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Abstract

Purpose: The construction industry is acknowledged to cause severe environmental stress. As the transition towards sustainability is slow paced this research tries to unravel the impediments for sustainable construction. This research should provide the authorities and policy makers a better understanding of why the transition towards sustainability is slow and how they could accelerate it.

Research design/approach: In order to find the impediments for sustainable construction theoretical concepts of multiple research strands have been applied. These concepts have been applied to development organizations who among others developed residences in The Netherlands. The essential information was obtained via 15 structured face-to-face interviews with employees of various development organizations.

Findings: The results of this research indicate 6 impediments for sustainable construction. First, there are no financial constructions to align the benefits of sustainable construction between developing organizations and future residents. Second, future residents are not aware of the benefits of sustainable residents. Third, there are insufficient incentives for using sustainable materials and constructions. Fourth, development organizations insufficiently adopt practices of progressive organizations. Furthermore law and regulation focus on too little aspects of sustainability and could provide a better understanding of what sustainability entails. Finally weak network ties can prevent fruitful cycles of learning and innovation.

Implications & limitations: The presented results provide the authorities and policy makers a better understanding of what impediments sustainable construction faces. This is essential as the authorities and policy makers could significantly contribute to the transformation of this industry. Especially the adjustment of current laws and regulations could contribute to sustainable competitiveness. As the found impediments for sustainable construction only reflects the encountered problems of one actor, the results cannot be generalized to the whole industry. Future research could explore the impediments other actors in the construction industry come across. Furthermore future research should also explore the possibilities of making existing buildings more sustainable.

1 Introduction

Environmental issues like global warming and depletion of raw materials raised the awareness that the nature of current economic activities has to change. Future economic developments in most sectors should be made sustainable in order to help resolve environmental issues. Such a radical transformation of a sector can be labeled as system innovation or transition. The construction industry can realize major environmental gains as buildings and their construction process heavily pollute the environment. Moreover the industry consumes vast amounts of natural resources and energy.

Environmental protection must coincide with economic development in order to be feasible. For a long time the relationship between sustainability and economic competitiveness has been seen as a necessary trade-off between the social benefits and the private costs of environmental protection. According to Porter & van der Linde (1995) this trade-off can be relaxed by means of innovation. Innovations could amplify sustainable development as they stimulate economic growth on the one hand and develop more sustainable products, services and processes on the other hand. Consequently the trade-off between social benefits and private costs seems to be changing towards a new paradigm, which can be referred to as sustainable competitiveness. Though innovation seems a plausible solution, the transition towards sustainability is very slow paced (Kastenhofer & Rammel, 2005) .

Realizing sustainable competitiveness in the Dutch construction industry would accelerate the transition toward sustainability. Unfortunately realizing sustainable competitiveness is difficult to accomplish.

1.1 Research question

Much attention has been given to the concept of sustainability and its general complications, nevertheless an understanding of the difficulties in the construction industry appears to be missing. Though the construction industry is often perceived to be conservative and sustainable construction is often perceived to be more expensive, impediments that individual organizations come across are not well comprehended. This research aims to find these impediments as a means to improve sustainable competitiveness in the construction industry:

How can sustainable competitiveness be improved in the construction process of residences?

1.2 Relevance

This research has both a societal and a theoretical relevance. Answering the research question contributes to theory as it indicates which theories are relevant for improving sustainable competitiveness. As such the constructed research framework could be used to find sustainability impediments in other sectors. However the societal relevance of this research is much higher. The findings of this research result into recommendations for the authorities and policy makers on how to accelerate the transition towards sustainability.

The outline of this report is as follows. Chapter two will provide an overview of relevant literature concerning sustainability and its transition. Chapter three shows the relevancy of sustainability in the construction industry and gives a general description of this industry. Chapter four elaborates on the used methodologies and the characteristics of the respondents who participated in this research. Chapter five presents the results of the mentioned impediments by the interviewees. Chapter six relates the main findings to used theoretical concepts. Chapter seven contains the conclusion which provides the answer to the research question. The paper ends with a discussion which elaborates on the limitations and recommendations for future research.

2 Theory

Numerous scholars explored the concept of sustainability which led to diverse theories. Exploring these theories could provide relevant knowledge for constructing the research framework. First the concept and the transition towards sustainability will be elaborated. Next, the crucial role of innovations will be discussed. Third, the role of networks concerning innovation processes is clarified. Fourth, the theory of institutions will be discussed as institutions significantly influence the transition process. After this, institutional entrepreneurship will be discussed as this theory claims to mitigate the influences of institutions on transitions. The final paragraph summarizes the main findings of the theories.

2.1 Sustainability

Many environmental problems have been solved since these have risen on the political agenda's in the 1970s. For the greater part these environmental problems have been reduced by means of policies and incremental technology improvements (Geels et al., 2008). Other environmental problems e.g. climate change and depletion of natural resources have aggravated. Sustainability is a widely recognized approach that tries to tackle these issues. In a sustainable world humans can survive without jeopardizing the continued survival of future generations of humans in a healthy environment (Brown et al., 1987). Consensus for the urgent need of sustainability at the worldwide level was achieved by Prime minister Gro Harlem Brundtland and her United Nations Committee in 1987 (Goodland, 1995). They introduced the notion of sustainable development as a means of making sustainability more practical. Ever since sustainable development has been used to get a grip on sustainability. Sustainable development "*ensures the needs of the present without compromising the ability of future generations to meet their own needs*" (WCED, 1987). Though the definition of sustainable development is generally accepted, achieving sustainable development remains complicated. According to Grosskurth & Rotmans (2003) this complexity is due to differences in time-scales, geographical scales and to the crossing of different domains which are economic, ecological and social. These domains can interchangeably be used with the terms people, planet and profit which also form the core of the 'triple bottom line' philosophy. This philosophy suggests that organizations who focus on sustainable development should balance financial, social and environmental performance (Pujari, 2006). The multiple interpretations add to the complexity of sustainable development. Additionally Martens (2006) argues that sustainable development is not only complex but also normative, subjective and ambiguous. It is normative as future generations should at least have the same possibilities as the current generation, it is subjective as sustainable development requires an estimation of what the needs of future generations are and how these should be met. Sustainable development is also ambiguous as the needs of future generations are determined by social-cultural, economical and ecological aspects all of which can be weighted differently (Rotmans, 2003).

