, Meadows, Randers, & Behrens, 1972; Sterman, 2000; Senge, Smith, Kruschitz, Laur & Schley, 2008; Forrester, 2009; Williams & Hummelbrunner, 2011; Habernfeller et al., 2015). Moreover, a thorough understanding of the interdependencies of influencing elements, helps to grasp the mechanism of a system's functionality (Ackoff, 1993). To that end, a system is not the sum of its elements, but the product of their interactions (Ackoff, 1994 b).

In a systems context, the BMfS is particularly interesting to investigate, because it connects the firm with its larger containing system, for instance its internal capabilities and the partner network surrounding a firm (Stubbs & Cocklin, 2008). As such a BMfS is a dynamic system in which the elements have to fit together well, in order to achieve superior organisational performance. Indeed, a recent development in the research field of BMfS is the application of a SD perspective on the interaction between the business model elements (c.f. Abdelkafi & Täuscher, 2016; Fernando & Yang, 2017). Abdelkafi and Täuscher (2016) take a high-level view on the interaction within the BMfS. Fernando & Yang (2017) investigate various dimensions to value and discuss several tools for value assessments for a BMfS from a system's perspective. Sommer (2012) motivates SD as an umbrella concept for understanding sustainability, and business models. He argues:

> "One of the few commonalities across all research domains [in this book] is the applicability of the systems [dynamics] perspective: Organisations can be viewed as systems, sustainability can be considered a systemic phenomenon, and the business model concept explicitly appreciates systemic characteristics in the business context." (Sommer, 2012, p. 18).

1.2   Research Problem

While we know a lot about the business model elements of a BMfS, we still lack an in-depth understanding how these elements are interrelated (Sommer, 2012; Mokhlesian & Holmén, 2012). Abuzeinab and Arif (2013) propose to research different business model elements in order to conceptualise a generic BMfS. In addition, two Master theses call for further

investigation on the business model elements themselves (Kolstad, 2013; Öberg & Andén, 2015).

Mokhlesian and Holmén present a first attempt to bundle the literature on business models in the construction industry that have integrated sustainability and point out one pivotal, causal relationship. They argue it exists between the elements value configuration, partner network, and capabilities (2010, 2012). This group refers to the value creation mechanism of the firm (Osterwalder, 2004, p. 79). In other words, it defines the value configuration system needed in order to achieve the firm's value proposition as well as to sustain the customer interface (Osterwalder, 2004). As such it is an inevitable mechanism within the overall business model, since the subsequent steps value delivery and value capture are not possible without value creation. However, it is worth noting that Mokhlesian and Holmén's findings are primarily normative and lack empirical evidence.

With this in mind, when taking architecture firms as the object of study, one distinct characteristic of the industry is important to mention: around 99% of all architecture firms have less than 30 architects and only a fraction of all architecture firms have more than 30 architects (Architects' Council of Europe, 2014). Hence, when studying architecture firms, there is reason to expect different findings for small and large firms.

Consequently, we define the problem as: *a lack of empirical understanding of the dynamic interactions between value configuration, partner network, and competency in the Business Model for Sustainability, with regard to the differences in small and large architecture firms.*

1.3 Research Question

The research question directly ties into the research problem. Given that a business model can be seen as a dynamic system, *how do the system dynamics between value configuration, partner network, and capability work in a Business Model for Sustainability, with regard to the differences in small and large architecture firms?*

1.4   Research Purpose

We build on the findings of Mokhlesian and Holmén (2010, 2012) that find that value configuration, partner network, and capabilities change as a group when firms in the construction industry embrace a BMfS. It is these three elements that constitute value creation in organisation (Osterwalder, 2004). By analysing the system dynamics between the three aforementioned elements we can draw conclusions about the value creation mechanism of the BMfS. Therefore, the contribution of this study is twofold. On the one hand, make a theoretical contribution as we react on the call of various scholars to analyse the elements of a BMfS (c.f. Sommer, 2012; Mokhlesian & Holmén, 2012; Abuzeinab & Arif, 2013). Thereby, we increase the theoretical understanding of BMfS, by applying a SD perspective. This piece of work will not close the research gap completely, yet contributes to the existing body of knowledge. On the other hand, make a managerial contribution. We provide practical insights for decision makers of architecture firms, which may now have a clearer picture in mind of how a BMfS creates value. Ultimately, this research advances the adoption of BMfS and therefore progresses sustainability as a whole.

1.5   Outline of Thesis

The next chapters proceed as follows: chapter two provides a comprehensive review of literature, commencing with sustainability, developing the Business Case for Sustainability and the Business Model for Sustainability, before going over to SD and concluding in the conceptual model. Chapter three discusses the methodological approach for the study. Chapter four presents and analyses the findings from the multiple case study with ten small and large architecture firms in Denmark and Germany as well as three interviews with experts from the industry and academia. Chapter five discusses the findings. Chapter six concludes the study with the main findings as well as managerial and theoretical implications.

2   Literature Review

2.1   Introduction

According to Easterby-Smith, Thorpe, and Jackson (2015) this literature review will be conducted as theoretical review as to evaluate and synthesise relevant literature on the influence of sustainability on the business model of architecture firms. The aim of this review is to provide the necessary context for conducting this research and derive a conceptual framework that can be used for the empirical part. The review is organised as follows: First, we introduce sustainability, its influence on business in general and business models in particular, ending in a narrower discussion of the architecture industry and the System Dynamics perspective. Second, we develop and operationalise the conceptual framework used for the empirical part.

2.2   Sustainability

Sustainability, or sustainable development, first received influential recognition through the Brundtland Report, published in 1987 (UNWCED). Sustainability, in this context, is defined as "to meet the needs and aspirations of the present without compromising the ability to meet those of the future" (UNWCED, 1987, p. 39). Responding to pressing issues such as poverty, environmental degradation, and inequality, the UN calls for economic growth that is both environmentally and socially sustainable (UNWCED, 1987). Economy, environment, and society have, in a later conference, been established as the three pillars of sustainability (UN Sustainable Development, 1992) that act "interdependent and mutually [re]inforcing" (UN General Assembly, 2005, p. 12).

Literature shows an increasing interest in sustainability. Early contributors, such as Davis (1960), advertise that business decisions should be evaluated beyond their mere economic impact. In a similar vein, Frederick (1960) argues that firms' resources should be used for broader social goals. Lee (2008) later argues that these early views are characterised by decoupling the achievement of social value from economic value. In 1983, Freeman calls upon the responsibility towards stakeholders other than the shareholders. Porter and van der Linde question the trade-off between social benefits and economic burden (1995). Building on the three pillars economy, environment, and society, also known as profit, planet, people, John Elkington (1997) coins the now famous term Triple Bottom Line and therewith makes sustainability a tangible objective for the business world. Indeed, the interaction of economy, environment, and society enjoys increasing appreciation in subsequent literature and soon becomes the core of many definitions for sustainability (cf. Dyllick & Hockerts 2002; Schaltegger, Beckmann, & Hansen, 2013, Bocken et al., 2014).

Despite the growing interest and importance paid to sustainability in business, there are voices against this development. An early contestant of sustainability was Milton Friedman, who explained at length in his now famous article from 1970 that the only "responsibility of business is to increase its profits" (p. 1). We partly agree with Friedman. We agree, in accordance with Werther and Chandler (2011) that a firm should not spend its resources in an area where it does not have expertise, just to follow some altruistic ambition. However, we can increasingly see that sustainability need not to be an altruistic ambition, but may actually contribute to increase profits (Schaltegger & Wagner, 2006). Hence, we refrain from seeing sustainability as a philanthropic approach and take on a progressive view that supports the business case for sustainability (Schaltegger & Lüdeke-Freund, 2012). Lüdeke-Freund (2009) points out that when a firm addresses the business case for sustainability, the business model will subsequently change. This realisation has led to the emergence of a new field of research, the business model for sustainability.

2.3   The Business Model for Sustainability

As sustainability moves beyond being a side project for frms, it becomes more integrated in firms (Belz and Peattie, 2009) and their business models (Elkington, 2004; Stubbs & Cocklin,

2008). As indicated in the previous section, business models need to be transformed, in order to capture the maximum possible economic success (Sommer, 2012; Schaltegger & Lüdeke-Freund, 2012). In their seminal article, Stubbs and Cocklin (2008) give an explanation why a transformation is necessary: the traditional profit-oriented model of a firm is inherently limited to creating economic value only, disregarding environmental and social value creation. Therefore, the traditional model of a firm needs to be transformed, in order to operate sustainably in the long-term (Stubbs & Cocklin, 2008; Lüdeke-Freund, 2009).

Literature provides various definitions and models for BMfS. The pioneers Stubbs and Cocklin (2008) develop an ideal type of BMfS, based on two case studies. They claim that firms seeking to adopt a BMfS need to "develop internal structural and cultural capabilities to achieve firm-level sustainability and collaborate with key stakeholders to achieve sustainability for the system that the organization is part of" (p. 103). This early model gives an account of attributes that a BMfS should possess, rather than a tangible model. An early contribution by Lüdeke-Freund (2009) builds its model on the four pillars value proposition, customer interface, infrastructure, and financial aspects, provided by Osterwalder (2004). In addition, Lüdeke-Freund (2009) adds another pillar, the non-market aspects, to address sustainability issues, and therewith makes a first attempt to provide a generic template for BMfS.

In subsequent publications we find an active discussion about value in regards to BMfS. Lüdeke-Freund (2010) claims that through a BMfS firms can deliver superior customer value. Schaltegger et al. (2012) combine the internal change needed with value, claiming that a BMfS may "create customer and social value by integrating social, environmental, and business activities" (p. 23). Bocken et al. (2014) assert that society and environment can benefit when firms change the way they create, deliver, and capture value. Bocken et al. combine the external stakeholders, society and environment, with internal changes needed regarding how firms deal with the value aspects. We conclude that a BMfS is defined by positively impacting external stakeholders, society and environment, and doing that through internal change regarding value. A recent definition captures all of those points and will therefore be used as the definition for BMfS in our thesis: "[a BMfS is] the rationale of how an organization creates, delivers and captures economic, environmental, and social forms of value simultaneously" (Joyce, Paquin, & Pigneur 2015, p. 4).

Schaltegger et al. (2012) develop a framework where they match the sustainability strategy of a firm with the necessary degree of business model innovation. The sustainability strategy can either be defensive, accomodative, or proactive and the correlated degree of business model innovation is business model adjustment/adoption, business model improvement, or business model redesign (Schaltegger et al., 2012). With increasing commitment to sustainability, more business model elements need to change, which might cause fractions, when the chosen sustainability strategy does not match the degree of business model innovation (Schaltegger et al., 2012). Sommer (2012) presents another approach, where he maps the radicalness of change from low to high as green evolution, isolated green adaption, staged green transformation, and green revolution. The higher the radicalness of change, the higher the magnitude of change, but the lower the timeframe of change (Sommer, 2012). In the end, we may argue that a need for classification of the degree of having transformed to a BMfS was needed, because the transformation to a BMfS is a process that takes time.

2.4 The Business Model for Sustainability in the Architecture Industry

Recent literature found interest in the construction industry and how sustainability changes the business models within that industry (e.g. Mokhlesian & Holmén, 2012; Abuzeinab & Arif, 2013). It is little wonder that the construction industry in particular is chosen, because it has a strong influence on society and environment (McDonald & Smithers, 1998; Tam, Tam, & Tsui, 2004; Tan, Shen & Yao, 2011).

A distinct characteristic of the architecture industry is the large skew towards small firms, leaving the industry only with a handful of large firms (Architects' Council of Europe, 2014). We further find evidence that sustainability measures may play out differently in small and large firms. For small firms, Baumann-Pauly, Wickert, Spence, & Scherer (2013) demonstrate that while firms may implement social measures rather easily, they have problems demonstrating those to the external environment and vice versa for large firms. Murillo and Lozano (2006) find similar results, pointing out that the personal values of the decision maker are key to sustainability in small firms. Dincer and Dincer (2013) stress that for small firms

the decision whether to engage in environmental and social activities depends on emotional factors, such as personal feeling or friends and family and on financial conditions. For large firms, Husted and Allen (2007) claim that sustainability can be source for innovation and provide the opportunity to develop capabilities unique to the firm. Moore and Manring (2009) illustrate that for large firms to become sustainable, they need to change their culture, which is based on the firm's capabilities, processes, and values. We clonclude that there are several distinct characteristics applying to small and large firms, which should be considered given the structure of the architecture industry.

Mokhlesian and Holmén (2012) compile a comprehensive overview of how different elements of a business model change, when a firm in the construction industry engages in sustainable construction. As architecture firms are part of the construction industry, we reasonably assume a strong relationship between the findings of Mokhlesian and Holmén and the applicability on architecture firms. Based on Osterwalder's view of a business model, Mokhlesian and Holmén (2012) find a strong relationship between the value proposition, capabilities, and cost structure on the one hand (Figure 2.1), and Value Configuration, Capabilities, and Partner Network on the other hand (Figure 2.2). The other elements of the business model do not change in a significant way (Mokhlesian & Holmén, 2012).

Mokhlesian and Holmén (2012) explain the relationship between Value Proposition, Capabilities, and Cost Structure in so far as offering sustainable construction changes the Value Proposition, which then in turn requires new Capabilities to deliver the Value Proposition. They note that additionally, the Cost Structure is impacted by the new Value Proposition.

Figure 2.1 Element linkage 1 (based on Mohlesian & Holmén, 2012)
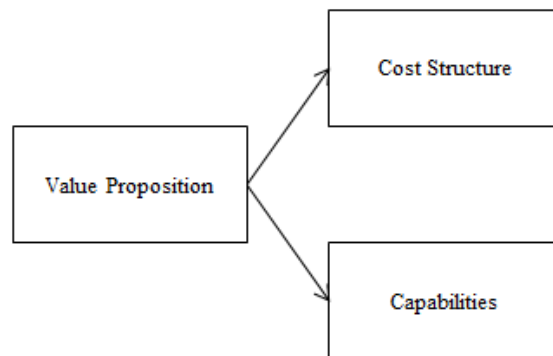
Figure 2.2 Element linkage 2 (based on Mokhlesian & Holmén, 2012)
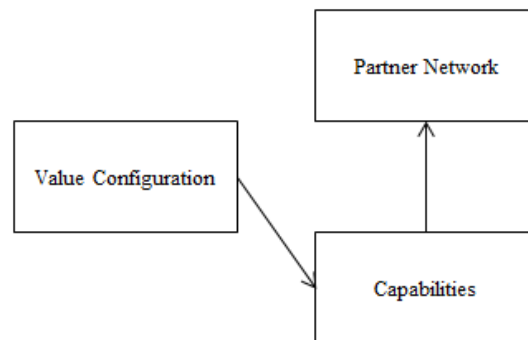
Mokhlesian and Holmén (2012) explain the relationship between Value Configuration, Capabilities, and Partner Network in so far as offering sustainable construction requires a change in the activities a firm performs, for which internal capabilities or external capabilities from the Partner Network are needed.

While both linkages are deemed as important by Mokhlesian and Holmén, it is the linkage between the Value Configuration, Partner Network, and Capabilities that stands out. This is because these three elements make up the Infrastructure Management of a business model, which describes "*how* a company creates value" (Osterwalder, 2004, p. 79). Recalling that current literature of the BMfS emphasises the value creating ability of the firm, the interaction between Value Configuration, Partner Network, and Capabilities should explain how a firm can actually create economic value through environmental and social measures. Therefore,

this linkage may provide the necessary understanding of the ability to deliver sustainable solutions and therefore sets the fundamental requirements that enable a BMfS.

Despite the initial efforts explaining the BMfS in the construction industry, much remains to be researched (Mokhlesian & Holmén, 2012; Abuzeinab & Arif, 2013). Mokhlesian and Holmén point out that certain elements of the business model should be examined in greater depth, in particular because their literature review lacks empirical evidence. Indeed, we find supportive evidence that suggest a more thorough analysis of certain business model elements (Sommer, 2012). Abuzeinab and Arif (2013) propose to research different business model elements in order to conceptualise a generic BMfS. Lüdeke-Freund (2009) proposed to investigate the different elements to find common themes. In addition, two Master theses call for further investigation on the business model elements themselves (Kolstad, 2013; Öberg & Andén, 2015).

2.5   System Dynamics

The origins of SD stems from systems thinking, which dates back to Ludwig von Bertalanffy, who published a seminal article in 1950. In essence, he argues that there are open and closed systems, which were not distinguished at that time (von Bertalanffy, 1950). This, however has implications on the behaviour and functionalities of the system under investigation (von Bertalanffy, 1950).

However, before going into further depth of the historic developments in the body of literature on SD, a definition of a system is provided. Thereby, a common understanding between the readers and the authors is established.

A system is a whole that consist of at least two elements, each of which can affect its behaviour or its functionalities (Ackoff, 1994 a). The human body, for example, is a biological system that consists of elements such as heart, lungs, and stomach (Ackoff, 1994 b). Every one of them can affect a human's behaviour or its functionalities (Ackoff, 1994 b). Second, all elements are interdependent, meaning that no element or collection of elements can have an independent effect on the whole (Ackoff, 1994 a). The way the heart works depends on what the lungs and the stomach do (Ackoff, 1994 b). The defining functionality is

something none of the elements, or collection of elements, have (Ackoff, 1994 b). Neither the heart lives on its own, nor the lungs, but the whole body as a system lives (Ackoff, 1994 b). All elements have to fit in order to function together (Ackoff, 1994 b). Therefore, a system is not the sum of its parts, but the product of their interactions (Ackoff, 1994 b).

As noted earlier, von Bertalanffy's published a seminal paper in 1950. Six years later, Boulding defined the investigation and organisation of "relationships into a coherent system" as General Systems Theory (1956, p. 197). Further, Boulding points out that the prevailing silo thinking in disciplines is insufficient for solving problems (1956). Two years later, Forrester transferred the Systems Theory to management science in a landmark article (1958) and his subsequent book "Industrial Dynamics" (1961). He synthesises that:

> "Managing is the task of designing and controlling a [...] system. Management science, if it is to be useful, must evolve effective methods to analyse the principle interactions among all the important components of a company and its external environment." (Forrester, 1961, p. 8)

Furthermore, he points out central characteristics (Forrester, 1961) that still hold true in contemporary SD (Wilms, 2001; Sterman, 2006; Williams & Hummelbrunner, 2011; Habernfeller et al., 2015). The investigation of feedback allows to draw inferences about how (1) corporate structures, (2) amplification of measures, and (3) delays in the system interplay and thereby determine whether a firm thrives or not (Forrester, 1961).

Yet another key figure in the field of systems theory is Russel Ackoff. He diagnoses that problems are to be solved from the viewpoint of a system as a whole, in opposed to analysing their elements separately (Ackoff, 1971). This is necessary because the overall functionality or performance of a system is affected in some cases when changes concern only some of the elements of the system (Ackoff, 1971). This stems from the relationships between the elements "how the parts interact and fit together" (Ackoff, 1971, p. 661).

In the year 1972 Meadows and colleagues published a book that received considerable attention (Meadows, Meadows, Randers, & Behrens). They challenge the feasibility of unlimited population and production growth and point out the environmental consequences thereof (Meadows et al., 1972). Their work is striking as it applies SD on the world's most pressing issues such as pollution and shrinking non-renewable resource reserves (Meadows et

al., 1972). The authors show convincingly how many interrelated loops reinforce each other and thereby continuously worsen an unsustainable development (Meadows et al., 1972). Thus, they call for a paradigm shift, in order to counter this trend and to avoid an eventual collapse of the social and economic system.

Two other frequently cited pieces of work are Peter Checkland's book *Systems Thinking, Systems Practice* and Peter Senge's book *The Fifth Discipline*. Checkland covers a broad range of theories on systems connected with the several research fields, such as complexity, social sciences and management (1981). However, his contributions to connect management science with the systems approach remain shallow. Despite the call for an overarching "scientific model of the system, incorporating measurements of factors such as chance and risk, with which to predict and compare the outcomes of alternative decisions, strategies or controls", his analysis remains vague and his proposals seem shallow (Checkland, 1981). In opposed to Senge, who applies SD on organisational learning in a rigorous and precise manner, while supporting his analysis graphically with simple causal loop diagrams (1990).

The post-2000 period may be characterised by finer grained systems research in the fields that this study is grounded on: sustainability, management, and BMfS. A prominent scholar, named John D. Sterman, noted in 2001 that SD as a research field is growing at fast pace (2001). Table 2.1 Synthesis of relevant literature on System DynamicsTable 2.1 summarises the most relevant scientific contributions since the beginning of the millennium on the aforementioned research fields.

Table 2.1 Synthesis of relevant literature on System Dynamics

Dimension	Authors	Main contribution
Sustainability	(Meadows, Randers & Meadows, 2004	The 30-year update on the breakthrough book by Meadows et al. (1972) advances the understanding and calls for actions in order to drive sustainability through a system dynamics view.
	Senge et al., 2008	They scrutinise in a comprehensive and in-depth manner how sustainability can be achieved by means of system dynamics.
Management	Sterman, 2000	A comprehensive guideline into system dynamics modelling by one of the most notable authors in this discipline.
	Wilms, 2001	Comprehensive and in-depth system-oriented management
	Forrester, 2003	A recap covering the most essential terms in system dynamics.

	Wilms, 2008	"Strategic management is ought to relate intended measures on the influencing variables" (p. 1). To minimise the conservation of resources, measures ought to be driven from promising levers that have a short-term impact.
	Casadesus-Masanell & Ricart, 2010	The study unveils sources of superior performance of a number of enterprises by applying Causal Loop Diagrams. Additionally, inferences are drawn to strategy and business models.
	Sanchez & Ricart, 2010	A multiple-case study on factors influencing the business model when embracing new ventures, through Causal Loop Diagrams.
	Williams & Hummelbrunner, 2011	A description and application of several approaches and concepts under the umbrella systems thinking. Very condensed and it clearly differentiates closely related concepts.
	Grüsser & Zeier, 2012	This piece synthesises research on management and SD. In this vein, it describes a systemic management approach.
	Vester, 2015	The author provides concepts and tools e.g. system dynamics to cope with ever increasing complexity as an interconnected mindset for decision makers.
	Haberfellner et al., 2015	Systems thinking and system dynamics are the integral elements that are applied to problem-solving and systems modelling.
BMfS	Sommer, 2012	Outlines how to successfully transform conventional business models into *green business model* by embracing systems theory.
	Abdelkafi & Täuscher, 2016	The authors take a high-level view on the interaction in a BMfS.
	Fernando & Yang, 2017	An investigation of the value creation process for a BMfS from a SD perspective.

The table reveals that there is yet a limited body of knowledge on BMfS from a SD perspective. Since all three studies that were conducted in this field were not geared towards the architecture industry, a knowledge gap remains. Against the solid background of the intersection between management and/or sustainability and the systems perspective as an umbrella concept, the conceptual framework is derived.

2.6   Conceptual Framework

Before we dive into analysing the interactions between Value Configuration, Partner Network, and Capabilities of the BMfS, we will develop a conceptual framework. Lapan, Quartaroli, & Riemer (2012) describe the purpose of a conceptual framework as to gather information from research that has investigated comparable topics. Sinclair (2007) calls the conceptual framework a travel plan. We see the conceptual framework as a guiding model that allows us to analyse the interactions in a structured way. Therefore, we will first, choose a suitable framework and second, develop the chosen framework.

2.6.1   Choosing the Conceptual Framework

The Value Configuration, Partner Network, and Capabilities are part of the BMfS, for which it makes sense to use some form of business model as the conceptual framework. For business models that are related to sustainability, we find two models that recently received some attention, which are the Triple Layered Business Model Ontology (cf. Joyce & Paquin, 2016) and the Strongly Sustainable Business Model Canvas (cf. Upward, 2013). Each of the two canvases adds additional elements to what we know from the Business Model Ontology by Osterwalder (2004). Therefore, they make it easier for the user to pinpoint how and which improvements a firm makes to the environment and society. However, given their young age, the newly developed models have not yet found wide recognition. Hence, little research is available that validates the applicability of the models beyond their normative appeal.

One framework that has been in use for many years is the Business Model Ontology by Osterwalder (2004). We refrain from using the term canvas, as it is commonly associated with practical brainstorming sessions, not intended for scholarly research. The Business Model Ontology has, however, an essential drawback, which is that it is originally conceived as an economic value producing business model, without particular consideration of environmental and social value. This makes it difficult to attribute sustainability activities to own business model elements. However, there are three reasons why the Business Model Ontology is a suitable conceptual framework. First, Sommer (2012) argues that profitability stems from the same business model elements as sustainability and thus the Business Model Ontology is also

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applicable on BMfS. Second, the Business Model Ontology is widely known and applied by researchers and practitioners. Therefore, using the Business Model Ontology as a conceptual framework, we can build on existant research and subsequent researchers may build upon ours. In addition, the findings may find quicker acceptance with practitioners, as they are familiar with the Business Model Ontology. Third, our research is based on the findings of Mokhlesian and Holmén, which use the Business Model Ontology as a conceptual model, too. For all of these reasons we decided against a business model tailored to sustainability and will use the Business Model Ontology by Osterwalder.

2.6.2   Developing the Conceptual Framework

As emphasised in the preceding sections the focus on this research are the Value Configuration, Partner Networks, and Capabilities. The terms have been slightly adjusted to the language of Mokhlesian and Holmén's (2012) work in order to show not only transparency in the terms, but also be in line with their vocabulary as we build upon their study. A holistic perspective of the whole business model, see Figure 2.3, allows the reader to place the three elements under investigation in its larger system (Osterwalder, 2004). It can be seen that all three elements were clustered by Osterwalder into Infrastructure Management. The author defines this group as "*how* a company creates value" (Osterwalder, 2004, p. 79). In essence, it explains the value system configuration needed in order to "deliver the value proposition and maintain customer interfaces" (Osterwalder, 2004, p. 79). A value system can be seen as a network that creates economic value by means of "complex, dynamic exchanges between one or more enterprises, its customers, suppliers, strategic partners and the community" (Osterwalder, 2004, p. 79). Osterwalder views the Value Configuration as activities to generate and transfer value, in connection with the relationship thereof, being in-house Capabilities and those obtained via the corporation's Partner Network.

The Business Model Ontology thus far only provides us with a generic template that might fit to any industry. To further explore the interplay between the three elements, this research builds upon the two literature reviews on the business model changes geared towards sustainable construction that found that it is vital to change the Infrastructure Management (Mokhlesian & Holmén, 2010; 2012). The authors reviewed 12 articles in 2010 and 35 articles, reviews, or books in 2012 and scrutinised them upon the business model elements.

We took this as a starting point and picked out of these 47 scientific papers only those that indicated a relationship between at least two of the three business model elements under investigation. This yielded 30 scholarly works, of which we reviewed 26 in detail, due to limited accessibility in three cases. In the following section the main findings in regards to the intersection between Partner Network, Capabilities, and Value Configuration are presented. The complete overview can be found in Appendix A.

Figure 2.3 The Business Model Ontology (Osterwalder, 2004, p. 44)
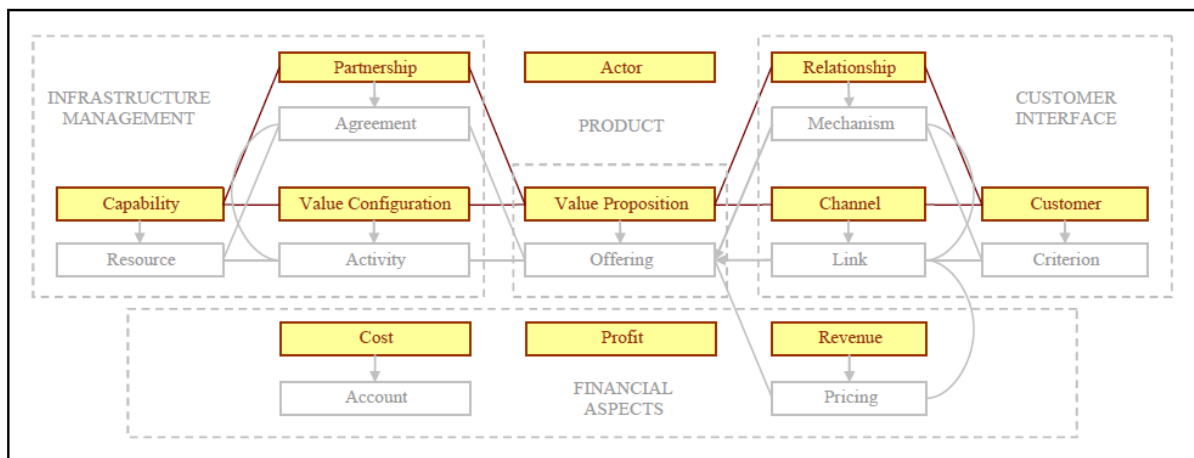
Partner Network

Ofori (2000) claims that the construction process is generally disintegrated and contains a number of actors with different goals. Hence, he argues that, in many cases, there is none of them assuming direct responsibility for environmentally-friendly practices. In the same vein, van Bueren and Priemus (2002) articulate that an implication of sustainable construction is that it demands the backing of the various parties involved at different places and times in the decision-making in order to achieve effectiveness. These various parties encompass, among others, construction firms and design bureaus (Kibert, 2007). In order to successfully implement sustainable solutions, not only a well-functioning interplay between these project participants is demanded, but also the integration of players (Kibert, 2007). Ideally, Reed (2007) argues that the responsibility lies with designers as well as stakeholders in general to develop an entire system of mutually beneficial relationships. Thereby, there is a greater benefit to be achieved that goes further than sustaining the environment and facilitates also health regenerations (Reed, 2007). The idea of an entire, well-balanced system of relationships is in line with Jones, Shan, and Goodrum's (2010) argument that a high degree

of congruency of goals between project players is essential for successful project results. In fact, it was found in their study that the notion sustainability is understood differently across actors in the industry. They concluded that a misalignment on not only the notion, but also the project goals may have negative consequences on the project progress as well as the relationship of project partners. These findings correspond with Nelms, Russel, & Lance, (2007), who found that identifying stakeholder's conflicting goals and aligning them is crucial to implement green buildings. Thus, an accurate alignment and communication between construction and design firms is deemed necessary to meet the owners' sustainability expectations (Jones et al., 2010; Ofori, & Kien, 2004). Theaker and Cole (2001) go even further and propose that cross-disciplinary working teams are considered to be successful measures that improve environmental performance. This is a major difference to the silo-thinking that traditionally prevailed the industry. Yet others (Bossink, 2004), claim that collaborations on different dimensions, "transfirm, intrafirm, and interfirm in the network of organisations" may be a lever for decision makers to cultivate, advance, and rejuvenate their firms' position on the competitive landscape, the quality of their ventures, as well as the cooperative composition of the sector in total. Winch, too, articulates in rather abstract form that "innovations on complex product systems are inherently interactive with the rest of the system   innovating within the parts while losing sight of the whole is inherently dysfunctional" (1998, p. 275). To conclude, what these papers have in common is the emphasis on the importance of the Partner Network for building up competencies in sustainability and thus the modification of the value proposition, a sustainable project solution.

Capabilities

Williams and Dair (2007) claim that currently there is a lack of knowledge in the construction sector regarding sustainability. They argue that this lacks of knowledge leads to the inability of making appropriate decisions in the design process and the implementation. Hence, the known and safe option of not sustainable solutions is often chosen. This means that without the proper knowledge, firms cannot build sustainably. Yet, 65% of contractors want firms to have knowledge in sustainable building (Ahn & Pearce, 2007). Skills that are demanded range from expertise in certification systems to life cycle analyses to hiring personell that is familiar with sustainability (Ahn & Pearce, 2007). Kibert (2007) claims that, in order to develop these competences, firms need to engage in "knowledge development [and] training" (p. 595).

Ofori and Kien (2004) underline this argument and state that futher education is key to building sustainably. Further, collaborations within the firm are needed (Bossink, 2004). To develop needed competences, firms may also engage with other actors in the industry (Kibert, 2007). Concluding, scholars have pointed out that there is a lack of knowledge regarding sustainability and that these need to be developed through (1) trainings, (2) internal collaboration, (3) and external collaboration.

Value Configuration

When an architecture firm decides to offer sustainable solutions, the way of performing its activities changes. There is now a need to also consider social aspects, such as "comfort, amount of space, mobility, access" (Kibert, 2007, p. 595) and also human health (Nelms et al., 2007). In addition, energy performance and maintanence are important to factors (Nielsen & Glavind, 2007). Sustainability considerations also go beyond mere energy consumption and needs to incorporate "site planning, waste management, selection of materials and design for flexibility, together with energy planning (Ngowi, 2001, p. 291). Also the recycling of materials after the initial purpose of the building has ended, plays an increasingly important role (Sterner, 2002) as well as considerations for future uses (Curwell et al., 1999). Further, sustainability considerations need to be taken into account early in the design phase, because subsequent processes are highly affected by these considerations (Sterner, 2002; Ngowi, 2001). Taking all these considerations together, life-cycle analyses play a key role, as they allow to evaluate the impact of the building in the long-term (Nielsen & Glavind, 2007; Nelms et al., 2007; Sterner, 2002; Ngowi, 2001; Ofori, 2000). Various scholars also point out that the activities of the architect now needs to be aligned with the objectives of various stakeholders (Jones et al., 2010), especially the building owner (Reed, 2007). In the end it is the decision maker's call, whether sustainability concerns will be integrated or not (Qi, Shen, Zeng, Jorge, 2010). Concluding, architecture firms need to take into consideration many aspects of sustainability, over the entire course of the building's lifecycle. These considerations need to be integrated early on in the design process and need to be coordinated with all relevant stakeholders.

