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**Sustainable entrepreneurship in the Dutch
construction industry - institutional context and
strategic responses**

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Abstract

On the basis of case-study research this paper contributes to our insights into what strategies entrepreneurs choose to sell new sustainable products and technologies in a conservative sector, in this case the Dutch construction industry. Theoretically it seeks to combine insights from institutional theory with the systems of innovation approach. First, it looks at the ways in which the 'status quo' in the form of set institutions, system- and market characteristics hinders or stimulates innovation and entrepreneurship. Second, it categorizes the strategies that entrepreneurs choose to react to these pressures, i.e. how entrepreneurs challenge or use the system to achieve success.

Introducing new sustainable products and technologies into 'old' industries, with set routines, collaborative patterns and power positions is a challenging matter. Yet, the necessity for such change in the building industry is evident as the sector is responsible for 40% of the total energy consumption in the Netherlands and for 35% of total waste (TNO, 2008). Common knowledge suggests that entrepreneurs or industry entrants should develop their strengths in niches (Geels, 2005) or develop collaborative strategies (Van de Ven, 2005) to be able to attack the established regime and thereby create space for new players.

This study has tested this common conception and found that entrepreneurs are not only hampered by their environments, they also find stimuli in it, and use 'old' routes as a vehicle to sell new products, as the established players add legitimacy and market power to the entrant's capabilities. Secondly we find that entrepreneurs do not use collaborative strategies to compensate for their lack of power. Rather they choose to rely on personal persuasion and try to 'surf the waves' of visionaries such as Al Gore to create enthusiasm and legitimacy for their products.

1 Introduction

Society increasingly imposes a challenge for changing the nature of economic activities in almost every sector of the economy. This structural, long-term reorientation and transformation of economic activities is termed a transition (Kemp, 1994; Geels, 2004). In the built environment such a transition is desirable for two reasons. First because the construction is a big user of energy and materials, and creates much waste. According to Spence & Mulligan (1995) it consumes 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. Second, because construction industries are not ‘footloose’, hence, all progress that is made in improving the sustainability performance of the construction industry benefits the regions and countries they operate in, while at the same time knowledge and experience can be built up that can be sold internationally.

The transition towards sustainability acknowledges the increasingly important societal requirement that economic, social and environmental impacts of developments in the sector need to be jointly considered. This entails changes that go beyond incremental processes caused by technical change only (Hekkert et al., 2007). Innovation processes are thought to be fundamental driving forces for realizing the transition in society towards sustainability (Geels, 2004; Hekkert et al., 2007). This results in *sustainable innovations*: new combinations that integrate all three aspects of sustainability and that have the potential to contribute to the transition by changing the sector towards a more sustainable state (Ashford, 2001). Sustainable innovations create win-win situations in terms of the triple bottom line by integrating economic health, social equity and environmental resilience. This goes beyond the old perspective that innovations can only contribute to sustainability with an inherent trade-off to economic profitability (Cohen & Winn, 2007). An important contribution to set in motion the transition is made by entrepreneurs that innovate (Geels, 2004; Hekkert et al., 2007). Entrepreneurs are venturesome people that are willing and able to experiment with innovations and that have the initiative and persistence to make change happen (Nooteboom, 2008). These ‘Schumpeterian entrepreneurs’ are able to overthrow and change the current structures around them and force the innovation process into new directions by shaping a new path towards renewal of the sector (Garud & Karnoe, 2001; Hekkert et al., 2007). Due to their ability to spawn variety and experiment with innovations in terms of new technologies and new organizational forms, entrepreneurs are thought to be in the right position to combine a contribution to the transition towards sustainability with an increase in economic competitiveness through the generation of value-adding sustainable innovations.

However, entrepreneurs are bound by the context in which they operate. Introducing and diffusing sustainable innovations necessitates far-reaching changes in the structure and organization of the entire *system context*. Entrepreneurs are influenced by its policies, regulations, interactions, norms, societal pressures etc. (Jacobsson, 2002). In the institutional theory literature this is described as a ‘field’ (Di Maggio and Powel (1983) whereas in the innovation systems literature it is referred to as an innovation system. When the sustainable innovations that entrepreneurs aim to introduce challenge the status quo, conflicts may arise with the established actors in the field and the institutional standards (routines, structures) (Hekkert et al., 2007). Institutional entrepreneurs, i.e. entrepreneurs that by the nature of their actions, or introduction of products or services have the goal or potential to change the existing institutions, must hence deploy strategies that not only focus on their business, but also on the active changing of the context that enables their business to take off. In this study we focus on such entrepreneurs that aim to introduce sustainable products and technologies to increase the sustainability of the Dutch construction sector.

In the next section we will discuss the theory on innovation and innovation systems and try to complement these theories with insights from institutional theory and market theory. After we have discussed the methodology for the empirical part of the paper, we will discuss our research finding with regards to system influences (section 4) and entrepreneurial strategies (section 5) as a response to these pressures. We end our paper with conclusion and policy recommendations.

2 Theory

2.1 Environmental pressures shaping entrepreneurship and innovation

The emergence of innovations does not take place in a vacuum, but rather occurs through a dynamic interplay between various actors such as firms, universities and government bodies (Jacobsson, 2002). This is the central idea behind the Innovation System approach, which views innovation as the result of the interactions in an innovation system consisting of all actors and institutions that affect both the rate and direction of innovation in society (Edquist & Lundvall, 1993). The Innovation System approach emphasizes that innovation is both an individual and a collective act, resulting from interactions and coordination between several firms and organizations rather than from the independent actions of single dominant firms (Edquist, 2001; Nooteboom, 2008).

Individual firms and entrepreneurs are the micro-level of an innovation system, but they act within the larger context of the innovation system on macro-level (Markard & Truffer, 2008). Various factors within the innovation system could exert a pressure on entrepreneurs on the micro-level, such as interdependencies with multiple stakeholders, processes of competition and cooperation, governmental policies, regulations, societal norms, values etc. These influences from the system context can be both an enabler and a constraint for sustainable entrepreneurial action (Leca et al., 2008). Influences from the system context that enable and stimulate sustainable innovation, could be explanatory factors for why in some settings entrepreneurs are able and willing to develop sustainable innovations while in other situations they are not.

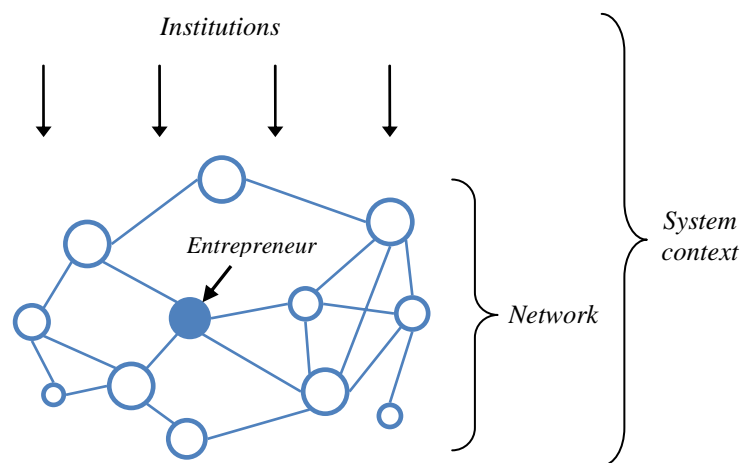


Figure 1: Entrepreneur operating in the system context: embedded in network interactions and under the influence of institutions.

This view on innovation as an interactive process of change embedded in a multi-actor network and influenced by institutional factors of the wider environment on the macro-level of the system (see figure 2), is shared by the multi-level perspective on innovation processes (Markard & Truffer, 2008). The multi-level perspective, like the innovation systems approach, stresses the importance of *interactions between multiple actors* for shaping innovation processes and stresses that innovation processes take place under the *influence of institutions* (Geels, 2005; Markard & Truffer, 2008; Coenen & Diaz Lopez, 2008).

When analyzing the influences from the system context of innovation processes, a clear distinction should be made between the 'players' and the 'rules of the game' (Klein Woolthuis et al., 2005). The players are the *actors* of an innovation system: various organizations (e.g. start-ups, large companies, government bodies, universities, research institutes etc.) that act and interact with each other. The 'rules of the game' are the *institutions* of an innovation system, which stipulate the norms, rules and (formal and informal) standards that regulate the interactions between actors (Jacobsson, 2002). The institutions shape, and are shaped by, the interactions between actors taking place within the innovation system. This distinction between actors and institutions is a crucial aspect to understand the structure of an innovation system and the activities that take place within it.

For the analysis of the system in which the entrepreneur operates, we built upon the Innovation System framework as introduced by Klein Woolthuis et al (2005). Additions include further elaboration on institutions to include insights from institutional theory into the framework, and inclusion of market structure. Whereas most 'innovation system' researchers explicitly position themselves as critics of the free market ideology, we are of the opinion that also in the systems of innovation we study, market forces are undeniable at work, and hence market failures play as much a role as system failures do. On the other hand, the more a system resembles a perfect market (e.g. perfect information, prices including all costs including externalities), the more positive stimuli one would expect from such a system. On a more abstract level one could question how one could separate a market from a system, and how one delineates them. In this paper we will not go into this question though. We let the research question guide the delineation of the system. In this article where we look at sustainable building, the system includes all actors and system interactions that influence sustainable building.