According to Rammel (in Kastenhofer & Rammel, 2005) the minimum requirement for sustainable development contains a radical change in modes of consumption, technology and decision making. These requisite changes indicate the need for a transition which denotes "*...a long-term change in an encompassing system that serves a basic societal function*" (Elzen & Wiczorek, 2005 p. 651). Additionally a transition

can be referred to as a fundamental change in thinking and acting (Transitienetwerk, 2007). A transition can also be labeled as system innovation and involves changes in a variety of elements, including technology, regulation, user practices and markets, cultural meaning and infrastructure (Elzen et al., 2004). Since at least past decade organizations spend much attention to the transition towards sustainability. Two major changes are required for a successful transition towards sustainability. On the one hand technological change is needed and on the other hand socio-cultural change. Unfortunately the transition towards sustainability is alarmingly slow, especially the rate at which green technologies and sustainable innovations are implemented (Kastenhofer & Rammel, 2005). The latter is perilous as innovation lies at the core of creating a sustainable society (WBCSD, 2002). Additionally Geels et al. (2008) state that more radical green innovations are needed as opposed to current incremental innovations. Most problematic pitfalls for successful transitions are backlashes, lock-in situations and short term thinking.

In 1992 international consensus was reached for the perspective that environmental protection should coincide with economic development in order to accomplish environmentally sustainable development. Scholars have generally accepted the idea of innovation having a prominent role in environmentally sustainable development. According to Hekkert et al. (2007) innovation is a key determinant for both long term economic growth and for relieving stress on the environment. This conception was earlier elaborated by Porter & van der Linde (1995) who stated that environmental regulations could enhance competitiveness if these regulations stimulate innovation. The trade-off between the social benefits and private costs seems to be changing towards a new paradigm. This shift can be referred to as sustainable competitiveness. Sustainable competitiveness can be defined as “...*economic growth activities that enhance and restore the health of natural and social systems upon which present and future economic growth depends while, under fair market conditions, producing goods and services that meet the test of international markets and maintain and expand real income*” (Government Nova Scotia, 2005). According to Weiss (1993) implementing appropriate regulatory tools could enhance sustainable competitiveness, even on international level.

2.2 Innovation

The OECD's Oslo Manuel (2005, p. 46 in de Mel et al. 2009) defines an innovation as “...*the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations*”. Lack of sustainable innovation and its diffusion can hamper sustainable competitiveness and therefore the transition towards sustainability. Two approaches that made theoretical contributions to the understandings of transitions emerged from the innovation literature and include the innovation system approach and the multi-level perspective. Innovation systems focus on the prospects and dynamics of innovations which have the potential to establish far reaching changes (e.g. toward sustainability). Innovation systems lead to the development, diffusion and use of innovations and are comprised of networks which include actors and institutions (Markard & Truffer, 2008). Innovation systems are capable of covering several dimensions as well geographical areas. A distinction can be made between national, regional, sectoral and technological systems. Unfortunately this system does not adequately show how transitions from one system to another come

about (Geels, 2004). The multi-level framework deals with transformations of regimes and involves a variety of innovations that can substitute established technologies and transform sectoral structures. The multi-level perspective examines the interaction between niche innovations (micro level) and socio-technical regimes (meso-level) in a broader environment of (macro) factors (Geels & Verbong 2006). The prominent aspect is the socio-technical regime, an interconnected, interrelated stable structure which includes established products and technologies, stocks of knowledge, user practices, expectations, norms regulations etcetera (Markard & Truffer, 2008). Both approaches have been applied in research of radical innovation and transitions in socio-technical configurations. Ditto both approaches have roots in evolutionary theory and among others highlight the importance of networks, learning processes and the crucial role of institutions for successful innovation processes. Both networks and institutions can affect firms at system level and will therefore be further elaborated.

2.3 Networking

Networks and networking are crucial for understanding innovation processes (Swan et al., 1999). Ahuja (2000) found three aspects of network structure that have important implications for the innovation output of an organization. Direct and indirect ties both positively influence innovation output, though the influence of the indirect ties is moderated by the amount of direct ties. It was also found that in interfirm collaboration networks structural holes decrease innovation output. Luke et al. (2004) identified the innovation benefits of networking. Benefits that can be distinguished are, risk sharing, gaining access to markets and technologies, bringing products to market more rapidly, obtain access to complementary skills, safeguarding property rights and gaining access to external knowledge. Complementary to innovation output, networks also contribute to the diffusion of innovations. Network interactions could also impede the innovations process. Klein Woolthuis et al. (2005) discuss two types of network failure, consequently the strong and weak network failure. The strong network failure occurs when renewal from outside is blocked which can have several causes. First the internal orientation of a network can cause myopia, second a lack of weak ties can prevent organizations from breaking through a strong internal orientation. Third organizations can be too dependent on other organizations which might restrain them from switching to alternative partners. On the other end weak network ties can prevent fruitful cycles of learning and innovation. According to Frambach & Schillewaert (2002) environmental influences comprised of network externalities and competitive pressures can directly or indirectly influence the decision of other organizations whether or not to do adopt innovations.