In the last step, we bring together the generic Business Model Ontology and the findings specificly for the architecture industry, in order to have a conceptual model for the BMfS in the architecture industry. In order to assure validity (see Chapter 3) of this research, concrete

and measurable indicators are needed (Baarda, 2010), which we may also call operationalisation. The transparent translation of the abstract term into measureable indicators is illustrated in Table 2.2 and Table 2.3.

Table 2.2 Operationalised Conceptual Model (1/2)

Business Model Element	Sub-Dimension	Indicators	Sub-Indicators	Architecture-Specific
Value Configuration "Describes the arrangement of activities and resources." (Mokhlesian & Holmén, 2012, p. 763)	**Activity** "An activity is an action a company performs to do business and achieve ist goals." (Osterwalder, 2004, p. 88)	**Configuration Type** (Osterwalder, 2004, p. 87)	**Value chain, value shop, value network** (Osterwalder, 2004, p. 87)	**Consider various sustainability aspects along the life cycle** (c.f. Liebsel & Glavind, 2007; Nelms et al., 2007)
		Activity Level (Osterwalder, 2004, p. 88)	**Primary activity, support activity** (Osterwalder, 2004, p. 88)	**Alignment of activities with stakeholders** (Jones et al., 2010; Reed, 2007)
		Activity nature (Osterwalder, 2004, p. 85-87)	**For Value Chain** (Osterwalder, 2004, p.88) **For Value Shop** (Osterwalder, 2004, p. 88) **For Value Network** (Osterwalder, 2004, p. 88)	**Sustainability considerations need to be integrated early on in the design process** (Sterner, 2002; Ngowi, 2001)
Partner Network "Portrays the network of cooperative agreements with other companies necessary to efficiently offer and commercialize value". (Mokhlesian & Holmén, 2012, p. 763)	**Agreements** (Osterwalder, 2004, p. 96)	**Reasoning** (Osterwalder, 2004, p. 96)	**Reduction of risk and uncertainty** (Osterwalder, 2004, p. 96)	**Well-functioning interplay and integration of players is needed to deliver sustainable solutions** (Kibert, 2007)
		Strategic Importance (Osterwalder, 2004)	**As a degree between 0-5** (Osterwalder, 2004)	**Congruency of goals between players essential** (Jones et al., 2010)
		Degree of competition (Osterwalder, 2004)	**As a degree between 0-5** (Osterwalder, 2004)	
		Degree of integration (Osterwalder, 2004)	**As a degree between 0-5** (Osterwalder, 2004)	**Cross-disciplinary working teams can improve environemental performance** (Theaker & Cole, 2001)
		Substitutability (Osterwalder, 2004)	**As a degree between 0-5** (Osterwalder, 2004)	

Table 2.3 Operationalised Conceptual Model (2/2)

Business Model Element	Sub-Dimension	Indicators	Sub-Indicators	Architecture-Specific
Capability "Outlines the competencies necessary to execute the company's business model" (Mokhlesian & Holmén, 2012, p. 763)	**Resource type** (Osterwalder, 2004) "A registry of pecuniary transactions (expenditure) of a certain category" (Osterwalder, 2004, p. 105)	**Tangible** (Osterwalder, 2004)	**Equipment** (Osterwalder, 2004), **financial assets, and technology** (Eisenhardt & Schoonhoven, 2001, p. 137)	**Develop knowledge through training and knowledge development** (Kibert, 2007; Ofori & Kien, 2004) **Firm intern collaborations to develop competences** (Bossink, 2004) **Collaborate with external partners to develop comepetences** (Kibert, 2007)
		Intangible (Osterwalder, 2004)	**Patents and brand** (Osterwalder, 2004)	
		Human (Osterwalder, 2004; Barney, 1991)	**Employees** (Osterwalder, 2004), **training, experience, relationships, and insight of individual managers and workers** (Barney, 1991, p. 101)	

2.7 Conclusion

During this review we have stressed the importance of sustainability and its influence on business. In particular, we have examined the architecture industry, leading to the conclusion that the business models of architecture firms are changing towards BMfS. However, little is known about BMfS and even less about BMfS in the architecture industry. In order to enhance the understanding of BMfS in the architecture industry, it is proposed to analyse the elements of a BMfS more into detail. In particular the elements Value Configuration, Capabilities, and Partner Network have a strong correlation. In addition, these three elements make up the value creating part of the firm. Especially for BMfS, where little is known, understanding the realtionship between these three elements allows to understand why some firms can produce economic, environmental, and social value simultanseously. With the developed conceptual framework, we have operationalised the Business Model Ontology and its elements, ready for use in the empirical part. Relating back to the aim of the theoretical review, we have both, provided the necessary context for this research and developed a conceptual framework.

3   Methodology

3.1   Introduction

In the following chapter we describe how the data was gathered and how it was subsequently analysed. To begin with, a foundation is set by explaining the research approach. From this standpoint the research design and research method are derived. Thereafter, we explain the data analysis step by step and lastly reflect upon the research quality.

3.2   Research Approach

Approaching a research we typically differentiate between deduction and induction, and increasingly also abduction. All three of them are aimed at making "logical inferences and build theories about the world" (Bryman & Bell, 2015). Deduction means "from the top down" (Lapan et al., 2012, p. 177) and starts from theory (Alvesson & Sköldberg, 2009). With a deductive approach the researcher uses some preselected theory and seeks data to prove that theory (Bryman & Bell, 2015; Alvesson & Sköldberg, 2009). Induction means "from the bottom up" (Lapan et al., 2012, p. 177) and starts from data (Alvesson & Sköldberg, 2009). With an inductive approach the researcher uses the data in order to derive some theory that explains the whole (Bryman & Bell, 2015; Alvesson & Sköldberg, 2009). However, there is rising criticism that both, induction and deduction, only barely attempt to understand the "underlying patterns and tendencies" (Alvesson & Sköldberg, 2009, p. 4). Hence, a third approach emerged, called abduction, which uses elements of both, induction and deduction (Alvesson & Sköldberg, 2009). Abduction seeks to develop data and simultaneously develop the proposed overarching pattern and therewith reveal underlying patterns. Abduction is therefore concerned with phenomena that existing theory cannot explain (Bryman & Bell, 2015). The research at hand tries to uncover the underlying patterns

of the new phenomenon Business Model for Sustainability (BMfS), guided through the overarching pattern of the Business Model Ontology, which may change in the course of the findings. Hence, we will follow an abductive approach in this research.

3.3 Research Design

3.3.1 Case Study

The Oxford Dictionary (2016) defines a case study as "a process or record of research into the development of a particular person, group, or situation." In business and management academia case study research design relates to some of the most famous studies. It differentiates itself from other methods as it focusses on the individuality or uniqueness of every case as well as a thorough comprehension of its complexity (Bryman & Bell, 2015).

Given that a business model is a system of activities, a case study design suits particularly well as case studies analyse a whole system in order to extract its uniquely functioning parts (Bryman & Bell, 2015). Besides, it is also suitable on a lower level - to identify various interrelations and patterns, which matches Osterwalder's aforementioned definition that a business model contains a set of elements and their relationships (Yin, 2014). Above all, it seems pertinent to remember that this study aims to shed light into how the system dynamics between three business model elements in a BMfS work. This implies to look beyond the surface of the three elements in order to reveal the value creation mechanism that differentiates successful from unsuccessful firms. As noted earlier, it is the synergy between the business model elements that generates superior performance and only by identifying and analysing the numerous interrelations and patterns by means of a studying several case companies such valuable insights can be derived.

Yin (2014) defines case study strategies along discrete dimensions: single case vs multiple case (among others). While a single case is usually chosen for critical, extreme, or unique cases serving as a showcase to a particular phenomenon (Saunders & Lewis, 2009), multiple case studies, of at least two cases, facilitate the collective exploration of phenomena (Bryman & Bell, 2015). Despite the advantages of a single case study, the multiple case study approach

entails disadvantages such as generalisability of findings to a larger number of architecture firms (Bryman & Bell, 2015). As noted earlier, every firm is unique (March, Sproull, & Tamuz, 1991), which inherently implies a discrepancy. Additionally, given that sustainable construction is a contemporary, but not brand new topic allowing to find more architecture firms that are engaged in sustainability, a concentration on multiple firms was chosen (Bryman & Bell, 2015). Thereby, multiple cases allow us to compare and contrast findings that stem from the cases, by means of a cross case analysis, that eases finding unique and common aspects in the sample under investigation (Bryman & Bell, 2015). Therefore, within the context of our investigation, a multiple case study as comparative design is the ideal means to gather the data needed to answer the research question. That, to recap, is "*how do the system dynamics between value configuration, partner network, and capability work in a Business Model for Sustainability, with regard to the differences in small and large architecture firms?*"

A comparative design, according to Brymann and Bell (2015), aims to analyse two similar methods on two contradictory cases. As outlined in the research question, differences between small and large architecture firms are the focal point of this study. In order to draw a clear line that differentitiates such enterprises in this regard, the number of employees was the determining factor. The decisive number is a work force of 30 people. This figure is based on a report of the Architects' Council of Europe (2014), which showed that the majority of architecture firms are smaller than 30 employees.

3.3.2 Case Selection

There are approximately 41,000 architecture firms in Germany and about 1,700 architecture firms in Denmark (Architects' Council of Europe, 2014). In the search for an overarching guideline to which architects are working, we found the German Council of Sustainable Building (DGNB) to be a suitable reference point when it comes down to sustainability. The DGNB objectively poses requirements towards which its members can orientate. The purpose of the DGNB is to advance the development of buildings that are both sustainable as well as economically efficient (DGNB, 2017c). Out of these 41,000 German architecture firms, roughly 1,200 are members of the DGNB (DGNB, 2017b). The DGNB has a spin-off in Denmark, called the Green Building Council Denmark (DK-GBC), which is working to

largely the same rules. Therefore, we find our case selection to be among German and Danish firms, as they have similar requirements towards working sustainably. The exact number of members of the DK-GBC is unknown. Regardless of the precise number of firms holding a membership DK-GBC, it is worth noting that strikingly, works according to the regulation system of the German Council (DK-GBC, 2017). That stems from the fact, that the DGNB enjoys increasing acceptance not only on national, but international level (Kibert, 2013). The acceptance ranges that far that its concepts and certification system are recognized by other councils for Green Building, such as Denmark (DGNB, 2017d). As a result, this makes the sample more homgenuous than one might assume at first sight and thereby avoids comparing apples with pears.

We are aware of the political, economic, social, technological, ecological, legal (PESTEL), and cultural differences between both nations. The PESTEL dimensions are described and compared in the Appendix B. Cultural differences are contrasted by means of Geert Hofstede's prominent cultural dimensions, see Appendix C. Even though both nations show similarities as well as contradictions, the diviations were not perceived to limit the results considerably. Therfore, we recognise that both countries are not perfectly homogenuous and acknowledge this as a research limitations.

Since the beginning of this research the goal has been to compare small and large architecture firms in regards of their BMfS. However, when analysing the interviews, we noticed distinct differences between architecture firms depending on their degree of sustainability. Therefore, we seized the opportunity to not only compare the findings between small and large firms that have BMfS, but also to compare them with firms that engage in no or to limited degrees in sustainability. In other words, we add another analytical dimension by comparing firms with a strong sustainable focus, with firms that have a less strong sustainable focus. As such, it has the advantage of serving as a control group. However, unfortunately it was not possible to find more architecture companies with a conventional business model in order to have a larger control group. Therefore, we acknowledge this as a limitation of our paper.

This constitutes a challenge in finding the right interview partners, and convincing them to participate in approximately one-hour in depth interviews. With this twofold selection criteria we intend to have a group of firms that, one the one hand, deliver answers to our research questions and provide a basis for cross case comparison, on the other hand. This group is

intended to encompass thirteen architects in their roles almost only CEOs (and two partners) from ten architecture firms. In research terms this is referred to as the study population (Lapan et al., 2012). However, when it comes to firm size, the degree of centrality of sustainability in the business model, professional experience, and gender diversity, our study sample is heterogeneous. This increases the representativeness of the samples in the study population (Baarda, 2010). In terms of the number of case companies the effort/benefit relation in regards to time and resource constraints was considered. Too many firms limit the depth and thereby possibly the insights into the phenomena. Whereas too few interview partners are disadvantageous in terms of the ability to derive and compare commonalities and contradictions among them.

All things considered, a starting point for finding potential interview partners was the DGNB and the DK-GBC.

3.3.3 Reflection on the Choice of Literature

The choice of scholarly work was derived from the research question guiding this thesis as well as the research purpose. As a result, two primary research fields were identified and covered in the literature review the Business Models for Sustainability and System Dynamics (SD).

Mokhlesian and Holmén's article from 2012 served as a starting point as it combines two theoretical fields (sustainability and business models) in light of business model changes towards sustainable construction. The emerging research area BMfS is included for two reasons. One the one hand, it represents the combination of Business Models and Sustainability and one the other hand it is deemed important to find answers that are more geared towards the contemporary notion of sustainability and its impact on business models. Last but not least, SD is covered in the literature review as well. It has been acknowledged as "a powerful analytical tool" within the context of sustainability as well as business models due to suitable systemic characteristics (Sommer, 2012, p. 18). Furthermore, given the research gap that there is a lack of empirical understanding of the dynamic interaction between three business model elements an analytical tool to unveil underlying mechanisms

was needed. Similarily, SD as an analytical tool is currently emerging in the research field of BMfS (Abdelkafi & Täuscher, 2016; Fernando & Yang, 2017).

Within these research fields, the selection of scholarly work was done based on importance and relevance (Easterby-Smith et al., 2015). Importance is the degree to which a specific book or article is considered pivotal to the subject matter (Easterby-Smith et al., 2015). Especially the research field of BMfS, for example, is a quickly growing body of knowledge that has received increasingly attention from academics and practitioners alike (cf. Schaltegger, Hansen, Lüdeke-Freund, 2016). The number of citations on the search engine Google Scholar served as a reference point to identify and compare landmark publications. On the contrary, relevance is characterized by the degree of suitability to our line of reasoning throughout the paper (Easterby-Smith et al., 2015).

3.3.4   Business Models as the Unit of Analysis

According to Easterby-Smith et al., (2015) the unit of analysis constitutes the entity that is the foundation of any sample. Again, in order to derive the appropriate entity, the research question and research goal served as an orientation. Against this background, the interplay, by means of system dynmaics, between three business model elements (1) value configuration, (2) partner network, and (3) capability in a BMfS is to be investigated.

A business model may be viewed as a system (cf. Porter, 1996; Zott & Amit, 2010; Sommer, 2012). Following Osterwalder's definition, a business model is "a conceptual tool that contains a set of elements and their relationships" (2004, p. 15). The three aforementioned elements are grouped to the sub-system Infrastructure Management, within the system of a business model (Osterwalder, 2004). The Infrastructure Management refers to "how a company creates value" (Osterwalder, 2004, p. 79). In this context, our in-depth investigation of the three business model elements sheds light into the value creation mechanism within a BMfS. In the analysis thereof, we are particularily interested in differences regarding small and large architecture firms as well as differences in the mechanism depending on the degree of sustainability the enterprises embrace.

3.4 Data Collection Method

3.4.1 Qualitative Data

As outlined in the research strategy, a qualitative approach will be pursued. Baarda argues that research that is qualitative in nature as it is mainly focussed on getting insights (2010). Thus, this research requires exploratory research as it deals with reasoning, rather than hard statistics, which is a characteristic of quantitative studies (Baarda, 2010). In other words, our research aims to discover "what is happening; to seek new insights; to ask questions and to assess phenomena in a new light" (Robson 2002, cited in Saunders, Lewis, & Thornhill 2009, p. 139). This approach is considered suitable for the research area of Sustainable Business Models as it is relatively young and dominated by theoretical, scholarly contributions in constrast to empirical evidences. Therefore, a qualitative approach gives more room for an exploratory, open-ended and qualitative research, in opposed to a fixed research question of a quantitative research (Baarda, 2010).

Furthermore, this study entails a trial and error approach due to continuous adaption in order to achieve its goals (Baarda, 2010). Investigating why things happen in the way they happen in order to explain the relationship between variables (Saunders & Lewis, 2009). These suits well against the background of our research question. The variables in this study relate to the business model elements: Value Configuration, Partner Network, and Capabilities.

3.4.2 Interview Type

There are three different kinds of interview types: ethnographic interviews (unstructured), guided open interviews (semi-structured), and market-research interviews (highly structured) (Easterby-Smith et al., 2015). The purpose of the study is two-fold. First, making a theoretical contribution by shedding light into the interaction between the elements of the BMfS. Second, making a managerial contribution by providing practical insights for decision makers in architecture frims into how a BMfS creates value. The context of this study is the architecture industry.

Against this background, it was deemed important to have some predefined structure in the form of the business model in general, and the Value Configuration, Partner Network, and Capabilities. We used leading questions for each of the three previously mentioned elements and then followed up with further in-depth questions. Thereby leaving some room to ask specific questions to each case was important as each firm is unique and has its own specifications (March et al., 1991). Hence, we evalutated the guided open interview to be the best approach to achieve the research purpose. The guided open interview with the topic guide has the right balance in the trade off between structure and flexibility. It is neither unfavourably rigid, such as the market-research interview, that permits little deviation from the topic guide, nor being too flexible with virtually no preparation, as in the ethnographic interview (Easterby-Smith et al., 2015). Indeed, Sterman (2000) argues that for research in SD guided open interviews are especially effective. In the same vein, in order to explore the open ended research question, the underlying patterns and dynamics of sustainability's impact on business models, some structure allows us to address the necessary indicators around the phenomena under investigation (see Table 2.2 and Table 2.3). Thereby, the risk to forget indicators for business model elements for a semi-structured interview is lower in opposed to an unstructured interview, which presumes no preparation. However, the highly structured interview, with a number of predefined responses leaves too little room for the explorative nature of this study (Easterby-Smith et al., 2015). Hence, the opportunity to raise follow-up questions, to reflect and steer the open dialogue context-specifically are important advantages of the guided open interview.

3.4.3 Interview Preparations and Procedure

As described in chapter 2 Literature Review the abstract concepts were translated into measurable indicators by means of an operationalisation (see Table 2.2 and Table 2.3). These concrete indicators build the foundation for the interview guide. The operationalisation shows transparently how abstract terms were step-by-step broken down. The more concrete the terms, the more context-specific adaptation was necessary, since not all indicators of the generic Business Model Ontology were suitable for our study. It is worth mentioning that despite the seemingly crystal clear cut between interview preparation and the execution, there are iterative adjustments along the research process that require an adjustment to the topic

guide, for example, after we learned from a previous interview. In addition, the topic guide is seen as a reference point to ensure that none of the three business model element is forgotten. Nevertheless, as outlined in the Interview Type, in the preceding paragraph, the topic guide is made for a semi-structured interview. As such, it is not a "tight corset", but an open guideline for a fruitful, effective, and efficient discussion with our interview partners.

Interviews have been conducted either via Skype call, due to the geographic distances to architects in Germany and Denmark, or in person. These take between 45 - 75min, depending on the interviewees' availability, expertise in sustainable architecture, and the fruitfulness of the discussion. Furthermore, all interviewees are asked whether they consent to recording the interview and whether we may mention their firm's name (Easterby-Smith et al., 2015). All firms had the chance to review the analysis for their firm before the submission of the thesis, validating the findings. In accordance with Glaser & Strauss (1967) and Easterby-Smith et al. (2015), all recordings are named, filed, and stored in a logical manner.

In addition, all interviews are transcribed in order to ease the data analysis. These facilitate the identification of patterns that can be addressed and further explored in the following interviews. Moreover, in the interview phase, the data was analysed in the meantime. This allows spotting patterns and testing them in subsequent interviews. Furthermore, in every interview, respondents were also asked whether they are available for any possible follow-up questions that may arise after the interview was conducted. For such cases respondents were contacted via e-mail or phone call.

3.4.4   Selection of Interviewees

Yin (2014) argues that various interview partners can bring in different viewpoints. Hence, we attempt to talk to as many architects of one firm as possible. Yet, there is always a trade-off between depth as well as time and cost constraints (Bryman & Bell, 2015). While we could arrange interviews with multiple respondents for 40% of all firms, for the remaining part of the firms we conducted interviews with one employee. This has been due to time and resource constraints on the firms' side. However, we always talked with either a person on CEO or partner-level or the responsible person for sustainability. Given that many firms have a small size, we therefore made sure to get the best possible interviewee.

Table 3.1 Participating Architecture Firms

Firm	Interviewee(s)	Position	Firm Size	Country
Henning Larsen	Martin Vraa Nielsen	Lead Sustainability Engineer, DGNB Consultant	250	Denmark
	Jakob Strømann-Andersen	Partner, DGNB Auditor		
aib	Philippe Vernin	Partner	35	Germany
ft+	Nicolai Thiele	Partner	10	Germany
	Stefan Friedrichs	Partner		
CREO Arkitekter	Ebbe Kristiansen	Responsible for Sustainability, DGNB Consultant	70	Denmark
Vilhelm Lauritzen Arkitekter	Louise Gerner Rasmussen	Responsible for Sustainability	100	Denmark
	Hans Rosenberg	Responsible for Sustainability, DGNB Consultant		
Juhr Architekturbüro	Michael Juhr	CEO	15	Germany
RUBOW Arkitekter	Susanne Hansen	Partner	70	Denmark
Gerber Architekten	Benjamin Sieber	Partner	80	Germany
	Georg Kolendowicz	Responsible for DGNB		
kuntzunbrück	Martin Kuntz	CEO	5	Germany
a-z architekten	Holger Zimmer	CEO	25	Germany

The selection of interviewees followed a non-probability sampling design (Easterby-Smith et al., 2015). This stems from the fact that the probability of any member of the population cannot be determined (Easterby-Smith et al., 2015). As outlined in section 3.3.1 Case Study two main sources for architects were the German Council for Sustainable Building with approximately 1,200 members and the Green Building Council Denmark, with an unknown number of members. Consequently, these numbers show that the population is very limited and thereby interview partners are difficult to obtain. Therefore, convenience sampling was applied (Easterby-Smith et al., 2015).

Convenience sampling refers to the selection of interviewees (sample units) in accordance to ease of accessibility (Easterby-Smith et al., 2015). We cold called and emailed firms from the

Table 3.2 Participating Experts

Name	Affiliation	Position	Expertise
Jörg Jaspers	TU Braunschweig	Head of Department, Building Management	Former architect and now contractor for the technical university
Florian Lüdeke-Freund	Hamburg University; Leuphana University	Research fellow	Coined the term BMfS and leading scholar on the field of sustainability

DGNB and DK-GBC after permission from the institutions. Nine of then firms were sampled through this method, one firm, Juhr Architekturbüro, was sampled via personal contacts. We listed the firms in Table 3.1.

In addition to architecture firms, we reached out to experts to support our findings. We contacted a leading scholar of the field of BMfS and an industry expert, as can be seen in Table 3.2.

3.5 Data Analysis

The data analysis proceeds in two steps. First, we categorise the firms in four quadrants, alongside the dimensions of firm size and degree of sustainability. Second, we analyse each firm for every quadrant according to SD, with a concluding summary per quadrant.

3.5.1 Categorisation

The first step in analysing the gathered data lies in clustering the interviewed architecture firms. We cluster the firms along two dimensions. First, the firm's size, measured in number of employees. The firm's size is deemed as large, when it employs more than 30 employees and otherwise is demmed as small. We based this number on a report of the Architects' Council of Europe (2014), which showed that the majority of firms are smaller than 30 employees. While it is interesting to study the majority of firms, we may assume that larger firms have a significant effect on sustainability, given their resource availability. Second, the

degree of sustainability, which is measured by five indicators. The five indicators are: (1) explicit focus on environmental considerations, (2) explicit focus on social considerations, (3) DGNB/DK-GBC membership, (4) DGNB or similar certification, and (5) DGNB or similar consulant or auditor in-house. Table 3.3 provides an overview with the motivation for each indicator. Whether or not a firm achieves an indicator or not, is a binary decision, where the firm receives a 1 if it fits with the indicator and a 0 if it does not. We have deliberately chosen five elements to be able to segment the firms into two categories, given a possible scoring between zero and five. Here we would like to flag that this categorisation is a degree of sustainability, meaning that no firm is operating entirely unsustainable or entirely sustainable. Categorising the architecture firm alongside the two dimensions will allow a categorisation in four quadrants. Given that large and small firms have different characteristics, we expect varying results. In the same vein, we expect varying results for less and more sustainable firms.

Table 3.3 Categorisation Motivation

No.	Indicator	Rationale
1	Explicit focus on environmental considerations	The environment is one of the pillars of sustainability. In the beginning of each interview we ask the interviewee what for their firm sustainability means. We expect an explicit answer without further follow-up question to not lead the respondent.
2	Explicit focus on social considerations	The society is one of the pillars of sustainability. In the beginning of each interview we ask the interviewee what for their firm sustainability means. We expect an explicit answer without further follow-up question to not lead the respondent.
3	DGNB/DK-GBC membership	The DGNB or Danish equivalent, DK-GBC, membership is an objective measure for whether the firm is engaged in sustainability issues.
4	DGNB or similar certification	The DGNB or similar certification is an objective measure for whether the firm has achieved to deliver projects with a high standard in sustainability
5	DGNB or similar consultant or auditor in-house	The DGNB or similar consultant or auditor in-house is an objective measure for whether the firm has invested in building in-house capabilities for sustainability.

3.5.2   Causal Loop Diagrams

In 2.6 we outlined the basic functions of SD. The firm, and the BMfS as its representation, can be regarded as a dynamic system. A system can be broken down in its subsystem and its parts. We regard the BMfS as the system, the Infrastructure Management as subsystem, and the Value Configuration, Partner Network, and Capabilities as its parts. We may use the term parts and elements interchangebly in this context.

A powerful technique in SD to understand the interdependencies within a system are Causal Loop Diagrams (CLDs). "Thinking in causal loop models is essential in regrards to market position and generation of competitive avantage" (Lüdeke-Freund, 2017, Appendix G) and therefore a powerful management tool. There are four essential factors in CLDs: *variables*, *causal links*, *delays*, and *feedback loops* (Sterman, 2000). Williams and Hummelbrunner (2011) outline a three step process to analyse data with CLDs and we will borrow an example from Sterman (2000) to illustrate the three steps in Figure 3.1.

Important to note is that CLDs only have a limited scope, meaning that some factors that might be relevant, such as regulations and politics are not considered.

Figure 3.1 Sterman's Chicken Example
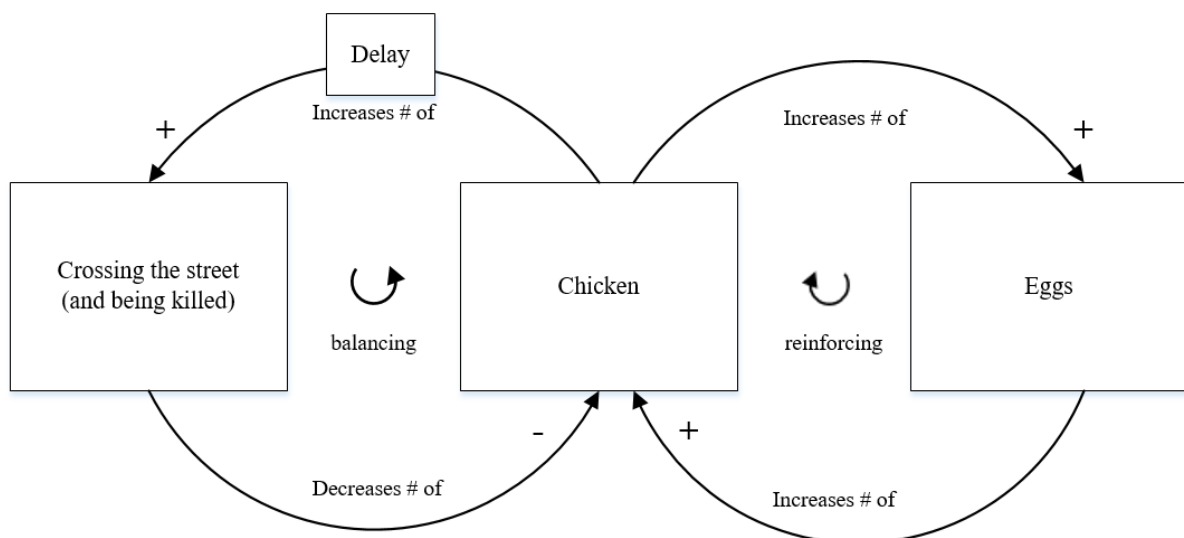
1. Identify variables

In the first step all relevant variables need to be identified (Williams & Hummelbrunner, 2011). The variables are the central hubs of any system, from which the interactions allow us to draw inferences about the dynamics of the system (Vester, 2015). Relevant literature and interviews may serve as valuable sources to derive the variables (Wilms, 2001). Hereby we used the conceptual framework to derive relevant variables. As such it served as a starting point for the interviews and was successively complemented by the empirical findings. In the example of Sterman, the variables are Eggs, Chicken, and Deadly Road Crossings.

2. Determine relationships

In the second step the relationships between the variables need to be identified (Williams & Hummelbrunner, 2011) by the causal links that indicate the influences between variables (Sterman, 2000). The arrows are the causal links, with + and – indicating a positively or negatively related effect. Positive means that when the cause increases, the effect increases and when the cause decreases, the effect decreases (Sterman, 2000). Conversely, negative means that when the cause increases, the effect decreases and when the cause decreases, the effect increases (Sterman, 2000). We illustrate the meanings of + and – in Table 3.4 and Table 3.5. For a complete model, the links are based on the interviewees' answers and supplemented by the interviewer's experience (Sterman, 2000). In the example, if we increase the number of chicken, we will receive more eggs. More eggs lead to more chicken. However, the more chicken we have, the more chicken try to cross the deadly road, which then may lead to less chicken. In this step the delays that may occur are also added (Williams & Hummelbrunner, 2011). In the example we may assume that in winter chicken are less outside and therefore run less of a chance to cross the road.

Table 3.4 Positive (+) Meaning

	Cause		**Effect**
If	Decrease	*then*	Decrease
If	Increase	*then*	Increase

Table 3.5 Negative (-) Meaning

	Cause		**Effect**
If	Decrease	*then*	Increase
If	Increase	*then*	Decrease

3. Forming feedback loops

In the third step feedback loops are added. We add feedback loops when causal links are circular (Sterman, 2006). Feedback can be either positive (reinforcing) or negative (balancing). Reinforcing links indicate "that if the cause increases, the effect increases *above what would otherwise have been,* and if the cause decreases, the effect decreases *below what would otherwise have been"* (Sterman, 2006, p. 139). Whereas balancing links imply "if the cause increases, the effect decreases *below what would otherwise have been,* and if the cause decreases the effect increases *above what would otherwise have been"* (Sterman, 2006, p. 139). This means that a feedback loop is an amplifier for the effect and is thus important in understanding the dynamics of a system. In the example, the R and B in small circles are the feedback loops. Only when we consider the feedback loops, we may understand that the increase in chicken and eggs or decrease in chicken because of road crossings, does not stop after one time. The process continues and grows stronger with time. Delays in this context are in particular important because cause and effect are not always closely related in time (Forrester, 2006). "[Delays] reduce the number of times once can cycle around the learning loop" (Sterman, 2000, p. 21) and therefore reduce the effect of the feedback loop.

While the chicken example depicts a simple system, we may easily imagine that a firm holds a complex system with many variables, causal links, delays, and feedback loops. The complexity of a system stems from the interactions within the system, which are depicted by the feedback loops (Steerman, 2000). Therefore, deriving the feedback loops from the architecture firms should allow us to understand the interdependencies of the business model elements. In our analysis, the three steps are not followed sequentially, but are rather used as an integrative approach to analyse the gathered data.

3.6   Research Quality

3.6.1   Reflection upon reliability and validity as research quality criteria

Despite the fact that reflecting upon the quality of our research is crucial, there is no consensus among academics which criteria to apply (Bryman & Bell, 2015; Alvesson & Sköldberg, 2008; Lincoln & Guba, 1985; and Silvermann, 2013). Reliability and validity are claimed to be inappropriate evaluation criteria in qualitative studies, since they are more suitable in quantitative studies (Bryman & Bell, 2015). Nevertheless, we believe that both terms are very comprehensive and that aspects of them are still applicable as quality criteria in this mostly qualitative study.

3.6.2   Reliability

In essence, reliability relates to the degree of repeatability of the study by another researcher (Bryman & Bell, 2015). The authors also define it the "consistency of a measure of a concept" (Bryman & Bell, 2015, p. 169). Even though it plays a more important role in quantitative studies, and this study is mostly qualitative in nature, this quality criterion is not to be neglected.

On the one hand, primary data such as interviews for example are not taken for granted and needs to be challenged. In order to further improve reliability, interview partners are asked for clarification in the event of doubt, in line with a generally critical viewpoint towards all sorts of information. The expert interviews serve as another source of verification.

On the other hand, external, secondary information are checked against the eight "big-tent" criteria for quality defined by Tracy (2010). These are "(a) worthy topic, (b) rich rigor, (c) sincerity, (d) credibility, (e) resonance, (f) significant contribution, (g) ethical, and (h) meaningful coherence" (Tracy, 2010, p. 837). However, it is to be pointed out that the significant contribution was not a selection criterion for all secondary data, yet for most. We believe that a few, very recent and thus not yet frequently quoted papers, for example, from

the emerging research field BMfS from 2016 and 2017 are deemed necessary for the purpose of this study.

3.6.3 Validity

Validity refers to "the integrity of the conclusions that are generated from a piece of research" (Bryman & Bell, 2015, p. 50). The authors distinguish between three dimensions of validity: measurement validity, internal validity, and external validity.