We describe the system interactions according to the following categories as inspired by previous literatures:

- **Infrastructure:** The enabling structures that make economic activities possible. Examples are roads, railways, IT infrastructure etc.. Absence of these would hinder innovation (an economic activity in general).
- **Institutions:** The formal and informal 'rules of the game' that enable or hinder innovation (North 1991, DiMaggio and Powel 1983). (*PS: this I still have to elaborate on*)
 - **Regulative institutions** rules refer to the written rules (laws, regulations) that can be enforced by a well functioning legal framework (police, courts), i.e. *coercive pressures*. Absence of well functioning formal institutions (i.e. absence of contract law or IP protection) hinders innovation, but too rigid formal institutions may have the same effect (i.e. bureaucracy).
 - **Social institutions** are the informal rules, i.e. are the norms, values, routines and standards that develop over time and form the implicit rules of the game, i.e. the *normative pressures*. Informal 'rules' can stimulate innovation if they value creativity and change, whereas the opposite is true if the consensus tends towards keeping things as they are.
 - **Competitive institutions** are formed by the *mimetic pressures* of competitors and peers; in face of uncertainties, actors mimic successful co-actors in their field assuming that if they are doing well, copying them will make their organization perhaps no better than the average, but also no worse.
- **Interaction:** A healthy mix between collaboration and competition stimulates innovation (Granovetter 1973, Burt 1982).
 - **Too much interaction leading to 'lock in':** Where close ties enable trust development, learning, knowledge exchange and innovation, too close networks will cause 'lock in'. Also blind spots.
 - **Too little interaction** hinders innovation as parties do not know each other and will hence not exchange information, engage in learning or collaboration...
- **Capabilities** (Penrose, :
 - Technological knowledge and know-how
 - Organizational / marketing knowledge and know-how
- **Market demand:**
 - Demand quantity
 - Demand quality

- **Market structure:**
 - Barriers to entry due to economies of scale / market concentration
 - Transparency / perfect information
 - Externalities / split incentives

The main contributions that have been added are the institutions and market characteristics. Adding institutions to the IS framework gives the framework more depth. Whereas the original framework built strongly on innovation literature that implicitly builds on the premises that technology creation (R&D, patents etc.) and knowledge exchange (e.g. between companies and knowledge institutes) in collaborative relationships are the main determinants for innovation, institutional theory - quite to the contrary - has as the main focus the question why companies behave similarly: why actors converge towards an (industry) norm. If this norm is very innovative behavior, the theory would expect all firms to strive for innovations, whereas if the industry is conservative, one can expect actors to follow this example. It describes how normative, coercive and mimetic pressures shape this behavior. As such it is a theory of convergence, whereas innovation theories are theories of divergence, of the question how actors come to new products and technologies. If innovation is to be understood in a system context though, one can not only look at determinants for change. One also has to look at determinants for stability, as systems fluctuate between stability and change. The combination of institutional and innovation theory gives us leads to explore this dynamic relationship between change and stability.

To understand why sustainable innovations are adopted or not, also market characteristics play an important role. Like all radical innovations, sustainable products and technologies often come at a cost. These costs often comprise of high upfront investments (e.g. R&D, patents), small production numbers (no scale economies), high sunk costs, and high costs of marketing, lobbying and creating awareness. To deal with these problems, one has to look at the market structure: the barriers to entry, the quantity and quality of demand etc. as the solutions to these problems will also, to a large extent, lie in these aspects (such as tax deductions, cartel policies, subsidies to support front runners and early adopters etc.).

With the inclusion of institutions and market characteristics, the IS framework provides a richer framework for analyzing the systems that surround innovation and sustainability issues. It gives a more complete picture of those factors that hinder and stimulate these developments, and hence can provide a more detailed picture also of how innovation and sustainability can be stimulated in a systemic way.

theoretical framework

Types of interactions:		Users	Producers	Knowledge providers	Third parties, Capital providers	Government
		(consumers, companies, lead clients i.e. government)	(MNEs, SMEs, entrepreneurs)	(universities, research institutes)	(banks, private)	(national, local)
Structure						
	Regulative					
	Social					
	Competitive					
	Too much					
	Too little					
	Technological					
	Organizational/ Marketing					
	Quantity					
	Quality					
	Externalities / Split incent.					
	Entry barriers/ Market power					
	Transparency/ Perfect info.					

An extensive description of all categories is included in Appendix A.

2.2 Entrepreneurial strategies to grow and deal with ‘the system’

Hekkert et al., (2007) claim that entrepreneurs are essential for a well functioning innovation system since they can transform new knowledge, networks and markets into concrete new business opportunities. However, the innovation systems literature falls short in explaining how entrepreneurs can do this. It insufficiently explains how entrepreneurs are able to overthrow and change the current structures around them and force the innovation process into new directions (Hekkert et al., 2007). In order to adequately understand what the strategies are of entrepreneurs to interact with the system context, the macro-level of the innovation systems approach has to be linked with the micro-level of entrepreneurial strategies.

The institutional entrepreneurship literature aims to explain how entrepreneurs can influence and shape the field in which they operate. This literature has originated in neo-institutional theory which seeks to

understand why organizations adhere to dominant practices in their organizational field (Goodrick and Salancik 1996). The explanation is sought in organizations seeking legitimacy by conforming to prevailing institutional norms for practice, i.e. the correct way of doing things according to societal norms, professional training and accreditation, state regulation (Meyer and Rowan, 1977, Scott and Meyer 1983, Di Maggio and Powell 1983). If this conception of reality would be correct, this would imply that innovation would be hampered as variety is not stimulated and selection processes tend to converge to the 'historic' norm. This implies that neo-institutional theory is limited when it comes to explaining how innovation and change occur in organizational fields.

Another characteristic of these early views was the lack of attention to agency and strategic behavior by the organizations in the field, let alone attention to entrepreneurs that actively want to change the field to create a market for their new products (Oliver 1991, Goodstein 1994). The literature on institutional entrepreneurship aims to address this 'shortfall' provided insights on how organizations can take actions to shape, change or overthrow the institutions, *despite* pressure towards stasis (Leca et al., 2008). DiMaggio (1988) introduced the notion of 'institutional entrepreneurs' and explained them as actors that contribute to the genesis of new institutions. As opposed to exogenous shocks that challenge institutions, institutional entrepreneurship literature focuses on the agency of actors "who can serve as catalysts for system change by taking the lead and giving direction for structural change in society" (Leca et al., 2008). However, institutional change can only be achieved by institutional entrepreneurs in certain cases and under certain conditions (Oliver, 1991), i.e. when institutional standards are unclear or when actors are limitedly dependent on the pressures steering towards conformity (e.g. resource dependency, laws that cannot be enforced). (Partial) immunity to these pressures in order to achieve institutional change requires power and legitimacy and hence the institutional entrepreneurship mainly focuses on large organizations as potential initiators of new institutions, whereas smaller firms acting will probably not live to tell the tale (Taminiau et al., 2008).

Sabatier (1988) and Van de Ven (2005) focus on smaller actors instead and propose collective strategies for smaller organizations to be able to actively influence their environments. Sabatier (1988) describes that advocacy coalitions consisting of a group of actors, including government agencies, societal organizations, academics, private businesses and individuals, act together to exert pressures on the policy cycle to influence policy making. Van de Ven (2005) suggests that entrepreneurs can coordinate their innovation activities through the strategy of 'running in packs': since individual entrepreneurs do not have the resources, power or legitimacy to produce institutional change alone, entrepreneurs should team up to do so. They should combine resources, competences and legitimacy to create critical mass for changing the institutions in order to make it collectively possible to commercialize a new business (Van de Ven, 2005). Both proposed strategies available to innovating entrepreneurs to change the system context are possible methods based on theoretical insights. However, there is no empirical evidence on the occurrence and effectiveness of these strategies in practice. Moreover, these methods are only two of the many potential strategies available to entrepreneurs to change the system context. More research is needed in order to find out which of the available strategies entrepreneurs actually use and whether strategies for collective entrepreneurial action are playing a vital role, which necessitates a detailed and comprehensive insight into the dynamic interaction between entrepreneurs and the system context.

In this research we focus on a specific sub-category of the institutional entrepreneurs being the sustainable entrepreneurs which we define as actors that want to reconcile economic growth with a contribution to sustainability in their business model. Previous research into this form of entrepreneurship had mainly focused on environmental entrepreneurs (Gerlach, 2003; Dijkema 2006; Cohen & Winn, 2007; Lepoutre, 2008) and on entrepreneurial action as a response to opportunity recognition in market failures (Cohen & Winn, 2007; Dean & McMullen, 2007; Hall & Lobina, 2007). This disregards the societal pressures from the broader setting of innovation in societal systems and the potential of sustainable entrepreneurs for achieving changes in the system. What we can learn from this literature though is the strategies they distinguish to actively promote sustainable innovations. Many authors speak of a distinction between reactive versus pro-active strategies (see for an overview: Lepoutre, 2008: page 39-41). A reactive strategy is deployed by entrepreneurs that adapt current practices to comply with

regulations or to enhance profitability by using end-of-pipe control measures which results in incremental reduction of their environmental impact (Lepoutre, 2008). On the other end of the spectrum, a pro-active strategy is followed by entrepreneurs that are continuously improving the sustainability of their business, by anticipating to future regulations, social trends and building resources, interacting with social conditions and creating value, beyond what is legally required or accepted as standard practice (Aragon-Correa & Sharma, 2003; Sharma & Henriques, 2005; Lepoutre, 2008). Pro-active entrepreneurial strategies are more likely to occur when the institutional context pushes firms towards more voluntary attention to sustainability, but are less likely to occur when the business environment is complex and uncertain since this makes it harder for entrepreneurs to recognize social issues (Lepoutre, 2008).

Dijkema et al. (2006) argues that for companies to be able to pro-actively contribute to sustainability, they should not only focus on the innovation and its position in their network, but also by including the social context. Therefore stakeholders should be involved and decision processes shared. Further influence should be exerted on public institutions, policy and regulatory frameworks (Dijkema et al., 2006). In a similar fashion, Garud & Karnoe (2001, 2003) describe the process of path creation. In their work they try to link the micro to the macro-level by describing how entrepreneurial strategy and action on the micro-level contributes to the 'co-shaping' of the system context on the macro-level. Where incumbent actors suffer from path dependence within the established system, innovative entrepreneurs can help to create a break-through in a technological regime through the process of 'path creation' (Garud & Karnoe, 2001). Such a new path is built up in small steps in which new social practices, products and services are slowly developed. The path creation literature assumes that this is a process of co-creation through interactions and learning processes of a multiplicity of actors such as users, producers, evaluators, and regulators. Agency is hence *distributed* over many actors and the inputs of all these actors together "co-shape and accumulate the artifacts, tools, practices, rules and knowledge" surrounding innovations (Garud & Karnoe, 2003). Actors do not only create and shape paths, they are also influenced by the emerging path as actors become *embedded* in the accumulating path.

In their study of the emergence of the Danish and US wind turbine industry, Garud & Karnoe (2003) identify two approaches for path creation: bricolage and breakthrough. The process of *bricolage* emphasizes the development of a path in small steps in which there is continuous feedback and interaction between actors. These processes of collaboration are considered crucial for the steady the steady development and adoption of innovations. The *breakthrough* approach assumes that actors can leap-frog an 'old' technology to a new ideal new path, e.g. African countries adopting mobile phones without first having had landlines with the concurrent physical IT infrastructure. In breakthrough processes there is such a strong belief in the potential of an innovation (hype) that actors believe that a new 'state' can be achieved through technology-push. Because actors aim to jump-start the ideal-type innovation at once, there is no process of co-creation. Rather they focus on finding the radical breakthrough, competitive pricing, limiting costs and on how to ensure wide adoption of the technology as quickly as possible. This leads to mostly short-term and one-off relationships where the advantages of learning and steady progress play a less important role.