2.4 Institutional theory

Institutional theory attends to the deeper and more resilient aspects of social structure. According to Klein Woolthuis et al. (2005) institutions reduce uncertainty in the economic system by providing generally accepted codes of conduct. Institutions can be defined as “...sets of rules that allow a plurality of persons to coordinate their behavior and to routinely solve typical problems that arise in social interaction” (Vanberg 2001b in Budzinski, 2003). Unfortunately institutions are frequently associated with organizations instead of rules. According to Bryant (1999 in Klein Woolthuis et al., 2005) organizations are the players that are subject to the rules. Scott (1995 in Geels, 2004) distinguishes three kinds of rules: cognitive, normative and regulative. Cognitive

rules constitute the nature of reality and the frames through which meaning or sense is made. Normative rules refer to values, norms, expectations, duties, rights, responsibilities. Regulative rules denote the explicit formal rules, which regulate interactions and constrain behavior. According to Budzinski (2003) cognitive rules should be distinguished from institutions as these refer to intrapersonal rules, while the latter refers to interpersonal rules. Klein Woolthuis et al. (2005) differentiate between hard and soft institutions where hard institutions refer to the formal regulative rules and the soft institutions denote the informal rules. Each of these rules together with the alignment of the rules has a stabilizing effect on the system which can contribute to the understandings of other stabilizing factors such as path-dependency and lock-in.

Institutional isomorphism refers to the increasing homogenization of organizations. DiMaggio & Powell (1983) differentiate three kinds of isomorphism which are held responsible for institutional isomorphism. Coercive isomorphism is a result of formal and informal pressures that organizations face due to dependency on other organizations and cultural expectations. Mimetic isomorphism results from uncertainty and ambiguity which causes organizations to mimic other organizations that are perceived to be more legitimate or successful. Normative isomorphism stems from professionalization. Professionalization can be interpreted as “...*the collective struggle of members of an occupation to define the conditions and methods of their work, to control the production of producers and to establish a cognitive base and legitimation for their occupational autonomy*” (DiMaggio & Powell, 1983, p. 152). Two aspects of professionalization cause isomorphism which include formal education and the growth and elaboration of professional networks which diffuse new models more rapidly.

In sum, institutions are able to stabilize systems and institutional isomorphism causes organizations to homogenize. Institutions are inclined to hamper the transition towards sustainability as they seem to stimulate the stasis of current systems. Organizational isomorphism includes elements which can influence the transition process towards sustainability.

2.5 Institutional entrepreneurship

According to the innovation system literature innovation is not a autonomous process, neither is its diffusion according to the multiple-level framework. Though innovation and diffusion are interactive processes, a prominent role can be assigned to entrepreneurs. This perspective dates at least back to the early neo-classical economists (e.g. Marshall) who believed provisioning innovation was a byproduct of entrepreneurs. Schumpeter further elaborated on this subject and defined the entrepreneur as an innovator (Praag, 1999). As entrepreneurs to are part of the system they are also subjected to institutional effects. These effects are likely to constrain innovation and its diffusion unless institutions can be changed or new ones can be created. The latter process is conceptualized as institutional entrepreneurship. The concept of Institutional entrepreneurship was established from the need to better understand the emergence of new institutions. Former institutional theories ascribed institutional change to exogenous shocks as opposed to endogenous explanations. Institutional entrepreneurship refers to “...*the activities of actors who have an interest in particular institutional arrangements and who leverage resources to create new institutions or to transform existing ones*”. (Maguire et al., 2004, p. 657). The relationship between interests, agency and institutions takes in a central role in institutional entrepreneurship. It is

improbable for institutional entrepreneurs to change institutions by themselves. Hence they need allies whose composition, just as the required skills, depends on the institution to be changed (Leca et al., 2008). Alteration of institutions can lead to social, political and economic change. According to Hwang & Powell (2005) shifts in institutional environment create opportunities to change forms of organizing and existing ways of conduct.

2.6 Conclusion

Sustainability is one of the concepts used to mitigate environmental issues. Improving sustainability requires sustainable development which is difficult to achieve. Sustainable development requires numerous changes which indicate the need for a transition. An important precondition for sustainable development is that it must be economically feasible to solve or mitigate environmental problems. Here an important role is attributed to innovations as they can relax the tradeoff between social benefits and private costs which consequently enhances sustainable competitiveness. Unfortunately green and sustainable innovations are implemented too slowly, and therefore hamper the transition. The innovations system approach and the multi level perspective contribute to understanding the process of innovation and how changes in systems come about. These approaches highlight the importance of networks, learning processes and the crucial role of institutions. Networks are important for both the innovation process as for its diffusion and adoption. Institutions stabilize existing systems which thwarts the transition towards sustainability. Institutional isomorphism refers to the phenomenon of organizations becoming more similar, which can influence the progression of transitions. Institutional entrepreneurs are able to change existing institutions or create new ones.

3 Construction industry

3.1 Need for sustainability

Due to societal pressures most sectors in the economy must transform in order to reach sustainability. Every sector requires a different approach to establish this transformation, moreover every sector entails a different urgency to reach sustainability. Construction is generally acknowledged to cause environmental stress. According to Spence & Mulligan (1995) the construction industry increases deterioration of the physical environment, the need for energy and atmospheric pollution. Annually 25% of the virgin wood and 40% of the raw stone, gravel and sand are consumed for building construction. Globally buildings consume 16% of the water and indirectly produce nearly 70% of all sulphur oxides (Dimson in Ngowi, 2001). Additionally buildings account for up to 50% of carbon dioxide emissions, 40 % of energy requirements, 71 % of electricity consumption, 50 % of raw materials and 40% of solid landfill waste (PRQ, 2008). Though sustainable competitiveness refers to activities which restore and enhance natural as well as social systems this research focuses on the natural aspect as construction is acknowledged to cause environmental stress.

3.2 Sector description

Accomplishing a high level of sustainable competitiveness in the Dutch construction industry is a difficult task as among others the sector is fragmented and therefore complex. Fragmentation occurs within sections in the value chain and due to non-integration between them. The industry is known for its project orientation which causes mutual relationships to be temporarily by nature. As the industry is mostly cost driven, costs outweigh values which means the lowest bidder frequently gets the construction project. This reduces the efficiency in terms of cost saving and waste of materials. Internally the sector is remarkably and persistently focused on the short term (PSIBouw, 2009a) which could be due to its cost saving and therefore conservative nature.