Even though measurement validity relates mainly to quanitative studies, we deem it relevant for the context of this thesis (Bryman & Bell, 2015), to address the so-called *construct validity* (Bryman & Bell, 2015). It refers to the extent that a concept measures what it intends to measure (Baarda, 2010). Thus, the questions in the topic guide must be valid in order to answer the research question of this study. Therefore, the abstract terms such as Value Configuration, for example, were operationalized into specific, measurable indicators from which the topic guide (see Appendix D) was derived (Baarda, 2010).

Internal validity is the confidence level that the causal relations of two or more variables indeed cause the variance discovered (Bryman & Bell, 2015). Hence, a distinction between dependent and independent variables is inevitable. Table 3.6 visualises this differentiation depending on the degree of granularity. It is worth noting that the information were derived from the operationalised conceptual model (see Table 2.2 and Table 2.3).

Table 3.6 Dependent vs independent variables

Degree of granularity	Dependent variable	Independent variables
The organisation's BMfS as a system	Organisation's BMfS	Value Proposition, Customer Interface, Infrastructure Management, Financial Aspects
One of the three sub-systems of a BMfS	Infrastructure Management	Value Configuration, Capability, Partner Network

Sub-sub-system of Infrastructure Management	Value Configuration	Configuration Type, Activity Level, Activity Nature
Sub-sub-system of Infrastructure Management	Capability	Tangible, Intangible, Human
Sub-sub-system of Infrastructure Management	Partner Network	Reasoning, Strategic Importance, Degree of Competition, Degree of Integration, Substituability

The table visualises that the dependent and independent variables clearly delineated. In fact, our empirical analysis goes even beyond simple linear causal links as we explore circular relationships (Sterman, 2000; Habernfellner et al., 2015). In the interviews, we asked the respondents about how the variables have or have not changed when sustainability became a driving force in the organisation that is when the Value Proposition changed towards sustainable architecture solutions. The individual case analyses with the raw data were transcribed from the interviews. By means of CLDs the raw data was translated (when necessary) into variables. The CLDs visualise the linear and circular relationships. It is worth noting that only the relevant variables were mentioned in opposed to listing all possible variables as thereby the overview gets lost (Sterman, 2000). Only by isolating the case-specific variables, the gist of the system and thereby the main causal loops can be identified (Williams & Hummelbrunner, 2011). This internal validity was further improved by sending the individual CLD in combination with the raw data to the interviewees. They were asked to review both and validate the correctness of the causal links. Only minor adjustments needed to be done when interviewees asked for a correction.

External validity relates to the generalisability of the research findings "beyond the specific research context" (Bryman & Bell, 2015, p. 51). Saunders & Lewis (2009) argue that generalisability is an issue due to few and thus not representative number of respondents. However, there are two counter arguments presented. First, Glaser & Strauss (1967, p. 23) argue that despite the fact that the samples may not be accurate, "but the concept itself will not change, while even the most accurate facts change." The accuracy of the concepts is dependent on the theoretical and research purposes defined (Glaser & Strauss, 1967). Our thesis is a multiple case study and involves partly one or maximum two interview partners

from one architecture firm. Given the small number of employees in a number of bureaus, obtaining more than one interview partner was not possible. Yet, by means of the comparative analysis, some generalisability to illustrate concepts is possible (Glaser & Strauss, 1967). Yin (2003) points out that case studies with a qualitative approach contribute considerably to theoretical propositions. This applies when the outcomes of one's study relate to existing theory, which allows a translation to a broader context (Yin, 2003). It is an examination of the applicability of existing theory to the case study context.

4 Empirical Findings

4.1 Introduction

In the following chapter we analysed the conducted interviews with ten architecture firms from Germany and Denmark. First, we categorised the firms into quadrants according to their firm size and their degree of sustainability. Second, we analysed each firm of every quadrant according to Causal Loop Diagrams (CLDs) and summarised the findings per quadrant. In the Empirical Findings we present an aggregated analysis of the quadrants, whereas a detailed firm by firm analysis can be found in Appendix E.

4.2 Categorisation

The categorisation of the firms happens alongside two dimensions: the firm size and the degree of sustainability. The firm size has been stated in the overview of participating architecture firms in Table 4.1. The degree of sustainability is summarised in table 4.1. The motivation for the categorisation for each firm in detail can be found in Appendix F. The result is the categorisation matrix in Table 4.1, where we find four quadrants of which three of them contain firms. Q1 shows Sustainable/Large firms, Q2 shows Sustainble/Small firms, Q3 shows Unsustainable/Small firms, and Q4 shows Unsustainable/Large firms.

The categorisation yields the following distribution: Six firms fit Q1, three firms fit Q2, one firm fits Q3 and no firm fits Q4 (Figure 4.1). Hence, we will discuss Q1 through Q3 in the following sections.

Table 4.1 Degree of sustainability of participating architecture firms

	Henning Larsen	aib	ft+	CREO Arkitekter	Vilhelm Lauritzen Arkitekter	Juhr Architekturbüro	RUBOW Arkitekter	Gerber Architekten	kuntzundbrück	a-z architekten
Explicit focus on environmental considerations	1	1	1	1	1	1	1	1	0	1
Explicit focus on social considerations	1	0	1	0	1	1	1	0	0	0
DGNB/DK-GBC membership	1	1	1	1	1	0	1	1	1	1
DGNB or similar certification	1	1	0	0	1	1	0	1	0	1
DGNB or similar consultant or auditor in-house	1	1	1	1	1	0	1	1	0	0
Total	**5**	**4**	**4**	**3**	**5**	**3**	**4**	**4**	**1**	**3**

Figure 4.1 Categorisation Matrix
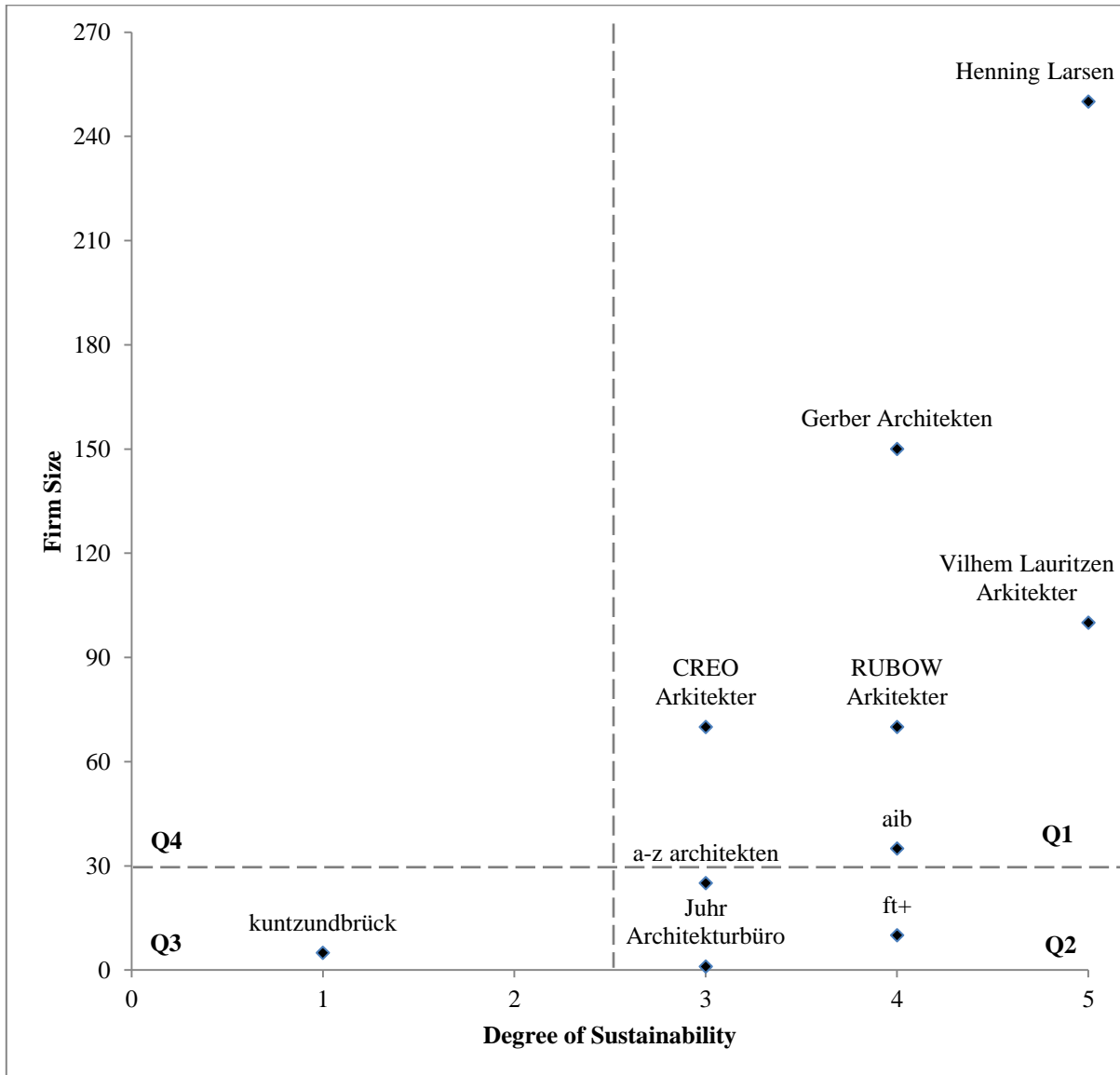
4.3   Quadrant 1

Quadrant 1 includes the firms aib, CREO Arkitekter, Gerber Architekten, Henning Larsen, RUBOW Arkitekter, and Vilhem Lauritzen Arkitekter (VLA). All six of them are characterised by a high degree of sustainability and a large firm size. We conducted interviews with a total of nine employees, each either partner or responsible for sustainability.

We take the Value Proposition as a starting point and thereof present the findings for each element under investigation, Value Configuration, Partner Network, and Capabilities.

4.3.1 Value Proposition

The Value Proposition describes the offering of an enterprise to customers (Osterwalder, 2004). We usually see two explanations for why the firms engage in sustainable construction. First, is a market demand that has developed.

> "We have to follow the demands from the clients" (Hans Rosenberg, VLA)

> "The reason that we focused on sustainability is that we saw for one that it is a topic that so drastically influence how we should construct buildings and two a market" (Martin Vraa Nielsen, Henning Larsen)

Second, it is a fundamental part of the firm.

> "We cannot make a good project without sustainability. [...] We need to have it." (Ebbe Kristiansen, Creo Arkitekter)

> "Sustainability is the foundation of this office" (Benjamin Sieber, Gerber Architekten)

> "VLA has a long story in sustainability" (Hans Rosenberg, VLA)

From this we derive that the Value Proposition of the firms in Quadrant 1 is geared towards sustainable buildings.

4.3.2 Value Configuration

The Value Configuration "describes the arrangement of activities and resources" (Mokhlesian & Holmén, 2012, p. 763), in order to create the offering. Osterwalder (2004) differentiates between three configuration types: Value Chain, Value Shop, and Value Network (also see conceptual model). The Value Chain, borrowed from Porter and Millar (1985), shows the main activities of a firm, spanning inbound logistics, operations, outbound logistics, marketing and sales, and service. The Value Shop, brought forward by Stabell and Feldstad

(1998) seeks to show the activities of a service firm, with the main activities problem finding and acquisition, problem solving, choice, execution and control, and evaluation, e.g. consultancies. The Value Network, as well borught forward by Stabell and Feldstadt (1998), seeks to provide a network service, linking customers, e.g. telecommunications provider. For architecture firms we decided to see the Value Configuration as a Value Shop, as it is a service coming close to what a consultancy offers.

One change that occured due to sustainability, which is frequently brought up by the interviewees, is that the complexity of projects increased. This is for instance shown by the fact that all planners and specialists now need to sit together at a table early on.

> "you need to include all planners at an early stage" (Philippe Vernin, aib)

> "We need to have an early collaboration because we make decisions in the beginning state that involve technical aspects and we can't ignore those" (Susanne Hansen, RUBOW Arkitketer)

Besides the early collaboration with experts we find little change to the overall process of the activities. As the Value Configuration is determined by "inside and outside activities and processes" (Osterwalder, 2004) we will have a closer look at the external Partner Network and internal Capabilities.

Furthermore, a striking finding concerns the mindset influencing the Value Configuration. Several firms share a holistic mindset that embraces the increasing complexity that the industry is witnessing.

> "The building industry is so much more complex than 5 years ago. In order to handle that complexity and get a more sustainable building in the end, made us realise that we need to maintain some part of that complexity." (Martin Vraa Nielsen, Henning Larsen)

Henning Larsen copes with the increasing complexity by integrating competences through the set up of a sustainability department on an organisational level. A major implication is that the firm can steer projects more proactively.

"From a productivity aspect, it's an efficiency aspect, that we know what they are talking about. And we are able to steer it more directly to where they want it and how they want it." (Martin Vraa Nielsen, Henning Larsen)

Besides, the holistic mindset encompasses life cycle assessments on the product level.

"A lot of sustainability issues should discuss over the lifecycle. It is mainly through certifications that [clients] ask for it." (Martin Vraa Nielsen, Henning Larsen)

For yet other firms, a holistic mindset helps to improve the collaboration with project participants.

"[...] we depend on having a collaboration with engineers that have also a holistic way of building a sustainable [solution]. So of course we have to team up with people that have the right kind of personnel to solve these problems." (Susanne Hansen, RUBOW).

"We need to have an early collaboration, because we make decisions in the beginning state that involve technical aspects and we can't ignore those. When it's holistic, you need to look into all aspects at once. [...] it needs to be a process with all the specialists at one table from the beginning." (Susanne Hansen, RUBOW Arkitekter)

"The discourse with the specialists through this integrated thinking [is necessary] to reach the goal. I can't solve it as an architect alone. I'm always dependent on the work of others" (Benjamin Sieber, Gerber Architekten)

4.3.3   Partner Network

The Partner Network "portrays the network of cooperative agreements with other companies necessary to efficiently offer and commercialize value" (Mokhlesian & Holmén, 2012, p. 763). From Osterwalder (2004) we derive five indicators of the Partner Network, Reasoning, Strategic Importance, Degree of Competition, Degree of Integration, and Substitutability (also see Table 2.2 and Table 2.3). While we did not find much evidence for Reasoning, most firms stated that partners have a high Strategic Importance for them.

"[Partners are] very, very, very important. We have to work with good partners" (Ebbe Kristiansen, CREO Arkitekter)

"[...] we depend on having a collaboration with engineers that have also a holistic way of building a sustainable [solution]" (Susanne Hansen, RUBOW Arkitekter)

"We have a fixed pool of engineers" (Georg Kolendowicz, Gerber Architekten)

"We are applying together [to competitions] with other offices that we got to know and come to appreciate" (Benjamin Sieber, Gerber Architekten)

Or as Martin Vraa Nielsen from Henning Larsen summarises the Strategic Importance of partners: "Mega!" Further, the interviewees claimed that it is rather difficult to find suitable partners outside of their fixed pool.

"Very, very difficult [to find a substitute partner]. [...] Everyone wants to work with the best ones all the time" (Ebbe Kristianse, CREO Arkitekter)

"[Finding other partners] is pretty difficult. The economic situation in Germany is that the build industry is doing very well. This means that all offcies are working at full capacity" (Philippe Vernin, aib)

"[...] We have established our network and you are used to each other. If you work with an offce that you don't know, it is always a bit more effort. [...] You have the best experiences within your network. [...] Of course you are looking for cooperative partnerships" (Philippe Vernin, aib)

Therefore, the increase in Strategic Importance, decreases the Substitutability of partners. Most firms try to counter this development by establishing close ties with their partners.

"We need to have an early collaboration, because we make decisions in the beginning state that involve technical aspects and we can't ignore those. When it's holistic, you need to look into all aspects at once. [...] it needs to be a process with all the specialists at one table from the beginning. [...] we do need a lot of people to collaborate from the first day of the design process" (Susanne Hansen, RUBOW Arkitekter)

"The discourse with the specialists through this integrated thinking [is necessary] to reach the goal. I can't solve it as an architect alone. I'm always dependent on the work of others" (Benjamin Sieber, Gerber Architekten)

"We need to work closely together. That's very important" (Ebbe Kristiansen, CREO Arkitekter)

For Henning Larsen, collaborating closely together goes even so far that they started integrating certain services, especially aimed at the social aspect of sustainability.

"(On the question whether integrating different competences is key to building sustainably) Yes. We have taken a fairly new service lighting design. We started to take on acoustics as being part of how you can increase the comfort in the buildings" (Martin Vraa Nielsen, Henning Larsen)

"We have it in-house. It is an integral part. It becomes a premise of our architecture" (Martin Vraa Nielsen, Henning Larsen)

While integrating sustainability services into the firm seems like a logical choice for Henning Larsen, another firm deliberatiely refrains from integrating partners into the firm, in order to have a higher stimulus for new happenings, especially with regards to sustainability

"We have the expectation towards specialists that they bring in their knowledge from previous projects, in order to have a mutual exchange. Not everything is in-house, in order not to do the same things all the time. That's an important topic for sustainability as a whole" (Benjamin Sieber, Gerber Architekten)

We conclude that firms counter the low Substitutability by collaborating closely together with their partners, in particular this holds true for sustainability projects and therefore they increase their Degree of Integration. Indeed, we find supporting evidence from literature asserting that a well-functioning interplay and integration of players is needed to deliver sustainable solutions (Kibert, 2007). Ultimately this allows the firms to increase their External Competences, used in the Value Shop. We depicted this scenario as a reinforcing loop, R1, in Figure 4.2.

Figure 4.2 R1 for Sustainable/Large firms
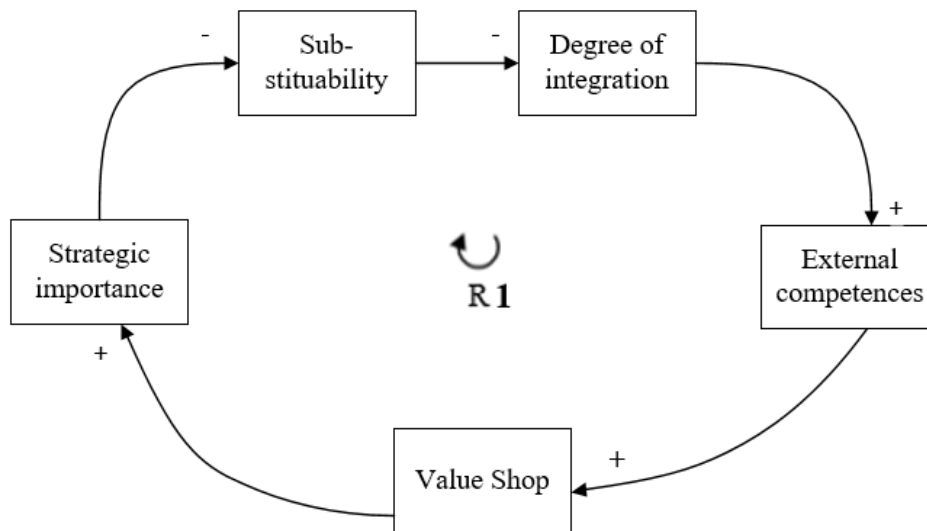
R1 allows us to understand why the six firms are able to constantly deliver on sustainable projects. According to the interviewees and literature, external competences are key to working sustainably. Hence, they manage to offsett the danger of low Substitutability with increasing the Degree of Integration, even to the extent that the largest firm of all six started integrating certain services.

4.3.4 Capabilities

Capabilities "outline the competences necessary to execute the company's business model" (Mokhlesian & Holmén, 2012, p. 763). According to Osterwalder (2004) there are three types of resources that the Capabilities depend on: tangible, intangible, and human. The empirical findings give little evidence to say that tangible resources are in particular important for architecture firms pursuing sustainability. However, intangible and in particular human resources are deemed crucial by the interviewees. One interviewee argues that due to sustainability their capabilities "totally changed" (Ebbe Kristiansen, CREO Arkitekte). We start by discussing the human resources.

According to Osterwalder (2004) the human resources are the employees and we expand this definition according to Barney (1991) and add training, experience, relationships, and insight

of individual managers and workers (also see conceptual model). Indeed, many of the interviewees respond that they engage in trainings.

> "[...] trainings contributed to the development of internal competences" (Ebbe Kristiansen, CREO Arkitekter)

> "Participation in trainings were shaping in the beginning" (Philippe Vernin, aib)

Some firms started to develop in-house trainings as they felt that they could not get out enough from external trainings. This stresses the strong effect of trainings on the capabilities of a firm.

> "Increasingly we are offering in-house trainings. We realised that the offering of the architecture association is highly repetitive" (Philippe Vernin, aib)

> "We also sometimes do Friday Seminars and in-house lectures in order to sensitise the people into that [sustainability] direction" (Benjamin Sieber, Gerber Architekten)

Indeed, we find supportive literature that claims that training and knowledge development positively contribute to the development of sustainable projects (Kibert, 2007; Ofori & Kien, 2004). Hence, we derive that firms increase their Internal Competences through Trainings, which allows them to improve the activities performed in the Value Shop, as depicted in Figure 4.3. We derive a reinforcing loop, R2, as the trainings are ongoing and reinforce themselves up to a point where firms are starting to integrate the trainings in-house to improve the experience.

Figure 4.3 R2 for Sustainable/Large firms
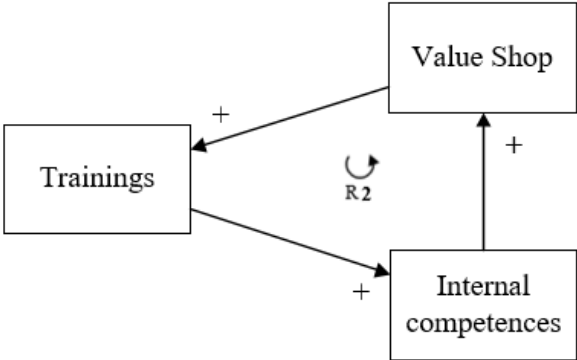
More importantly though, for the development of internal competences, is the Learning on the Job. Several interviewees highlighted that the architect learns most when actually working on the project.

> "[...] we learn a lot from these processes with all these specialists at a table. If you have a lot of specialists in a room, then you learn, you don't need to go to a course because you have it all in front of you" (Susanne Hansen, RUBOW Arkitekter)

> "It takes time but it is also realising that [...] it is a continuous process of figuring out what impacts or what parameters enable sustainable architecture" (Martin Vraa Nielsen, Henning Larsen)

> "[Sustainable projects are an] ongoing process, step-by-step. With every step it's going better and better" (Ebbe Kristiansen, CREO Arkitekter)

Hence, we derive that an increase in working on sustainable projects leads to an increase in Learning on the Job. Martin Vraa Nielsen and Ebbe Kristiansen note, however, that this is a process that develops over time. Further, we find that this Learning on the Job is often stimulated by increasing the Dialogue among Employees.

> "[...] an internal dialogue among employees, knowledge sharing [...] contributed to the development of internal competences (Ebbe Kristiansen, CREO Arkitekter)

> "We need to have good communication in the company. That is very important. [...] We can learn from each other (Ebbe Kristiansen, CREO Arkitekter)

> "Every employee needs to have an understanding for sustainability. If the employee cannot make sense of when the specialist says something like geothermal energy, then he can't do it" (Benjamin Sieber, Gerber Architekten)

> "Three years ago we thought it was necessary to have leading employees to be in charge of sustainability [...] but we actually realised that [...] everybody works in sustainability now, we all kind of know hwat this is all about" (Susanne Hansen, RUBOW Arkitekter)

Literature suggests that firm internal collaborations are needed to develop competences (Bossink, 2004), which we identify to be in line with the findings, shown by the increase in the

Figure 4.4 R3 for Sustainable/Large firms
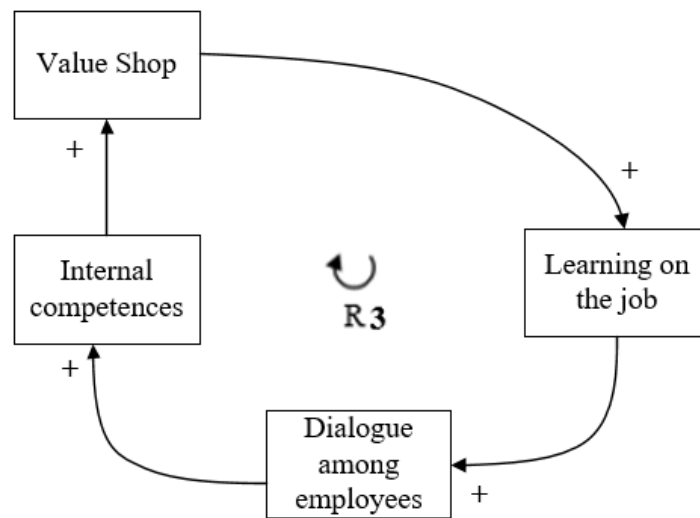
Dialogue among Employees. Therefore, we derive the reinforcing feedback loop R3, as shown in Figure 4.4. As firms build sustainable buildings, they are learning about how to design them and spread that knowledge with other employees in the firm, eventually increasing the Internal Competences. Those then allow to improve the projects done in the Value Shop. As Martin Vraa Nielsen and Ebbe Kristiansen point out, this is a continuous process and it takes time to figure everything out.

Further, several firms claim that the close cooperation with partners allowed them to learn from the partners.

> "And then we learn a lot from these processes with all the specialists on a table. If you have a lot of specialists in a room, then you learn, you don't need to go to a course because you have it all in front of you in a way" (Susanne Hansen, RUBOW Arkitekter)

> "What is important to us is the exchange with others, which have the same problem" (Benjamin Sieber, Gerber Architekten)

> "Yes I think so (on the question whether capabilities have been influenced by partners as a facilitator of learning). Personally I have been learning a lot about how to do things in sustainability. [...] We have learned a lot from each other" (Hans Rosenberg, VLA)

Stemming from the close integration of partners, the firms were able to increase their own, internal competences and hence strenghten the sustainability project they can do in the Value

Figure 4.5 R4 for Sustainable/Large firms
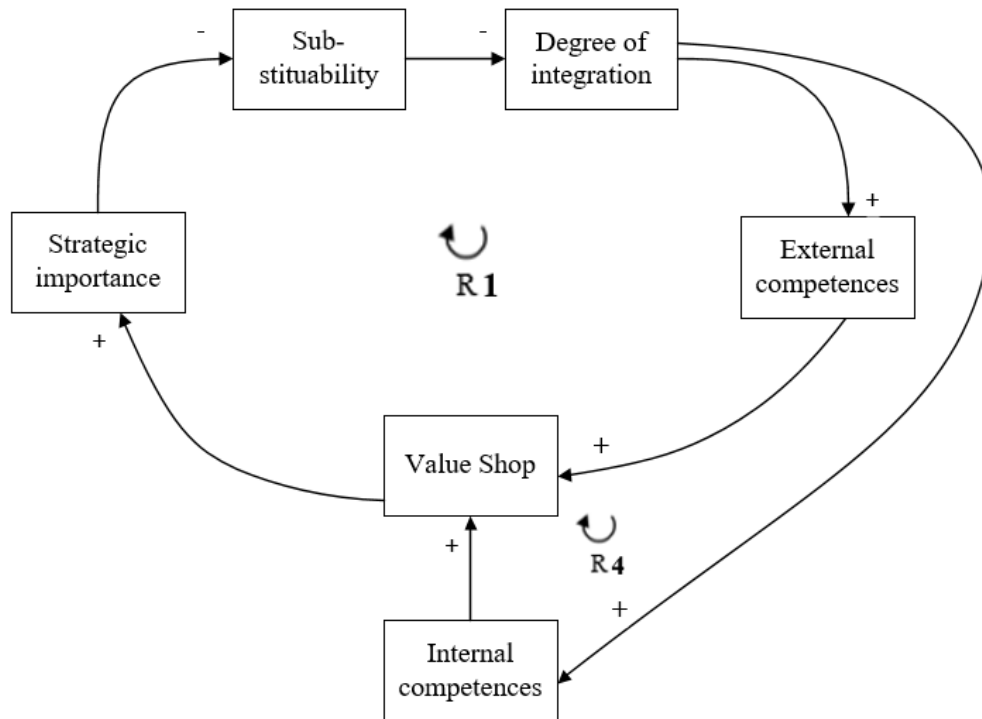
Shop. Through parts of the R1, this learning effect leads to yet another reinforcing feedback loop, R4 (Figure 4.5).

According to Osterwalder (2004) intangible resources are either patents or brands. In the case of our study we found evidence that the brand is a factor in enhancing the Value Proposition of a firm.

> "I very much think so [that people come to us because of our sustainability image]. It is one factor of our attractiveness" (Martin Vraa Nielsen, Henning Larsen)

Given that an architect mostly advertises him or herself through its own buildings, we find a reinforcing loop, R5, between Value Shop, Brand, and Value Proposition. We insert a delay between Brand and Value Proposition to stress that there is some time delay before the brand can have an effect on the market (Figure 4.6).

Figure 4.6 R5 for Sustainable/Large firms
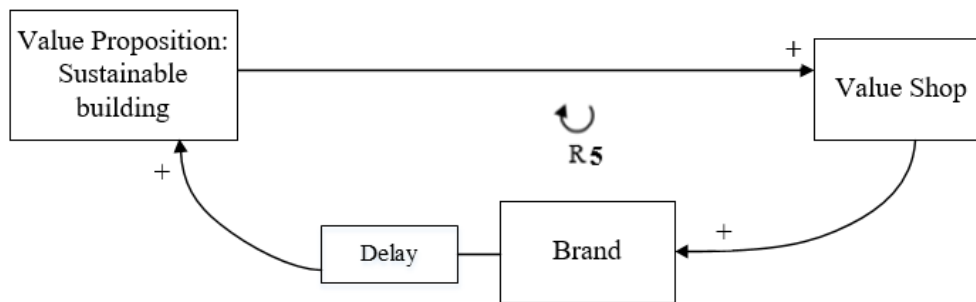
Lastly we find that the membership in councils for sustainability, such as the DGNB or the Danish equivalent, the Green Building Council, affects the company in two ways. First, it increases the experience exchange and may therefore develop internal competences, and second, it can be used as a marketing tool.

"The entire force of knowledge in Germany comes together [in the DGNB] and we can try to develop something" (Georg Kolendowicz, Gerber Architekten)

"What is important for our office is the exchange with others, who have the same problems, who then can help us, for which it was immediately clear that we participate in the founding of the DGNB" (Benjamin Sieber, Gerber Architekten)

"We need to acquire knowledge [at events of the DGNB] to sell ourselves" (Martin Vraa Nielsen, Henning Larsen)

"We go to meetings and courses [of the Green Building Council] all the time" (Ebbe Kristiansen, CREO Arkitekter)

"There is definitely the Green Building Council that does these knowledge sharing [and] we try to participate (Louise Gerner Rasmussen, VLA).

"[The DGNB] is of course also a market instrument for the office" (Benjamin Sieber, Gerber Architekten)

4.3.5   The Whole Picture

The SD perspective shows what usually remains unseen. It sheds light on the underlying mechanisms of the value creation part of the BMfS. Modelling the value creation as CLDs, depicted in Figure 4.7, allows visualising and understanding the mechanisms behind the BMfS. From this we can derive why some firms have a superior sustainability performance over others.

The Value Shop is for most parts the connector between the Partner Network and the Capabilities or the External and Internal Competences, respectively. Just like a body can only function when all elements such as lungs, heart, and stomach work together, the BMfS can only function, when the Value Shop, External Competences, and Internal Competences work together. This stems from the fact that neither the architect himself nor the partners can construct a house on their own. What is not clear until seeing the BMfS from a SD perspective is that all the feedback loops mutually reinforce each other. While we might normally assume that the partners of a firm are entirely disconnected from the Brand of a firm, we see that working together with partners enhances the quality of the buildings that firms can design. Since the buildings are the architecture firm's figurehead, any factor that increases the quality of the building will automatically increase the Brand effect. In the same way, it is not that Trainings, Learning on the Job, or the high Degree of Integration have an independent effect on the Internal Competences, but rather that all amplify each other. Therefore they do not have a linear relationship to each other, but instead we now see the underlying circular relationship between the variables. It is therefore not the sum of all parts that determine the overall functionality of the BMfS, but the product of its interactions. In other words, the variables do not sum up, but multiply each other.

A striking characteristic of the findings of Sustainable/Large firms is the dominance of reinforcing loops, without any balancing loop. The reinforcing loops are catalysts that not only keep the value creation in constant motion, but also multiply each other. As Sanchez and Ricart argue, "positive feedback loops […] help a business model to gain strength over time" (2010, p. 140). Therefore, the Sustainable/Large firms are able to shorten time delays. Moreover, these interlocking feedback loops make it difficult for others to copy (Porter, 1996). It is not enough to merely invest in Trainings, but the entire system must be geared

towards constantly reinforcing sustainability. Only when all mechanisms are in place, the BMfS becomes strong enough to deliver superior sustainability performance.

In particular when all feedback loops are reinforcing, without any balancing loops, this is important to notice, because it shows that once all parts work together, sustainability will develop itself faster and faster over time into the business model. The constant reinforcement of all loops leads to a virtuous sustainability cycle (Sanchez & Ricart, 2010) and ultimately explains why the Sustainable/Large firms were able to create a BMfS.