Entrepreneurial strategies

	<i>Reactive</i>	<i>Pro-active</i>	<i>Source</i>
<i>Individual</i>	Acquiesce/ compromise ¹ Avoidance ¹	Defiance ¹ Manipulation ¹ Breakthrough ²	¹ Oliver (1991) ² Garud & Karnoe (2001, 2003)
<i>Pro-active (inter-firm)</i>		Running in packs ³	³ Van de Ven (1994)
<i>Pro-active (public-private)</i>	Industry associations	Advocacy coalitions ⁴ / Bricolage ²	⁴ Sabatier (1988) ⁴ Dijkema et al (2006)

In short, innovation systems and neo-institutional theory explain how context shapes the actions of actors within that context, but falls short in explaining how change comes about and which role individual innovative entrepreneurs play in orchestrating change in a certain direction (in our case sustainability). Micro-approaches on the other hand put much emphasis on strategic behavior and choice, without giving due respect to how contextual issues influence the (success of) choices. This research therefore focuses on the interaction between the macro-level of innovation systems and the micro-level of entrepreneurial strategies in order to gain insight into the dynamic interactions between both levels (Hekkert et al., 2007; Markard & Truffer, 2008). This research aim is illustrated in the research model in figure 2.

What are the strategies of entrepreneurs to change the system context for the successful introduction and diffusion of sustainable innovations?

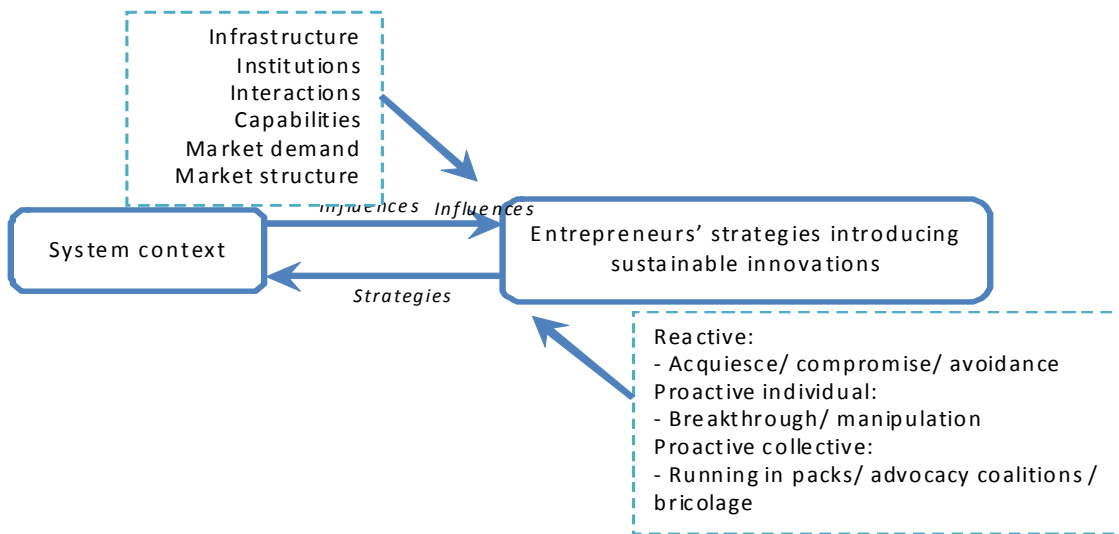


Figure 2: Influences and strategies

The notion of path creation (Garud & Karnoe, 2001) makes a first step in the direction of exploring how entrepreneurs create examples by which they lead others in a certain direction. They do not provide a bottom-up overview though which strategies entrepreneurs actively use to create and shape a 'new path'. Literature that does address the question for room for agency of individual actors include the work of DiMaggio (1988), Oliver (1991) and Leca et al. (2008). These authors assume that actors need to be large and powerful to be able to resist or change the system. Sabatier (1988) and Van de Ven (2005) to the contrary believe that smaller actors can also exert their influence by choosing collaborative strategies. Sabatier (1988) in this light explores the possibilities of advocacy coalitions, whereas Van de Ven (2005) suggests that entrepreneurs should be 'running in packs' to gain the necessary power. However, these theoretical insights do not satisfactorily explain whether and how small innovative entrepreneurs without power or without the right relationships can possibly influence the system to such an extent that they can successfully run their businesses (create legitimacy for their activities) and potentially change the system so that their 'niche' becomes more mainstream. What is missing in the literature is a clear understanding of how entrepreneurs *interact* with the system context which, besides their reaction to pressures from the system context, also includes how entrepreneurs aim to influence the system in which they operate (Leca et al., 2008).

3 Methodology

In order to determine the interactions between entrepreneurs and the system context, this research has empirically studied the interactions of entrepreneurs introducing innovations in the field of sustainable energy production, distribution and management in the Dutch construction industry. This includes residential buildings, such as houses and apartment complexes, as well as utilities buildings, such as commercial, industrial or governmental buildings. The industry is being pushed towards sustainability. On the one hand, the Dutch government actively stimulates sustainable innovation in the energy sector (NOI, 2007). This motivates entrepreneurs to try to exploit the opportunities that arise during the envisaged transition. On the other hand, mainly on the side of the commercial developments (offices), clients ask for sustainable solutions as they can reduce exploitation costs and improve their image.

We focus on the role of entrepreneurs in this transition. Although much attention has been given to how entrepreneurs innovate, much less is known on how entrepreneurs can bring about changes in their system's context. This research aims to address this issue, by investigating *the strategies of entrepreneurs to change the system context for the successful introduction and diffusion of sustainable innovations*. For this cause, interviews have been held with 16 entrepreneurs and we have asked them 1) which influences they experience from their context and 2) which strategies they consciously use to influence this context.

This empirical research specifically focuses on the micro-level of entrepreneurs to determine how they interact with the system context. Since there is a lack of insight in the dynamics on micro-level, such a research calls for an explorative approach, rather than to test existing theories. The empirical part of this research is thus meant to find out how things work on micro-level to find out what the range of experiences and strategies is by directly asking the entrepreneurs themselves. For this purpose, the first step was to establish criteria to identify the entrepreneurs introducing sustainable innovations in this sector, which make up the population subject in this research. All interviewees had to satisfy four criteria: 1) they are entrepreneurs that create new economic activity leading to change in the marketplace, 2) they innovate, i.e. successful experimentation, development and introduction of new products, processes, combinations, services or organizational forms, 3) they contribute towards sustainability, i.e. they have the ability to be scaled up to change or replace current practices in the sector which results in reduced deterioration of the human environment and/or of natural resources while at the same time retained or improved economic competitiveness, and 4) they belong to the sector, i.e. they are suppliers of innovations (based on various technologies) to the sector energy in the built environment in The Netherlands. Thus, all entrepreneurs that have been interviewed by definition aim to contribute to the transition towards sustainability in the sector.

In total 16 entrepreneurs were selected for the empirical research. These entrepreneurs all satisfy the 4 population criteria mentioned above. However, some variety exists within this achieved domain in terms of the phase in the life-cycle of the companies and the technologies that are used for the sustainable innovations. The range of specific characteristics of the interviewed entrepreneurs is presented in table 1 and the distribution of the size of the companies in figure 3, see the references for further details.

Reference number:	Phase in life-cycle:	Technology used for sustainable innovation:
1	Start-up	Photo-voltaics with solar thermal
2	Growth	Photo-voltaics, solar thermal, urban wind, biomass
3	Start-up	Photo-voltaics
4	Maturity	Heat collection & storage
5	Start-up	Solar thermal, water power
6	Growth	Solar thermal, wind, heat pump & storage

7	Start-up	Urban biowaste
8	Growth	Photo-voltaics
9	Start-up	Electricity, electronics
10	Start-up	Urban wind power
11	Growth	Climate systems, electronics
12	Growth	Electricity, wireless electronics
13	Growth	Wind, solar thermal, photo-voltaics, heat storage
14	Growth	Heat exchange
15	Start-up	Solar thermal
16	Start-up	Mechanics and photo-voltaics

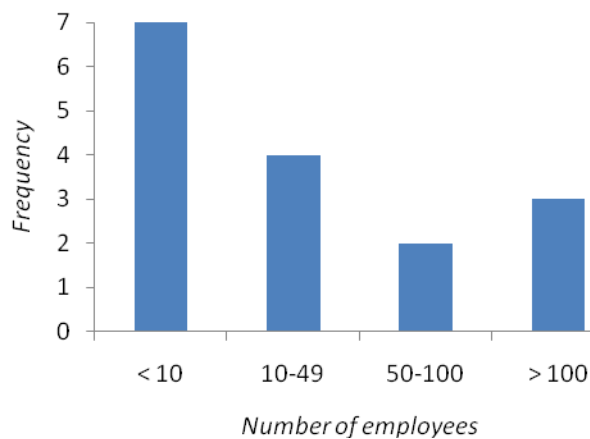


Figure 1: Size distribution of interviewed entrepreneurial companies

We give a brief sketch of the type of entrepreneurs we have interviewed. The numbers in the text refer to the entrepreneur as mentioned in the table above.

Eleven out of 16 interviewed entrepreneurs are driven by idealism. One phrases it as: *“I want to contribute to the sustainability of this world”* (1). However, commercial motives are equally important: *“Idealistic motives are helpful at the start, but in order to be successful and to make an impact business sense is crucial”* (10). We observe that the entrepreneurs that emphasize business skills most (6 out of 16) also seem to show faster growth than those that emphasize idealistic motives.

All entrepreneurs are convinced of the economic viability of the triple bottom line: *“we make profit by fully focusing on sustainability”* (6) and hence do not consider upfront investments problematic. Their vision on the future is clear and focused on the long term. They also want their company or innovation to be an important building block of that future. Thirteen out of the 16 entrepreneurs want to fundamentally change energy production, use and management in construction. However, they are aware there still is a long way to go in achieving the envisaged transition: *“we have to fundamentally change the structure in the sector and transform the lifestyles of people”* (9). All entrepreneurs thereby acknowledge that their innovation cannot become successful in the current system’s status quo, and hence they emphasize the need for change to increase the potential for sustainable innovations. All but one of the respondents believe that the future state of the system will include a decentral two-way electricity grid, and many of their companies depend on this.