Numerous subsectors in the construction industry exists, all of which need a different approach and policy in order to change which is complicating. Another problem is that every actor in the value chain argues other actors in the value chain should take the lead. Lack of trust can be appointed as the major barrier for change. One might say the building industry will only change if they are forced to change. The Construction industry involves numerous actors such as, the authorities (local, regional, national), knowledge institutes, housing corporations, suppliers, architects, capital providers, project developers, contractors, installation service providers, advisors, owners and residents.

Environment-friendly construction processes are believed to create a competitive advantage since at least past decade. Unfortunately sustainable construction did not advance as predicted. Finding impediments of sustainable construction should provide valuable insights which could explain why sustainable competitiveness in this industry is difficult to achieve.

4 Methodology

This section will elaborate on the methodologies that were implemented in order to answer the research question. This research is of exploratory nature as the objective is to gain new insights regarding the impediments for sustainability. Case studies are a preferred research strategy when ‘how’ or ‘why’ questions are being posed (Yin, 2003). As this research question is exploratory by nature using a case study would be legitimate.

4.1 Research framework

Sustainable development has interested many scholars which resulted in fruitful insight regarding its possibilities and difficulties. Unfortunately no single theoretical approach can be used to analyze the impediments in the construction industry. Consequently multifarious concepts discussed in chapter 2 will form the basis of the research framework which consequently will be applied to the construction industry.

4.1.1 *Concepts*

Reviewing the discussed literature yields various concepts which relate to sustainability as preconditions, key processes and complexity exemplifiers. These concepts comprise, technological change, socio-cultural change, different time scales, different geographical scales, crossing of domains, cognitive rules, normative rules, regulative rules, coercive isomorphism, mimetic isomorphism, normative isomorphism and network interactions. Directly or indirectly these concepts all relate to sustainability at a system level and have implications for sustainable competitiveness. Exploring these concepts at micro level should provide crucial insights into the barriers of sustainable competitiveness in the construction industry.

4.1.1.1 *Technology & socio-cultural change*

Crucial preconditions for the transition towards sustainability elaborated by Elzen & Wieczorek (2005) are socio-cultural and technological change. As these notions are interrelated and mutually dependent both need to be changed substantially. In concordance Kemp (1994) argues that environmentally benign technology is crucial for environmental sustainability. From this viewpoint it would be beneficial to explore if sufficient technology is available and whether relevant actors are aware of the technological applications capable of progressing sustainable construction. As discussed social changes and changes in culture are both required. However these concepts show significant overlap with the concept institutions. Klein Woolthuis et al. (2005) project culture as an element of institutions. Institutional theory attends to the deeper and more resilient aspects of social structure. For these reasons social-culture change will not be part of the research framework.

4.1.1.2 *Time scales, geographical scales & crossing of dimensions*

Factors that exemplify the complexity of sustainable development are differences in time-scales, geographical scales and the crossing of domains. The first two can be referred to as split incentives. Split incentives refer to the situation where a problem causer does not bear the costs of the problem or the one solving the problem, in this case located in a different time or geographical scale, does not reap the benefits. The crossing of domains comprises a complexity beyond the scope of this thesis. Instead the

concept value chain will be added as a third split incentive. In this case an actor in the value chain invests in sustainable residences but does not reap the benefits of it, however another actor in the value chain does. The presence of split incentives in the construction industry could hamper its transition towards sustainability. For this reason it is imperative to explore if split incentives are present in the industry.

4.1.1.3 Institutions & institutional isomorphism

A significant role in the journey towards sustainability can be attributed to innovation. Crucial factors for successful innovation processes and adoption include institutions, institutional isomorphism and network interactions, the latter is discussed in the next section. Institutions can hamper the transition towards sustainability indirectly through innovation as well as directly as they stabilize current systems. Institutions provide generally accepted codes of conduct based on regulative, normative and cognitive rules. Institutional isomorphism refers to the increasing homogenization of organizations due to coercive isomorphism, mimetic isomorphism and normative isomorphism. Although these theories do not influence sustainability identically, they share some overlapping concepts. Both discuss the normative aspect (normative rules, normative isomorphism) which respectively lead to the stabilization of current systems and homogenization of organizations. As these concepts do not influence sustainability equable they will be utilized separately. Normative rules are crucial as they among others indicate what norms should be obtained and who should be responsible to suffice them. Normative isomorphism could elucidate how professionalization influences sustainable construction. Ditto both theories emphasize formal rules described in the concepts regulative rules and coercive isomorphism, though the latter also relates to informal rules. Consequently these concepts are united and utilized as regulative institutions which could clarify the role of law and regulation in pursuing sustainability. Cognitive rules provide individuals among others priorities, problem agendas, beliefs, bodies of knowledge, models of reality, categories, classifications and search heuristics. Insufficient cognitive rules could clarify if and why individuals prioritize sustainability. Finally mimetic isomorphism explains why organizations imitate other organizations and could therefore explain if and why organizations ensue other organizations in their pursuit of sustainable construction.

4.1.1.4 Network interactions

Networks are crucial for understanding as well as contributing to the innovation process. Additionally network partners could influence the decision to adopt innovations. As such this concept could clarify whether sustainable innovations or innovative processes are sufficiently developed and adopted. Furthermore exploring network interactions in the construction industry could also unravel other barriers for more sustainable development.

4.1.2 Actors

The discussed concepts must be applied to relevant actors as a means of finding impediments for sustainable construction. As these concepts try to unravel impediments at system level it is crucial to include all relevant actors. Due to the voluminous group of relevant actors it is imperative to categorize these actors. A prominent actor influencing the construction industry are the authorities. Authorities can be subdivided into local, regional and national level, all of which influence the construction industry in different ways. Actors in the construction industry itself include architects, project developers, contractors, housing corporations, suppliers, installation service providers and advisors. Consumers also play a crucial role in the construction industry. Here

consumers are referred to as the residents, which can either buy or rent a residence. Other relevant actors include capital providers and knowledge institutes.