Figure 4.7 The Whole Picture for Sustainable/Large firms
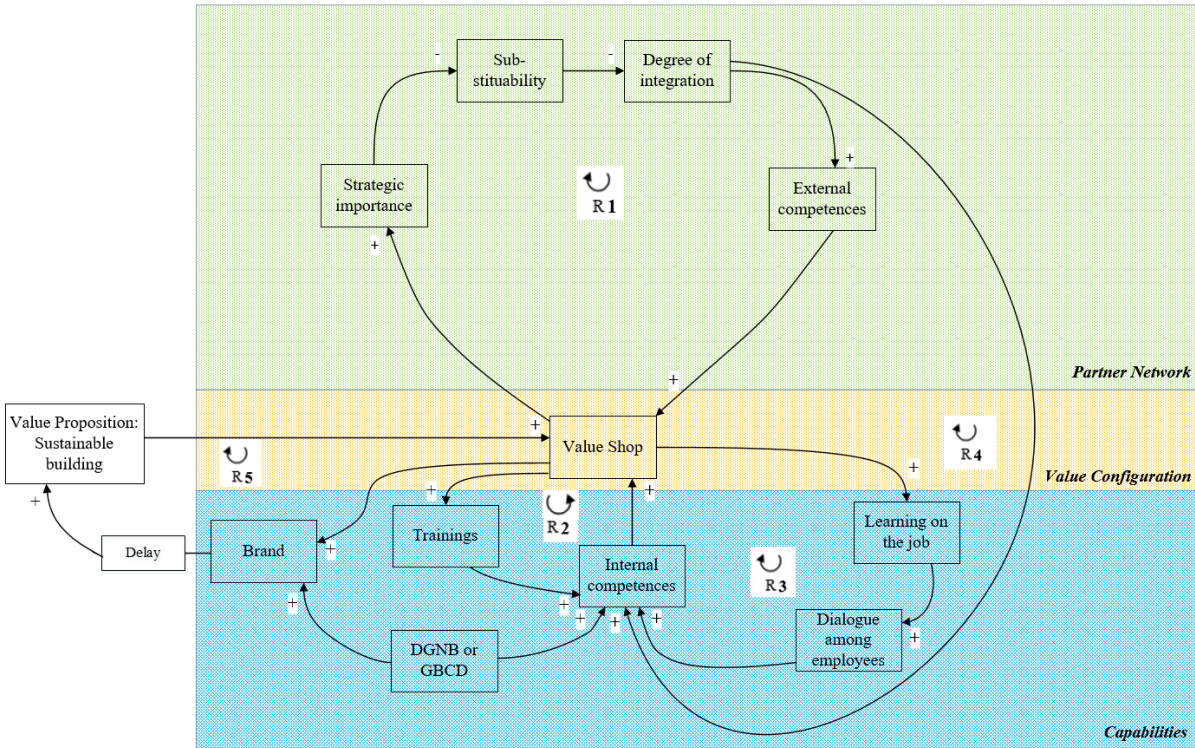
4.4   Quadrant 2

Quadrant 2 includes the firms a-z architekten, ft+, and Juhr Architekturbüro. All three of them are characterised by a high degree of sustainability and a small firm size. We conducted interviews with a total of four employees, each either CEO or partner. We take the Value Proposition as a starting point and thereof present the findings for each element under investigation, Value Configuration, Partner Network, and Capabilities.

4.4.1 Value Proposition

The initiative to build sustainably was unanimously taken by the CEOs or partners of the firm. We usually see two explanations for why the firms engage in sustainable construction. First, is an internal drive of the architects.

> "[We started building sustainably] because we said there is being built so much nonsense and so much short-lived [buildings] and much is then again demolished and this doesn't make any sense" (Michael Juhr, Juhr Architekturbüro)

This complies with the preceeding literature stating that it is the personal values of the decision maker, luring a small firm into sustainability (cf. Murillo & Lozano, 2006). Second, sustainability has gained importance as a topic and thus also in the firm.

> "The intensified public debate and news on sustainability by companies in our region conveys to our firm too" (Stefan Friedrichs, ft+)

From this we derive that the Value Proposition of the firms in Quadrant 2 is geared towards sustainable buildings.

4.4.2 Value Configuration

We found varying opinions on whether sustainability had an impact on the activities that a firm performs. On the one hand, one firm asserts that the activities have changed profoundly.

> "[The activities] have already changed an will change more" (Nicolai Thiele, ft+)

On the other hand, another firm asserts that the activities have not changed.

> "[The activities] do not change at all" (Michael Juhr, Juhr Architekturbüro)

A third firm asserts that the changes did not stem from sustainability.

> "Yes [the activities changed], however, I would not only see that for sustainability" (Holger Zimmer, a-z architekten)

Literature assumes that sustainability factors along the lifecycle of a building need to be considered (Liebsel & Glavind, 2007, Nelms et al., 2007; Sterner 2002; Ngowi, 2001). And indeed we find that the firms in Quadrant 2 are doing so.

> "[Factors that are] not considered in the first sketch in terms of apsiration, quality, [and] sustainability will be difficult [to] consider afterwards along the project" (Holger Zimmer, a-z- architekten)

Hence, we conclude that the process of activities in so far as there is an increased need for the early consideration of sustainability factors in the process. Therefore sustainability projects demonstrate a higher degree of complexity. Further literature states that the Value Configuration can only be changed with a change in Partner Network and Capabilities (Mokhlesian & Holmén, 2012). However, we need to note that the arrangement of activites did not change per se, but rather more complex requirements are added, due to sustainability.

Furthermore, a striking finding concerns the mindset influencing the Value Configuration. Several firms share a holistic mindset that embraces the increasing requirements that the industry is witnessing.

> "[Partner are] very important [for our long-term success]. Without them we would not been able to cope with the ever-increasing requirements." (Stefan Friedrichs, ft+)

> "We live this [sustainability]. […] We think also a lot about processes, internally and externally." (Stefan Friedrichs, ft+)

> "How can we change processes overall to simplify steps and reduce the wastes." (Stefan Friedrichs, ft+)

> "Yes, one has to pay attention to the interfaces [to other project participants] and details." (Holger Zimmer, a-z architekten)

This stands in stark contrast to the traditional silo-thinking that prevailed the industry and is in line with the recommendations of scholars to foster closer project collaborations (Theaker and Cole, 2001).

Osterwalder argues that the Value Configuration creates value through "inside and outside activities" (2004, p. 83), hence through the Capabilities and Partner Network. Therefore, we will focus on the Partner Network and Capabilities and its influence on the Value Configuration.

4.4.3   Partner Network

For the firms in Quadrant 2 we see the commonality high Strategic Importance of partners.

> "If we want to reach a sustainable product, we need to see that all partners are also obliged to be sustainable. This means that we went on the search where is the technical building equipment specialist, where is the structural engineer, where is the acoustician who thinks that way" (Michael Juhr, Juhr Architekturbüro)

> "[Partners are] very important" (Nicolai Thiele, ft+)

> "[Partners are] very important. Without them we would not be able to cope with the ever-increasing requirements" (Stefan Friedrichs, ft+)

The Strategic Importance of partners is further underscored by the fact that one firm has regular quality evaluations with its partners to ensure the best possible partnerships.

> "We evaluate [our partners] two, three times per project. We also send [the evaluation] to the firms. It also contains specific sustainability criteria" (Michael Juhr, Juhr Architekturbüro)

In addition, several interviewees have pointed out that there are not many partners that have entirely internalised the sustainability idea.

> "There are a few, for example specialists planners, that have joined trainings that are on eye level or from which you can learn something. Obviously we are selecting based on that. However, there is always a fraction that is very complacent. With those one is ought to be careful" (Holger Zimmer, a-z- architekten)

> "We are thinking ahead in regards to construction planning. [The sustainability idea] is less present at many partners" (Nicolai Thiele, ft+)

Thereof we derive the conclusion that there is only a limited number of partners a firm can choose from and hence the Substitutability of partners decreases. Further, we find that the collaboration with partners is extremely high, in particular with regards to sustainability projects.

> "If we want to be able to cope with the requirements of sustainability, we must close our ranks and understand the process of each other. This is a contunuous alignment" (Stefan Friedrichs, ft+)

The close collaboration leads to empathy that is devleoped with the partners.

> "The greatest change is the empathy that develops with the people we work together with" (Nicolai Thiele, ft+)

However, this is a process that takes time.

> "[Empathy] isn't there form one day to another" (Stefan Friedrichs, ft+)

One firm goes even that far that they have rented out a part of the office to an energy specialist to be able to have a close cooperation.

> "There was a PhD student of the Technical University of Darmstadt, who writes his dissertation on solar panels, suddenly standing at the door. He is becoming an entrepreneur doing energy simulations. [Building up competences] may take way too long, but all of that fortunately happened now. [...] It has always been my vision, why don't we do anything with energy concepts? That's what's happening now" (Holger Zimmer, a-z architekten)

However, we also see the deliberate choice to not integrate partner into the firm, in order to have a greater stimulus from outside.

> "We have thought about [integrating competences into the firm]. [...] This has one disadvantage for me. You always draw on the same experiences. The influence from outside is missing. The development is therefore limited" (Stefan Friedrichs, ft+)

Ultimately we conclude that the increase in Strategic Importance is followed by a decrease in the Substitutability, which is then offset by an increase in the Degree of Integration. The close cooperation then leads to an increase in the External Competences of the firms.

> "We exchange much more. The dialogue has intensified and everyone gains competences of everything" (Nicolai Thiele, ft+)

Consequently, we derive the reinforcing loop, R1, between the Strategic Importance, Substitutability, Degree of Integration, External Competences, and Value Shop (Figure 4.8). R1 allows us to understand why the three firms are able to constantly deliver on sustainable projects. According to the interviewees and literature, external competences are key to working sustainably. Hence, they manage to offsett the danger of low Substitutability with increasing the Degree of Integration.

Figure 4.8 R1 for Sustainable/Small firms
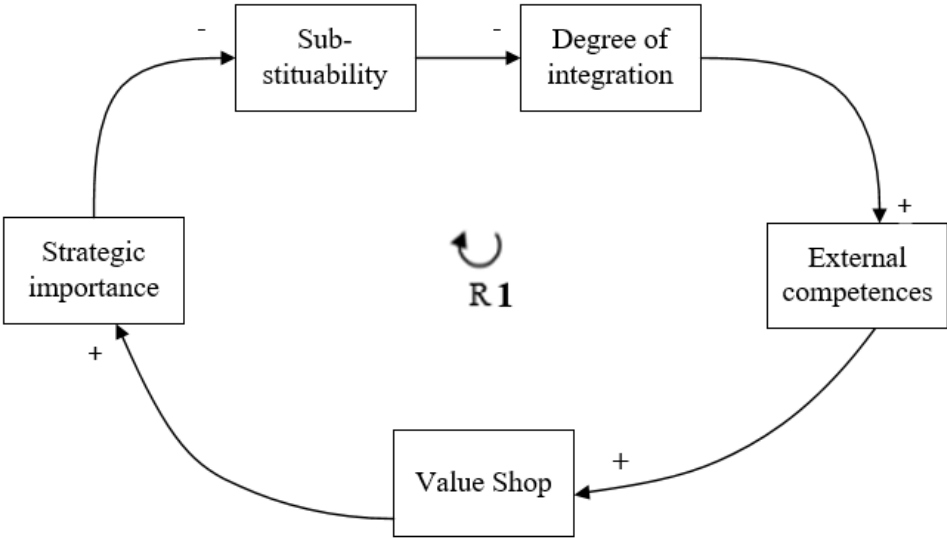
4.4.4 Capabilities

In order to develop the Internal Competences of the firms, the interviewees agreed that the employees and their knowledge are key to delivering a sustainable solution.

> "[The most important resources] are the employees and they need to be trained well" (Nicolai Thiele, ft+)

"You first have to develop the tools within your company, say further trainings for employees and acquire common knowledge" (Michael Juhr, Juhr Architekturbüro)

In order to educate the employees, the preferred method are Trainings.

"We definitely had to generate new knowledge and aquire new knowledge. We have done trainings [...] (Michael Juhr, Juhr Architekturbüro)

"Every employee needs to go to trainings. Everybody needs to get used to the sustainability idea. Otherwise we prepare them to leave the company" (Nicolai Thiele, ft+)

Therefore, we derive that Trainings are used to develop Internal Competences, which then again enhance the activities performed in the Value Shop, leading to the reinforcing loop, R2 (Figure 4.9).

Figure 4.9 R2 for Sustainable/Small firms
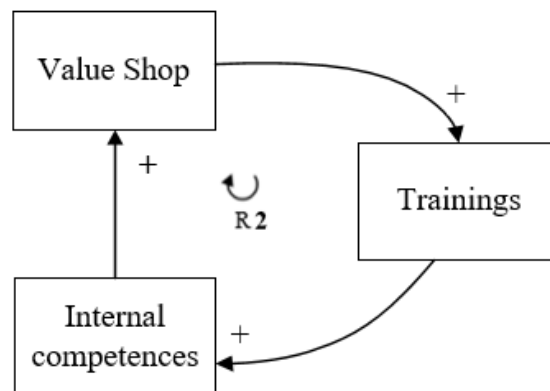
Further, several firms claim that the close cooperation with partners allowed them to learn from the partners.

"[...] you can find some experts that are skilled, with whom you can talk on eye level and learn from. We are in particular looking for those partners" (Holger Zimmer, a-z architekten)

"[Partners are] very important. Without them we wouldn't be able to cope with the increasing requirements. We are never at the end of the learning process. [...] we need to get closer together and understand the processes of each other" (Stefan Friedrichs, ft+)

Stemming from the close integration of partners, the firms were able to increase their own, internal competences and hence strenghten the sustainability project they can do in the Value Shop. Through parts of the R1, this learning effect leads to yet another reinforcing feedback loop, R3 (Figure 4.10).

Figure 4.10 R3 for Sustainable/Small firms
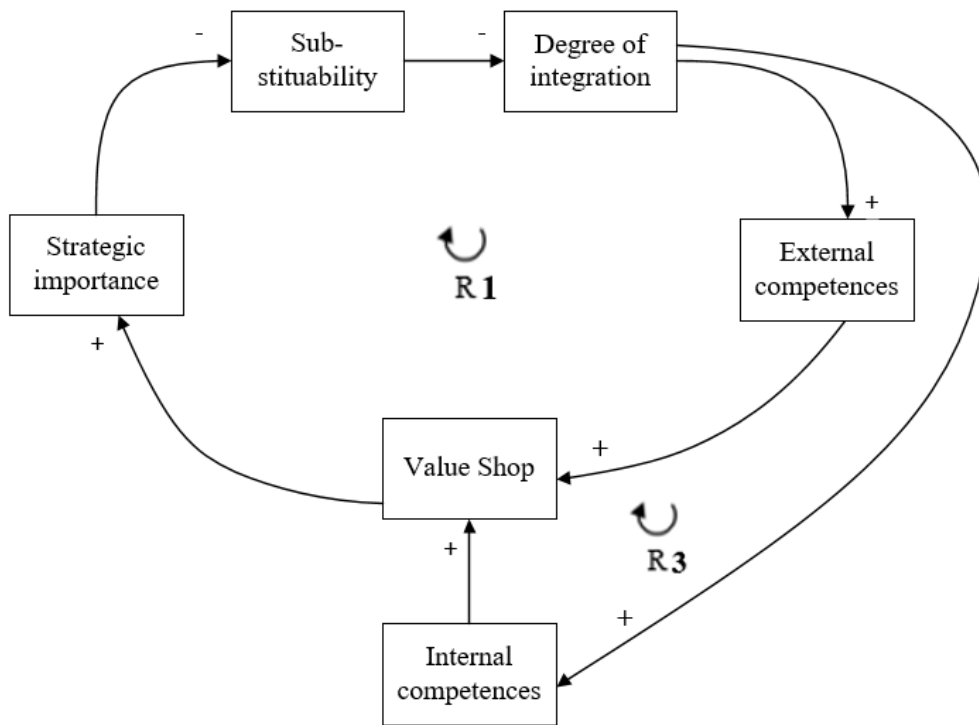
Through the engagement in sustainability projects, the firms could increase their Brand. The firms received different awards and certifications.

> "First of all you need to have a certain degree of recognition. You need to say that you are doing it. Only because I set myself the objective to focus my firm in the next three years on [sustainability], I don't get any clients" (Michael Juhr, Juhr Architekturbüro)

> "The acceptance that came via the architecture prices [in sustainability], but also the, I guess not a single negative, media report [about us]. [...] That's how one gains [acceptance] very well (Holger Zimmer, a-z architekten)

Also, the brand image helped one firm to stand out as an employer, as they received applications specifically because of their sustainability Brand.

"Slowly, we are receiving applications [of people] who are interested in [sustainability]" (Nicolai Thiele, ft+)

The Brand image helped the firms to reinforce their Value Proposition and therefore receive new sustainability projects. Hence, we derive the reinforcing loop R4 (Figure 4.11). We see that this loop is strongly reinforcing itself. As Mr Juhr asserts, the first few projects are tough, but eventually it becomes easier. Therefore, we insert a delay between Brand and Value Proposition, to stress the time needed for the Brand to be effective. Indeed, Mr Zimmer says that the Brand comes with experience, hence with the projects done in the Value Shop.

"You need to get the first two, three buildings going, after that it gets easier" (Michael Juhr, Juhr Architekturbüro)

"When [customers] come to us and they are informed, which happens a lot, they say how they have found us. 'You engage in this and we haven't found any other architect.' [...] it has something to do with experience" (Holger Zimmer, a-z architekten)

"It is so that you tried for many years [to become sustainable]. You need to slowly bring the client onto your side" (Stefan Friedrichs, ft+)

Figure 4.11 R4 for Sustainable/Small firms
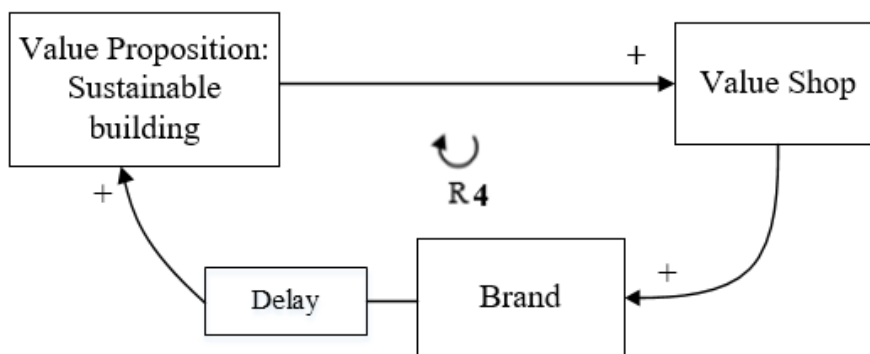
Lastly, we find that two of the three firms actively engage in lectures that they hold. This allows them two things. First, it enhances their Internal Competences, because they are in an engaging interaction with other professionals.

"[...] we have written and held lectures. You always get great feedback, which means you first give some input with the lecture, but thereafter you receive much feedback, many opinions" (Michael Juhr, Juhr Architekturbüro)

"[We] hold lectures at universities and universities of applied sciences, [and] the professional association" (Holger Zimmer, a-z architekten)

Second, it allows the firms to write follow-up publications that enhance the Brand.

"Memberships in councils only make sense when you are in a leading position to hold lectures and publish publications" (Michael Juhr, Juhr Architekturbüro)

The DGNB can be a channel to make the first step to these lectures. Even if the third firm does not hold any lectures, it tries to increase their coverage by participating in a university project.

"I was at the DGNB's annual general meeting and there was an employee of the Leibniz University in Hannover and he called me up two days later and [asked] if we were interested in joining a research project regarding the topics sustainability and digitalisation" (Stefan Friedrichs, ft+)

Indeed we find support that claims that the DGNB or similar associations positively contribute to knowledge exchange.

"If you belong to an association you are inspired to change your way of thinking. It is difficult to say from today to tomorrow now I am sustainable. [...] It is not possibe without the DGNB" (Nicolai Thiele, ft+)

From this information we derive another reinforcing loop, R5 (Figure 4.12). Having a sustainable Value Proposition allows the firms to hold Lectures that increase their Internal Competences. Joining an association is therefore an important catalyst. As the Internal Competences feed directly into the Value Shop, the loop is closed through the Brand with the Value Proposition. Therefore, R5 amplifies R4 and allows for both, a development of Internal Competences and an increase of the Brand.

Figure 4.12 R5 for Sustainable/Small firms
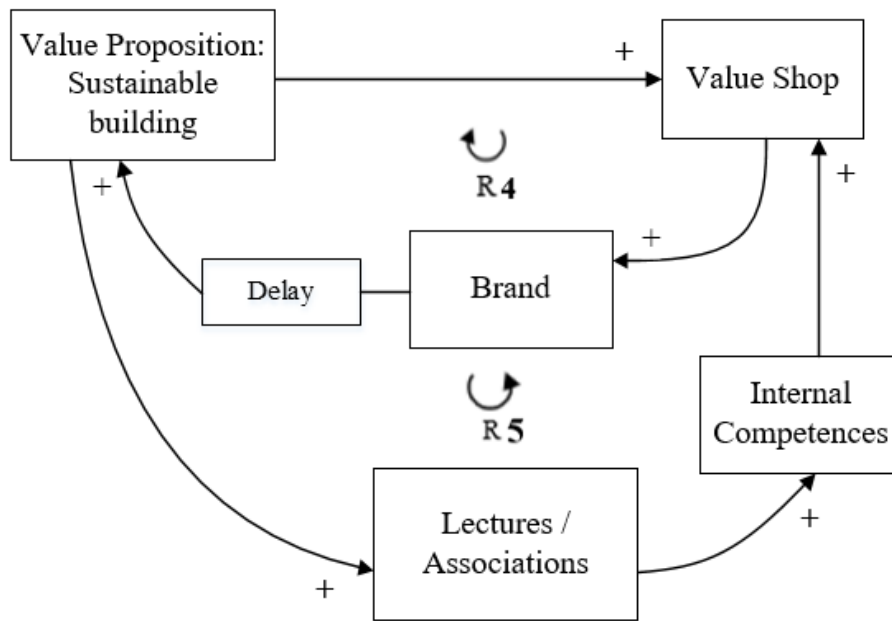
4.4.5 The Whole Picture

The SD perspective shows what usually remains unseen. It sheds light on the underlying mechanisms of the value creation part of the BMfS. Modelling the value creation as CLDs, depicted in Figure 4.13, allows visualising and understanding the mechanisms behind the BMfS. From this we can derive why some firms have a superior sustainability performance over others.

The Value Shop is for most parts the connector between the Partner Network and the Capabilities or the External and Internal Competences, respectively. Just like a body can only function when all elements such as lungs, heart, and stomach work together, the BMfS can only function, when the Value Shop, External Competences, and Internal Competences work together. This stems from the fact that neither the architect himself nor the partners can construct a house on their own. What is not clear until seeing the BMfS from a SD perspective is that all the feedback loops mutually reinforce each other. While we might normally assume that the partners of a firm are entirely disconnected from the Brand of a firm, we see that working together with partners enhances the quality of the buildings that firms can design. Since the buildings are the architecture firm's figurehead, any factor that increases the quality of the building will automatically increase the Brand effect. What stand

out for Sustainable/Small firms is the need to increase their Internal Competences with Lectures/DGNB. Again, on the first glance this might only affect the Internal Competences, but in the bigger picture we can see that it is an indirect driver for the Brand and further amplifies the other feedback loops around Internal Competences. Hence we now see the underlying relationships between the variables. It is therefore not the sum of all parts that determine the overall functionality of the BMfS, but the product of its interactions. In other words, the variables do not sum up, but multiply each other.

A striking characteristic of the findings of Sustainable/Small is the dominance of reinforcing loops, without any balancing loop. The reinforcing loops are catalysts that not only keep the value creation in constant motion, but also multiply each other. As Sanchez and Ricart argue, "positive feedback loops […] help a business model to gain strength over time" (2010, p. 140). Therefore, the Sustainable/Large firms are able to shorten time delays. Moreover, these interlocking feedback loops make it difficult for others to copy (Porter, 1996). It is not enough to merely invest in Trainings, but the entire system must be geared towards constantly reinforcing sustainability. Only when all mechanisms are in place, the BMfS becomes strong enough to deliver superior sustainability performance.

Figure 4.13 The Whole Picture for Sustainable/Small firms
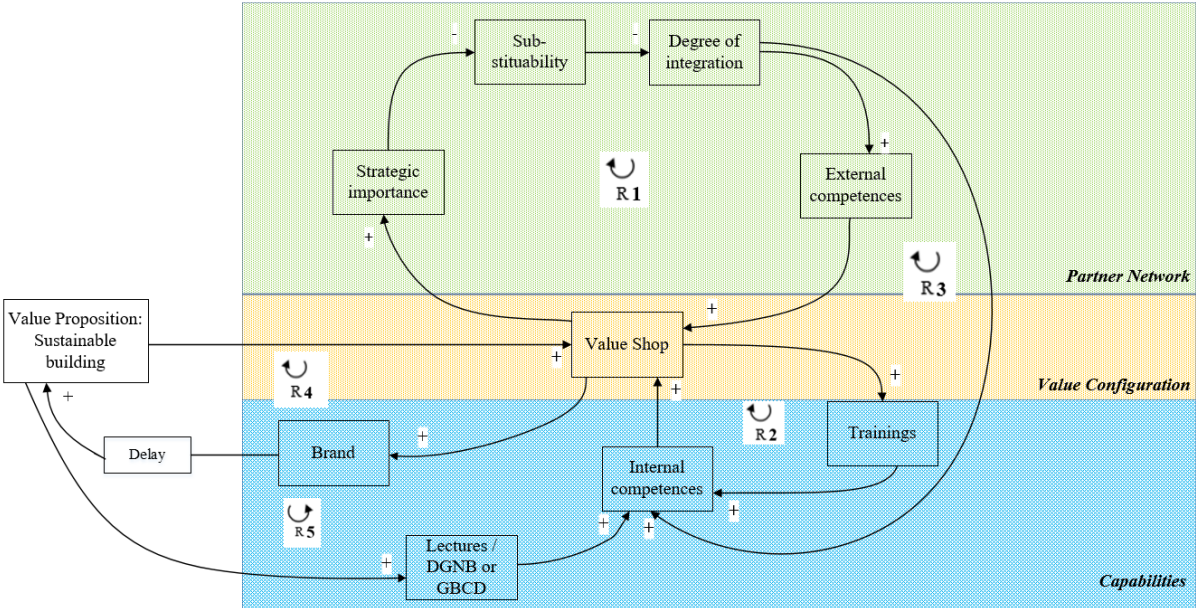
4.5   Quadrant 3

Quadrant 3 includes the firm kuntzundbrück. The firm is characterised by a low degree of sustainability and a small firm size. We conducted an interview with the CEO of the firm. As this quadrant only contains one firm we will discuss that particular firm more into depth. We take the Value Proposition as a starting point and thereof present the findings for each element under investigation, Value Configuration, Partner Network, and Capabilities.

4.5.1   Value Proposition

The firm kuntzundbrück designed as its very first project the first low-energy building in Bavaria. As Mr Kuntz puts it "it was a pioneer work" (Martin Kuntz, kuntzundbrück). However, kuntzundbrück did not manage to follow up on specialising themselves in the energy niche.

> "Our office doesn't have the focus area of energy-efficient buildings" (Martin Kuntz, kuntzundbrück)

Mr Kuntz claims that a firm cannot continue following every innovation as it needs to deal with the survival of th firm.

> "[The first project] was done with youthful enthusiasm, but an office will not be able to go with all innovations over time in the fight for survival." (Martin Kuntz, kunztundbrück).

Today, kuntzundbrück is facing strong external pressures, such as cost and time.

> "The trend goes towards pragmatism in my observations, which means the emphasis on the factors cost and time." (Martin Kuntz, kunztundbrück).

From the aforementioned information we derive that the Value Proposition of kuntzundbrück is defined by cost and time.

4.5.2 Value Configuration

The Value Configuration, of which the Value Shop is the essential part, was different when engaging in the low-energy project.

> "It was much different with regards to the willingness of doing things that you don't know" (Martin Kuntz, kuntzundbrück)

Doing things that are unknown, often stems from an increased complexity in projects. However, since we know that the Unsustainable/Small firms do not engage in sustainability projects, we assert a lower degree of complexity for their Value Shop. In today's projects we assume that the Value Shop is working with less complexity than for a firm actively engaged with sustainability.

4.5.3 Partner Network

The low-energy building required the collaboration with a firm that was specialised on energy calculation and another architecture office. Therefore, kunztundbrück needed to draw on External Competences.

> "If you want to plan a low-energy building, then the first thing to do is to call the energy consultant to get him on the team." (Mr Kuntz, kunztundbrück).

This means that there is a Strategic Importance of drawing on External Competences. As this project was in 1994 and the subject of energy-efficiency just recently came up, we reasonably assume that there are only few specialists, hence an increase in the Strategic Importance of the specialist leads to a decrease in Substitutability of that specialist. Further, Mr Kuntz claims that kunztundbrück did not build up a strong partner network.

> "I say that we don't really have a network with our small office. We don't have, as other large offices, a fixed network of cooperations" (Mr Kuntz, kunztundbrück).

Thereof, we draw the conclusion that because of the non-existent cooperations kunztundbrück was not able to keep up a strong network. Paired with the low substitutability of specialists, this leads to a decrease in the activities that the firm can provide, the Value Shop.

Figure 4.14 R1 for Unsustainable/Small firms
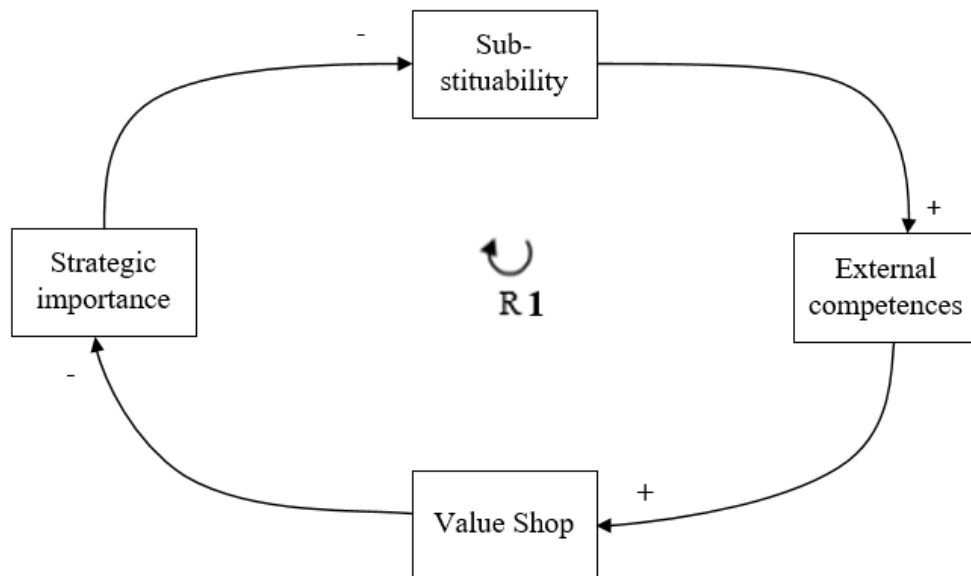
Today the projects in the Value Shop are mainly driven on cost and time aspects. Since the firm does not have a strong network, we assume that the Strategic Importance has decreased. This means that it does not matter much with whom the firm cooperates, because it is working on generic cost and time-pressured projects. The Substitutability therefore increased, since the firm does not need any fixed partners. This affects the External Competences in such a way that they do not develop and may even decrease. This creates the reinforcing loop R1 (Figure 4.14). R1 may offer another explanation for why kunztundbrück did not follow up on energy-efficient buildings. The non-existent network does not allow the firm to engage in working on energy-efficient buildings, and since it is a reinforcing loop, we may regard this as a continuous spiral, where with every new project, the likelihood of engaging in energy-efficient, and for that matter sustainable project, decreases. Interestingly, both partner firms from the initial project managed to strive in the energy niche and are rather large today.

4.5.4   Capabilities

For the first-ever project of the firm, kunztundbrück designed a low-energy building. However, immediately after realising the project, new projects in sustainability did not come up.

"The hope that people would call after this pioneer project [...] unfortunately didn't realise" (Martin Kuntz, kuntzundbrück)

Still, kuntzundbrück tried to get a university teaching position, but did not get it.

"I have tried to get a university teaching position with this topic, which almost worked out, but only almost" (Martin Kuntz, kuntzundbrück)

This project would later on give them credits as it went through the newspapers. The project also led, much later on, to another project, confirming the time delay.

"When it was positively finished, it went through all the newspapers. The project is still shown as flagship in Bavaria. [...] We had another project afterwards; ten years later we built a large passive house [...]" (Martin Kuntz, kunztundbrück).

From this we derive that the project enhanced the Brand of kunztundbrück and that, with a long time delay, led to another project. This leads us to the reinforcing loop R2 (Figure 4.15). R2 might be one piece in the puzzle to explain why kunztundbrück did not continue focusing on low-energy houses. The market response took a long time until another project for sustainability came up.

Figure 4.15 R2 for Unsustainable/Small firms
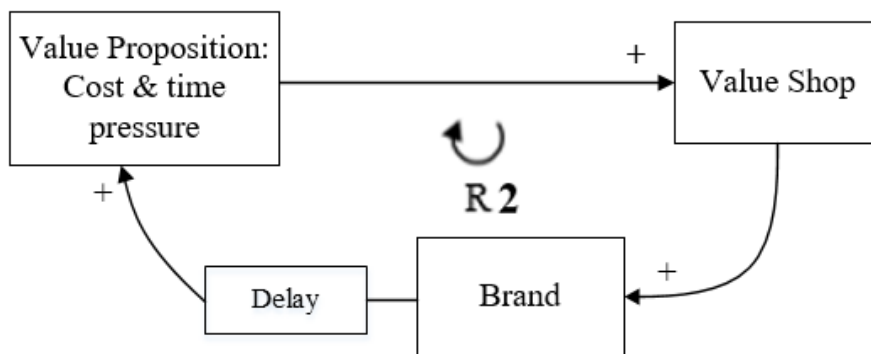
Mr Kuntz claims that, due to the small size of the firm, there are resource constraints pressuring the firm, not allowing, for instance, to constantly send employees to trainings.