3.1 Data gathering: interviews with entrepreneurs

To gather data, a series of in-depth, face-to-face interviews have been held with the 16 entrepreneurs introducing sustainable innovations in the sector energy in the built environment. This qualitative format has been chosen because this research aims to investigate a ‘how’ question which demands qualitative way of research offering the necessary flexibility to appropriately investigate the strategies of entrepreneurs and the causal relations underlying them (Yin, 1994). All interviews have been held with the entrepreneurs themselves: the people within the entrepreneurial companies who are able to explain the rationales behind the strategy of the entrepreneurial undertaking – in most cases this was the founder and CEO of the company. These are the experts on the questions in this research and are best able to report how they experienced influences from the system and how they react and contribute to it.

The interviews have been held in a semi-structured way. The questionnaire was designed with items reflecting the theoretical concepts as discussed in the theory section of this paper. The list of item included in Appendix 1. The questionnaire has been used in an open way to allow the interviewees to explain underlying motivations for their actions. In order to analyze the data gathered from the 16 interviews, the conceptual distinctions regarding the interactions between entrepreneurs and the system context as introduced in the theoretical section have been used. First of all, each interaction with the system context that an entrepreneur mentioned, was assigned to a specific *category of system interactions*, as defined the theory section. Next we looked which actor was (co-)involved in creating this interaction, e.g. the *actor ‘government’* is typically involved in making and checking regulation. Sometimes influences or strategies are perceived to be specifically located with a single actor, whereas others are multi-actors or multi-facetted, which is characteristic of a system’s functioning. By putting the categories of system interactions on the vertical axis and the groups of actors on the horizontal axis, a two-dimensional framework is created where the influences from the system context and the strategies from entrepreneurs can be clearly mapped (see table 1).

4 Results section A: Influences from the system context

The interviews have led to a list of 22 influences (see appendix I) that have been mentioned by entrepreneurs, with underlying explanations for these influences. When these influences from the system context mentioned by the entrepreneurs are put into the two-dimensional framework as outlined in the methodology, 6 distinct groups of influences emerge which are shown in table 4 which we present at the end of this section as a summary of the results. In the table a red circle indicates that the system interaction is considered an impediment for sustainable innovation in the construction industry, whereas a green 'block' indicates a stimulus for innovation.

4.1 Infrastructure

Infrastructure plays a role in the implementation of various new products as current infrastructures in houses and offices are based on the 'old' paradigm of one central grid for electricity and water, and individual end-users that use and do not produce. In the 'new' paradigm the users can also become producers and the water- and electricity grid can become more de-central. In practice, the entrepreneurs were stumbling into problems with the implementation of their products that enable this switch, i.e. one entrepreneur that sells an electricity switch board that allows households to share electricity amongst them, stumbled into the problem that houses are and have to remain separate units in the current system. Related to this electricity problem is the uncertainty in The Netherlands about the 'feed-in' tariffs as there are no clear cut plans of regulations in this field.

Other such problems are the use of rain water for domestic usage. In the past mistakes were made by installers which caused 'grey' water to mix with drinking water. As a result, regulations were made more stringent on using grey water for e.g. toilets and washing machines, making the introduction on greener technologies in this field more difficult.

4.2 Institutions

4.2.1 *Regulative institutions*

Positive: Rules and regulations pushing the 'laggards' forwards

Specifically in the field of regulative institutions, the interviewed entrepreneurs mention strong coercive pressures mainly due to the rules and regulations from the government. Some entrepreneurs (1,4,5) find regulation a 'pushing mechanism' for large incumbent firms to push them towards sustainability (such as energy labels and energy performance standards). Indirectly this creates a demand for entrepreneurs that supply innovative sustainable solutions to these large players.

Regulations are experienced by reactive entrepreneurs as a driver for sustainable innovations, and by pro-active entrepreneurs as a barrier. Subsidy schemes contain barriers for both types, but pro-active entrepreneurs do not depend on them.

Negative: Lack of speed and uniformity leaves entrepreneurs looking for direction

Five pro-active entrepreneurs (2,8,9,10,15) experience regulation as a barrier to innovation as they try to introduce solutions that are "ahead of current standards and requirements" (2) and hence find the current regulation restrictive for their actions. One states that they "even introduce illegal innovations, because the government is too slow with adapting the regulations" (9).

Eight entrepreneurs, in various manners, point to the problem that the rules and regulations are conflicting and that as a result they do not know what to do, or which regulations to keep an eye on for the product development or business activities. First, there is a lack of standardization of policies and regulations in innovation and sustainability (1,2,9,10, 15,16) and too little coordination between the national, regional and local governmental levels (2,10). For instance, national and local rules on planning regulation differ, and regulations conflict each other in their implementation. An example is that the requirements for sustainable technologies conflict with the requirements concerning ‘visual aspects’ of houses and streets (the Dutch *welstandscommissie*). This is the case for solar heat boilers and urban windmills (1,2,3,5,10,15).

Subsidies hinder the innovators

Whether entrepreneurs are so called ‘front runners’ or more followers, they both predominantly see subsidies more as an obstacle than as a stimulus for innovation. One entrepreneur describes the problem as follows: “The whimsical and unreliable nature of the subsidy policies makes long-term positive influences impossible” (5). He refers to the effect, experienced by 13 out of all entrepreneurs, that the short term nature of subsidy programs creates shocks in the market (1-3,5-10,13-16). Additional complaints concern the vast amounts of complex paperwork involved (1,6,9,13,14,16) and the long waiting times for approval (3,7,9,10,14,15). One entrepreneur states that the unreliability of the government is “killing for investors” (9). Most companies therefore choose not to get involved in subsidy schemes and rather ‘go their own way’.

An exception to this rule are the subsidies given for demonstration projects (6,7,11,14) and long-term tax deduction schemes (11,12). These measures are considered clear and reliable.

4.2.2 *Social institutions*

Negative: Mindsets of companies and consumers need to change but it is hard to do so

An important barrier mentioned by entrepreneurs resides in the minds of people (normative pressures). Many entrepreneurs are of the opinion that it is not yet ‘normal’ to use sustainable innovations in constructions and houses (1,3-0,11,13,15,16). One phrases it as “people first need to grasp the concept of sustainability in their mind”⁹. The required change not only includes the products and processes, but the whole value chain. However, this change is difficult. Some entrepreneurs state that actors around them fear innovation, they rather stay within the old, safe routine: Many actors...:

- “have prejudices against sustainable innovations” (6)
- “are reluctant to try something new” (4)
- “are unwilling to implement sustainable innovations” (7)

The common belief is that sustainability costs money, that sustainable innovations don’t work (well) and that they increase risk and complexity.

Two actor groups are considered to be especially conservative when it comes to sustainable innovation are the installers and investors. Seven out of 16 entrepreneurs (3,5,6,8,11,13,15) typify the installers as a very difficult hurdle to take in transforming the construction industry as they have the most direct link to the end-users (both offices and houses) but refuse to change their working routines. This is seen as a result of their low level of education and their general resistance to change as they often do not believe the claims of novel products and they avoid the risk of trying them. The result is that sustainable solutions are not even being offered to the end user and hence the market stays very small.

The second group of actors that have not got a mindset in which sustainability plays a role, are the investors. Entrepreneurs describe how they are always searching for investors but that these:

- “look at profitability on the short term” (9) (whereas sustainable investments often pay back in the long run)
- “are more reluctant when investing in sustainability” (1)

Finding funding sometimes costs time, but eventually all 16 entrepreneurs succeeded with private investors, with government funding or by using own capital.

Negative: Lack of long term vision of the government hinders investments and innovation.

Eleven entrepreneurs stress that the national government does not adequately built a culture, norms, values, a vision (*normative pressures*) that supports sustainability in general, and in the construction industry in specific: “it does not clearly indicate a direction for progress of society” (13). “The government does not stick to the choices they make. This short-term behavior coupled with major political changes every 4 years is hurting the national reliability and stability” (8). The consistency of public policies is crucial for the entrepreneurs as they can develop their business strategies accordingly: “the government should worry about vision and the long-term, then I can start worrying about my short-term survival” (3).

Positive: Awareness in general, and Al Gore in specific, stimulates green construction

Five of the entrepreneurs emphasize the great importance of media attention and a clear vision of (representatives of) the government as it creates legitimacy for the entrepreneurs (4,5,7,9,10,12,15). These policy messages give a clear signal to the society as a whole, and to the business community is specific, that this is the way developments will go. All 16 entrepreneurs indicate that these are important influences to them as it:

- creates legitimacy and awareness with customers (e.g. after Al Gore’s plea for sustainability, people do not have to explain the reasons for investing in sustainable solutions anymore), and hence also creates more demand (1-3, 5,8-13,15,16)
- creates a guideline for investments, e.g. the feed-in measure in Germany makes that people can invest in that technology knowing that they have a set period of time, and a set price, which makes it possible to make a calculation on whether investments can be earned back, stimulating companies to invest in new products and application (4,6,14)
- increases the awareness at local and municipal *governments* with as an effect that they initiate building projects (6) and support actors involved in such projects (6,7,9,13).

4.2.3 *Competitive institutions*

Positive: Competitions proves new developments to be challenging!

Entrepreneurs perceive no negative influences from competing entrepreneurs, since all of them are fighting the same enemy^{3,7,9,12}. In fact, actions by competitors even result in a positive influence for entrepreneurs, since it leads to “increased attention for the emerging entrepreneurial industry”³.

Negative: Competition on price rather than quality and innovation

Half of the entrepreneurs argue that mainly in the construction industry (more so than with energy providers) there are still opposing institutional forces as competition is still based primarily on price and not so much on other aspects such as quality, innovativeness or sustainability. Entrepreneurs note that “the building market still believes sustainable investments are costing money”¹¹, and that there is a lot of “ignorance and lack of knowledge”⁶ and partly due to the fact that most investors, contractors and consumers “look on short-term pay-back times and not on the longer term”⁹. So, although increased awareness has provided a strong boost for sustainable entrepreneurial undertakings, barriers still exist in other categories of system interactions.