4.2 Delineation

The focus of this empirical research is on the construction of residences in The Netherlands. As many actors and organizations are involved in this process it is beyond the scope of this thesis to explore every aspect of the system. Alternatively the perspective of one actor is used to look at the system. This research is focused on project developing organizations in the Netherlands. These organizations are the main initiators of residence construction projects, plus they remain influential during the whole construction project. As such they are one of the primary actors and should be able to provide insights in the transformation process of this sector towards environmental sustainability. In addition qualitative research found that people believe project developers and capital providers to form the main barriers to more sustainable approaches in the construction value chain (WBCSD, 2009). These conceptions regarding project developers could be due to their conservative nature and their need to accomplish projects as quick as possible, meeting only minimum requirements.

As a main criteria constructing residences should at least be part of the organizations main activities. No specific criteria are required regarding the size of the organization or the extent of sustainability implementation. Questioning one individual of every organization should deliver more insight into the problems of sustainable competitiveness in this industry. This individual should be either a project developer or an employee who has significant knowledge of sustainability. As the objects under study concern individuals this research is focused on the micro level.

4.3 Data gathering

In order to glean the essential data and information interviews have been held with 15 individuals. Interviews are one of the most important sources for case study information, especially in exploratory studies. The interviews were held face-to-face, giving the respondents the opportunity to directly react to the questions and explain causal inferences. The interview entailed 27 main questions, distributed over 10 concepts, of which almost all contained sub questions. Consequently the questions were highly structured, along the lines of a formal survey (Yin, 2003). Questions asked were the same for each interviewee which produced qualitative as well as some quantitative data. Anonymity was assured to both individuals as well as to their organization as a means to avoid receiving socially desirable answers.

4.4 Diversity & description of interviewees

As the criteria for project developing organizations is minor, it is important to assure there is sufficient diversity among the selected organizations. Diversity is required as this research focuses on system level, consequently the selected organizations should represent the diversity of the organizations in the industry. Two diversity drivers were considered when selecting project developing organizations. First, the selection should comprise small, middle sized and large organizations. Second, it is vital to include both conservative and progressive organizations in terms of sustainability.

Approximately 31 organizations were approached to participate in this research. This yielded 17 respondents of which two unfortunately replied too late. Consequently nearly 55% of the approached organizations indicated willingness to participate. Most interviewees (12) were directly involved with project development, other occupations included: director of strategy & risk, commercial manager and innovation manager.

As a means to describe the participating organizations while providing anonymity their size and main developmental activities are represented in table 1.

Table 1: characteristics of interviewees' organizations

Nr.	Size (empl.)	Main activities (Development)
1	3700*	Commercial real estate development (care centers, night life centers, schools, offices and sport accommodations), residential development (sail, housing corporations)
2	84	Development of residences, shops, offices, integrated area development
3	300-500	Development of residences, commercial real estate (office, shop, multifunctional), area development
4	80	Integrated area development (realization houses for sale, schools and other facilities)
5	75	Commercial real estate development, integrated area development, retail development
6	60	Development of offices, shopping centers, integrated projects
7	11.000	Residential & non-residential construction
8	30-35	Development of residences, shops, offices
9	100-110	Development of residences for housing corporations and sale
10	13.000*	Multi functional area development & development of shops, offices, residences, museums, sports accommodations
11	35	Development of high quality residences and business housing
12	60	Area development with a strong focus for residences (50% for sales, 50% for housing corporations) whether or not with social and neighborhood facilities.
13	300-350	Development of residences for rent out purposes (free sector)
14	200	Development of integral residential areas, residential projects and small-scale multifunctional projects
15	50	Advise on new development (residential, non-residential)

* These numbers represent the umbrella organization, the main activities described are of that of the subsidiary

5 Results

In this section the results of the interviews are presented. First the results of the interviews are discussed according to the concepts deducted from literature. Discussing these concepts instead of merely indicating discovered impediments is essential for answering the research question. Subsequently discovered impediments are outlined.

5.1 Technology

Technology is perceived to have a prominent role in sustainable construction, though this role seems to be gradually changing. Technology is often referred to as the basis of sustainable building which means that progressive organizations who implemented sustainability early on had a tendency to start with technology. Now most organizations are aware that sustainability entails more aspects than mere energy management. Especially to progressive organizations technology is only one of the many aspects which comprise sustainability. Concerning sustainability more weight is given to the processes that are involved in the building processes, for example how cities should be structured in a sustainable manner. For the greater part (12/15) the interviewees indicated to be well or at least reasonably informed about the present technological applications. Advisors prove to be the main source of technical information followed by internal knowledge teams of which some perform research themselves. Other channels used to gather this information are trade associations, centre's of knowledge, information days of the industry, studies from their own projects, universities, internet, letters from the building industry, professional literature and handbooks. In some cases organizations were approached by organizations who developed new technologies. Though the channels for obtaining information are quite diverse, the majority (14/15) indicates to have no problems obtaining the relevant information. For improving the structure and flow of this information roles are attributed to trade associations, authorities and centers of knowledge. Implementing sustainable techniques do not form a problem to the majority of the interviewees. Most developing organizations only use technologies which are previously implemented by other organizations and proved to deliver good results. Organizations implementing new techniques come across different problems. Authorities can hinder the implementation of new technologies, new technologies can negatively influence the livability of the consumer, moreover they are perceived to be very expensive. Most interviewees (12/15) are convinced sufficient technology is present to satisfy the set criteria by the government for at least the next decade. In case technical applications are believed to be insufficient a significant role to stimulate the direction and development of techniques is attributed to the authorities, businesses, universities and centers of knowledge.