"It may be a matter of time and costs how many trainings you may want and can afford. The one who is on trainings is not in the office and since there are only four to five

people in the office and if constantly two are on trainings, we couldn't run the office."
(Mr Kuntz, kunztundbrück).

Hence, an increase in Resource Constraints decreases the ability to constantly develop the competences needed for sustainability activities in the Value Shop.

4.5.5   The Whole Picture

The SD perspective shows what usually remains unseen. It sheds light on the underlying mechanisms of the value creation part of the BMfS. Modelling the value creation as CLDs, depicted in Figure 4.16, allows visualising and understanding the mechanisms behind the BMfS. From this we can derive why some firms have a superior sustainability performance over others.

Figure 4.16 The Whole Picture for Unsustainable/Small firms
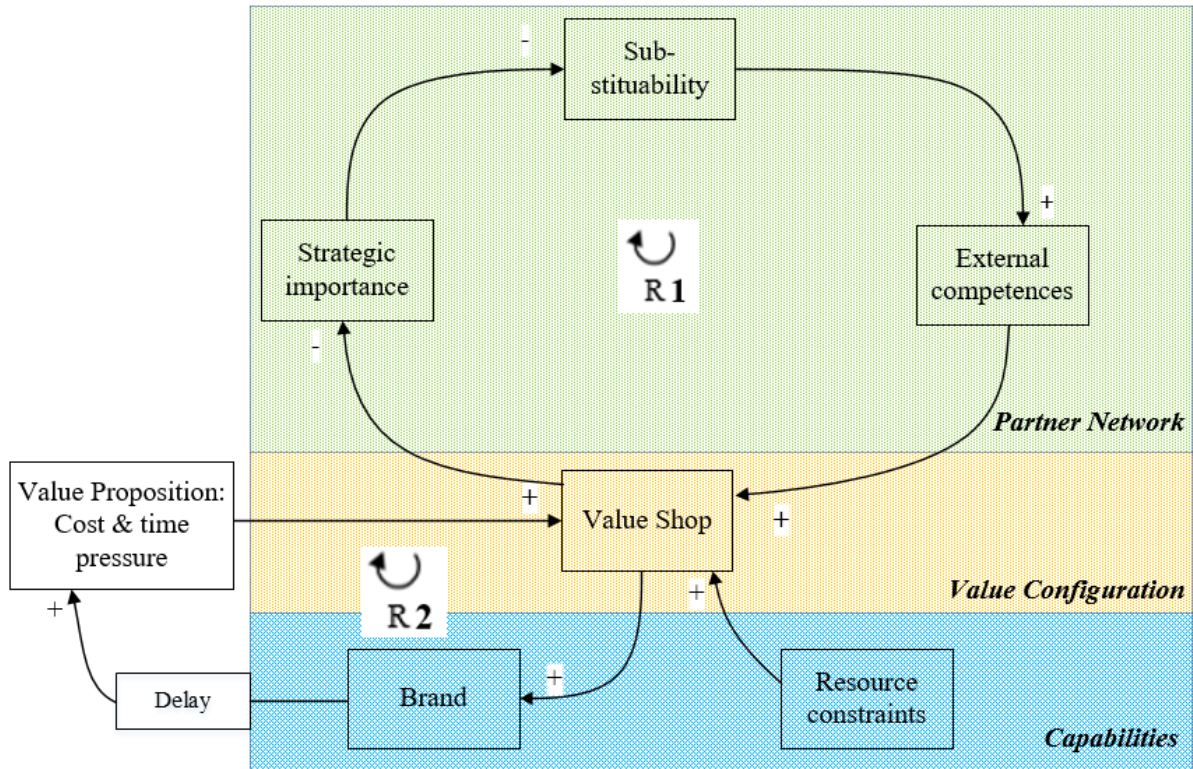
For Unsustainable/Small firms we see a simple picture, with merely two feedback loops. Yet, these two feedback loops determine the value creation part of the business model and they are crucial to understand in connection. The cost and time Value Proposition does not allow the firm to build up competences in sustainability, for which the firm will only create buildings that are trimmed to cost and time factors. This will lead to the reinforcement of the Brand as cost and time-oriented and start the entire cause-effect relationship over again. Therefore, the two feedback loops strongly reinforce each other and therefore further strengthen the Value Proposition and Brand of the firm as cost and time-oriented, which makes it even more difficult to engage with sustainability over time.

One can observe a limited number of reinforcing loops. Reinforcing loops can be seen as catalysts in the business model that reinforce the business concept over time. However, given the resource constraints that constantly affect the Value Proposition, a limited amount of catalysts leads to too little motion in the mechanism until it eventually dies and the resource contraints pressure the CEO to offer cost and time solutions.

5 Discussion

5.1 Introduction

While we analysed each quadrant individually in the Empirical Findings, we compare all quadrants against each other in the Discussion. With the purpose of explaining the system dynamics of Value Configuration, Partner Network, and Capabilities, in the light of small and large firms, this is an essential step. In the same step, we compare the more sustainable firms with the less sustainable firms, in order to receive concrete information about why some firms are able to create economic value through social and environmental measures, while others are not. This strenghtens the findings and ensures that the findings are unique to firms that apply a Business Model for Sustainability.

5.2 Value Configuration

For the Value Configuration we find varying statements, some of which argue for a strong change in the value configuration due to sustainability and some of which arguing for no change at all. The primary change that the interviewees brought up for Sustainable/Large firms and Sustainable/Small firms is the need for an early consideration of all experts. Only when all experts are sitting at one table early on, a sustainable project is possible. Unsustainable/Small firms argue that more effort is needed for a sustainable project.

Despite the proposed changes in the Value Configuration we do not see that the actual planning phases of the architect changes. The tasks that an architect needs to accomplish are extended by sustainability specifications and an early integration of experts. As will get more obvious in the following sections, the Value Configuration and the Value Shop for that matter, is the connector of the Partner Network and the Capabilities.

Additionally, we find that a number of Sustainable/Large and Sustainable/Small firms share a holistic and integrative mindset. It allows them to break up the silos that traditionally prevailed the industry (Theaker and Cole, 2001) and opens up potential on several dimensions. While Sustainable/Large firms may integrate competences and thereby gain greater control allowing them to steer a project more efficiently, in the case of Henning Larsen, an organisational dimension may be observed. Other Sustainable/Large firms such as RUBOW and Gerber Architekten apply a holistic, integrative approach to improve the collaboration in their project teams. Whereas Sustainable/Small bureaus pay attention to the interfaces to other project participants, in case of a-z architekten, or even consider the external processes of partners and overall to improve them. This fosters the collaboration among industry players and leads to a more integrative project approach, in opposed to the rigid silo thinking. Hence, we see similarities to the systems approach in which the management relates to "designing and controlling a […] system" (Forrester, 1961, p. 8). Thus, an integrative approach is a means to understand the system e.g. overall process an architecture firm is part of in order to modify it successfully (cf. Ackoff, 1994 b; Wilms, 2001; Vester, 2015).

5.3   Partner Network

All three quadrants had one feedback loop in the Partner Network element. Sustainable/Large firms had a reinforcing loop, coming from an increase in sustainable projects in the Value Shop, increasing the Strategic Importance of partners, decreasing the Substitutability of partners, increasing the Degree of Integration, increasing the External Competences, and finally increasing the work that can be done on the project in the Value Shop. Sustainable/Small firms showed the same picture. Unsustainable/Small firms have a reinforcing loop as well, however it looks different. The increase in cost and time pressured project leads to a decrease of Strategic Importance of partners, leading to more Substitutability and to less External Competences.

Comparing Sustainable/Large firms and Sustainable/Small, we see strong similarities in the variables that both quadrants carry. The firms in both quadrants deem their partners extremely important and state that there is little substitution for them. In order to cope with the little substitutability, they tie strong relationships with their partner firms. Henning Larsen, from

Sustainable/Large firms, started integrating sustainability services within their firm and formed an own department of around 20 employees, attempting to cope with the importance and little substitutability of partners. Indeed, we see that a-z architekten, from Sustainable/Small firms, also started cooperating closely with an energy expert, sharing the same office space. However, we may also take notice that some firms, both from Sustainable/Large firms and Sustainable/Small firms deliberately did not integrate partners into the firm, as to allow for a higher stimulus from outside, in particular important for sustainability. Furthermore, the balancing feedback loop allows drawing the conclusion that having a close cooperation, enables the firms to constantly draw on a pool of partners, without which they would not be able to deliver a sustainable solution. Therefore, integrating or aligning with partners is found to be a key aspect in achieving a BMfS, both for small as also for large firms.

Comparing Unsustainable/Small firms to the other two quadrants, we see that the firm in Unsustainable/Small firms was not able to develop a strong relationship with their partners, in particular with the partners they had initially on their low-energy project. The Sustainable/Large firms and Sustainable/Small firms were able to balance out the substitutability with an increased integration of partners, whereas the Unsustainable/Small firms fell into a reinforcing loop, which only intensifies with time. This means that not balancing the substitutability with a stronger degree of integration, took a toll on the external competences that the firm could draw upon. Hence we draw the inference that part of why Unsustainable/Small firms do not have a BMfS is the missing integration of partners.

Lastly, taking all three quadrants, we see that a close integration of partners allows both, large and small firms, to constantly deliver sustainable solutions. Failing to integrate partners closely will lead to decreasing External Competences and the inability to deliver sustainable solutions.

5.4   Capabilities

Sustainable/Large firms and Sustainable/Small firms have three feedback loops in the Capabilities element, of which some are similar. Unsustainable/Small firms have one

feedback loop. Sustainable/Large firms and Sustainable/Small firms share the reinforcing loop, coming from an increase in sustainable projects in the Value Shop, leading to an increase in Trainings, leading to an increase in Internal Competences, ultimately leading to better sustainability projects in the Value Shop. This goes hand in hand with respective literature, claiming that competence development and training are key to build sustainably.

Both, firms from Sustainable/Large firms and Sustainable/Small firms claim that trainings have been in particular valuable in the beginning of the sustainability process. Interestingly, the two largest Sustainable/Large firms increasingly offer in-house trainings. This shows on the one hand that external trainings become repetitive after some time, but on the other hand underscores the importance that the firms pay to trainings. We further see that for Sustainable/Large firms and Sustainable/Small firms the membership in associations, such as the DGNB, positively contribute to the development of Internal Competences. This might be through trainings that these associations give themselves or the mere exchange with other professionals in the field, for whom sustainability is also a significant topic. This makes the reinforcing loop even stronger and allows the Sustainable/Large firms and Sustainable/Small firms to constantly develop their Internal Competences necessary to always stay up to date with the latest developments. The reinforcing loop explains that with an increasing numer of sustainable projects the firms engage in more trainings, hence the need for in-house trainings to keep up the quality and development of employees. More trainings inevitably lead to stronger Internal Competences which then again allow for delivering better sustainability projects.

Unsustainable/Small firms claim that resource constraints do not allow for intensive trainings, as otherwise too little employees would be in the office. Given the importance of trainings found in Sustainable/Large firms and Sustainable/Small firms, we see a stark contrast to Unsustainable/Small firms. This may give partial explanation for why Unsustainable/Small firms do not follow a BMfS. Strikingly is as well that Sustainable/Large firms and Sustainable/Small firms strongly emphasised the value they get out of associations such as the DGNB. Unsustainable/Small firms are in fact a member of the DGNB, but do not actively participate. We conclude from this that regardless the size, a basic foundation of knowledge about sustainability needs to be acquired, especially in the early stages, through trainings. Associations such as the DGNB can be a catalyst to drive Internal Competences, in particular for smaller firms.

In order to develop Internal Competences, Sustainable/Large firms stress the importance of Learning on the Job, claiming that the largest learning effect happens right on the project. Through an increased Dialogue among Employees, the gained knowledge spreads quickly throughout the firms, increasing the Internal Competences available to the firms. Therefore, the second reinforcing loop of Sustainable/Large firms is an increase in sustainable projects in the Value Shop, increases the Learning on the Job, increases the Dialogue among Employees, increasing the Internal Competences. Only Sustainable/Large firms explicitly state this process. While we may assume that also the Sustainable/Small firms and Unsustainable/Small firms experience a learning effect while working, we conclude that the increased dialogue and therefore fast-spread knowledge about sustainability showed the Sustainable/Large firms the importance of Learning on the Job, for which they are emphasising it. Being aware about this process allows the Sustainable/Large firms to foster the Dialogue among Employees and further deepen their Internal Competences.

Another striking difference between Sustainable/Large firms and Sustainable/Small firms opposed to Unsustainable/Small firms is the reinforcing loop going from Degree of Integration to Internal Competences. The close cooperation with partners allows the Sustainable/Large firms and Sustainable/Small firms to further deepen their Internal Competences, whereas Unsustainable/Small firms fail to do so, because they do not have a close cooperation in the first place.

All three quadrants share a feedback loop, which is the reinforcing loop between Value Proposition, Value Configuration, and Brand. Since an architect advertises him or herself with the buildings he or she designs, whatever comes out of the Value Shop will determine for great parts the Brand of a firm. Important to notice is that before the Brand can enhance the Value Proposition of a firm, there is a time delay, because as the interviewees claim, it takes some time before the Brand around sustainability is built.

We saw that Unsustainable/Small firms did not receive follow-up assignments after their initial project on the low-energy building. This is due to the delay that occurs and we find the same delay for Sustainable/Large firms and Sustainable/Small firms. Because the Unsustainable/Small firms need to survive and apparently cannot receive another project focused on sustainability, Unsustainable/Small firms respond to the market pressure of cost and time and offers solutions that are geared to cost and time issues. Since these projects seem

easier to get, the Brand of cost and time and therefore the Value Proposition of cost and time slowly reinforces itself, until it is difficult to escape the tightened Brand. Surely, Sustainable/Large firms may have a larger geographic reach and are able to run several projects at the same time and can therefore offset the time delay. Also, large firms may take some risk with sustainability without having losses that threaten their existance. Indeed we find that Mr Jaspers claims that large firms have a higher change to be successful with sustainability (2017, Appendix G). But why could the Sustainable/Small firms develop a sustainable Brand? From the interviews we derive that the Sustainable/Small firms all engage in some way or another in the DGNB, hold lectures, and participate in research projects. Indeed we find that Unsustainable/Small firms are member of the DGNB, but do not engage much. Further we find that Unsustainable/Small firms tried to get a teaching assignment at a university, but unfortunately did not receive it. We have also shown in the Empirical Findings that the DGNB membership and the lectures that the Sustainable/Small firms hold, contribute positively to the Brand of the firm, which is a reinforcing loop, unique to Sustainable/Small firms. Here we find the explanation that small firms' engagement in sustainability issues through associations or lectures positively contribute to their Internal Competences and indirectly to the Brand, possibly shortening the time delay.

5.5   The Whole Picture

As we have now discussed each element and the interactions within the elements, we now move to put them into perspective and take on a broader view, in which all elements interrelate.

Mokhlesian and Holmén (2012) present a linear relationship between the Value Configuration, Partner Network, and Capabilities (see Figure 2.1 and Figure 2.2). However, we find that the Sustainable/Large firms and Sustainable/Small firms demonstrate an extremely multifacetted interplay between the variables of Value Configuration, Partner Network, and Capabilities. We find many reinfocing loops that foster the sustainability development. Each reinforcing loop is a catalyst for another. Hence, the feedback loops make each other exponentially stronger and the time delays shorten. Conversly, Unsustainable/Small firms contain only two reinforcing loops. Therefore,

Unsustainable/Small firms have less motion within the BMfS. It therefore becomes much more difficult for Unsustainable/Small firms to perpetuate the sustainability development throughout the business model.

5.6   Summary

From the preceeding discussion we can abstract some key interdependencies between the three elements in question, Value Configuration, Partner Network, and Capabilities, illustrated in Figure 5.1. For the Sustainable/Large firms and Sustainable/Small firms we derive a strong reinforcing loop, R1, between the Value Configuration and the Partner Network, allowing for constantly delivering on sustainable projects. Interestingly, there seem to be two opinions on how far partners should be integrated. While some few start integrating sustainability services into the company in order to steer projects efficiently, most others keep the partners external to the company, in order to receive a higher stimulus of experience regarding sustainability. For Unsustainable/Small firms however, we derive a reinforcing loop, R1, demonstrating the inability to build up strong External Competences through an integration of partners.

Further, we derive a reinforcing loop, R2, for Sustainable/Large firms and Sustainable/Small firms between the Value Configuration and the Capabilities. However, we would like to note that the shortcoming of such an abstract visualisation does not represent the magnitude of the feedback loop, as we revealed that the Sustainable/Large firms in particular emphasised the Learning on the Job, for which we expect a stronger reinforcing loop than for Sustainable/Small firms. On the flipside, we see that the Unsustainable/Small firms did not manage to create any respective feedback loop, ultimately not building Internal Competences in sustainability. The Internal Competences of Sustainable/Large firms and Sustainable/Small firms are further amplified by R4, whereas Unsustainable/Small firms do not have this feedback loop. This also indirectly has an effect on the Brand of the firms.

Lastly, we find a reinforcing loop, R3 and R2 for Sustainable/Large firms, Sustainable/Small firms, and Unsustainable/Small firms, respectively, between the Capabilities and the Value Proposition. Again, at this level of abstraction the findings seem alike, however,

Sustainable/Large firms and Sustainable/Small firms managed to have a stronger reinforcing loop through means such as memberships in sustainablity associations or lectures. Therefore, the reinforcing loop for Unsustainable/Small firms is much weaker. Figure 5.1 shows the Value Configuration as a connector between the Partner Network and Capabilities. From this we can once again see that Unsustainable/Small firms have less feedback loops than Sustainable/Large firms and Sustainable/Small firms.

Figure 5.1 Interdependency of Value Configuration, Partner Network, and Capabilities
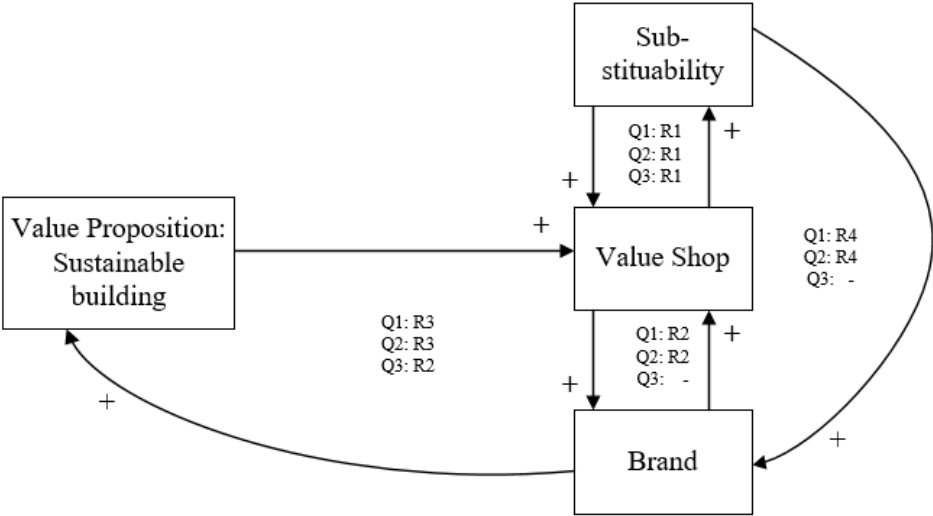
6 Conclusion

The construction industry strongly affects economy, environment, and society. Within the industry, the architect has a pivotal position to drive change. Driving that change results in a new business model, which literature calls the Business Model for Sustainability (BMfS). In particular the value creating part of the BMfS is deemed important for the industry, hence the Value Configuration, Partner Network, and Capabilities of a firm. However, little is known about the interaction between these three elements. Yet, understanding how architecture firms create sustainable value, is the necessary first step towards a BMfS. In an attempt to understand the interactions between Value Configuration, Partner Network, and Capabilities, we applied a System Dynamics (SD) perspective on the issue and posed the research question: how do the system dynamics between Value Configuration, Partner Network, and Capabilities work in a Business Model for Sustainability, with regard to the differences in small and large architecture firms? Through a multiple case study with ten firms we revealed the salient interactions between the three elements in question and abstracted the results in Figure 5.1. From this, we derive six propositions.

1. Integrating partners closely copes with the low substitutability of partners and leads to increased external competences

While some studies claimed that partners are important, we could demonstrate the magnitude of this importance by illustrating the case of Unsustainable/Small firms, failing to integrate partners closely. We could also demonstrate why integrating partners closely is paramount in sustainable construction. The low substitutability of partners leads to a decrease in external competences, if no integration occurs. Since an architecture firm is dependent on the expertise of other actors, drawing on strong external competences is extremely important. We could further demonstrate that integrating partners into the firm presents a strategic choice between the ability to efficiently steer projects and receiving more stimulus for sustainability from partners. Lastly, we conclude that the close integration of partners is of upmost importance for both, large and small firms in the architecture industry.

2. Sustainability associations and holding lectures can be catalysts for driving internal competences and brands, in particular for small firms

Two important capabilities are the internal competences and the brand of firms. First, internal competences are the knowledge of employees in the case of architecture firms. Architects increase their knowledge while working on a project or through trainings. By actively engaging in associations that deal with sustainability or holding lectures about sustainability, the knowledge and hence the internal competences can be increase substantially. Second, the brand of a firm needs time to develop. Actively engaging in associations that deal with sustainability or holding lectures about sustainability, the brand is developed at an increased rate, offsetting the temporal delay to receive new projects. In the comparison of all three quadrants we see that this holds true in particular for small firms. Literature largely neglects this opportunity.

3. Learning on the job paired with a strong dialogue among employees is the main driver for internal competences, in particular for large firms

Literature stresses the importance of trainings in order to develop knowledge about sustainability. However, in this study we were able to show the importance of learning on the job, as several interviewees state this as crucial in the learning process for architects. In particular the large firms emphasise this learning process and underline it with an increased dialogue among employees which fosters the gained knowledge. Literature fails to address this important cornerstone in developing internal competences for sustainability.

4. Developing close relationships with partners increases internal competences

As we could show, the close relationships with partners for Sustainable/Large firms and Sustainable/Small firms allowed to develop further internal competences through a briskly exchange between the partners. Since the internal competences are a pivotal linchpin in the entire system, this exchange further strenghtens the sustainability projects the firms are able to deliver and henceforth also indirectly the brand.

5. The mechanisms for a BMfS are largely the same for small and large firms

As the purpose of this research was to compare the findings for two groups, small and large firms, we derive the striking conclusion that there are surprisingly little differences in how the Value Configuration, Partner Network, and Capabilities work. Indeed, the similarities prevail. The functionality for both, small and large firms rest on a close integration of partners and learning from them, building strong internal competences, and building a sustainability brand. One difference, however, as was pointed out earlier, is that small firms can strengthen their internal competences with holding lectures and engaging in associations and large firms can strengthen their internal competences with an increased dialogue among employees.

6. The more catalysts that mutually complement each other, the better the odds for driving sustainability into the business model

Throughout the findings of this study we could track the high amount of reinforcing feedback loops for Sustainable/Large firms and Sustainable/Small firms that functioned as a catalyst for sustainability. Those catalysts complemented each other and therefore strengthened the overall BMfS. Since Unsustainable/Small firms showed significantly less catalysts, we conclude that more catalysts that complement each other, lead inevitably to better odds for driving sustainability into the business model.

6.1   Theoretical Implications

The present study is strongly grounded in the work of Mokhlesian and Holmén (2012), who propose a relationship between the Value Configuration, Partner Network, and Capabilities, but called for a detailed investigation. We reacted upon their and other researchers' call and provided an in-depth analysis of the interaction of the three elments and the variables that constitute them. Therefore we delivered a first contribution to closing the research gap in existing literature by clearly illustrating how the elements relate to each other. Some scholars started applying the SD on the BMfS, for which our findings advance this field of research. Further, we verified that trainings are important to develop sustainable competences. We also added a new element that is necessary to build sustainable competences, which is learning on

the job, which is new to the sustainability in the architecture industry literature. We also added associations and holding lectures as a new catalyst that is not yet rooted in literature.

6.2 Managerial Implications

The findings of this paper show highly applicable implications for architecture firms, but may also be partly applied on the construction industry as a whole, due to common characteristics and the need for collaboration in the industry, and somewhat to firms at large. Managers may use the findings to either start driving sustainability into their firm or improve on their already done efforts, as they now have a clearer picture in mind, of how sustainable value is created. While literature on BMfS is often quite normative, our findings present tangible outcomes that allow the managers to take immediate action.

6.3 Limitations

A major limitation of this study is the limited generalisability of the findings in Unsustainable/Small firms and the missing firms in Unsustainable/Large firms. More firms in both quadrants would have allowed for a better comparison. Further, the depth in which each case was studied could have been deeper. Nevertheless, we sent the Causal Loop Diagrams including a description to each interviewee for verification, in order to make up for this shortcoming. Lastly, the applicability of the findings outside of the construction industry is low. We may however reasonably assume that some of the found characteristics apply on firms at large.

6.4 Future Research

We would like to further promote the SD approach, as it is unique in its ability to uncover underlying interactions, as this study demonstrated. Especially for BMfS, which operate

entirely on interactions, we would like to see more research in this direction. A possible starting point would be to investigate the second interaction between the elements Value Proposition, Capabilities, and Cost Structure for architecture firms, which was proposed by Mokhlesian and Holmén (2012). Another interesting avenue would be to study the Customer Interface, as there are divergent findings for the demand of sustainable solutions, but still many firms are able to acquire customers that are longing for sustainable solutions. Hence, who are these customers and how can they be attracted through customer relationships or different channels? In addition, our own study can be further strenghtened, by complementing the missing findings of Unsustainable/Large firms and the little findings of Unsustainable/Small firms. Our research has also shown that architecture firms are learning on the job, therefore a more into depth research on learning processes for sustainability in the architecture industry may be valuable.

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Appendix A

Literature Review based on Mohlesian and Holmén (2010, 2012)

Author(s)	Elements	Intersection			Content
Ngowi (1998)	3, 5, 7	Value Configuration		Partner Network	[not relevant due to different focus]
Ngowi (2001)	1, 5, 6, 8, 9	Value Configuration	Capability		A sustainable value confrigration goes beyond energy consumption. It fact, it comprises "site planning, waste management, selection of materials and design for flexibility, together with energy planning" (Ngowi, 2001, p. 291).
					Furthermore, it is emphasised that it is crucial to take sustainability into account in the building design phase as all subsequent, downstream processes are affected by it.
					In addition, the whole building's life cycle it to be environmentally-friendly and there is supposed to be a fit among all practices. Studies in Botswana have shown that there are opportunities at every stage of the life-cylce. Ngowi argues that a fit among them in line with harmony to nature may form a competitive advantage for such firms.
Ofori (2000)	1, 2, 5, 7, 8	Value Configuration		Partner Network	It is concluded that the construction process generally disintegrated and contains a number of actors with different goals. Hence, in many cases, there is none of them assuming direct responsibility for environmentally-friendly practices. Thus, the concentration should be on integration, the whole product-life-cylce as well as the involvement of all actors in along all phases of the production process and stakeholders is especially vital. Thereby, not only the fragmentation is lowered, but also the win-lose paradigm that typifies this sector is countered.
Bon and Hutchinson (2000)	5, 7, 8	Value Configuration		Partner Network	[not relevant due to different focus]

van Bueren and Priemus (2002)	4, 5, 7, 8	Value Configuration		Partner Network	An implication of sustainable construction is that it demands the backing of the various parties involved at different places and times in the decision-making in order to achieve effectiveness.
Williams and Dair (2007)	5, 6, 7, 8	Value Configuration	Capability	Partner Network	Current shortcomings of the sector are insufficient knowledge and power. In terms of knowledge a "lack of information, awareness, and expertise in sustainability issues" was identified. As a result there is a knowledge gap amogst this mostly professional actors, conclude the authors. Consequences of this relate one the one hand to an inability to make adequate decisions about the degree of sustainable solutions. On the other hand this lack of knowlegde hindered the implementation of sustainable solutions. In such cases, the safe option of prefered, due to a lack of information among actors.
Kibert (2007)	1, 5, 6, 7, 8, 9	Value Configuration	Capability	Partner Network	A implementation [of sustainable solutions] demands the interplay of public policy by means of regulations, perks and disincentives; as well as "real estate, finance, and insurance industries; and the role of institutions of higher learning, design firms", and construction firms to engage in knowledge development, training, and the integration of a large number of players that are part of this complex built industry (Kibert, 2007, p. 595).
					Sustainable solutions comprise the advancement and adjustment of social expectations, such as "comfort, amount of space, mobility, access etc." (Kibert, 2007, p. 595). Investigations show that small-sclae projects allow an easier integration of such elements in comparision with large-scale projects, which are characterised by conflicting goals in some aspects.
					Pivotal changes in education and training as well as the relationships and roles among players, and their offerings, tools, approaches have not undegone to a suffient degree yet (Kibert, 2007, p. 599).
Ahn and Pearce (2007)	6, 7		Capability	Partner Network	The authors study shows that more than every second respondent (65%) demands "green building skills and knowledge including basic knowledge and concepts", as well as knowledge of "green building rating system[s], life-cycle cost of green building[s], green building process" and previous experience with green building projects when recruiting new staff (Ahn & Pearce, 2007, p. 23). Furthermore, [building] owners have to be in the picture regarding potential savings based on life-cycle assessments.

Reed (2007)	5, 6	Value Configuration	Capability		The authors argue that it is the responsbility of designers as well as stakeholders in general to develop an entire system of mutually beneficial relationships. Thereby, there is a greater benefit to be achieved that goes further than sustaining the environment and facilitates also health regenerations.
					The first step is to identify the required relationship patterns, since the key processes and core systems are largely known. The next step includes metrics and bechmarks to gauge the degree of improvement. An understanding and alignment of objectives and individual aspirations for the project and the venue among all actors is essential. Alongside the project, a group dialogue between the building owner and the design team is crucial to clarify questions and open points. This fosters integration in opposed to laundry lists and fragmented activities.
Sayce et al. (2007)	1, 3, 5, 7, 8, 9	Value Configuration		Partner Network	[not relevant due to different focus]
Jones et al. (2010)	1, 4, 5, 7	Value Configuration		Partner Network	Jones et al. conclude that a high degree of congruency of goals between project players is essential for successful project results. In fact, it was found that the notion sustainability is understood differently across actors in the industry. A misalignment on not only the notion, but also the project goals may have negative consequences on the project progress as well as the relationship of project partners. Thus, an accurate alignment and communication between construction and design firms is deemed necessary to meet the owners' sustainability expectations.
Lam et al. (2010)	5, 6, 7	Value Configuration	Capability	Partner Network	Stakeholder involvement is paramount when preparing arranging green specifications. Addtionally, "the effectiveness of the supply chain and monitoring mechanism" when delivering sustainable solutions is critical.
Qi et al. (2010)	4, 5, 6	Value Configuration	Capability		The environmental concerns of decision makers as well as the size of contractor companies influence whether green construction efforts are undertaken. Furthermore, governmental regulations are a lever towards adoptation too.

Presley and Meade (2010)	1, 2, 5, 6, 7, 8	Value Configuration	Capability	Partner Network	The Enterprise Performance Management Methodology (EPMM) analyses implemtation issues from to perspectives - ex ante and ex post. In particular, the section on partnerships and suppliers and their satisfaction can be seen as a way to not only gauge, but also improve this aspect in accordance with other sections. These comprise project results (e.g. society and environmental impact of projects), customer and society results, and organisational business results. This holistic viewpoint allows to manage the balance of all towards a sustainable, successful project by minimising implementation issues.
Nelms et al. (2007)	5, 7, 8	Value Configuration		Partner Network	The ecological impact of sustainable construction projects is to be minimised while human health as well as the life cycle impacts are to be evaluated. Ine essence, the authors developed a framework that concentrates on the implications and ambitions for technology implementations "in a given decision context and the identification of where stakeholders' objectives align and conflict" (Nelms et al., 2007, p. 250).
Nielsen and Glavind (2007)	5, 7, 8	Value Configuration		Partner Network	Sustainable design considers the whole lifecycle of a building by taking the energy performance as well as the maintenance.
Sterner (2002)	3, 5, 6, 8	Value Configuration	Capability		The ecological, sustainable construction process begins in the planning phase and considers not only the maintance and serviceability of a building along its whole lifecyle, but it ends with the recycling of ist materials when the building is torn down.
Theaker and Cole (2001)	1, 5, 6, 8	Value Configuration	Capability		The successful transformation of current cities towards sustainable one goes beyond technological challenges - in fact it is rather "a social, cultural, and political challenge" (Theaker & Cole, 2001, p. 408). Cross-disciplinary working teams are considered to be successful measures that improve environmental performance. This is a major difference to the silo-thinking that tradionally prevailed the industry.
Meyer (2009)	5, 6, 8, 9	Value Configuration	Capability		[not relevant due to different focus]
Curwell et al. (1999)	5, 6	Value Configuration	Capability		Post-occupancy evaluations allows to gauge the actual performance against the predicted performance. From these it can be learned whether a building lives iup to ist expectations.