4.3 Interaction: Collaboration and knowledge exchange in networks

4.3.1 *Too much interaction: lock-in due to closed collaborative ties between vested interests*

Another strong barrier to sustainable entrepreneurship mentioned by entrepreneurs is that of too strong collaboration between actors with vested interests. Projects in the built environment require inputs and effort from many stakeholders, from governments, businesses, owners, developers, suppliers etc., which makes cooperation and coordination crucial. All the interviewed entrepreneurs indicate that the large players occupy the strong and powerful positions within the construction networks (1,2,4,6,11-13,15) who “seek to maintain power and control in the sector” (1) as this increases their profits. The whole supply chain, up to the contacts with the customers, is dominated by these large players. The interactions between them are based on historic relations, are rigid and fixed. Entrepreneurs mention that they cannot interact with them, because “these stakeholders have been operating and cooperating in the same manner for decades”¹¹ and “the whole system with all activities is based on rusted routines”⁶ which are hard to change. This creates strong network failures based and ‘lock-in’ in the sense that new knowledge, know-how and working routines will be hard to establish with these players and hence, the industry will tend to stay conservative

From the energy sector there is a less negative influence coming from vested interests than from the building sector, since most of the large players are forced to become more sustainable. However, these large energy companies have power and a strong energy lobby: “they can afford to hire their own lobbyists”³. Although the government aims to force these big companies to move towards sustainability through regulation and negotiation, the energy lobby can influence, stall or even prevent this. The entrepreneurs lack this power^{3,6,9,10,13-16}, and argue that “they are too small to have an influence”¹⁶. System following entrepreneurs connect with the vested interests and as a result mainly experience positive effects from the initiatives of energy companies – including increased media attention for sustainability, the ability to participate with large players in large projects, gaining access to existing markets and gaining access to higher governments. System building entrepreneurs cooperate outside of the vested interests and experience more opposing effects from them, such as the delaying of sustainable investments and lobbying to halt new sustainability regulations. Therefore, system building entrepreneurs argue that energy companies have no real incentive for reducing energy consumption or for promoting sustainable energy, they have “no clean motives”⁶, but rather a “conflict of interests”^{1,8} since their primary aim is to make as much profit as possible from selling energy. According to the system building entrepreneurs, energy companies are sometimes an initiator for sustainability, but mostly they follow other actors and “do not run forward in the field of sustainability”¹³ as they do themselves.

4.3.2 *Too little collaboration between governmental bodies*

Moreover, the government suffers from weak interaction failure, which also primarily hurts system building entrepreneurs. The national government tends to listen mainly to the large industrial players and does not support innovative SME’s. Innovative entrepreneurs that do not have relationships with these large players, are overlooked by the government^{8-10,15,16}. The government is open to sustainability initiatives from established players, but “does not listen to ideas from newcomers”¹⁰. The national government follows the hype of the technology of the day which is led by large industrial companies, while sustainable innovations by entrepreneurs “need long-term encouragements”⁸ that are independent of individual powerful actors. Governments are in the unique position to ignore the powerful position of individual stakeholders to stimulate an entire industry and therefore they should initiate overarching cooperative projects for sustainability.

4.4 Capabilities

4.4.1 *Technological knowledge and know-how*

Technology, in the form of technological knowledge and development, was mentioned by 75% of the entrepreneurs as being an important enabling factor, but all of them emphasized that “there are other factors that eventually make the difference”¹¹ for successfully developing sustainable innovations^{1,3-7,11-16}. However, some differences are noticeable between reactive and pro-active entrepreneurs: whereas the reactive ones feel they are waiting for the technology to ‘prove itself’ (“the technology is not yet ready and needs further development before we can proceed”⁵), the proactive entrepreneurs emphasize that the technological developments underlying their innovations are “essential for staying competitive”⁸ and “make our existence today possible”⁹. Also, these entrepreneurs emphasize the role of knowledge providers in this process: “the availability of technological knowledge providers forms the foundation of our existence”⁸⁻¹⁰.

4.5 Market characteristics

4.5.1 *Market demand*

Quantity of demand

All entrepreneurs mention that there is a small, but growing demand for sustainable technical solutions in the construction industry. In the offices market this demand is more developed as the future user is more involved in the design and development of the buildings, and sees clear advantages in a sustainable office because of the positive effects of a reduced energy bill and a better image for the company.

In domestic housing the link to the final user is more distant and users are more interested in common characteristics as comfort and price. Still, there is a clearly a growing demand for sustainable solutions as end-users want to contribute to a more sustainable world and want to increase their independency of central providers as a reaction on fluctuating (and feared increasing) energy and water prices. The entrepreneurs all are convinced of the market potential.

Quality of demand

In the current state of the art in the construction industry, demand is still very much on price. In many sectors of the construction industry, tendering procedures decide who will get the job. The result of these purchasing processes is that temporary coalitions between price fighters prevail over longer term strategic partnerships that strive for quality and innovation. Common sense is that (semi) government bodies should play the role of ‘lead customer’ in creating quality demand. However, these bodies are also subject to national and European legislation on procurement procedures.

4.5.2 *Barriers to entry*

Investment costs

Although almost all sustainable innovations require initial investments, all sustainable innovations eventually pay-back economically within 1 to sometimes 15 years. This is because some innovations

directly and immediately lead to cost-savings, whereas others require large upfront investments and have long pay-back times. All the entrepreneurial companies in this research were actively focused on contributing to sustainability and have experienced growth in recent years in terms of turnover and employees. This confirms the proposition of the literature on sustainable entrepreneurship: entrepreneurs are indeed able to reconcile economic growth with a contribution to sustainability.

Market power by incumbent firms

The strong and closed networks in the construction industry are considered limiting for the possibilities for entrance of innovative entrepreneurs, since they feel that there is “little room for outsiders to enter the competition of the industry”². 14 (out of 16) entrepreneurs mention strong negative influences from these vested interests and say they have to fight them in order to gain a position and power and to successfully introduce their sustainable innovations. The fact that projects concerning energy in the built environment typically involve many stakeholders from both the energy and the building industries increases the complexity of changing this process towards sustainability. It is much harder to get all these stakeholders facing in the same direction to try something new – there can easily be “just one stakeholder that veto’s the implementation”⁷ of sustainable innovations^{4,6,7,11,15}. And if the entrepreneurs do find a way in to establish a position in the industry, often they remain dominated by a large partner or a more powerful supplier who can effectively control the small entrepreneur due to it’s power over resources or market access^{3,8}.

Transparency

Entrepreneurs indicate that although there is a general awareness on sustainability, (end) users have insufficient knowledge on the potential of new technologies and products: the costs and benefits are not clear, and externalities are not counted into the price.

4.6 Conclusion: System and market pressures

In table 4 we present the influences as discussed above.

Drivers (green) and barriers (red) for sustainable innovation

Types of interactions:	Users (consumers, companies, lead clients i.e. government)	Producers (MNEs, SMEs, entrepreneurs)	Knowledge providers (universities, research institutes)	Third parties, Capital providers (banks, private)	Government (national, local)
Structure					‘Old’
Regulative		Regulation pushing			Conflicting rules & regs
Social		Old routines and beliefs keep actors ‘imprisoned’			Lack vision / guidance
Competitive		Vision, media attention → beliefs start to change!			
		Price competition			
Too much		Lock-in			
Too little					Lack inter-govern collab
Technological		Knowledge exchange			

Organizational/ Marketing					

Quantity			Lack demand	
Quality	Price buying			Procurement
Externalities / Split incent.				
Entry barriers/ Market power		Large players block entry		
Transparency/ Perfect info.	Cost-benefits not well known			

In short, the most important drivers for sustainable innovation were the general public awareness of sustainability and developments in technology. One could also conclude though that an important driver is the entrepreneurs' faith in the future of sustainable technologies. The fact that they put their livelihoods on the line for these products and technologies means that they believe in it and will do anything it takes to 'make it happen'. In the latter part, we will elaborate on the strategies these entrepreneurs use to try to influence the system and market in such a way that their businesses gain legitimacy and become successful.

The most important barriers were the social institutions, the beliefs and old routines that keep actors 'imprisoned' in the old paradigm, and the regulative institutions that were unclear, not visionary and inconsistent, making entrepreneurial strategy and action difficult. Next to that were too close network linkages that also form a cause for 'lock in' where vested interests on the one hand block out market entry, and on the other hand 'lock in' old habits and routines in closed network structures between incumbent firms.

5 Results section B: Entrepreneurial strategies

This section discusses the empirical results on the strategies that entrepreneurs have for influencing the system context to create the necessary changes in the system which are crucial for the successful introduction and diffusion of their sustainable innovations.

The 8 system following entrepreneurs^{1,3,4,5,7,12,14,16} and the 8 system building entrepreneurs^{2,6,8,9-11,13,15} that have been interviewed in this research, have shown to clearly differ in the mix of influences they perceive and in the mix of strategies they use to influence the system context. Some influences and strategies that have been found are the same for both types, but some influences and strategies strongly belong to one particular type of entrepreneur. These differences make that the two types of entrepreneurs have a different approach for interacting with the system context. Therefore, the next paragraphs discuss the results on the influences and the strategies that have been mentioned in detail for each of the two types of entrepreneurs.

The *distinction between reactive and pro-active* is made based on whether the entrepreneurs use existing structures to sell new products (reactive) or whether they consciously try to establish new structures, for instance networks, to challenge the existing structure (pro-active).

The *distinction between individual and collective* is made based on the theories on ‘running in packs’ and ‘advocacy coalitions’ where potential competitors join forces to jointly create new markets and new structures (horizontal relationships). Therefore, partnerships with other (established) actors that provide complementary benefits such as access to existing markets, are not considered a collective strategy, but an individual partnership. Making use of collective structures such as industry associations do represent a collective tactic, and as it makes use of existing structures is labeled as reactive.

The interviews have led to a list of 23 tactics (see appendix II) that are mentioned by entrepreneurs as being used to influence the system context. For all the tactics, the entrepreneurs have explained the underlying rationales for why these strategies are pursued, to whom they are directed, how it is carried out and – where applicable – their effectiveness. In order to analyze these results, the strategies are put in the same table as the influences, leading to the emergence of 5 distinct groups of strategies in table 4. These 5 strategies are being used by both the reactive and pro-active entrepreneurs, but in different ways. Some strategies are done in the same way by both entrepreneurial types, while some strategies are executed with a different approach. The details of the strategies for each of the two types of entrepreneurs will be discussed below.