5.2 Split incentives

Among the interviewees there is a general consensus (15/15) concerning the financial consequences of sustainable construction. This kind of construction is more expensive which has two major consequences. First, the financial consequences dissuade organizations to construct sustainable houses or at least less sustainable. Second, the organizations that do persuade sustainable construction incur high costs. The majority of the interviewees (12/15) finds it difficult to retrieve these extra costs. Organizations retrie-

ving these extra costs usually aloft the price of residences or rent. Another mentioned solution is to offer new home owners financial options to exploit energy equipment. Grievous it is perceived (13/15) that most consumers are not willing to pay for a more sustainable residence which causes the demand for these houses to be rather low. According to one respondent merely 1-2% is willing to pay more for a sustainable house, 20-25% is willing to pay for a sustainable residence when this is financially attractive, the rest does not appear to have any interest for a sustainable house. The demand for sustainable buildings is perceived to be higher for commercial property. An often heard explanation for this difference is that organizations occupying these buildings take future costs into account. Indeed sustainable buildings can offer financial benefits to its occupiers as the operating costs are significantly lower. Unfortunately future home owners do not take future costs into account when they buy a house. Getting subsidies is another method of retrieving extra costs resulting from sustainable construction. According to the majority (13/15) there are subsidies available for making houses more sustainable. The greater part of this group (8/13) tries to apply for subsidies where they can. Unfortunately subsidies often consist of small amounts, moreover applying organizations must meet high requirements.

In general the concept total cost of ownership is very well known (12/13) and applied (10/13), though this often is not intentionally done to improve the sustainability of the building. Cradle to cradle is also a well known concept (14/15) though it is applied to a far lesser extent (4/14). The interest for the latter concept is still growing, applying this concept is often perceived to be one of the challenges for the future. Some view implementing cradle to cradle as a task for the more progressive organizations.

A small majority (8/15) of the interviewees consciously uses reusable materials for the construction of new houses. The others do not use reusable materials unless law and regulation force them to do so. Most organizations (11/15) do not consciously use sustainable materials for the construction of houses. They do try to use materials that last long but not in the sense that they use low amounts of energy in production, processing and transportation. Furthermore none of the interviewees uses constructions that can be dismantled easily if the building should be demolished. However some (6/15) do indicate to use flexible constructions. A minority (6/15) of the respondents consciously makes constructed houses more time resistant, this is usually done by making the houses more flexible and even multifunctional.

5.3 Institutions

5.3.1 Normative rules

Implementing sustainability in the organization is often a top down decision. In most cases (11/15) implementing sustainability did not create real problems. In some organizations implementing sustainability led to resistance and discussions which can come back every construction project. Especially the older generation of the interviewees' organization is not easily convinced of the benefits that sustainable construction offers. For this reason they are probably less ambitious to implement it. The organization which claimed to be most progressive concerning sustainable construction faced the most resistance, consequently implementing sustainability led to a cultural clash. Constructing residences inexpensively was always their top priority, this had to change in order to create more sustainable residences. As project developers are just one of the

many actors in the value chain it is crucial that other actors also implement sustainability. The minority (6/15) faced some problems here, these organizations were confronted with conservative partners such as contractors. One respondent claimed principals occasionally withdrew their project when they proposed to construct sustainably.

5.3.2 *Regulative rules*

The respondents are divided concerning the clarity and consistency of law and regulation regarding sustainable construction. Some mention that construction requirements in municipalities can significantly differ. Furthermore respondents believe the policy for sustainable building should be described much clearer. Unfortunately there are many critiques on the contents of current regulation. On the one hand the requirements for sustainable building are believed to tip the scales, while on the other hand some believe law and regulation should be more strict. It is also believed that the policy is focusing too much on just a few sustainability aspects while ignoring other important aspects.

No consensus is reached concerning the level of stimulation with respect to sustainable construction. Some (9/15) believe set requirements, subsidies and prize contests provide adequate stimulation. Others (6/15) believe current stimulation is insufficient, they believe more and better subsidies could stimulate sustainable construction. A slight majority (8/15) perceives current law and regulation as an impediment for sustainable construction. They among others believe law and regulation create conflicting interests. Likewise authorities are perceived to be somewhat bureaucratic and unclear. They should as well involve relevant actors early on, for example when they create zoning plans.

5.3.3 *Cognitive rules*

Relevant actors in the construction industry increasingly realize they have to incorporate sustainability in their strategy. The interviewees (15/15) feel that in this respect consumers are more conservative. Consumers do not prioritize sustainable residences which is a perceived barrier for sustainable construction. Raising customer awareness with respect to environmental benefits is generally not believed to be efficient for breaking down this barrier. It is perceived that the demand for sustainable residences will only grow substantially when they prove to be more comfortable or less expensive in the long run. As sustainable residences proved to be less expensive in the long run it would be beneficial to raise customer awareness with respect to this fact. Creating awareness is mostly seen as the role of the authorities although this is also remonstrated a few times. Some plead for a large scaled approach, like a campaign, where different actors should contribute. Mentioned actors include the authorities, real estate agents, banks, project developers, trade associations and contractors. The media is an important instrument to better inform customers about sustainable residences. Relevant actors should also better inform consumers directly about the benefits of sustainable houses, here banks and project developers are of critical importance, although developers generally do not have a good reputation.

5.4 **Mimetic isomorphism**

A slight majority (9/15) was capable of appointing a competitor which they believed to be the best and strongest in the industry. Few of them (4/9) were actually observing these organizations but were not able to explain how these organizations implement

sustainability. Developers generally do keep an eye on their competitors but do not necessarily look at specific organizations. Some respondents kept track of other construction projects but did not necessarily keep an eye on the initiating project developer. Generally (13/15) organizations do not influence each other substantially, occasionally some project elements were implemented in their own projects. Organizations who are more conservative in terms of sustainability should therefore be forced to adopt sustainable construction processes.

5.5 Normative isomorphism

There seems to be no consensus whether the new generation is better educated concerning sustainable techniques and materials. On the one hand some (7/15) realize the new generation of employees gained more knowledge concerning sustainability. Education does seem to provide the new generation a certain mindset with regard to sustainability. This mindset among others allows the new generation to see the positive effects of sustainable construction. The new generation is also perceived to be more interested in sustainability, moreover education helps to make sustainability more tangible. On the other hand some (8/15) do not perceive any difference concerning the education. Generally it is perceived to be the role of education providers to give more attention to sustainability. Though education is believed to be very important for improving the sustainability of constructed buildings it is not perceived (14/15) to be an impediment. Knowledge obtained by working is believed to be more important as this market is constantly developing.