Ofori and Kien (2004)	3, 5, 6, 7, 8	Value Configuration	Capability	Partner Network	Further education of architects is essential for the complete integration of green design into architecture firms. The more further education, the more deeply green design becomes rooted in the focal firms. In addition, the role of clients is not to be underestimated. Their priorities determine the project goals and since they have been, and still are, merely geared towards reducing expenditure as much as possible, environmentally-friendly solutions have a lower priority. However, in order for such solutions to be priorised higher among the goals, all actors in the project are to speak the same voice. From the design, to considering the materials, until the pollution and waste emitted throughout the entire life cycle.
Mehta (2001)	1, 5, 6, 8	Value Configuration	Capability		[not relevant due to different focus]
CIB definition (1994)	1, 5, 6, 8	Value Configuration	Capability		Not scientific
Bossink (2004)	5, 6, 7	Value Configuration	Capability	Partner Network	Collaborations on different dimensions, "transfirm, intrafirm, and interfirm in the network of organisations" may be a lever for decision makers to cultivate, advance, and rejuveniate their firms' position on the competitive landscape, the quality of their ventures, as well as the cooperative composition of the sector in total.
Bröchner (2010)	6, 7		Capability	Partner Network	Contractors work together with numerous kinds of external actors on research and development and innovation. However, these patterns vary depending on the activity type, strictness of the definition of innovation, and the course decided by the corporation. While in the Swedish markets the major contractors play a dominent role in leading novel solutions in the sector, other markets outside Sweden are characterised by a dominent role from consultants and suppliers to push innovations.
Winch (1998)	6,7		Capability	Partner Network	"Innovations on complex product systems are inherently interactive with the rest of the system innovating within the parts while losing sight of the whole is inherently dysfunctional" (Winch, 1998, p. 275).

Appendix B

PESTEL Analysis

Dimension	Germany	Denmark
Political	Since 2013 a conservative party (CDU/CSU) in coalation with a social party (SPD) in power (MarketLine, 2016 a).	Since 2015, a center-right coalation is in power (MarketLine, 2016 b).
Economical	Germany grew by 1.5% in 2015 (MarketLine, 2016 a). It is Europe's economic powerhouse.	Denmark grew by 1.2% in 2015 (Forbes, 2017).
Social	The nation is on the sixth place out of 188 countries according to the Human Development Index	The country has a shortage of skilled labour and the government undertook measures (MarketLine, 2016 b).
Technology	The access of the internet grew significantly from 31.7% in 2001 to 88% in 2015 (MarketLine, 2016 a)	The percentage of mobile penetration grew from 96 per 100 people in 2014 to 126 in one year (MarketLine, 2016 b).
Environmental	Germany is exposed to a severe threat from airborne particulates that worsen the pollution (MarketLine, 2016 a). Statistically, every second measuring station in urban surroundings exceeds the limits (MarketLine, 2016 a).	Denmark has been among the leading nations in regards to environmental legislation. A close involvement in environmental topics on contient and world-wide level is predominant (MarketLine, 2016 b).
Legal	The country obeys mostly to free trade regulations (MarketLine, 2016 a).	In regard to the Index of Economic Freedom, Denmark is ranked 12th in 2016 (MarketLine, 2016 b).

Appendix C

Hofstede Culture Analysis (Hofstede, 2017)

Germany
in comparison with Denmark

	Germany	Denmark
Power Distance	35	18
Individualism	67	74
Masculinity	66	16
Uncertainty Avoidance	65	23
Long Term Orientation	83	35
Indulgence	40	70
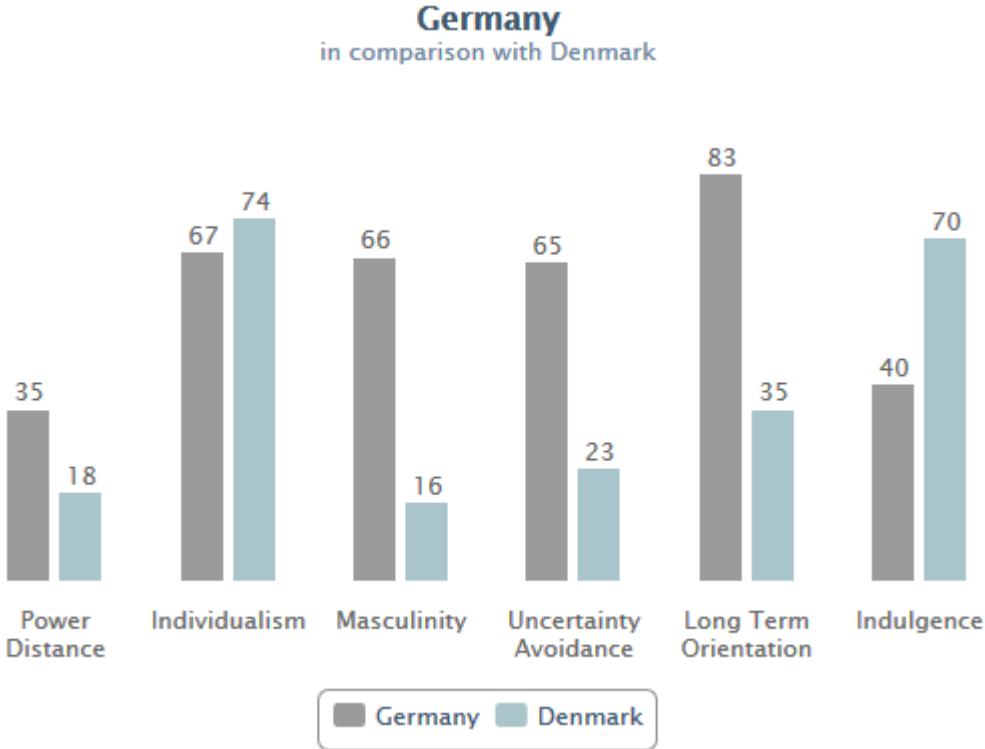
Appendix D

Topic Guide

Indicators	Sub-Indicators	Architecture-Specific	Interview Questions
Configuration Type (Osterwalder, 2004, p. 87)	**Value chain, value shop, value network** (Osterwalder, 2004, p. 87)	**Consider various sustainability aspects along the life cycle** (c.f. Liebsel & Glavind, 2007; Nelms et al., 2007)	How do sustainability projects differ from conventional projects?
			What are the most important tasks of your employees?
Activity Level (Osterwalder, 2004, p. 88)	**Primary activity, support activity** (Osterwalder, 2004, p. 88)	**Alignment of activities with stakeholders** (Jones et al., 2010; Reed, 2007)	Are there additional tasks?
			Does the overall process change?
Activity nature (Osterwalder, 2004, p. 85-87)	**For Value Chain** (Osterwalder, 2004, p.88)	**Sustainability considerations need to be integrated early on in the design process** (Sterner, 2002; Ngowi, 2001)	
	For Value Shop (Osterwalder, 2004, p. 88)		
	For Value Network (Osterwalder, 2004, p. 88)		
Reasoning (Osterwalder, 2004, p. 96)	**Reduction of risk and uncertainty** (Osterwalder, 2004, p. 96)	**Well-functioning interplay and integration of players is needed to deliver sustainable solutions** (Kibert, 2007)	Who are the most important actors you work with?
			Do you need partners when conducting sustainable projects?
Strategic Importance (Osterwalder, 2004)	**As a degree between 0-5** (Osterwalder, 2004)	**Congruency of goals between players essential** (Jones et al., 2010)	How important do you think are these actors for your long-term success?
Degree of competition (Osterwalder, 2004)	**As a degree between 0-5** (Osterwalder, 2004)	**Cross-disciplinary working teams can improve environemental performance** (Theaker & Cole, 2001)	Are these actors you work with competitors?
Degree of integration (Osterwalder, 2004)	**As a degree between 0-5** (Osterwalder, 2004)		How closely are you linked to these actors? Do you learn from your partners?
Substitutability (Osterwalder, 2004)	**As a degree between 0-5** (Osterwalder, 2004)		How difficulut is it to find a substitute partner?

Tangible (Osterwalder, 2004)	**Equipment** (Osterwalder, 2004), **financial assets, and technology** (Eisenhardt & Schoonhoven, 2001, p. 137)	**Develop knowledge through training and knowledge development** (Kibert, 2007; Ofori & Kien, 2004)	What are the most important resources of your firm? Do you participate in trainings?
		Firm intern collaborations to develop competences (Bossink, 2004)	How do you develop sustainability competences? Did your knowledge need to change in order to build sustainably?
Intangible (Osterwalder, 2004)	**Patents and brand** (Osterwalder, 2004), **and (DGNB) certifications and memberships**	**Collaborate with external partners to develop comepetences** (Kibert, 2007)	
Human (Osterwalder, 2004; Barney, 1991)	**Employees** (Osterwalder, 2004), **training, experience, relationships, and insight of individual managers and workers** (Barney, 1991, p. 101)		

Appendix E

Appendix E.1 ft+

Value Proposition

The *initiative* to build sustainably was taken *by the decision makers*, the partners Mr Thiele and Mr Friedrichs. Furthermore, it is found that the *public debate* contributed to this choice.

> "The intensified public debate and news on sustainability by companies in our region conveys to our firm too." (Stefan Friedrichs, ft+)

This resulted in a changed *Value Proposition* from conventional buildings to *sustainable buildings*.

Value Configuration

> "[The activities] have already changed and will change more." (Nicolai Thiele, ft+)

We find that a sustainable building (*Value Proposition*) had a strong impact on the activities performed internally in the organisation, the so-called *Value Shop*. That is, the "problem
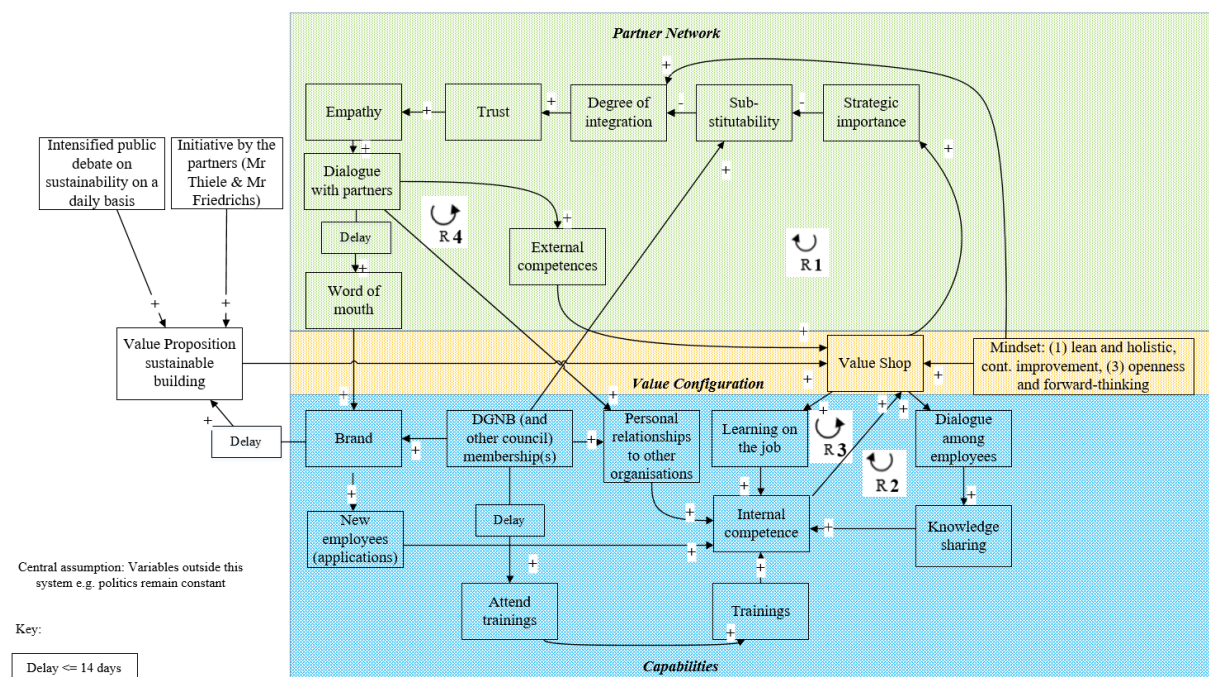
"The processes change and the competences of the employees, because everybody learns from everybody. The dialogue increases and everybody gains competences from everybody. We exchange [information/competences] much more. We tackle the problem at the root." (Nicolai Thiele, ft+)

Therefore, a more *intensive dialogue among employees* led to more intensive *knowledge sharing* and thereby a continuous *internal competence* development cycle. This, in turn, affects the arrangement of internal activities to find solutions, for example, and is thereby a reinforcing cycle (reinforcing loop 2). Mr Thiele notes, problems are more solved at the root cause.

"[The sustainability idea] goes through the entire office." (Nicolai Thiele, ft+)

As a result, many employees are capable of many fields.

Capabilities

"We live this [sustainability]. One has to have determination towards it. We think also a lot about processes, internally and externally. How can we become lean? Not only on the construction site, this applies to the [our] office too. Where are the [partner's] problems? How can we resolve them? (Stefan Friedrichs, ft+)

[We do continuous improvement processes] on small scale [compared to Toyota]. We're working hard on that. [...] How can one improve that [process]? It's all about the small steps, not the big ones." (Stefan Friedrichs, ft+)

"I was at the DGNB's annual general meeting and there was an employee of the Leibniz university in Hanover and he called me up two days later and [asked] if we were interested in joining a research project regarding the topics sustainability and digitalisation. It is, again, also about establishing contacts." (Stefan Friedrichs, ft+)

We found four main reasons for the profound change in activities is a mindset that embraces (1) lean management from a holistic process perspective, (2) continuous improvements with questioning the status quo, and (3) openness as a concept for the future for forward thinking.

The concept of (1) lean management is perceived as a means to remove as much waste across processes as possible. This comprises mostly the consumption of time, emissions, and effort internally and externally across the partner network.

> "[Lean management] is a topic that first came up at smart building. The idea of lean construction was presented. [...] Ten years ago, I read *The Toyota Principle*." (Stefan Friedrichs, ft+)

> "We have to streamline the processes and thereby become sustainable" (Nicolai Thiele, ft+)

> "How can we change processes overall to simplify steps and reduce the wastes." (Stefan Friedrichs, ft+)

Viewing processes from a holistic viewpoint allows a more effective, efficient, and integrative project - not only during planning, but also in terms of execution. Thereby, traditional "silo thinking" that prevailed the industry is replaced and opens up for revealing and solving partners' most pressing issues. Furthermore, the central sustainability mindset spans beyond ft+'s firm's boundaries and is ingrained across the whole building construction cycle.

In the same vein, (2) questioning the status quo in a reflective and continuous manner is perceived to be a major difference in opposed to competitors. In particular, continuous learning is seen as a catalyst to drive change and to keep up with market developments.

> "We're a small, quick-witted force. [...] When one compares themselves with large companies, there have to fight other battles. At large offices it's about 1-2 specialists and the others need to follow and that takes forever. We are observing also [such] developments in Industry 4.0." (Stefan Friedrichs, ft+)

> "We can act faster. We want to make building faster and cheaper and thereby meet the requirements." (Stefan Friedrichs, ft+)

> "A way to look beyond the common assumptions. [...]" (Stefan Friedrichs, ft+)

Therefore, we derive a reinforcing cycle (reinforcing loop: R3). The more *learning on the job,* the more the *internal competences* are improved, which implies a positive effect on the arrangement of activities e.g. solution finding (*Value Shop).*

The notion of (3) openness as a concept for the future refers primarily to forward-thinking that stems from the roles Mr. thiele and Mr Friedrichs play in other committees, councils, and research projects.

> "We have to open our doors widely and have to check where does the input [from outside] come from? [...] What are pressing issues, worries, and ideas? (Stefan Friedrichs, ft+)

> "We ought to adopt the pioneer spirit like it is common in other countries e.g. the United States. [...] To contemplate what the " (Stefan Friedrichs, ft+)

> "I am member of the working committee of the employer's association here [in the region]. [...] We are part of Industry 4.0 and we are observing the processes and changes [that come with it]. When we'll have autonomous driving one day, that means for us [ft+] as a consequence that large places reserved for parking lots will become obsolete. And this is a topic for architecture and urban planning." (Stefan Friedrichs, ft+)

> "We do exchange with other architects at DGNB events but architects generally don't like to exchange." (Nicolai Thiele, ft+)

> "The DGNB makes us future-proof, however only in conjunction with the other associations previously mentioned [e.g. building smart]." (Nicolai Thiele, ft+)

We identified that the *personal relationships* and *access to external competences* facilitate access to researchers and other managers in the region. This, in turn, gives "food for thought" when considering the impact of trends on the industry early on.

> "Modifying [in the industry] is key, yes." [on the question whether this gives a competitive edge] (Stefan Friedrichs, ft+)

> "Of course, this [being part in committees, research projects, and councils] has marketing advantages too." (Stefan Friedrichs, ft+)

"Moreover, it contributes positively to the public image and thus the reputation of the architecture firm in the region." (Stefan Friedrichs, ft+)

We found that beyond the immediate advantages of access to knowledge there the sustainability image is fostered too. As a result, the reputation for sustainable building offerings benefits and leads to applications.

"Slowly, we are receiving applications [of people] who are interested in this [sustainability]." (Nicolai Thiele, ft+)

"Yes, certainly [we are receiving applications due to our reputation in sustainability]. Via our website and the DGNB, [and] indirectly via *building smart*." (Stefan Friedrichs, ft+)

Taking a closer look at employees revealed that they are the most important resource of the firm. Furthermore, training was highlighted as an important means for staff to prosper.

"[The most important resources] are the employees and they need to be trained well." (Nicolai Thiele, ft+)

"[The most important resource] are the employees and they need to be extremely well educated [here meant as: further development in opposed to academic education]." (Nicolai Thiele, ft+)

"Every employee needs to go to trainings. Everybody needs to get used to the sustainability idea. Otherwise we prepare them to leave the company." (Nicolai Thiele, ft+)

"Precisely [we go to trainings]. We are obligated to participate at six trainings [a year] in order to keep our DGNB consultant certificate." (Stefan Friedrichs, ft+)

It was found that the *internal competences* as well as *external competences* shape ft+'s understanding of the *desired building properties*. One aspect of this stems from *learning on the job*.

Last but not least, I pivotal competence are life-cycle assessments of building projects. On the one hand, they show clients the impact of the construction over the entire lifecycle and, on the

other hand, pave the way for a truly sustainable building (Ofori, 2000; Ngowi, 2001; Sterner, 2002; Ofori & Kien, 2004; Ahn & Pearce, 2007; Nelms et al., 2007; Nielsen & Glavind, 2007).

> "An essential part [in projects] is the consideration of life-cycle assessments. We present opportunities [to the client] early on and let them decide." (Stefan Friedrichs, ft+)

Partner Network

Any architect needs access to external knowledge in order to complete building projects, regardless of their degree of sustainability.

> "The greatest change is the empathy that develops with the people that we work together with. More emotions are created. Thereby we become more customer-oriented. And this encompasses our whole office." (Nicolai Thiele, ft+)

> "[Empathy] isn't there from one day to another. That is rethinking." (Stefan Friedrichs, ft+)

Hence, the intensified internal dialogue, knowledge sharing and competence developments encompasses the partner network too. To be precise, we conclude that directly influences the way how the aforementioned internal activities are arranged (*Value Shop*) in order to design, coordinate, and construct a sustainable building (*Value Configuration*).

> "[Partner are] very important [for our long-term success]. Only when they have success, we have success. We realise that partners increase the trust and open themselves up. Within it [trust] it is not possible." (Nicolai Thiele, ft+)

> "[Partner are] very important [for our long-term success]. Without them we would not been able to cope with the ever-increasing requirements. We are neverdone with the learning process. If we want to be able to cope with the requirements of sustainability, we must close our ranks and understand the processes of each other. This is a continuous alignment. Therefore, partners will be very important [in the future]." (Stefan Friedrichs, ft+)

"Transparency is important. Otherwise there is distrust." (Stefan Friedrichs, ft+)

"The processes are changing and thereby the competences of every single employee, since everyone notices more from others. The dialogue has intensified and everyone gains competences of everything. No single one has core competences. We exchange much more. Wir resolve the problem at the root." (Nicolai Thiele, ft+)

We find that a more intensified dialogue with external experts fosters the improvement of internal activities (reinforcing loop 4). In particular Mr Thiele emphasises empathy to be the key to developing trustful partner relationships.

We exchange [information/skills/competences] much more. We tackle the problem at the root." (Nicolai Thiele, ft+)

"We are thinking more about the project/building process up front." (Nicolai Thiele, ft+)

"Yes, I firmly believe that [we are more integrated with our partners]. It's a slow process. And then suddenly one notices that we pull together." (Stefan Friedrichs, ft+)

As a result, we conclude that a deeper understanding of the partner's challenges allows to find more viable project solutions. Thus, this intensifies not only the degree of integration, but also strengthens partner relationships.

"We are thinking ahead in regards to construction planning. "[The sustainability idea] is less present at many partners" (Nicolai Thiele, ft+)

Last but not least, the disadvantage of some partners having a competence shortage in terms of sustainability expertise causes the worsening of finding substitute partners (*Ease of finding substitutes*), Thiele points out.

"When you belong to an association [DGNB] then you are being inspired to change your way of thinking. It is difficult to say from one day to another we are sustainable now. It does not work without the DGNB (and other associations)." (Nicolai Thiele, ft+)

"By listening to new things (in DGNB events) you can build up internal competences and demand them." (Nicolai Thiele, ft+)

"The accession [to the DGNB] is very important to us." (Stefan Friedrichs, ft+)

"We are seizing the opportunities that the DGNB offers. We have access to specialist planning [for example]. And we draw on that." (Stefan Friedrichs, ft+)

"Also, word of mouth is a source of new contacts in sustainability too." (Stefan Friedrichs, ft+)

"We have already considered [to integrate competences]. Where the sustainability concept is not yet so widespread. But then one is more into general planning. This has a disadvantage for me. Then you miss out on revealing blind spots. The influence from [an] outside [perspective] is missing. This limits further development." (Stefan Friedrichs, ft+)

However, the *membership* to the *DGNB* allows to offset this shortcoming of finding too few *substitute* partners as it facilitates access to a network of competitors, craftsman, engineers, lightning specialists and the like that embrace sustainability. Thus, it is a corrective loop (reinforcing loop: R1). In addition, the increased *degree of integration, trust, empathy,* and *dialogue to partners* leads to more access to *external competences,* which affect the internal activities (*Value Shop)* and *Strategic Importance* positively.

Appendix E.2 CREO Arkitekter

Value Proposition

The initiative to build sustainably was taken by one *employee*, our interviewee. This resulted in a changed product (*Value Proposition*) from conventional buildings to sustainable buildings.

> "The design of the building needs to be sustainable." (Ebbe Kristiansen, CREO Arkitekter)

> "I push the company. [...] We cannot make a good project without sustainability. [...] We need to have it." (Ebbe Kristiansen, CREO Arkitekter)

Value Configuration

Although not explicitly stated, CREO Arkitekter's activities increased in complexity, as the subsequent paragraphs illustrate.
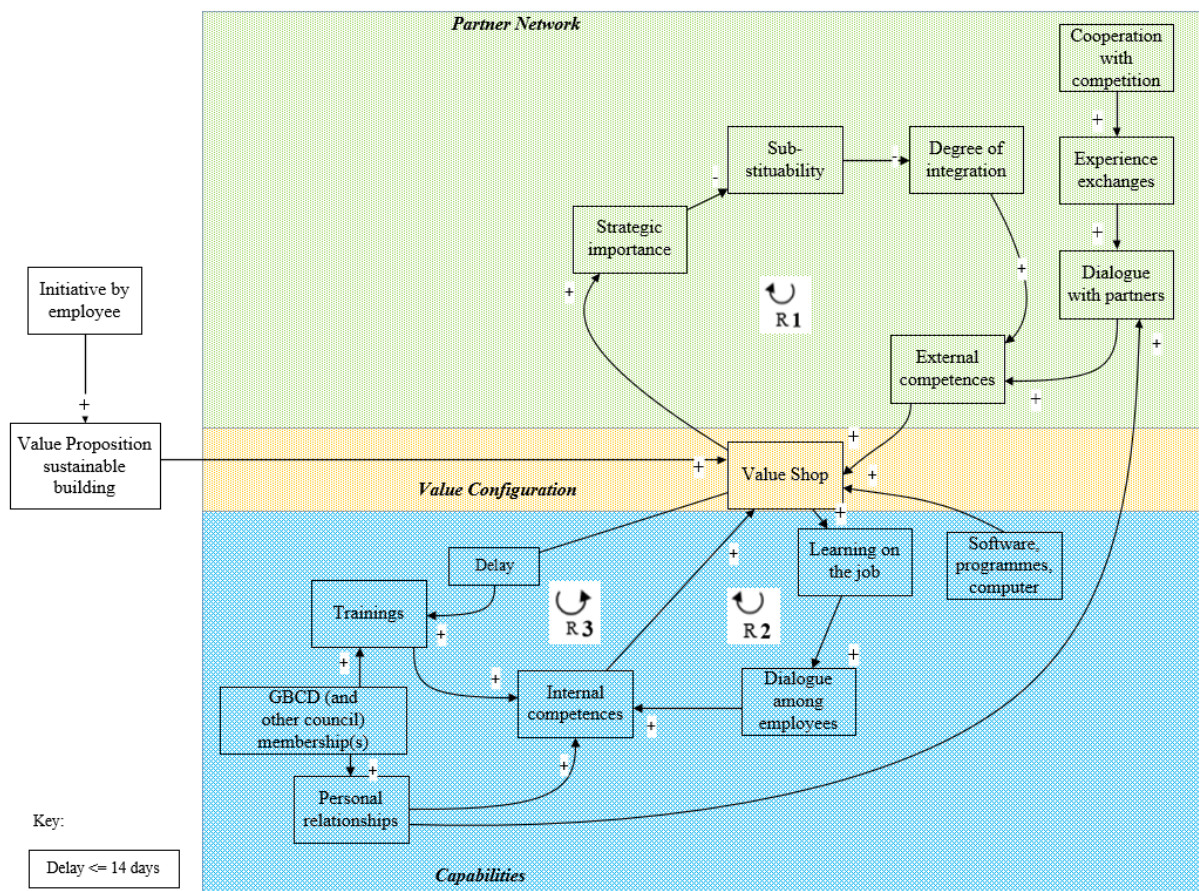
Partner Network

The task to build sustainably demands input from other project participants. Since sustainable solutions synthesize knowledge from different actors in the project, there is an inherent need for capable partners.

> "Very, very, very important (are partners for long-term success). We have to work with good partners." (Ebbe Kristiansen, CREO Arkitekter)

> "We need to work closely together. That's very important." (Ebbe Kristiansen, CREO Arkitekter)

As a result, the degree of importance for long-term success rises (*strategic importance*).

> "Very, very difficult (to find a substitute partners). [...] Everyone wants to work with the best ones all the time." (Ebbe Kristiansen, CREO Arkitekter)

However, this makes finding substitute partners more challenging. Hence, there is a low *substitutability.*

CREO Arkitekter uses the DK-GBC to engage more closely with partners.

> "Yes (on the question if the DK-GBC serves as a platform to find partners), we go to meetings and courses (of the DK-GBC) all the time. [...] It helps us to get better. [...] It helps us to use less time on the next project." (Ebbe Kristiansen, CREO Arkitekter).

> "Yes (working with competitors). [...] Sometimes work together, sometimes we compete." (Ebbe Kristiansen, CREO Arkitekter)

> "We try to get experience exchanges, but sometimes we forget it. [...] The time schedule is very short." (Ebbe Kristiansen, CREO Arkitekter)

> "Yes (on the question if the DK-GBC serves as a platform to find partners), we go to meetings and courses (of the DK-GBC) all the time." (Ebbe Kristiansen, CREO Arkitekter)

Thus, cooperating with competitors is also a means to access external competences and we derive a higher *degree of integration* of partners, hence reinforcing loop 1.

Capabilities

A closer look behind the mechanism how Creo develops its competences reveals a few interesting findings.

> "Totally changed [capabilities] (on the question if they have changed due to sustainability)." (Ebbe Kristiansen, CREO Arkitekter)

> "First, software and programmes were deemed necessary as tools to cope with the needs sustainability demands." (Ebbe Kristiansen, CREO Arkitekter)

> "Technology changes very fast in Denmark. [...] It's changing a lot the whole time." (Ebbe Kristiansen, CREO Arkitekter)

> "We need to have the newest software, programmes, and computers." (Ebbe Kristiansen, CREO Arkitekter)

> "Programmes are important for competitions." (Ebbe Kristiansen, CREO Arkitekter)

Hence, we derive that programmes are needed for CREO Arkitekter to deliver on sustainable solutions.

In order to incorporate the client's wishes, the firm's employees conduct the classic architecture processes of designing and modelling the house (*Value Shop*). Experience in this is obtained during the projects (*learning on the job*). This can be understood as learning by doing.

> "It's about the projects (where do you get the experience?)." (Ebbe Kristiansen, CREO Arkitekter)

> "[Sustainable projects are an] ongoing process, step-by-step. With every step it's going better and better." (Kristiansen, CREO Arkitekter)

> "Second, an internal dialogue among employees, knowledge sharing, and trainings contributed to the development of internal competences." (Ebbe Kristiansen, CREO Arkitekter)

> "We need to have good communication in the company. That is very important." (Ebbe Kristiansen, CREO Arkitekter)

> "Some people have good ideas. [...] Everybody can say something in the project. [...] So together we are strong. [...] We can learn from each other." (Ebbe Kristiansen, CREO Arkitekter)

Therefore, *learning on the job* is found to cause a more intensive *dialogue among employees* which thereby leads to a continuous *internal competence* development cycle (reinforcing loop 2).

In addition, Ebbe noted he translates the German DGNB standard into Danish and helps to tailor it to Danish market conditions. This allows for trainings in sustainability, suited to the DK market.

> "I made the books. And the DGNB manuals. I translate [them] from German to Danish. [...] how to do it the Danish way." (Ebbe Kristiansen, CREO Arkitekter)

We conclude that the more *trainings,* the more *internal competences,* which affects the activities such as solution finding (*Value Shop)* positively. It is a reinforcing cycle (reinforcing loop 3).

It is worth mentioning that the two previously mentioned reinforcing loops share two common variables: *internal competences* and *Value Shop.* This fact causes an amplifying effect, which again reinforces both cycles - just like two catalysts in contrast to one.

Appendix E.3 Henning Larsen

Value Proposition

The initiative to build sustainably is twofold: First, Henning Larsen saw a market opportunity.

> "The reason that we focused on sustainability is that we saw for one that it is a topic that so drastically influence how we should construct buildings and two a market" (Martin Vraa Nielsen, Henning Larsen)

> "For sure there was a recognition that there was a market share […] but actually I genuinely believe that architects every time they get a project they want to do it a good as possible." (Martin Vraa Nielsen, Henning Larsen)

Second, some architects at Henning Larsen embraced sustainability and thereby contributed to drive change (*initiative by employee)*.

> "Yes, I think so (on the question, if there was an internal drive)." (Martin Vraa Nielsen, Henning Larsen)

Our interviewees are two of several dedicated experts on sustainability matters.
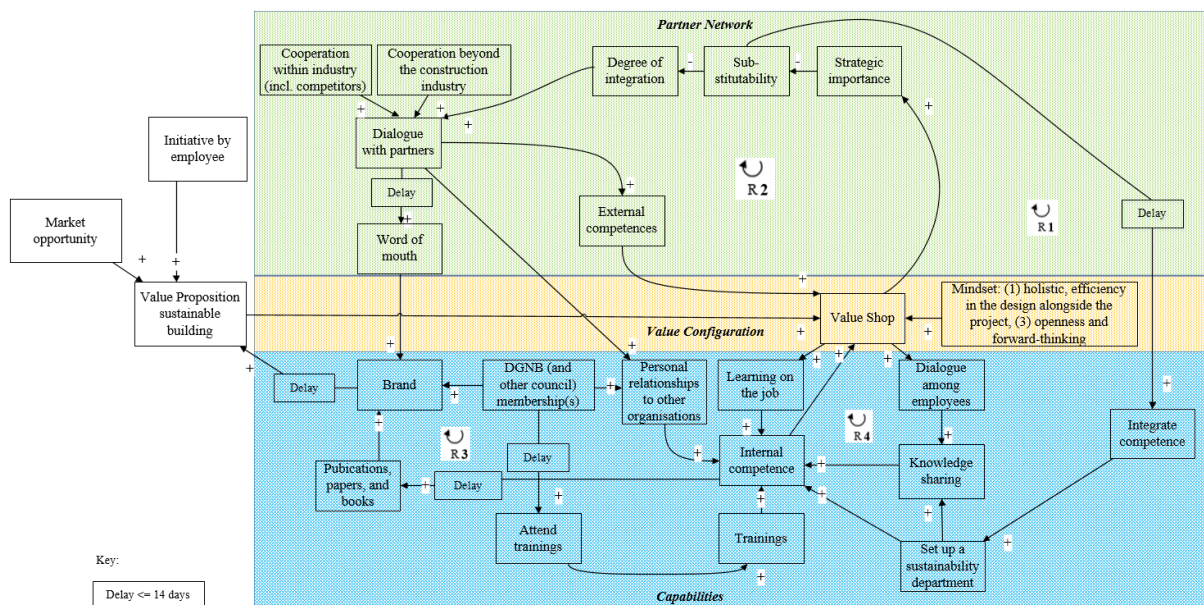
"Some of the projects can be very focused on the environmental issue[s] (…) [or] very focused on the social benefits. (…) It can be including diversity in the learning environment, be accessible for different culture and gender." (Jakob Strømann-Andersen)

"We are able to handle more complex issues. There is a lot of certification happen right now so you have to certify your buildings according of LEED, DGNB, there's many of them." (Martin Vraa Nielsen, Henning Larsen)

"Yes, that's part of it (on the question if strategic design refers to life cycle assessments)." (Martin Vraa Nielsen, Henning Larsen)

"A lot of sustainability issues should discuss over the lifecycle. It is mainly through certifications that [clients] ask for it." (Martin Vraa Nielsen, Henning Larsen)

Thus, we conclude that Henning Larsen has undergone a product change (*Value Proposition*) from conventional buildings to sustainable buildings across all building categories the firm engages in.

Value Configuration

An architecture firm advertises itself with the buildings that have been built. We find that reputation is increased through sustainable buildings.