Strategies of entrepreneurs to influence system context

Characteristics:	Users (consumers, companies, lead clients i.e. government)	Producers (MNEs, SMEs, entrepreneurs)	Knowledge providers (universities, research institutes)	Third parties, Capital providers (banks, private)	Government (national, local)
Structure					'Old'
Regulative		Regulation pushing			Conflicting rules & regs
Social	Legitimize: media, advertising, marketing, demonstration projects vision / ... dance
Competitive		Price competition			
Too much		Partnering for market access and legitimacy			Lobbying for vision, clear regulation, regulative
Too little					Lack inter-govern collab
Technological			Knowledge exchange		
Organizational/Marketing					

Characteristics

Quantity	Private persuasion on price and quality	Lack demand		
Quality				Procurement
Externalities / Split incent.				
Entry barriers/ Market power	Build up niche versus incumbents			
Transparency/ Perfect info.	Provide information			

Whether entrepreneurs are pro-active or reactive, all make use of network relationships to achieve their goals: All 16 interviewed entrepreneurs mention the power of engaging in relationships with others: “making smart combinations makes that we are stronger together”⁶, “we can offer a more complete and integral product package to the market”¹¹ and “we can combine our knowledge and add our values up together”¹⁰.

Tactics used by all entrepreneurs – ‘Make some noise’ to get heard

All 16 entrepreneurs also mention the creation of legitimacy through emphasizing and showing how their innovation corresponds to the normative institutional context. They do this primarily through demonstration projects. For every entrepreneur, projects to demonstrate their innovation are extremely important and “worth gold in order to show that it can be done” (7). Demonstration projects are valuable

in order to show results, get actual measurements, provide evidence that the innovation works and is feasible, reduce risks and uncertainties, get references and gain persuasive power and legitimacy¹⁻¹⁶. Furthermore, almost 90% of the interviewed entrepreneurs have strong marketing and media strategies in order to strengthen and legitimize their business position. Media exposure, media interviews, free publicity, awards, articles in professional magazines and other ways of “getting heard”⁹ and “making noise”¹ are very important for potential customers to hear about your products: “promotion is the key to market success”¹.

Information to buyers

Finally, the interviewed entrepreneurs mention specific strategies in order to remove the barriers in the category of social institutions, particularly with respect to actors in the industry, with consumers and with capital providers. These strategies are important for both the reactive and pro-active entrepreneurs. They are used to change the ‘normal’ behavior, routines, practices etc. of other actors, in order to successfully guide the implementation and use of their sustainable innovation: “I need to educate consumers to break with traditional procedures”¹. An important characteristic of this strategy is to provide clear information to customers.

Increasing transparency for customers and re-sellers

Six entrepreneurs^{3,9-12,15} actively focus on creating transparent calculating methods which offer “clear insight into the product effects”¹¹ or by providing “easy access and information about governmental regulations”¹⁰. Through providing this information, entrepreneurs indicate that “uncertainty for consumers is reduced”¹² which increases the likelihood of buying. Moreover, four entrepreneurs^{2,5,6,15} actively educate their distributors or installers so “they know how to work with and sell their innovation”⁵.

Changing the public opinion

Furthermore, by using an approach of direct marketing and interacting in private with consumers at public fairs, stands and in demonstrations, entrepreneurs are able to directly change the behavior and attitude of their potential customers. Also, investors are most of the time persuaded to invest in sustainable innovations through this strategy. Although the strategy of private persuasion is very individual and time-consuming in changing buyers’ and partners’ mindsets, it is considered as being a vital strategy for the successful diffusion of sustainable innovations: “making your proposition clear for customers is the most important part”¹².

5.1 Reactive entrepreneurial strategies

During the interviews it was found that entrepreneurs have two different approaches towards interacting with the system context. The reactive entrepreneurs ‘follow the system’ in the sense that they connect to incumbent actors and institutions in order to introduce and diffuse sustainable innovations in their aim to successfully run their company. For the reactive entrepreneurs the introduction and diffusion of sustainable innovations does not coincide with large changes in the system context. Although all entrepreneurs very much depend on changes in the system for the successful introduction and diffusion of their innovations, this type of entrepreneur believes they “simply can’t change the system themselves” (7).

5.1.1 Reactive individual

For all entrepreneurs, pro-active and reactive, partnering is considered an important strategy for reasons such as knowledge exchange, not only for the specific technology, but also for the “tacit knowledge surrounding technologies” (3).

Counteracting lack of demand by tapping into existing sales channels

For the reactive entrepreneurs, partnering is mainly about creating market access through existing channels, or to “approach the market together in a powerful block” (7). It is mainly the reactive entrepreneurs that acknowledge and accept the dominant role of existing parties. They: “control the distribution channels for addressing the market” (1). They hence want to make use of these market channels. However, they do find it difficult to find such partners within the incumbent firms: “it is hard to find a willing person in every organisation you aim to cooperate with” (7).

Counteracting lack of demand by tapping into existing markets

Next to the partnership strategy to sell their own products, 5 out of the 8 reactive entrepreneurs emphasize (mainly the smaller ones) to focus on direct sales to existing markets as they aim to connect their innovation to already existing markets (1,4,12) as they state that “direct sales is the most important strategy” (12) since this “reduces the efforts needed of creating your own market” (1). Some already know the market before they introduce the innovation, but do not yet know who exactly their customers are: “it takes some networking and tapping into the network in order to find out who your actual customers are” (3). In fact, more successful entrepreneurs have closely watched the emergence of the market they focus on and often have started from a perceived market opportunity: “we started because of a strong commercial need for sustainability”¹². R

Problem solving with help of the ‘frontrunners’ desk’

A government initiative, the ‘frontrunners desk’, is by 7 out of 16 entrepreneurs mentioned as a stimulus for innovating entrepreneurs by listening to the specific problems of SME’s and removing specific barriers and regulations (11,12), by providing network activities that give access to policy makers, politicians, new customers etc. (6,11,12) and by providing funding (5,7,10,14).

5.1.2 *Reactive collective (public-private)*

The reactive collective strategy does not exist in the manner as described in the literature of ‘running in packs’, i.e. partnering with similar companies to create a power coalition. As the reactive strategy mainly follows existing paths, it logically does not create collectives, coalitions, or other power vehicles to challenge the existing status quo, as the reactive strategy is not aimed at path creation, but just as selling their products, technologies and running their firms. However, path creation could be the unintended result from their actions.

Collective actions that can be categorised into the reactive collective strategies are the use of industry associations and existing platforms, and the use of the media.

Counteracting lack of social awareness by ‘making noise’

Via the media entrepreneurs try to increase their legitimacy, not only with respect to the market, but also with respect to competitors: “much attention means that other players in the sector cannot crush or ignore me anymore”⁹. Also, getting promoters such as celebrities, powerful or inspiring people to back the company gives an important impulse. Using the power, legitimacy and influence of people from outside the company can provide “important backing to validate and authorize the innovation”⁹ and for making implementation projects happen due to their stronger power to convince others. Through all these mechanisms, entrepreneurs influence the government, industry actors, customers and other actors by calling at their awareness and by persuading them of the role, the importance and the usefulness of their innovation for sustainability. This approach is a way to change the social institutions so it becomes more favorable for the entrepreneurs.

Increasing market power through industry associations

Although a strategy of running in packs was not found, entrepreneurs do use existing industry associations (7 out of 16) to influence the government (2,3,6,8,10,13,15). As such an organization represents the whole sector, it has more power to lobby for regulatory changes and to create legitimacy

for the new industry. They take the lobbying activities out of the hands of the individual companies as these are too small, have too little time or too few resources to lobby themselves, e.g. for certificates, common standards, consumers communication, quality warranties etc. Five entrepreneurs mention that if they want to change regulations, they do it through their industry association^{2,3,6,8,10}. However, the industry associations are not perceived as very effective at influencing the government: “activities with industry association involve very long-term processes while it is unsure if you will profit from them”³. The four entrepreneurs that are active members of the industry association have more than 50 employees and in all 7 cases of branch organizations involvement, the entrepreneurs mention that this is in market segments where power positions are well established. The entrepreneurs explained that in their view, industry associations come into existence “when competition for market share is not so tough anymore, when the market shares have become settled down and when it is more clear which actors have the power in the market”⁹. Only when this has happened, and when competitive risks and uncertainties are lower, actors are willing to group together. One entrepreneur phrased this process as: “it is much easier to form a branch organization when there are 4 large players left, than to start cooperation with 20 small entrepreneurs”¹⁴. In the early stages of market creation entrepreneurs will try to create a temporary monopoly power rather than teaming up and sharing the pie.

5.2 Proactive entrepreneurial strategies

The pro-active entrepreneurs consciously try to build new network relationships and create new institutions for the introduction and diffusion of their sustainable innovations. By these actions they try to create a new system around their innovation that is more sustainable and that competes with the old system. One entrepreneur phrases it as follows: “we aim to create a young, growing forest with many small innovative trees” to compete with the “unsustainable old forest” (9). The more pro-active entrepreneurs have a longer term strategy.

5.2.1 Pro-active individual

Counteracting lock-in by creating new partnerships for knowledge exchange

Individual partnering occurs mostly with partners whose power and market positioning are relatively well established and positioned: entrepreneurs like to be “relatively certain that there will not be any competition, where the powerful position of the other partner can only help the entrepreneur”⁹. The partnerships are complementary in terms of market access, of knowledge, of technologies, of products etc. and therefore mostly vertical or diagonal in the supply chain. Most partnerships are not relationships based on price and performance, but are longer term, stronger relationships based on *trust*, or as one entrepreneurs says: “where we understand and respect each others problems”⁸. Some entrepreneurs are really ‘agile’: they don’t employ many people themselves, but instead have many and strong relationships “to tap into the knowledge of others and stay flexible themselves”¹⁰. The most mentioned reasons for partnering are:

- knowledge exchange e.g. about the market, possible partners, regulations, politics, entrepreneurship,
- demand e.g. how it can be created through partnering with users, retailers, sales organizations, dealer networks or advisory companies “to create more certainty of getting the innovation sold” (2).
- supply e.g. “secure access to resources reduces uncertainty” (8)
- funding e.g. “partnering with banks, venture capitalists or investors is a necessity” (13)

Counteracting lack of demand by creating new markets and distribution channels

Whereas we have discussed how the reactive entrepreneurs take existing markets as their point of departure, and use existing distribution channels and direct sales to access these markets, the pro-active entrepreneurs also actively try to create new markets by persuasion of potential customers: “consumers do not yet know what innovation they want to buy in the future, you have to convince them to buy yours”

(13). In this way we “directly create and design our own market for the product” (13) without having to rely on existing actors or market structures. For this it is “crucial to follow all developments that can stimulate or change your market” (13).