5.6 Network interactions

Though few organizations do have contracts with suppliers, most network partners are selected on a project basis. Network partners can be advisors, contractors, retailers, other developers, installers and capital providers. Some organizations do have preference lists which mainly concern contractors and advisors. Generally network partners are considered important for introducing new processes or technologies. Network partners do not seem to hinder the implementation of new processes and technologies as project developers select adequate partners for each project. Most of the interviewees (11/15) together with their network partners are consciously trying to develop more sustainable residences. In this process learning from each other is inessential. Network partners are usually (15/15) open to new methods which can increase the sustainability of houses, although some mention that contractors can be a little conservative.

5.7 Problem outlining

Main impediments deducted from the results can be structured into problem areas and are represented in the table below (table 1), which is based on the research framework. The presented impediments either are perceived impediments by the respondents or are deducted from the interviews by the author (incentives & weak ties). The underlying reasoning for these problem areas is elaborated below, starting with the most important problem area and concluding with the least important.

Table1: Problem areas developers encounter with sustainable construction (dark areas indicating most significant problems, light areas indicating less significant problems)

Actor:		Authorities	Industry	Consumers	Capital providers	Knowledge institutes
Category of system influence:						
Technology						
Split incentives	Time scales		Incentives			
	Geographical scales					
	Value chain		Financial models			
Institutions	Cognitive			Awareness		
	Normative	Focus & intelligibility				
	Regulative					
Network interactions			Weak ties			
Normative isomorphism						
Mimetic isomorphism			Ensure			

5.7.1 Financial models

The majority of the interviewees believes the extra costs for making residences more sustainable cannot easily be retrieved. In theory sustainable houses are beneficial to both developers and consumers, nevertheless it appears problematic to align these benefits financially. Either there presently are no or few financial constructions to align these benefits or product developers are not aware of them. This impediment affects project developers of both private and rental residences. Rental houses can be divided into the free rent sector and social rent sector. In the free sector rent prices can be raised as well as the selling price of private houses. Social rent houses pose a more difficult problem as these rent prices are restrained by a score system. One respondent however explained the authorities will adjust the score system by adding energy efficiency to the score system. Each of these problems need different solutions which pose huge challenges. Actors affected by this issue also include consumers and capital providers. Consumers are not capable of reaping the benefits of sustainable houses as they do not want to pay more for a sustainable residence. Capital providers could lose a share of their returns when no solution is provided as constructed residences are obliged to comply with the increasing requirements set by the authorities.

5.7.2 Awareness

According to most interviewees consumers often are not aware of the benefits sustainable houses could yield. Though some respondents indicated that sustainable technologies could negatively affect the livability of the residents it could also increase their comfort substantially. Significantly decreasing energy costs is perceived to be a major advantage of sustainable construction. These benefits usually are not taken in account by prospective residents. As one interviewee explained “most consumers do not realize how high their energy costs are, but neither do I”. This lack of awareness is perceived to be one of the reasons causing the demand for sustainable houses to be low. Though the construction industry is considered to be a market of supply not of demand, the respondents argue they generally do respond to consumer demand.

5.7.3 *Incentives*

Though the authorities do provide some criteria concerning sustainable materials and constructions for new residences there are no incentives to exceed these criteria. This causes the construction of residences to consume more energy than would be necessary. Furthermore the amount of landfill waste remaining after demolishing residences would be unnecessarily large. Consequently this problem is transferred to the future and to different locations. Developers generally see it as their task to develop new houses which should last a substantial time period and are not so much concerned with the demolition phase.

5.7.4 *Ensnare*

Project developers generally do observe other organizations and projects, however the impact of these observations on their own organization is minor. Consequently conservative project developers, in terms of sustainability, do not naturally ensue progressive firms. This implicates that these firms will have to be pushed by the authorities to adopt more sustainable construction processes which is unfortunate.

5.7.5 *Focus & intelligibility*

Some developers mention that although law and regulation are clear and consistent they often miss the right focus. Law and regulation are focused too much on certain aspects while ignoring others which could significantly contribute to the transition towards sustainability. Consequently sustainability in the construction industry is not progressing as rapidly as it could. The authorities should realize that sustainability is an extensive concept. When the authorities comprehend the difficulty of the concept and adjust their policy, they could also make the concept more intelligible to relevant actors in the construction industry. This could clarify certain issues for project developers who often struggle with the implementation of sustainability.

5.7.6 *Weak ties*

Cooperating on a project base is not perceived to be an impediment to sustainable construction. Most project developers along with their network partners consciously try to progress in terms of sustainability. In this process they learn from each other by working together on projects. However the author believes that the constant change of network partners could hamper the transition towards sustainability.

6 Relate findings to existing literature

6.1 Technology

Technological change is one of the preconditions for a successful transition towards sustainability. This conception is shared by most developers which often view technology as one of the prominent elements or even as the basis for sustainable construction. According to Voss & Kemp (2006 in Kemp & Martins, 2007) sustainable development cannot be defined into an end state with corresponding criteria. Consequently the required level of technological change is unclear. Technological change is difficult to determine and the required change depends on the industry. Here the norms imposed by the authorities can serve as a point of departure. Most developers believe present technologies would be sufficient to suffice the imposed norms for at least next decade. However Geels et al. (2008) indicate that more radical green innovations are needed, which could implicate that present norms should be more strict.

6.2 Split incentives

Split incentives generally increase the complexity of the transition towards sustainability. The construction industry also suffers from split incentives. In the construction process of houses this problem is twofold. First, sustainable houses decrease energy costs substantially and can increase comfort, both are beneficial to the resident. However most developers are not able to retrieve the extra costs as there is no financial mechanism to accomplish this or they are not aware of them. Second, using more sustainable materials and constructions mainly benefits the society as sustainability is a collective good. Project developers do not directly benefit from this but they are expected to construct more sustainably.