"We are trendsetters in sustainability." (Martin Vraa Nielsen, Henning Larsen)

"I very much think so [that people come to us because of our sustainability image]. It is one factor of our attractiveness factor[s]." (Martin Vraa Nielsen, Henning Larsen)

"Yes of course they have [on the question do you think the GBCD and the DGNB have increased your brand value?]. It is a good position to sell services for us." (Jacob)

This entails that the incorporation of sustainability aspects changes the traditional building. This, too, entails that the activities that are to be performed must change as well.

"Seeing the design potential. Us being able to say that this is better than something else. Technical knowledge being implemented early in the process." (Martin Vraa Nielsen, Henning Larsen)

"We bring in the people [of the new sustainability department] when we have the discussions [in the project teams]. The same people are not following each project for all phases or the whole period. They are coming in at different kind of phases, different kind of scales, if we do the mathing, Master Plan, if we do building design, facade design. (…) so we have different people that is related to the different element of the building process." (Jakob Strømann-Andersen).

"We [the new sustainability department] work very closely with all the projects that [are] in the office." (Jakob Strømann-Andersen)

"The building industry is so much more complex than 5 years ago. In order to handle that complexity and get a more sustainable building in the end, made us realise that we need to maintain some part of that complexity." (Martin Vraa Nielsen, Henning Larsen)

"Able to handle more complex issues [of sustainability projects]. There is a lot of certification[s]." (Martin Vraa Nielsen, Henning Larsen)

Partner Network

Despite the fact that Henning Larsen is one of the country's major architecture firms, several specialised partners are needed for sustainability endeavours. In fact, Mr Vraa Nielsen (Henning Larsen) reveals that partners are integral for the organisation's long term success (*strategic importance*).

"Mega! Both in terms of client relations […] [Sustainability] helped us to build more long term relationships [with the client]." (Martin Vraa Nielsen, Henning Larsen)

"They [external partners] are quite important. We (…) don't have the ambition to be independent. (…) We always team up with partners, collaborators." (Jakob Strømann-Andersen)

"Yes, it is quite important for us to build relationships, strategic relationships not only with our clients (…)". (Jakob Strømann-Andersen)

Therefore, the company decided to *integrate* several external *competences* such as lightning into the own organisation.

"It [the sustainability department] is about 18 … 20 people with all included. Interns, PhD, communication, landscape architects, architects, engineers, social scientists." (Jakob Strømann-Andersen)

"This is the three kind of bones that we have in our department: the scientific part, the research and development, and the project-related [consulting]."

"It's important for us (…) that we challenge the system [DGNB] all the time." (Jakob Strømann-Andersen)

"The mere fact that we have people in-house that know what that is, instead of external consultants, then we know what it is, we don't draw something that doesn't comply, that is an efficiency aspect. That they know what they are talking about it." (Martin Vraa Nielsen, Henning Larsen)

"But it's important for us to follow-up [on further process stages after the design], because then we have the responsibility of what we're doing and then we have to control and minimize the risk of changes during the design. So we are actually selling the service from the first sketch to the end product. (Jakob Strømann-Andersen)

"[Is integrating different competences key to building sustainably?] Yes. We have taken a fairly new service lighting design. We started to take on acoustics as being part of how you can increase the comfort in the buildings." (Martin Vraa Nielsen, Henning Larsen)

"But we move out to the project when we are working together with them. (…) So to have kind of a base where we share knowledge. But we try to bring that out to the projects sitting together with the project team. (…) It's important to keep that knowledge close to the project team." (Jakob Strømann-Andersen)

"We have it in-house. It is an integral part. It becomes a premise of our architecture." (Martin Vraa Nielsen, Henning Larsen)

"Yeah [on the question whether his department is a way to bundle knowledge and to advance]". (Jakob Strømann-Andersen)

"Yeah" [on the question whether relationships helps to develop internal knowledge]. (Jakob Strømann-Andersen)

We find that this has three main advantages: first, it reduces the need to find substitutable project partners from the firm's network. This is a balancing, also known as corrective, loop. Second, an integration and internal alignment allows Henning Larsen to reap efficiency gains and to bundle and advance knowledge in-house (*develop competence*).

"They [customers] can see that we are capable of adapting to the new reality [sustainability]. (Question: does this convey some more trust?) Yes." (Martin Vraa Nielsen, Henning Larsen)

"We also branch out much more because I think we started to take on board competences that maybe wasn't part of the building process before." (Martin Vraa Nielsen, Henning Larsen)

"I think it [DGNB certificates] is good for opening up for the complexity and opening up and making us able to compare stuff. Of course through these very technical specifications we tend to generate new knowledge as well." (Martin Vraa Nielsen, Henning Larsen)

"From a productivity aspect, it's an efficiency aspect, that we know what they are talking about. And we are able to steer it more directly to where they want it and how they want it." (Martin Vraa Nielsen, Henning Larsen)

"To some extent it doesn't matter [the sustainability expertise of the engineers]. To a lesser and lesser degree as we think we can handle it ourselves." (Martin Vraa Nielsen, Henning Larsen)

Hence, we conclude that there is a reinforcing loop (#1). Namely, the shortcoming of finding less *substitute* partners in the firm's network made the firm opt for *integrating competences* by *set[ing] up a sustainability department.* That, in turn, fosters *internal competences,* which are applied in the activities in projects (*Value Shop).* Lastly, we find that this is an adequate response to the high *Strategic Importance* as it counters the initially, disadvantageous situation of finding substitute partners.

The interviewees also note that Henning Larsen works with competitors.

> "Yes, quite often [that we work with competitors]. We will be the ones bringing the sustainability profile." (Martin Vraa Nielsen, Henning Larsen)

> "Yes, it is quite important for us to build relationships, strategic relationships not only with our clients, but also our competitors. (…) We really want to go into relationships and partnerships and we share knowledge with our kind of competitors or architectural offices that also have these services. Yeah" [on the question whether this helps to develop internal knowledge].

> "Mainly yes" [the experience exchange happens on project level only]. (Martin Vraa Nielsen, Henning Larsen)

This goes even beyond experience exchanges with competitors and encompasses even related industries and society at large.

> "We are very kind of engaged in relationships and communities where we talk between companies to strengthen our position as an architectural company. (…) This is networking or knowledge sharing in a more common way." (Jakob Strømann-Andersen)

> "We are participating in different kind of networking." (Jakob Strømann-Andersen)

> "For us it is just important that it is maybe not only people (…) within the building industry. It can also be more data driven industries that work with Big Data, it can be people that work with health, social sciences, but the relationship is always important. (…) We are always looking out for collaborations." (Jakob Strømann-Andersen)

"That can be manufactures (…) Small, informal knowledge sharing communities (…) the process, how we can bring the architecture more up in the value chain in the society." (Jakob Strømann-Andersen)

We conclude that projects facilitate an opportunity to learn from partners and thereby allow to access external competences of specialists such as the DGNB, craftsmen, engineers, and even rivals.

Thus, we conclude that due to a higher *degree of integration* a more intensified *dialogue with partners* fosters the advancement of access to *external competences* and thereby in turn affects the internal activities (*Value Shop)* and *Strategic Importance.* As such, it is a reinforcing loop (#2) since it offsets the initial, unfavourable situation of limited *substitutability* of partners in the firm's network.

It is to be noted that both corrective or balancing loops are interconnected. This means that they amplify each other - just like two catalyst.

Capabilities

From a competence perspective the *setup of a sustainability department* fosters the dialogue among employees as well as the competence development in-house. It is obvious that this encompasses *knowledge sharing* as well.

This goes in line with the recognition that *learning on the job* is a vital factor too.

"It takes time but it is also realising that […] it is a continuous process of figuring out what impacts or what parameters enable sustainable architecture." (Martin Vraa Nielsen, Henning Larsen)

"We are often kind of translators between the external consultancy and our inhouse team. (…) We try to convert what the engineers are saying into more design related solutions that the design team can take into their design. (…) The whole idea is that we bring in this knowledge to create better architecture. An architecture that keeps the process from the beginning until the end. (Jakob Strømann-Andersen)

"If we set a team where we don't think a certain consultant has the proper competences in sustainability then we tend to try and take more of that service ourselves so we can control it and steer it in what we think what is a better way and then they do more of a documentation role, whereas when we think it is a very capable consultant within a wider range of sustainability aspects then we can pull back a little. It depends very much on the project." (Martin Vraa Nielsen, Henning Larsen)

"We build it [sustainability concepts] in-house." (Martin Vraa Nielsen, Henning Larsen)

"We do a lot of publications, books, papers. (…) The PhD[s] that do the scientific approval or the scientific papers, articles, that kind of proof a concept of what we are doing." (Jakob Strømann-Andersen)

"I think that we don't kind of hide any knowledge, that's also why we do publications that's free to download." (Jakob Strømann-Andersen)

"It always comes down to personal relationships. That's part of our branding and ethos that we provide this integrated approach." (Martin Vraa Nielsen, Henning Larsen)

Therfore, we draw the conclusion that *publications, papers, and books* positively influence the *brand,* which affects the *Value Proposition: sustainable building,* which influences the arrangement of activities *(Value Shop), learning on the job* and that in turn leads to more *publications, papers, and book.* Hence, we find a reinforcing loop (#3).

"The mere fact that we have people in-house that know what that is, instead of external consultants, then we know what it is, we don't draw something that does not comply, that is an efficiency aspect. That they know what they are talking about it." (Martin Vraa Nielsen, Henning Larsen)

"We can get more services [of the project]. Obviously we want as big as a part of the cake as possible." (Martin Vraa Nielsen, Henning Larsen)

We draw the conclusion that a more intensive *dialogue among employees* leads to more *knowledge sharing* and thereby a fostered *internal competence* development, which influences the activities internally for solution finding, for example, *(Value Shop)* positively. In other words, it is a continuous competence development cycle (reinforcing loop 4).

Another source of competences are the *trainings* provided to members in the *GBCD* and the *DGNB (and other council memberships)*.

> "It's more going to actual conferences about educational buildings or healthcare buildings. We need to acquire that knowledge to sell ourselves." (Martin Vraa Nielsen, Henning Larsen)

Such memberships also facilitate access to a network of other firms with similar aspirations in sustainable building (*personal relationships to other organisations*).

> "It always comes down to personal relationships. That's part of our branding and ethos that we provide this integrated approach." (Martin Vraa Nielsen, Henning Larsen)

Appendix E.4 RUBOW Arkitekter
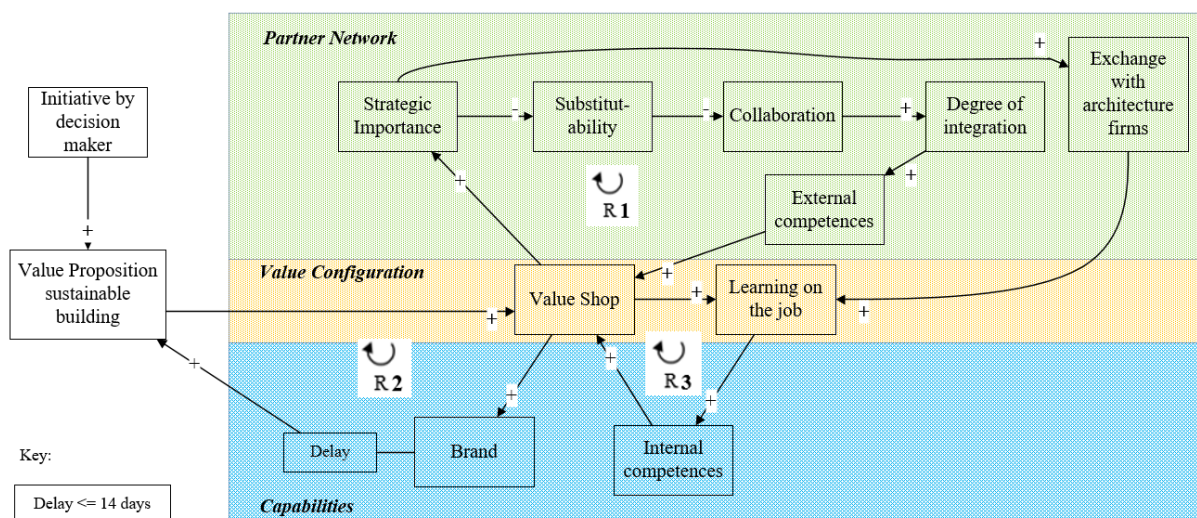
Value Proposition

Ms Hansen explained that the office had a rather technical approach in the past and changed towards a holistic approach, that includes social, financial, energy, environmental, and life cycle considerations.

> "We look into all manners where we have social aspects and financial aspects and energetic aspects and environmental aspects, but also we look into how we can make clever solutions where architecture [has] a long lifespan." (Susanne Hansen, RUBOW).

In particular Ms Hansen highlights the social considerations that are increasingly important and can now be backed up with scientific research.

> "[...] the holistic part is also being aware of research in social behaviour research and how the building can make you recover from sickness in a faster way, how [it can] affect the way you learn in school [...]" (Susanne Hansen, RUBOW).

We conclude that RUBOW significantly changed their *Value Proposition* towards sustainable buildings with a holistic perspective and a strong emphasis on the social factors.

Value Configuration

The changed Value Proposition logically lead to more sustainable projects in the *Value Shop*. Completing more sustainable projects will in turn increase the Value Proposition to the customer.

Partner Network

Ms Hansen asserts that RUBOW resorts to *external competences*, e.g. "construction engineers, ventilation engineers, electrical engineers, daylight engineers" (Susanne Hansen, RUBOW). Taking on sustainability, RUBOW needs to collaborate with engineers that adopted a holistic perspective as well.

> "[...] we depend on having a collaboration with engineers that have also a holistic way of building a sustainable [solution]. So of course we have to team up with people that have the right kind of personnel to solve these problems." (Susanne Hansen, RUBOW).

Therefore, we conclude that the *strategic importance* of capable partners increases. In addition, Ms Hansen argues that "in Denmark our engineers are very conservative and therefore we are lacking engineers that are comfortable working in between fields instead of in their own speciality" (Susanne Hansen, RUBOW). Only the engineering firms that have young employees offer the holistic perspective that is necessary and therefore RUBOW is "looking for partnerships where we can get in touch with some of the younger engineers, because that's where the real solution actually evolves" (Susanne Hansen, RUBOW). Also, "there are some people where we say that it is not working" (Susanne Hansen, RUBOW), demonstrating that there is only a limited number of partners that can be worked with. Hence, the *substitutability* decreases, as RUBOW needs to be selective in their choice of partners.

RUBOW is collaborating closely and early on with its partners, in particular for sustainability projects.

> "We need to have an early collaboration, because we make decisions in the beginning state that involve technical aspects and we can't ignore those. When it's holistic, you need to look into all aspects at once. [...] it needs to be a process with all the specialists at one table from the beginning. [...] we do need a lot of people to collaborate from the first day of the design process." (Susanne Hansen, RUBOW).

This leads us to the conclusion that there is an increase in *collaboration* and thus a higher *degree of integration* of the partners in the projects. We argue that the higher degree of integration is crucial to allowing the work on a sustainability project. Hence, we close the loop as the degree of integration directly feeds into the Value Shop, representing the work on the project. Thereof we derive the reinforcing feedback loop R1. R1 indicates that RUBOW can work on sustainability projects despite the little substitutability of partners, because of their strong collaboration with partners.

As aforementioned, the best way for employees to acquire knowledge about sustainability is by learning on the job. Learning on the job is increased through the knowledge *exchange with architecture firms* that are working on the same project, in particular when the competences are complementary to the ones of RUBOW.

> "[...] we did a competition with an architecture firm that is specialised in reusing materials which is a very special field which we would never be able to know much about. [...] They know things that we have no idea about and that is the whole point of the collaboration. [...] We could learn each other things." (Susanne Hansen, RUBOW).

Capabilities

Following a change in the Value Proposition, the way in which RUBOW is working today had effects on the way a project (Value Shop) is tackled. In particular important is the learning effect, which is according to Ms Hansen the greatest when actually working on the project. Therefore, there is a high degree of *learning on the job*.

> "[The employees] need to grow with the assignment. Getting experience. [...] It's just about doing the projects and gaining experience from project to project. That is actually the best learning method." (Susanne Hansen, RUBOW).

The logical conclusion of learning is that we see an increase in the *internal competences*, which then again allow to deliver a better project, hence positively influences the Value Shop. We derive the reinforcing loop R3 from this. R3 tells us that the more sustainable projects RUBOW takes on, the more internal competences the firm develops and hence is able to deliver better projects. While this may seem obvious, we notice that B1 allows, on the one hand, a continuous working process and hence a continuous learning on the job. On the other

hand, B1 leads to an improved learning on the job, because now it is possible to learn from many specialists that need to work closely together.

> "[...] we learn a lot from these processes with all these specialists on a table. If you have a lot of specialists in a room, then you learn, you don't need to go to a course because you have it all in front of you" (Susanne Hansen, RUBOW).

Hence, R3 and therefore RUBOW's ability to constantly deliver and grow with sustainable projects is amplified by R1. This means that if RUBOW would not be able to self-correct the low substitutability through an increased collaboration, the learning on the job would suffer, which is deemed most important by Ms Hansen.

Another capability that has developed over time is the brand of RUBOW. As the architect advertises him or herself mainly through the buildings that are built, we derive the brand from the Value Shop. The brand again allows to credibly offer the Value Proposition of sustainable buildings. However, we inserted a delay, as Ms Hansen argued that RUBOW formerly neglected leveraging their brand, but now increasingly attempts to use it.

> "We have actually done this mistake of not using [sustainability] enough for our branding [...] since everything we do is sustainable, it's not a big deal and we forgot to mention it. So it's a lack in branding strategy. We're trying to be a little bit more explicit about the fact that we are doing sustainable design." (Susanne Hansen, RUBOW).

Hence, we derive the reinforcing loop R2. When considering R1 and R3 as well, we see that R2 is amplified by R1 and R3. R3 can only constantly reinforce itself, because of the reinforcing loop R1. The more internal competences RUBOW builds through R3, the better the buildings will become and hence increase the brand of RUBOW, leading to an increased and improved Value Proposition, R2.

Appendix E.5 kuntzundbrück

Value Proposition

The firm kuntzundbrück designed as its very first project the first low-energy building in Bavaria. As Mr Kuntz puts it "it was a pioneer work" (Martin Kuntz, kuntzundbrück). However, kuntzundbrück did not manage to follow up on specialising themselves in the energy niche.

> "Our office doesn't have the focus area of energy-efficient buildings" (Martin kuntz, kuntzundbrück)
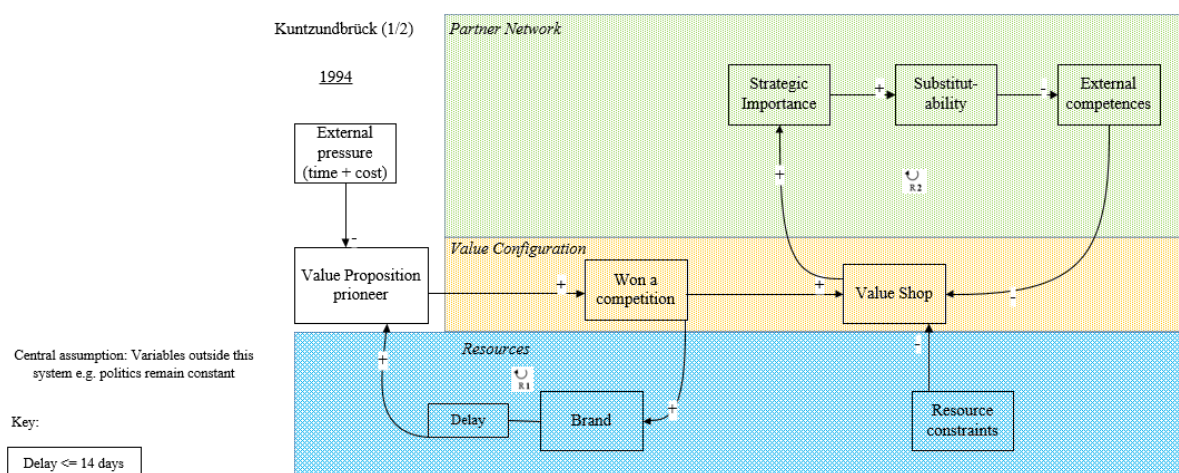
Mr Kuntz claims that a firm cannot continue following every innovation as it needs to deal with the survival of th firm.

> "[The first project] was done with youthful enthusiasm, but an office will not be able to go with all innovations over time in the fight for survival." (Martin Kuntz, kunztundbrück).

Today, kuntzundbrück is facing strong external pressures, such as cost and time.

> "The trend goes towards pragmatism in my observations, which means the emphasis on the factors cost and time." (Martin Kuntz, kunztundbrück).

From the aforementioned information we derive that the Value Proposition of kuntzundbrück is defined by cost and time.

Value Configuration

The Value Configuration, of which the Value Shop is the essential part, was different when engaging in the low-energy project.

> "It was much different with regards to the willingness of doing things that you don't know" (Martin Kuntz, kuntzundbrück)

Doing things that are unknown, often stems from an increased complexity in projects. However, since we know that the Unsustainable/Small firms do not engage in sustainability projects, we assert a lower degree of complexity for their Value Shop. In today's projects we assume that the Value Shop is working with less complexity than for a firm actively engaged with sustainability.

Partner Network

The low-energy building required the collaboration with a firm that was specialised on energy calculation and another architecture office. Therefore, kunztundbrück needed to draw on External Competences.

> "If you want to plan a low-energy building, then the first thing to do is to call the energy consultant to get him on the team." (Mr Kuntz, kunztundbrück).

This means that there is a Strategic Importance of drawing on External Competences. As this project was in 1994 and the subject of energy-efficiency just recently came up, we reasonably assume that there are only few specialists, hence an increase in the Strategic Importance of the specialist leads to a decrease in Substitutability of that specialist. Further, Mr Kuntz claims that kunztundbrück did not build up a strong partner network.

> "I say that we don't really have a network with our small office. We don't have, as other large offices, a fixed network of cooperations" (Mr Kuntz, kunztundbrück).

Thereof, we draw the conclusion that because of the non-existent cooperations kunztundbrück was not able to keep up a strong network. Paired with the low substitutability of specialists, this leads to a decrease in the activities that the firm can provide, the Value Shop.

Today the projects in the Value Shop are mainly driven on cost and time aspects. Since the firm does not have a strong network, we assume that the Strategic Importance has decreased, but the Substitutability increased, since the firm does not need any fixed partners. This affects the External Competences in such a way that they do not develop and may even decrease. This creates the reinforcing loop R1. R1 may offer another explanation for why kunztundbrück did not follow up on energy-efficient buildings. The non-existent network does not allow the firm to engage in working on energy-efficient buildings, and since it is a reinforcing loop, we may regard this as a continuous spiral, where with every new project, the likelihood of engaging in energy-efficient, and for that matter sustainable project, decreases. Interestingly, both partner firms from the initial project managed to strive in the energy niche and are rather large today.

Capabilities

For the first-ever project of the firm, kunztundbrück designed a low-energy building. However, immediately after realising the project, new projects in sustainability did not come up.

> "The hope that people would call after this pioneer project [...] unfortunately didn't realise" (Martin Kuntz, kunztundbrück)

Still, kunztundbrück tried to get a university teaching position, but did not get it.

> "I have tried to get a university teaching position with this topic, which almost worked out, but only almost" (Martin Kuntz, kunztundbrück)

This project would later on give them credits as it went through the newspapers. The project also led, much later on, to another project.

> "When it was positively finished, it went through all the newspapers. The project is still shown as flagship in Bavaria. [...] We had another projects afterwards; ten years later we built a large passive house [...]" (Martin Kuntz, kunztundbrück).

From this we derive that the project enhanced the Brand of kunztundbrück and that, with a long time delay, led to another project. This leads us to the reinforcing loop R2. R2 might be one piece in the puzzle to explain why kunztundbrück did not continue focusing on low-

energy houses. The market response took a long time until another project for sustainability came up.

Mr Kuntz claims that, due to the small size of the firm, there are resource constraints pressuring the firm, not allowing, for instance, to constantly send employees to trainings.

> "It may be a matter of time and costs how many trainings you may want and can afford. The one who is on trainings is not in the office and since there are only four to five people in the office and if constantly two are on trainings, we couldn't run the office." (Mr Kuntz, kunztundbrück).

Hence, an increase in Resource Constraints decreases the ability to constantly develop the competences needed for sustainability activities in the Value Shop.

Appendix E.6 a-z architekten

Value Proposition

The initiative to change the offering (*value proposition)* was taken by the CEO Mr Holger Zimmer.

> "The whole [building] life cycle, meaning to minimise the consumption of resources. [...] We attempt to toss away less." (Holger Zimmer, a-z architekten)

> "It is important to us [to use] natural and renewable resources. [...] In opposed to synthetic products and their properties in terms of fire safety for example, then one arrives at the materiality and the comfort buildings are ought to have." (Holger Zimmer, a-z architekten)

Based on these quotes we draw the inference that the *value proposition* is geared towards *sustainable buildings.* In addition, the decision maker emphasised that "pioneer work was needed [in the year 2000] on the own projects in the beginning" (Holger Zimmer, a-z
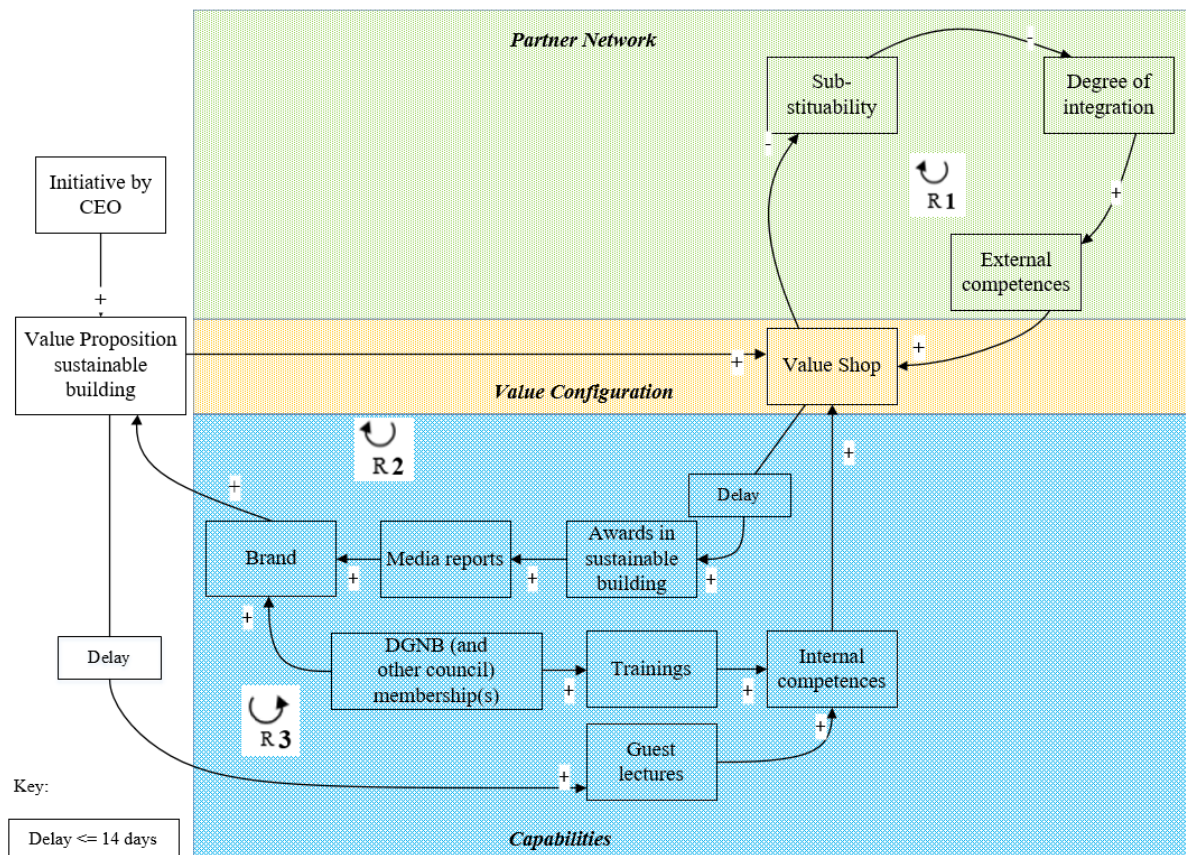
architekten). This is backed up by a number of customers asking for sustainable building solutions.

> "Yes, a specific target group of customers" (on the question whether customers come explicitly to them due to him, because they have built up a brand in sustainability). (Holger Zimmer, a-z architekten)

> "When builders come to us and they are informed, which happens a lot, they say how they have found us. You [a-z architekten] engage in this, and we haven't found any other architect here in this region. And when they research, they come to us, and then it's clear, it has to be a passive house precisely on the comma, and that's what's it gonna be, it has something to do with previous experience." (Holger Zimmer, a-z architekten)

Value Configuration

The change in the *Value Proposition* is implied a different arrangement of internal activities (*Value Shop*) in order to find viable solutions in sustainability. Even though this development stems not solely from sustainability.

> "Yes, however, I would not only see that for sustainability. I think that the requirements overall have increased. [Nowadays] with the first blueprint of the building I meet the fire safety expert and I think this has generally improved or became necessary, because the directives have become so diverse. So that one meets the team actually already to discuss the first sketches." (Holger Zimmer, a-z architekten)

> "[elements that are] not considered in the first sketch in terms of aspiration, quality, sustainability will be difficult or if even considered afterwards along the project. Unless legal requirements or so force one to go down that road." (Holger Zimmer, a-z architekten)

Partner Network

The aforementioned quote in the *Value Configuration* section illustrates the earlier integration of external specialists into the building project. However, it does not reveal the *Partner Network* challenges that a a-z encountered when modifying their product offering of sustainable buildings (*Value Proposition*).

"Pioneer work was needed in the own projects in the beginning [in year 2000]. For example, the structural engineers considered us insane when we wanted to isolate the base plate. In the meantime, this is almost standard." (Holger Zimmer, a-z architekten)

"There are a few, for example specialist planners, that have joined trainings that are on eye level or from which you can learn something. Obviously we are selecting based on that. However, there is always a fraction that is very complacent. With those one is ought to be careful." (Holger Zimmer, a-z architekten)

We find that a-z architekten faced a *substitutability* challenge of capable partners when engaging in sustainability. However, by means of trainings and selecting the right partners this imbalance has levelled.

Another means to counter this was increasing the degree of integration in order to build up internal competences to become more independent from partner's lack of expertise.

"[Recently] there was a PhD student of the Technical University Darmstadt, who writes his dissertation on solar panels, suddenly standing at the door. He is becoming an entrepreneur doing energy simulations. [...] That [building up competences] may take way too long, but all of that fortunately happened now. [...] It has always been my vision, why don't we do anything with [...] energy concepts? That is what's happening now." (Holger Zimmer, a-z architekten)

As a result, *external competences* are increasing, which positively influences the *Value Shop*. We derive a reinforcing loop 1 from this, as the initial need for *substitutability* was partially offset by this undertaking.

The closer alignment of *external competences* started with an collaboration of a PhD student from a related professional field. Even though Mr Zimmer notes that it has always been his vision to integrate energy concepts into his firm, this sudden opportunity caught him by surprise.

Capabilities

In addition, holding and visiting guest lectures with the professional association and at universities helped to advance internal competences alongside the building projects his firm is engaged in.

> "Trainings must be joined, as we [architects] have an obligation to do so. However, enthusiasm for architecture also plays a role. We are going to many trainings and hold lectures at universities and universities of applied sciences, [also] the professional association." (Holger Zimmer, a-z architekten)

Mr Zimmer emphasises the necessity of an architect to learn about the interfaces to other members of the projects as well as their details too.

> "Yes, one has to pay attention to the interfaces [to other project participants] and details." (Holger Zimmer, a-z architekten)

Furthermore, the own brand is an important factor to underline the *Value Proposition* towards customers for example. We find that positive media reports as well as prices in sustainability were levers to strengthen the brand and to enhance the acceptance of sustainable building in the region.

> "The acceptance that came via the architecture prices [in sustainability], but also all the, I guess not a single negative, media reports [about us]. [...] That's how one gains [acceptance] very well." (Holger Zimmer, a-z architekten)

We draw the conclusion that a change in the *Value Proposition* causes an increase in the activities *(Value Shop)* performed internally. These activities lead after the project completion to a sustainable building, for which, in some cases and after some time (*delay*), a-z architekten receives *awards in sustainable building*. In turn, this triggers *media reports* and thereby fosters the *brand* image and inspires consumers to approach the firm for future building projects (reinforcing loop 2).

Further, the CEO noted that he holds and attends *guest lectures* at universities and universities of applied sciences. He says they have done this for about 15 years now since they engage in the topic. Thus, we see a not only a correlation, but also a reinforcing cycle between the *guest*

lectures, developing *internal competences*, the *Value Shop,* the *awards in sustainable building, media reports,* their positive impact on the *brand,* and the fostered *Value Proposition* (reinforcing loop 3).

Besides, it is to be noted that the reinforcing loops are interconnected, as they share two connections (*Value Proposition* and *Value Shop*). This implies that both reinforcing loops amplify each other continuously, which is positive.

> "Enthusiasm for architecture also plays a role. We are going to many trainings and hold lectures at universities and universities of applied sciences, [also] the professional association. That goes very well, maybe because we have been engaged in that [sustainability] topic for about 15 years now." (Holger Zimmer, a-z architekten) (Holger Zimmer, a-z architekten)

Appendix E.7 Juhr Architekturbüro

Value Proposition

The change to build more sustainably was taken on by the CEO, because he argued that the way buildings are constructed were often nonsense.