Three out of the 8 pro-active entrepreneurs that are already in their growth phase (2,6,13) have a clear structure for direct sales and distribution channels in place to create and reach the market. In a way, they are creating a niche-markets (a new market set aside from the regime) where “more knowledge and higher qualities are required and thus higher prices are justified” (6).

5.2.2 *Pro-active collective (private-private)*

Creating complementary networks and value chains – creating a niche

Whereas the previously mentioned partnership make pro-active use of partnerships to create e.g. new markets, the pro-active entrepreneurs mention that suitable candidates for partnerships to change existing structures cannot be found among actors with vested interests. This is where a clear distinction has been found in the partnering strategies between pro-active and reactive entrepreneurs. Whereas the reactive entrepreneurs state they just can’t go around the vested interests: “we simply can’t do it without them” (7), the pro-active entrepreneurs claim that the incumbents oppose sustainable innovation: “some companies see nothing in sustainable innovations” (11). Therefore, as one actor phrases it, the pro-active entrepreneurs “specifically choose to collaborate with those organizations who genuinely want to support our sustainable innovation. In that respect, relationships with vested interests are really our worst enemy” (11). These entrepreneurs look for like-minded actors that are willing to do something new, to take risk, that trust the entrepreneur and that are prepared to innovate together and “to stand stronger together” (6) and become more visible for many others in the network.

An important strategy for these pro-active entrepreneurs is to create new networks around their sustainable innovation. All 8 pro-active entrepreneurs explain that they aim to bring together a “new network consisting of a consortium of willing partners”¹⁵ that together cover all necessary functions and steps for the successful introduction and diffusion of the sustainable innovation. They aim to create a network of “willing people in the right organizations that together span the whole supply chain”¹¹, in order to implement the sustainable innovation. This confirms the idea of running in packs (Van de Ven 2006), forming a pack to achieve change. These entrepreneurs consciously do not team up with the established players who do not always “see a need for sustainability”⁹. They try to legitimize their innovation elsewhere as: “in an environment more in favor of sustainability, introducing the innovation is easier”⁸.

This is mostly done in an early stage of commercialization of the innovation, since entrepreneurs mention that “most of the important decisions and partnerships are created in the early stages of a project”⁶ where partners show commitment to implement the sustainable innovations. This strategy of creating a new network of players that all support the innovation creates a group force which creates access the market, visibility for governments and leads to the successful introduction of the sustainable innovation. Through this strategy, pro-active entrepreneurs are able to leverage the necessary power and position to oppose vested interests in order to create a new sustainable system context.

Creating networks between competitors – running in packs

Four of the pro-active entrepreneurs mention the possibility of collaboration to influence the government (2,6,9,10). These entrepreneurs acknowledge that coordination and cooperation between competitors might be useful in order “to better address, to guide and to break open a common market”¹⁰ and to achieve market growth for the entire growing industry (“to increase the whole pie”⁶). However, *not one* of the entrepreneurs **actually pursues** this strategy. Entrepreneurs do not collaborate with other small, growing entrepreneurs in their field of business and do not try to influence the regulative institutions or network failures with the government. Since the entrepreneurs introduce innovations which create entirely new markets, all competitors are still fighting hard to gain market share (“to increase my own share of the pie”⁶). Cooperation or even coordination would bring about business risks for the entrepreneur,

especially at this early stage: “releasing and revealing vital and strategic information to the competition would greatly undermine my strategic position”⁹. The interviewed entrepreneurs believe that the “individual profits of fighting alone to gain market share, currently outweigh the collective profits of partnering together with competitors to increase the market as a whole”⁶. Increasing the market as a whole simply has no priority for entrepreneurs – no new entrant is willing to take the initiative to cooperate. Innovative entrepreneurs live to compete and believe they have a competitive advantage over their competitors: “I am passionate to fight for market share”⁶.

5.2.3 Proactive strategy (private-public): Advocacy coalitions - bricolage

As described in the influences (paragraph 4.2.1.1), entrepreneurs mention strong negative influences coming from the government in the categories of network interactions (no guidance) and regulative institutions (barriers in regulation and subsidies). The more reactive entrepreneurs choose to work around this by teaming up with established companies and by selling themselves and their products on characteristics that do not need too much persuasion (i.e. costs, comfort).

More pro-active entrepreneurs, on the other hand, actively want to challenge regulations and vested interests where they are perceived counterproductive. Some of these entrepreneurs talk to politicians “to voice the obstacles they perceive and stress the importance of their innovative company and the new industry as a whole” (8,13). They also stress the importance of political savvy and playing political games in order to get support for their company: “it all comes down to politics”¹³ and “our growth is due to clever political maneuvering”⁸. But *lobbying to change regulations* is difficult for every entrepreneur: “it’s a daunting if not impossible task on local level, on national level and especially on European level”². Companies that can effectively lobby usually have power and the necessary resources and critical mass to influence the government, while all other entrepreneurs that have been interviewed are relatively small or young players introducing sustainable innovations that do not have enough power: “there is no way we can influence the government”². This conforms the work of Oliver (1991) that states that only large players can at the right time (e.g. a crisis), influence the set ‘rules of the game’.

System characteristics that hinder but are left untouched by the entrepreneurs

Much to our surprise, the pro-active entrepreneurs state that they do not try to change the social institutions (norms, values, culture) surrounding sustainability in the construction industry:

- “we have given up trying to convince others of the importance of sustainability” (11)
- “we do not have enough time” (10)
- “it is the task of other stakeholders to change the social institutions” (8)

They indicate that individual actions have too little impact, that set ideas are too hard to change, and hence that they feel that it is not their task to try to change these.

Actors hence do not try to change the institutions, but try to *adapt and connect* to them and thereby create support and legitimacy for their innovation. They can *use* the increased awareness of sustainability in the normative institutions of the entire society, to create legitimacy for their own innovation with certain actors on a smaller scale. Another tactic is focusing and emphasizing other advantages *instead* of sustainability advantages, such as cost savings, simple and quick installation, increased comfort levels etc.: “we strategically do not emphasize sustainability but focus on other advantages, because that is what convinces our consumers best”¹.

5.3 Conclusion – Entrepreneurial strategies to counteract system- and market pressures

Differences have been found between the influences mentioned by the two types of entrepreneurs introducing sustainable innovations. In this part of the paper we described how reactive entrepreneurs try to work round lack of legitimacy by emphasizing different aspects of their products and working with the established order, whereas pro-active entrepreneurs try to create a niche ‘next to’ or in competition with the existing order. So, whereas the entrepreneurs mention that they feel they cannot change the broader

context around their innovations, they do have strategies to change the conditions that influence the adoption of their innovation. In this process, the reactive entrepreneurs tend to stay within, and the pro-active entrepreneurs move out of the regime.

As a result of these various ways of operating, these actors also perceive the influences from the system differently. The reactive entrepreneurs experience rules and regulations as an important stimulus to move the laggards forwards, whereas the pro-active ones feel rules and regulations lack behind the state of the art and ‘keep them up’.

The most important pressures from the system on all entrepreneurs lie within the category institutions: regulative, social and competitive pressures shape the field. Interaction – in this case lock in due to too close interactions, and partnering strategies to aim for business success, also plays an important role. Technological and organizational capabilities play only a minor role. Actors either have knowledge in-house, or know where to get it.

With regard to the actors behind the influences, table 4 showed that there are three actor groups that are considered a barrier for innovation:

- The government with their lack of vision and consequent inconsistent policies
- The large incumbent players in the construction industry that throw up barriers of entry for new actors with their closed network structures
- The installers that ‘block’ access to markets as they do not want to try out new technologies and do not sell these to their customers (whereas they are the ones with most customer contact).

With respect to the government we find no evidence that actors try to change the government’s perceived failure in guiding the economic system to a more sustainable new equilibrium. Actors do complain, but at the same time feel they have no ‘voice’ to protest against it, and hence decide to leave it as it is and try to work with the regulative system, or work around it.

The entrepreneurs do take action to address the other actor groups: they try to build up competing coalitions to break open the collusive industry structures, and try to convince installers and re-sellers with cost as well as ideological arguments to join them on their path to sustainability.

In the table below we summarize the two types of entrepreneurs as distinguished in this study.

System interactions of *reactive and pro-active* entrepreneurs.

		Reactive entrepreneurs	Pro-active entrepreneurs
Characteristics		No long-term vision, innovations have short pay-back times and lead to immediate (cost) advantages.	Often known as ‘frontrunners’, have long-term vision and usually longer pay-back times of their innovations.
Context interactions		They connect with vested interests and with existing markets. Guidance from the government gives an impulse for their innovations. Industry association represent them in context.	They create a new network of willing players outside of the vested interests. Experience lack of guidance from the government as a problem. Feel cooperation with vested interests is counterproductive.
Dimensions	Regulative	Regulation & subsidy schemes provide impulse for sustainable innovations. They comply with regulations and are dependent on subsidies.	They go ahead of the government: do not depend on subsidies, find that most regulations are barriers and voluntarily set new standards.
	Social	They focus on sustainability, but they evade opposing actors and emphasize other advantages of the innovation.	Sustainable norms and values are emphasized to legitimize their sustainable innovation.

		Reactive entrepreneurs	Pro-active entrepreneurs
	Competitive	They compete on market characteristics: price, comfort etc.	They persuade others to think differently about their innovations.
	ilities	Wait for technology to prove itself commercially so they can adopt it.	Technology is impulse for innovation, and relationships with knowledge providers gives stimulus for change.
	demand	They try to reach the market through existing channels	They try to create new demand by informing, demonstrating etc.
	structure	They make use of existing structures	They try to challenge existing power coalitions by creating new ones.

Besides system and market influences mentioned by the entrepreneurs, we want to draw attention to the influences that have *not* been mentioned. These lacking influences reside with certain actor groups and with certain categories of system interactions. First of all, when looking at the actor group of consumers, the only things of importance to entrepreneurs seem to be the social institutions within this actor group (the way they think about sustainability). Apparently, the entrepreneurs do not see a role for consumers, or end users, in their potential networks or in influencing rules and regulations. This confirms 'common wisdom' about the construction industry in which end-users are actually never part of developments (i.e. one can only buy a house or office that has already been designed or built!). Whereas changing this would probably be wise, actors within the industry seem not to see this as an obvious option.