6.3 Institutions

Institutions include social-cultural aspects which should be changed to accomplish a successful transition towards sustainability. Sustainability is an important factor to all developers. They realize they can contribute to sustainability and are willing to do so. It is perceived that future residents generally do not prioritize sustainable houses which is a major impediment to sustainable construction. Unfortunately future residents are not aware of the fact that sustainable houses could be financially beneficial and could provide them more comfort. Consequently cognitive institutions concerning future residents form a barrier to sustainable construction. The respondents often see this as a challenge for the authorities but also realize that the construction industry should contribute as well, including capital providers. Law and regulation is frequently seen as an impediment for the transition towards sustainability. Therefore adjusting law and regulation is expected to accelerate the transition towards sustainability.

6.4 Mimetic isomorphism

Mimetic isomorphism refers to the process of organizations imitating other organisations in times of uncertainty or ambiguity. Sustainability is a comprehensive notion which is often problematic to implement into corporate strategy. This situation could cultivate uncertainties in organisations when it comes to dealing with sustainability. Moreover, according to Martens (2006) sustainable development is an ambiguous process. The arguments presented could stimulate organisations to mimic others, yet this generally does not occur. Respondents do indicate to take notice of other organisations' activities though they generally do not adopt much aspects of these organisations. Consequently project developers do not necessarily follow other organisations when it comes down to implementing sustainability. As a result these organisations need to be stimulated to adopt sustainability.

6.5 Normative isomorphism

Normative isomorphism is due to professionalization which implicates that organisations become more similar due to education and professional networks. From this point of view paying sufficient attention to sustainability in relevant educational programs could accelerate the transition towards sustainability as relevant actors should possess and use more knowledge concerning sustainability. Unfortunately there is no concord whether or not the new generation of employees is better educated in sustainability. Two explanations could clarify this phenomena. First the new generation of employees is better educated concerning sustainability but this is not noticed. Second the education concerning sustainability did not improve significantly. However, the quality of education is not perceived to be an impediment for sustainable building.

6.6 Network interactions

Network compositions of each developer varies with every project. Though projects are known to be lasting many years few official agreements are arranged for future projects. Collaborating exclusively on project base could indicate network failure. Weak network ties can prevent fruitful cycles of learning and innovation (Klein Woolthuis et al., 2005) which could be imperative for the transition towards sustainability. This vision is supported by PSIBouw (2009) which believes strategic alliances offers numerous benefits. According to Maarten Rutten strategic alliances, which is a form of supply chain management, are proved to produce interesting innovations. Supply chain management could reduce short term thinking as actors should have to focus less on being the cheapest, this could increase the innovative output of the industry.

7 Conclusion

This research has investigated the question how sustainable competitiveness could be improved in the construction process of residences. Instead of mere asking interviewees what difficulties they come across, to find the answer to the research question, they were requested to answer questions deduced from literature. As such, used theoretical concepts proved essential as the questions forced the interviewees to comment on various aspects of sustainability, which they may would not have mentioned otherwise. Face-to-face interviews have been held with 15 individuals from the Dutch construction industry who are either project developers or have significant knowledge concerning sustainability. The results of these interviews indicate 6 distinct problem areas.

First, project developers generally find it problematic to retrieve the extra costs incurred for making houses more sustainable. This is due to the lack of financial models which should align the benefits of developers and future residents. It was also found that future residents are not aware of the benefits sustainable residences provide, which causes the demand for such houses to be low. Next, project developers do not receive sufficient incentives to use sustainable materials and constructions. Furthermore project developers do not substantially adopt practices from other organisations. Consequently the authorities must force them to adopt more sustainable practices. Law and regulation was also perceived to be an impediment as it is focusing on to little aspects of sustainability which hampers sustainable construction. Finally product developers appear to have weak network ties as their network partners differ each construction project.

These results provides the authorities and policy makers more insight into the impediments of sustainable construction. It also indicates how they could contribute to the transition towards sustainability in this sector. They can contribute in four ways. First they could help to create new financial models for retrieving the extra incurred costs by project developers. As one project developer mentioned the score system of social rent houses is going to change to help retrieve the extra costs incurred. This could implicate that law and regulations must be adjusted to make these financial constructions operative. Second they could raise the awareness of future residents about the benefits of sustainable houses, as such they can collaborate with the construction industry. An often heard approach to raise the awareness is via the media. Third they could better stimulate the use of sustainable materials and constructions. This could be achieved by among others providing subsidies or raising the norms concerning sustainable materials and constructions. Finally, policy concerning sustainable construction could be more strict and should focus on more sustainability aspects. Moreover they could provide a clear understanding of what sustainability entails. Most of these recommendations are generally supported by Weiss (1993) as she states that implementing appropriate regulatory tools could enhance sustainable competitiveness. As such the adjustment of law and regulation together with an increase of supply chain management could increase the innovative output of the construction industry.

The results indicate that most applied theoretical concepts appear to be relevant for identifying impediments in the construction industry. Especially split incentives and institutions proved to be rather useful. Surprisingly both technology and education were generally not considered to be impediments for sustainable construction. Respondents generally indicated that the discussed concepts covered all impediments they come across.

8 Discussion

This section will shortly describe the limitations of this research as well as opportunities for future research. The results of this research are based on the perceptions of the respondents, consequently these results cannot be checked using quantitative data. Furthermore only one actor is used to expose the impediments for sustainable construction. Because of this, the results cannot be generalized for the whole industry. Other actors could be exposed to different impediments which restrain them from contributing to sustainable construction. Future research could explore which impediments other actors in the construction industry come across. Such research could provide policy makers a better understanding of the impediments for sustainable construction. Moreover used concepts could be further elaborated as this could provide additional information concerning impediments in the construction industry.

Although this research is focused on the construction of residences, it is more important to make existing residences and other existing buildings more sustainable. Future research could explore the possibilities for making these buildings more sustainable.

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