> "[We started building sustainably] because we said there is being built so much nonsense and so much short-lived [buildings] and much is then again demolished and this doesn't make any sense." (Michael Juhr, Juhr Architekturbüro)

Therefore we derive an increase in the *Value Proposition of sustainable buildings*.

Value Configuration

The change in Value Proposition certainly also increased the amount of sustainable projects handled in the *Value Shop*. However, it is interesting to note that the essence of the design process of a sustainable building "does not change at all" (Mr Juhr, Juhr Architekturbüro) in comparison to conventional projects.
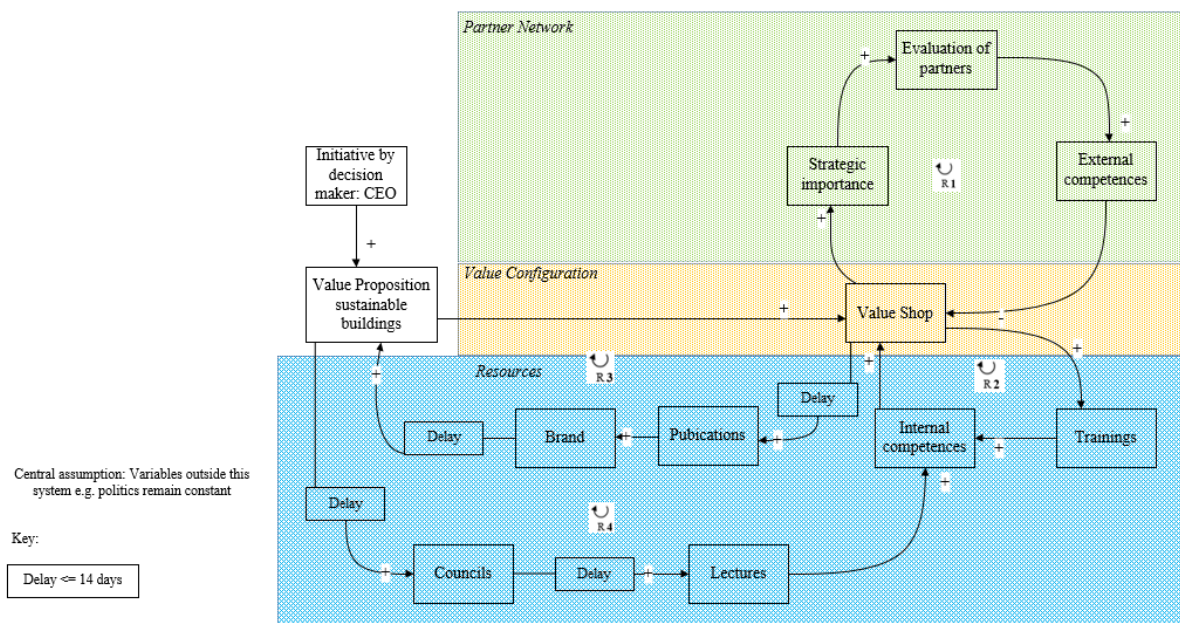
Partner Network

While the core design process may not have changed significantly, the Partner Network did. In order to build sustainably, the firm needed to select new partners and pay attention to partners that think sustainably, too. Therefore, an increase in the Value Shop leads to an increase in specialised *external competences* needed.

> "If we want to reach a sustainable product, we need to see that all partners are also obliged to be sustainable. This means that we went on the search where is the technical building equipment specialist, where is the structural engineer, where is the acoustician who thinks that way." (Michael Juhr, Juhr Architekturbüro).

Mr Juhr claims that partners are of "maximum" importance (Mr Juhr, Juhr Architekturbüro). Hence we derive an increased *strategic importance* of the partners. Juhr Architekturbüro makes sure that the partners comply with the sustainability standards through *evaluations of partners* twice or thrice per project per partner.

> "We have gathered a pool of firms over the years which we evaluate in our quality management system. We evaluate [our partners] two, three times per project. We also send [the evaluation] to the firms. It also contains specific sustainability criteria. (Michael Juhr, Juhr Architekturbüro).

We derive from this that the evaluations of partners lead to an increased ability to perform sustainability activities in the Value Shop, because every partner constantly needs to make sure that their skills are up to the standard, hence reinforcing loop R1.

Capabilities

Key to being able to deliver sustainable solutions was the acquisition of new knowledge, hence an increase of *internal competences*. Mr Juhr argues that the first thing to do was to go to *trainings*. Hence, we derive an increase in trainings that lead to an increase of internal competences, which then again lead to an increase in the activities done in the Value Shop, hence reinforcing loop R2.

> "You first have to develop the tools within your company, say further training for employees and acquire common knowledge." (Michael Juhr, Juhr Architekturbüro).

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"We definitely had to generate new knowledge and acquire new knowledge. We have done trainings [...]" (Michael Juhr, Juhr Architekturbüro).

In order to be able to deliver sustainable solutions, Juhr Architekturbüro needed to gain some degree of recognition and thus increase its *brand*. An important way to do that was through *publications*.

"First of all you need to have a certain degree of recognition. You need to say that you are doing it. Only because I set myself the objective to focus my firm in the next three years on [sustainability], I don't get any clients." (Michael Juhr, Juhr Architekturbüro).

"Memberships in councils only make sense when you are in a leading position to hold lectures and publish publications" (Michael Juhr, Juhr Architekturbüro).

Therefore, we see an increase in the brand through publications that may showcase the buildings of Juhr Architekturbüro, leading into an improved Value Proposition. The entire brand building process does not happen quickly. As Mr Juhr asserts that "you need to get the first two, three buildings going, after that it gets easier" (Mr Juhr, Juhr Architekturbüro). Therefore, we inserted some delays to strress this time impact. The connection between the Value Shop, the increased brand through publications and the increased Value Proposition lead to the reinforcing loop R3. It shows that the brand will improve over time and that with more and more projects the Value Proposition sustainable buildings will be reinforced.

Moreover, Mr Juhr states that he is member of several *councils* in leading positions, which allow him to hold *lectures* on events. Lecture are in particlar valuable as they allow for feedback on the ideas that the firm has and therefore directly feed into the development of internal competences.

"[...] we have written lectures and held lectures. You always get great feedback, which means you first give some input with the lecture, but thereafter you receive much feedback, many opinions." (Michael Juhr, Juhr Architekturbüro).

The thereof developed internal competences allow for increased sustainability activities in the Value Shop and since the outcome of the activities are the buildings, with which an architect advertises himself, this directly feeds into the ability to publish publications and enhance the brand. We therefore derive the reinforcing loop R4, which amplifies R3.

Appendix E.8 Gerber Architekten

Value Proposition

Sustainability has been an integral part of Gerber Architekten early on. Therefore it is a driving force of the *Value Propositon*.

> "Sustainability is the foundation of this office." (Benjamin Sieber, Gerber Architekten)

Value Configuration

Certainly, the Value Proposition based on sustainability drives the projects in the *Value Shop*.

Partner Network

As for the partnerships of Gerber Architekten, we recognise that partners need to be integrated early on in the process so that the knowledge of all experts is considered and no mistakes are done.
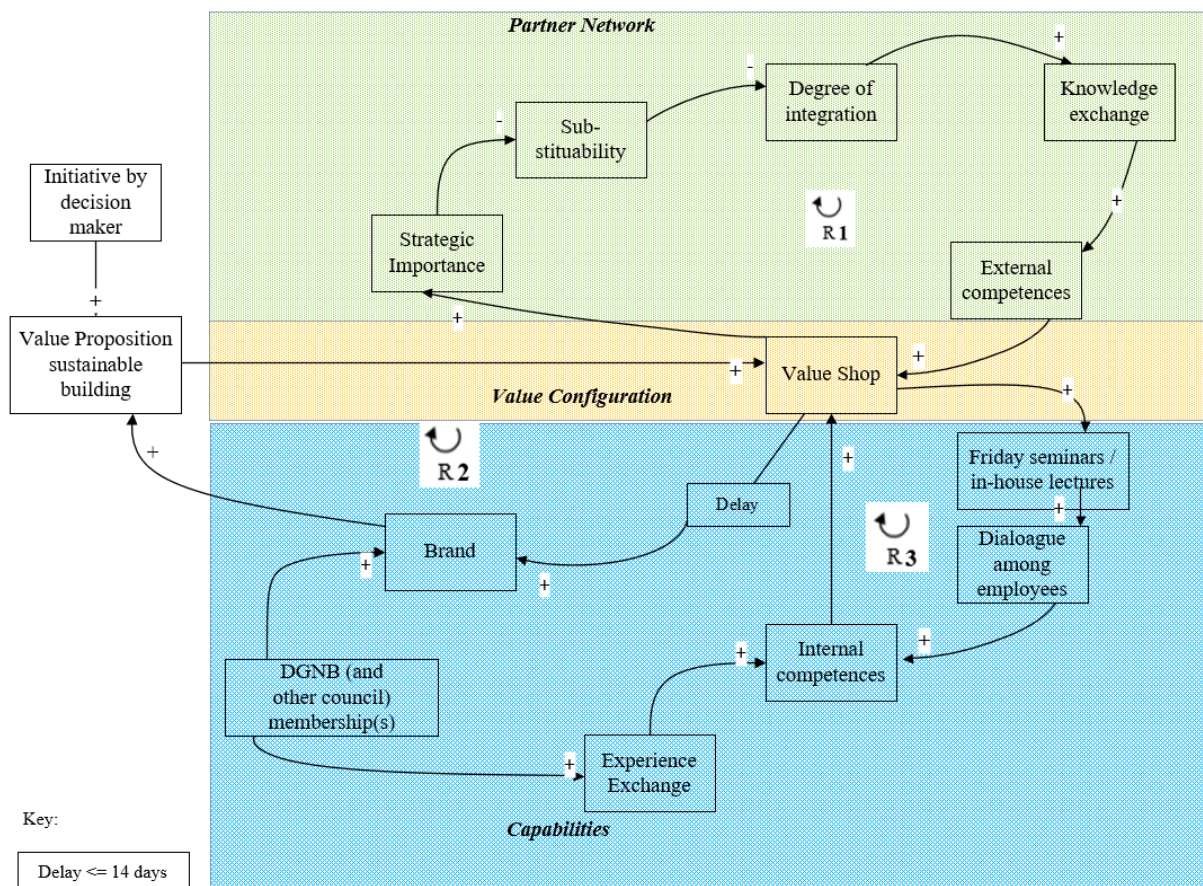
"[Integrating partners early is important] because I generate a higher knowledge base, which I can then consider and I won't miss out on any points." (Benjamin Sieber, Gerber Architekten)

Hence, there is an increase in *strategic importance* of partners. In addition, there are certain partners that seem to have particular strong competences.

"We have a fixed pool of engineers" (Georg Kolendowicz, Gerber Architekten)

"We are applying together [to competitions] with other offices that we got to know and come to appreciate" (Benjamin Sieber, Gerber Architekten)

Therefore, we derive that with increasing strategic importance, the *substitutability* of partners decreases. Then again, Gerber Architekten follows an "integrative approach" (Mr Sieber, Gerber Architekten), in which partners are a crucial part.

"The discourse with the specialists through this integrated thinking [is neccessary] to reach the goal. I can't solve it as an architect alone. I'm always dependent on the work of others." (Benjamin Sieber, Gerber Architekten).

Therefore, the decrease in substitutability leads to an increase of the *degree of integration*.

More importantly though is the increased *knowledge exchange* that Gerber Architekten values with its partners. Gerber Architekten purposely keeps the partners external to the firm and does not integrate them to allow for a maximum of different ideas and experiences for each project.

"[...] we have the expectation from specialists that they bring in their knowledge from other projects, in order to drive mutual idea generation. We don't have everything in-house, so that we don't just draw back on our own experiences. And this is important for the topic sustainability as a whole." (Benjamin Sieber, Gerber Architekten).

This increased knowledge exchange then leads to an increase in *external competences* and ultimately leads to the reinforcing loop R1.

Capabilities

In order for all employees to be on the same page, Gerber Architekten has so-called *Friday Seminars* and *in-house lectures*.

> "Every employee needs to have an understanding for sustainability. If the employee cannot make sense of when the specialists says something like geothermal energy, then he can't do it. [...] We also sometimes do Friday Seminars and in-house lectures in order to sensitise the people into that direction." (Benjamin Sieber, Gerber Architekten).

Therefore, an increase in sustainable projects in the Value Shop, leads to an increase in Friday Seminars and in-house lectures. Furthermore, Gerber Architekten also allows an increased *dialogue among employees*.

> "[We also tell employees] then you can also talk with MR XY if you want to know more." (Benjamin Sieber, Gerber Architekten).

This then leads to an increase in *internal competences* and allows a better work on the activities in the Value Shop. From this we derive the reinforcing loop R2. R2 simply tells us that the increase in the Value Shop increases the internal competences through trainings and the dialogue among employees.

Further we make the reasonable assumption, based on our interview experiences that an architecture firm advertises itself via the products that it created in the Value Shop and therefore an increase in Value Shop leads to an increase in the *brand*. The brand may then, with some delay, support the Value Proposition. This creates the reinforcing loop R1, which tells us that the more sustainable buildings Gerber Architekten builds, the better the brand will become and therefore allows the firm to deliver a better Value Proposition and that this loop constantly continues.

Gerber Architekten is a founding member of the *DGNB*. Being a founding member gives the firm some credibility and Gerber Architekten uses it as a marketing tool, which increases the brand of the firm.

> "[The DGNB] is of course also a marketing instrument for the office." (Benjamin Sieber, Gerber Architekten)

Therefore, the membership in the DGNB increases the brand effect of R2.

For Gerber Architekten it was important to join the founding of DGNB in order to exchange with others and drive forward sustainability.

> "What is important for our office is the exachnge with others, who have the same problems, who then can help us, for which it was immediately clear that we participate in the founding of the DGNB." (Benjamin Sieber, Gerber Architekten).

> "The entire force of knowledge in Germany comes together [in the DGNB] and we can try to develop something." (Georg Kolendowicz, Gerber Architekten).

Hence, we derive that the DGNB led to an increase in *experience exchange*, which then positively affected the internal competences of Gerber Architekten and further enhanced the ability to work on sustainability projects in the Value Shop. Therefore, the membership in the DGNB increases the internal competences and increases the effect of R3.

Appendix E.9 aib

Value Proposition

According to Mr Vernin, sustainability has been a process that slowly changed the industry and aib adapted to it.

> "This is a process that the industry slowly experienced and some adapted faster and some slower. [...] This is a topic that is also put in the focus by the German Government." (Philippe Vernin, aib)

Hence, we derive that the *Value Proposition* is *market-driven* as aib adapted to the market.
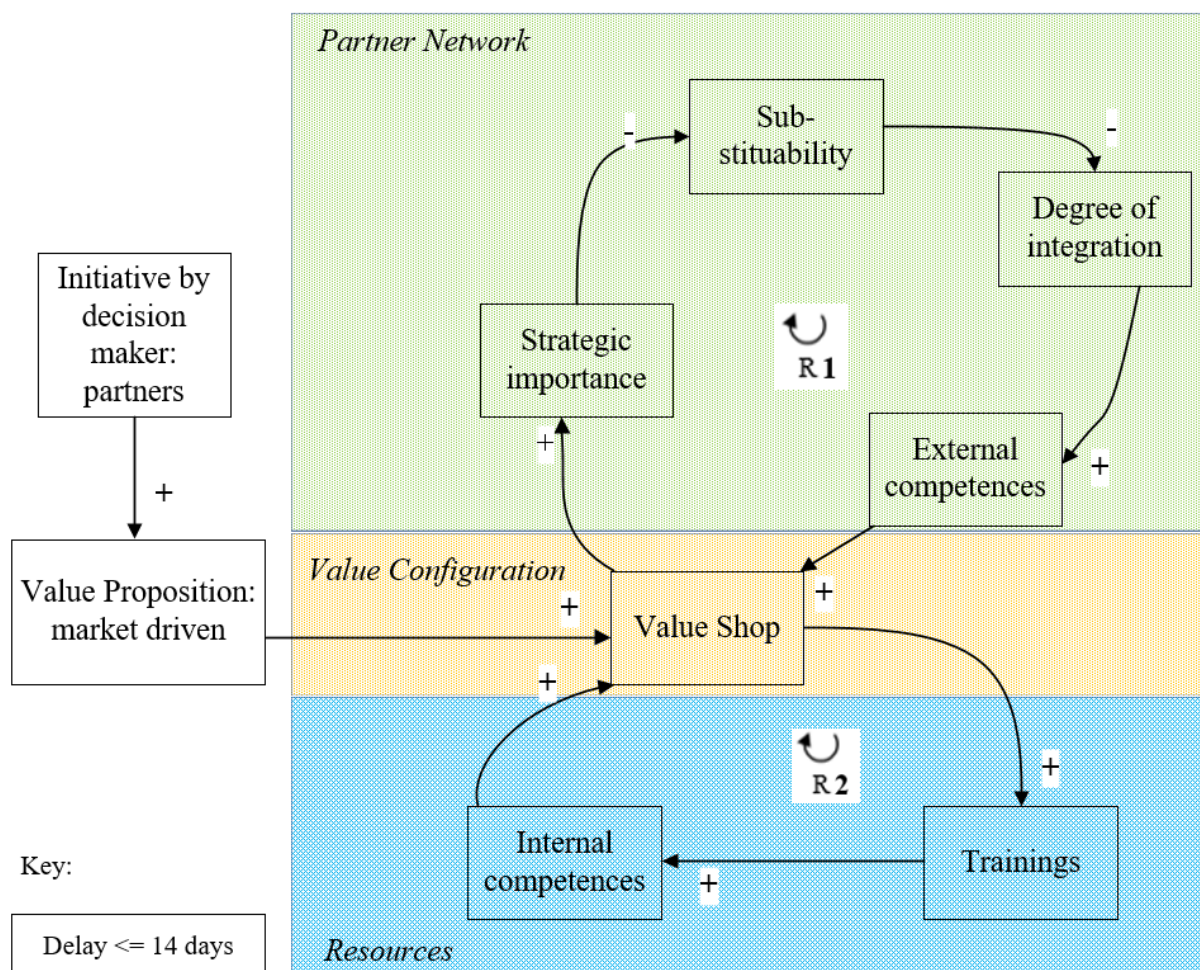
Value Configuration

The Value Configuration, mainly determined by the *Value Shop*, or the activities and projects a firm does, is characterised by aib's origin in industrial construction. Because of this origin, the firm early integrates all planners into the planning phases.

> "We are coming from the industrial construction, so that we integrated all planners at an early point in time" (Philippe Vernin, aib).

Partner Network

For aib the partners are very important and the firm seeks good relations with the partners. Mr Vernin claims that the firm has its established network and seeking new partners means more effort. In particular for sustainability projects particular specialists are needed.

> "[...] We have established our network and you are used to each other. If you work with an office that you don't know, it is always a bit more effort. [...] You have the best experiences within your network. [...] Of course you are looking for cooperative partnerships." (Philippe Vernin, aib)

> "For the execution of a [sustainability] certification you definitely need some more specialised offices." (Philippe Vernin, aib)

Therof we derive that partner have a high *strategic importance* for aib, in particular for sustainability projects. Moreover, Mr Vernin claims it is difficult to find new partners.

> "[Finding other partners] is pretty difficult. The economic situation in Germany is that the build industry is doing very well. This means that all offices are used to capacity." (Philippe Vernin, aib)

From this information we derive the conclusion that the *substitutability* decreases. However, aib's approach to working with their partners is to include them early on in the design process.

> "We are coming from the industrial construction, so that we integrated all planners at an early point in time" (Philippe Vernin, aib).

Hence, aib has a high *degree of integration* of their partners, which allows them to increase their *external competences* and therefore deliver a good project in the Value Shop. This realisation opens up for the reinforcing loop, R1. aib sucessfully manages to correct the decrease is substitutability through a strong alignment with their partners and early integration. This then allows for external competences to develop and lead to a successful project execution.

Capabilities

In order to increase the *internal competences*, aib is increasingly organising *in-house trainings*, as they lack the stimulation from externally organised trainings. In particular in the beginning, trainings were important to develop competences in sustainability.

> "Increasingly we are offering in-house trainings. We realised that the offering of the architecture association is highly repetitive." (Philippe Vernin, aib)

> "Participation in trainings were shaping in the beginning." (Philippe Vernin, aib)

Therefore, we conclude that trainings lead to better internal competences and especially important when you set out to develop competences in sustainability. This leads to the reinforcing loop R1. R1 shows that in order to deliver a project, internal competences are needed. Because it is a reinforcing loop, aib needed to constantly do trainings, which is also the reason why they started developing in-house trainings.

Appendix E.10 VLA

Value Proposition

According to Hans Rosenberg sustainability has a long history at VLA.

> "VLA has a long story in sustainability." (Hans Rosenberg, VLA)

In addition the notion sustainability in the firm's context is understood according to the world-famous Brundtland report.

> "We have this three main categories: social issues, economic issues, and environmental issues." Hans Rosenberg, VLA

Thus, we derive that the *Value Proposition* is a *sustainable building*. Additionally, Hans Rosenberg (VLA) also notes that the "We [VLA] have to follow the demands from the clients", too.
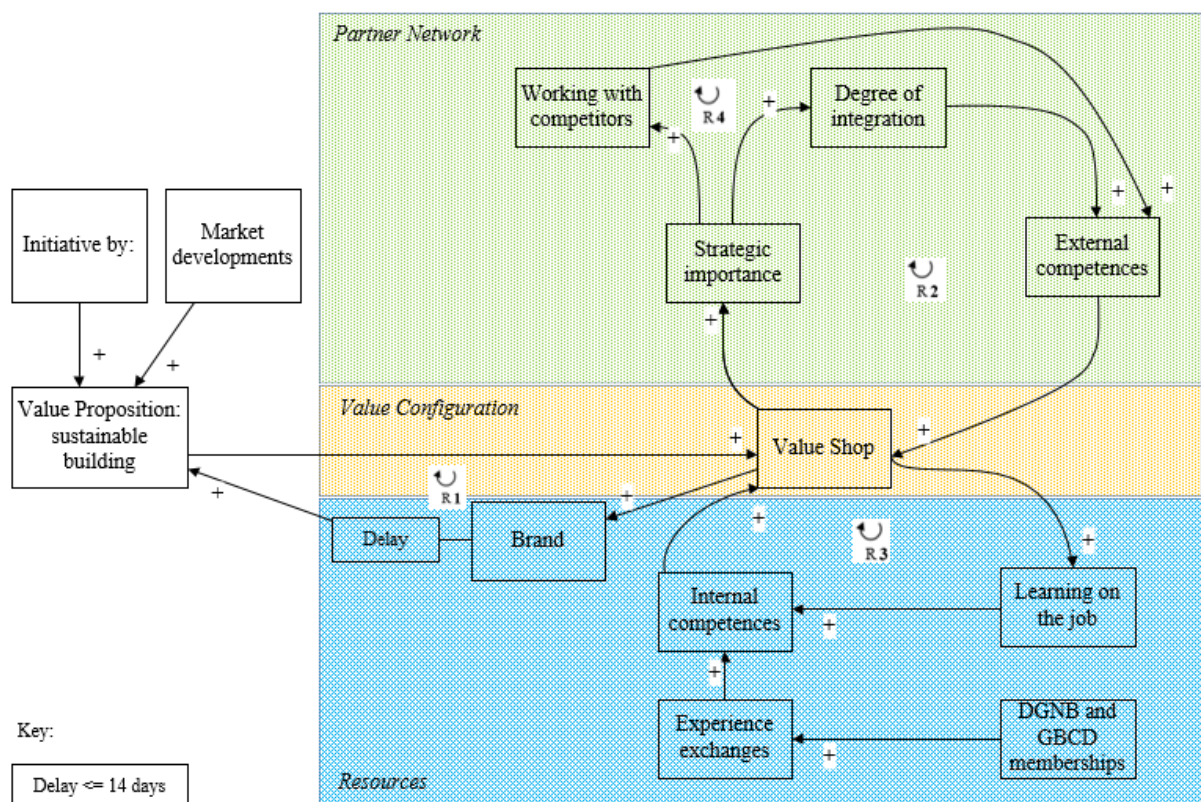
Value Configuration

This section refers to the *Value Shop*, meaning how a firm solves problems and finds solutions to client's issues or wishes. In essence, it covers the arrangement of activities in order to get the job done.

Hans Rosenberg outlines that these activities have been complemented by some special or extra tasks in opposed to conventional projects.

> "In sustainability there are some let's say specialised things we have to do. [...] When we do sustainable projects, for example DGNB, [...] the LCC [...] none of the existing partners in the project can do it. Right now… I mean we can do it, but not in a very high level. [...] Also, there is some large task in gathering information that hasn't been there before." (Hans Rosenberg, VLA)

> "When you work with sustainability you have to look at what has to be done. And then you divide the work between the different actors in the project. Until now we have succeeded in only having the parts we actually can do in-house." (Hans Rosenberg, VLA)

Hence, the *Value Shop* changes in so far as there is more complexity in the tasks at hand.

Partner Network

For VLA external partners are perceived to be pivotal for the firm's long term success (*strategic importance*).

> "Very important. It requires more working together. It requires a lot more information flow between partners in the project. [...] It is very important that all partners are aware of that." (Hans Rosenberg, VLA)

This mindset of *strategic importance* not only impacts, but mirrors the team work on a daily basis too, both interviewees affirm. Collaboration is that close and intensified that the people from the various firms merge to one true team (*degree of integration*).

"It [the degree of integration] is quite close. You kind of develop a team. [...] you don't distinguish whether you're from one or the other company (on the question how closely they are integrated with partners)." (Louise Gerner Rasmussen, VLA)

"It [the degree of integration] is very close." (Hans Rosenberg, VLA)

We find that the high *strategic importance* and the high *degree of integration* lead to more *external competences* that VLA accesses. This loop closes at the *Value Shop*, as these information are integrated in the arrangement of activities, problem solving, and solution finding. Therefore, it is a reinforcing cycle that can be seen as a catalyst to get projects going (reinforcing loop 2).

Additionally, there is one other variable that amplifies this loop - the *degree of competition*, that is collaboration with rivals. As working together leads to access to *external competences*, the previously explained reinforcing loop is accelerated.

"In the last five years it has really grown, the amount of projects that we work with companies that are also our competitors. [...] It is a development that is happening all over Denmark that clients for large projects, especially public projects, kind of demand that there is more than one company." (Hans Rosenberg, VLA)

"It is a way to combine competences. You could have one company that has a lot of experience with laboratories for instance and then you have the other company that is the young, innovative architecture company. Together they make a good team." (Louise Gerner Rasmussen, VLA)

All the preceding observations are backed up by the interviewees when they were asked whether there has been generally a change in the partner network. Even though the partners as such have barely changed, which might be due to the long history in sustainable building of VLA, the intensity of collaboration has changed.

"It hasn't really changed much - the partners. [...] The thing that has changed is more the way the existing partners is working together. [...] In the existing structure we need something more or something else than we are used to. [...] The work with sustainability requires a workflow, information flow between the different partners in the building industry. A contractor should deliver some information to us pretty early in the project

compared to before. There is a lot of things to think of in the early stage." (Hans Rosenberg, VLA)

"I agree. I mean I think that the partners are pretty much the same. But there might be [...] extra work within the group, the same group. Architects have to deliver more documents and also engineers have to [...] do the calculations and prove it [...]. The work is more." (Louise Gerner Rasmussen, VLA)

We identify an additional reinforcing loop 4 from *Strategic Importance,* to *Working with competitors,* to *External competences,* to *Value shop.*

Capabilities

Customers expect the sustainability aspect in VLA's offerings.

"I think they expect that we can do that [sustainability]." (Louise Gerner Rasmussen, VLA)

A reinforcing cycle (reinforcing loop 1) can be observed. A change in the offerings of *sustainable building(s) (Value Proposition),* triggers more activities to be performed internally to deliver on this promise to customers (*Value Shop).* When the building project is completed, this fosters the *brand* image and thereby leads to strengthening the offering (*Value Proposition).*

VLA concentrates on in-house competence development in contrast to acquiring external expertise.

"When you work with sustainability you have to look at what has to be done. And then you divide the work between the different actors in the project. Until now we have succeeded in only having the parts we actually can do in-house. [...] We haven't had the need [to acquire competences], we have learned." (Hans Rosenberg, VLA)

"We kind of developed them [competences] … let's say in-house." (Hans Rosenberg, VLA)

By taking a closer look at the competence development at the architecture firm, three variables contribute to *internal competence* development. First, *learning on the job*.

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"Yes, I think so (on the question whether capabilities have been influenced by partners as a facilitator of learning). Personally I have been learning a lot about how to do things in sustainability. [...] We're learning a lot from each other." (Hans Rosenberg, VLA)

"Yes, I guess (on the question whether capabilities have been influenced by partners as a facilitator of learning)." (Louise Gerner Rasmussen, VLA)

Second, the *DGNB and DK-GBC memberships*. These provide knowledge sharing events (*experience exchange*) that are attempted to be joined. Thus, *experience exchanges* are identified to be the third essential variable.

"There is definitely the Green Building Council that does these knowledge sharing. [...] We try to participate (on the question whether they do experience exchanges)." (Louise Gerner Rasmussen, VLA)

A competence development cycles (reinforcing loop 3) can be observed between *learning on the job*, *internal competences*, and the *value shop*. In addition, this loop is amplified by the *experience exchanges* initiated by the *DK-GBC and DGNB* councils.

Appendix F

Appendix F.1 Henning Larsen

Indicator	Reasoning	Score
Explicit focus on environmental considerations	"You can be really energy efficient, but if you don't cosider which materials you use to be energy efficient, it doesn't make sense" (Martin Vraa Nielsen)	1
Explicit focus on social considerations	"Indoor climate and the comfort is much more important now" (Martin Vraa Nielsen)	1
DGNB/DK-GBC membership	Yes	1
DGNB or similar certification	Yes	1
DGNB or similar consultant or auditor in-house	Yes	1

Appendix F.2 aib

Indicator	Reasoning	Score
Explicit focus on environmental considerations	"Careful handling of the environmental resources" (Philippe Vernin)	1
Explicit focus on social considerations	-	0
DGNB/DK-GBC membership	Yes	1
DGNB or similar certification	Yes	1
DGNB or similar consultant or auditor in-house	Yes	1

Appendix F.3 ft+

Indicator	Reasoning	Score
Explicit focus on environmental considerations	"I have to look at the materials used [...] how are they achieved, how are they produced" (Nicolai Thiele)	1
Explicit focus on social considerations	"Achieve the maximum of comfort for the human" (Nicolai Thiele)	1
DGNB/DK-GBC membership	Yes	1
DGNB or similar certification	No	0
DGNB or similar consultant or auditor in-house	Yes	1

Appendix F.4 CREO Arkitekter

Indicator	Reasoning	Score
Explicit focus on environmental considerations	"[...] the building equipment. I can do something about this one" (Ebbe Kristiansen)	1
Explicit focus on social considerations	-	0
DGNB/DK-GBC membership	Yes	1
DGNB or similar certification	-	0
DGNB or similar consultant or auditor in-house	Yes	1

Appendix F.5 Vilhelm Lauritzen Arkitekter

Indicator	Reasoning	Score
Explicit focus on environmental considerations	"We have these three main categories social issues, economical issues, and then the environmental issues" (Hans Rosenberg)	1
Explicit focus on social considerations		1
DGNB/DK-GBC membership	Yes	1
DGNB or similar certification	Yes	1
DGNB or similar consultant or auditor in-house	Yes	1

Appendix F.6 Juhr Architekturbüro

Indicator	Reasoning	Score
Explicit focus on environmental considerations	"All energy that is being used in the building by the building, should be generated by the building itself" (Michael Juhr)	1
Explicit focus on social considerations	"Our intention was to build houses that [...] are multi-user capable" (Michael Juhr)	1
DGNB/DK-GBC membership	-	0
DGNB or similar certification	Yes	1
DGNB or similar consultant or auditor in-house	-	0

Appendix F.7 RUBOW Arkitekter

Indicator	Reasoning	Score
Explicit focus on environmental considerations	"We look into all manners where we have social aspects and financial aspects and energetic aspects and environmental aspects" (Susanne Hansen)	1
Explicit focus on social considerations		1
DGNB/DK-GBC membership	Yes	1
DGNB or similar certification	-	0
DGNB or similar consultant or auditor in-house	Yes	1

Appendix F.8 Gerber Architekten

Indicator	Reasoning	Score
Explicit focus on environmental considerations	"functional and energy-optimised" (Benjamin Sieber)	1
Explicit focus on social considerations	-	0
DGNB/DK-GBC membership	Yes	1
DGNB or similar certification	Yes	1
DGNB or similar consultant or auditor in-house	Yes	1

Appendix F.9 kuntzundbrück

Indicator	Reasoning	Score
Explicit focus on environmental considerations	-	0
Explicit focus on social considerations	-	0
DGNB/DK-GBC membership	Yes	1
DGNB or similar certification	-	0
DGNB or similar consultant or auditor in-house	-	0

Appendix F.10 a-z architekten

Indicator	Reasoning	Score
Explicit focus on environmental considerations	"Trying to use as little resources as possible" (Holger Zimmer)	1
Explicit focus on social considerations	-	0
DGNB/DK-GBC membership	Yes	1
DGNB or similar certification	Yes	1
DGNB or similar consultant or auditor in-house	-	0

Appendix G

Interviewee	Direct Quote, 2017
Florian Lüdeke-Freund	In Strategic Management there are approaches to apply causal chains. And at the end of the day, strategic management is nothing but causal network diagrams.
	Thinking in causal loop models is essential in regards to market position and generation of competitive advantage.
Jörg Jaspers	The larger the office, the better the possibility to specialise on sustainability.