Another important observation is that when complaining about regulations, entrepreneurs only look at the government and do not mention influences from others, such as industry players. The entrepreneurs are primarily blaming the government for the absence of supportive regulative institutions. Finally, it can be noted that technology and providers of technological knowledge do not seem to have a very important influence on the introduction and diffusion of sustainable innovations.

6 Conclusion and discussion

Much discussion has taken place in the literatures on innovation and innovation systems, as well as institutional theory on how change can occur in relative stable structures. In all these literatures entrepreneurs are considered important potential change agents, either as individual institutional entrepreneurs (e.g. large players that consciously try to change the rules of the game) or as groups of new entrants forming a niche (Geels 2004, Kemp), create a path (Garud & Karnoe (2001, 2003) or 'run in packs (Van de Ven 2005). On the other hand, many studies show how system change has come about as a result of disruptive events or changes in technologies or rules and regulations. The study of the role of entrepreneurs is especially interesting for those situations where system change is desirable for society as a whole, as is the case for sustainable innovation. If entrepreneurs can make a difference, supporting entrepreneurship in an economy could be an important driver of change.

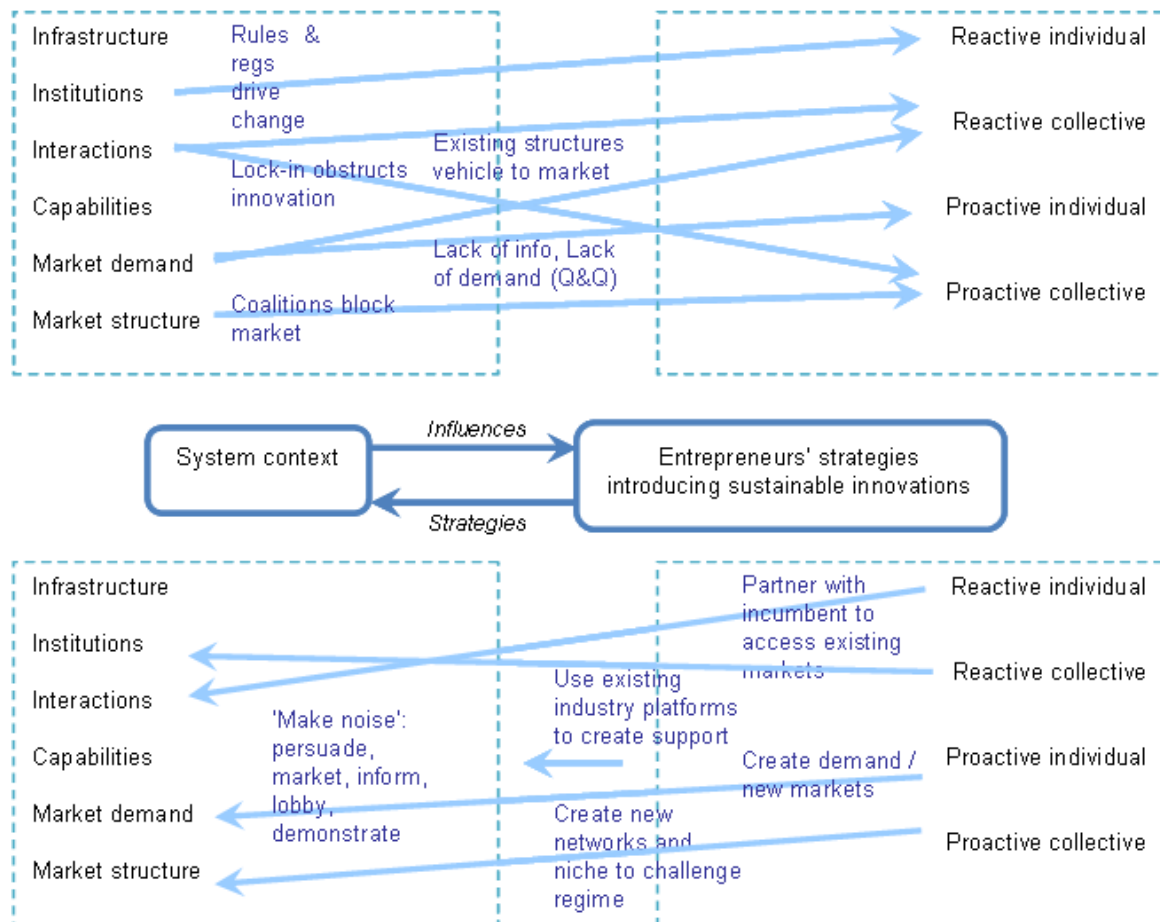
An essential missing link in these literatures is what strategies entrepreneurs have to try to change the rules in their favor. Whereas different literatures all tell a part of the story, there is still limited theory building on the interaction patterns between system- and market characteristics and entrepreneurial strategies, i.e. can small entrepreneurs change the rules of the game, or can only large powerful cooperation do so? Can individual actions change the system by little steps (bricolage) or is coordinated action and collaboration a prerequisite for change?

6.1 Conclusion of our findings

Our first observation however is that the empirical findings confirm the proposition of the literature on sustainable entrepreneurship that entrepreneurs are able to reconcile economic growth with advancements in sustainability (Lepoutre, 2008; Dijkema 2006; Gerlach, 2003; Cohen & Winn, 2007). Whether or not their new products and technologies fit with the existing structures or are already forming new niches, the entrepreneurs find enough 'ground' to build up their businesses and marry idealistic goals with business profit.

Once we delved further into the interaction between the context pressures on the entrepreneurs on the one hand, and the entrepreneurial strategies on the other hand, we see an interesting picture emerge.

Figure 5: Entrepreneur – system interactions



The strongest example of this is the fact that most entrepreneurs experience the limiting nature of old beliefs, routines etc. (social institutions), rules and regulations (regulative institutions), and competitive structures (competition on price) but that entrepreneurs do not challenge these rules of the game directly. They generally feel they cannot change these institutions: they are too small, the government does not listen, the habits, norms and values will not change fast enough etc.. The Dutch government, that wants to be a protagonist of innovation and the transition towards a more sustainable society, comes out especially negative: they are seen as barrier rather than a stimulus for innovation and sustainability.

As a response entrepreneurs to their inability to change these factors directly they decide 'to make some noise' in the hope that the attention to new development slowly warms people to adopt new ideas, or leave the changing of institutions just to whoever feels responsible to do so. Generally entrepreneurs choose to work on their individual goals rather than some collective aim to overthrow a regime. We conclude that entrepreneurs are 'street wise' in their decision on what to spend their resources. They are business managers, and not ideologists. They are also wise in the way they aim their strategies so that they address only those pressures from their environment that they experience as hindering the success of their businesses in the long run.

The question whether the entrepreneurial actions as we describe add up to regime change cannot be answered as the reactive strategies (which on face value seem to lead to more business success than the actions of the pro-active entrepreneurs) might lead to unintended field change and the actions of pro-active entrepreneurs might not. To draw conclusions on this question we would have to perform a study in retrospect. In this study we are interested in the dynamic relationship between the pressures of the

system and the responses of the entrepreneurs without judging the effectiveness of those strategies. By studying these processes we can confirm or falsify some of the theories in institutional entrepreneurship and theories on the role of entrepreneurs in innovation systems.

6.2 Discussion on contribution to theory

Interesting are the insights we gained by creating a fine grained matrix to study entrepreneurial strategies. From our analysis we learn that reactive entrepreneurs experience less limiting pressures from their system context and also use the system to 'get to market', while the pro-active actors feel 'locked-in and tied down' by the current system and try to create a new networks of willing players, and new markets of 'early adopters' to challenge the regime.

The findings also show that whether entrepreneurs want to overthrow existing structures, or just make their individual business a success within existing structures, all actors make use of partnerships to try to achieve their goals. This confirms the view of the innovation (system) literature that emphasizes that innovation is both an individual and a collective act (Nooteboom, 2008, Klein Woolthuis et al., 2005, Edquist 1992).

The inclusion of institutional theory into the innovation system framework provided valuable additional explanatory power to the model: the influences that entrepreneurs experience mostly fall into these categories. These findings correspond to the idea of institutional entrepreneurship: entrepreneurs, who choose to introduce sustainable innovations and thereby choose to resist the current institutional environment, undergo pressures from these institutions for not complying with them (Oliver, 1991).

Also the inclusion of market characteristics have proven valuable. It enabled us to see that whereas entrepreneurs feel that the institutional context is too broad and 'set' to influence, these actors do feel that they can influence the market by providing information (increasing transparency), creating markets by direct sales and persuasion, and creating competing market structures by creating niches that challenge existing 'market concentrations' of incumbents.

Also, the empirical findings confirm the theoretical insight that interaction is not always good. Whereas in the literature on innovation and innovation systems, collaboration is always highly valued, the danger of too strong collaborative relationships leading to 'lock in' and 'blind spots' is often overlooked (Klein Woolthuis et al., 2005). Our research confirms that too much interaction can seriously hamper the development and diffusion of sustainable innovations.

In the actions of the entrepreneurs we recognize the process of path creation as described by Garud & Karnoe (2001, 2003). The empirical findings confirm the distributed nature of agency over a multiplicity of actors, with their distributed competencies (i.e. the reactive entrepreneurs in teaming up with incumbents, the pro-active ones creating new channels and networks). Interesting here is that the pro-active entrepreneurs truly aim for establishing a new, competing sector to challenge the old system, and try to do so by creating markets (persuading customers/ users) and creating new networks (getting complementary partners).

Theories on collective entrepreneurial action need to be nuanced according to the results of this research. The empirical findings have shown that none of the entrepreneurs in practice uses the strategies of advocacy coalitions (Sabatier, 1988) or running in packs (Van de Ven, 2005). Entrepreneurs do not collaborate with competitors to create power versus incumbent players, rather they form complementary networks in which they secure access to resources (knowledge, funding) and market access. Small entrepreneurs fight individually rather than cooperate.

7 Policy recommendations and notes for further research

From our research we derive conclusions on two aspects that are related to policy. First we conclude that the use of the market and system failure framework gives valuable insights into the character of a system's functioning and the weaknesses in this system as experienced by an important group of actors, i.e. the entrepreneurs that have the potential to change a system in a positive direction. The framework provides a wide scope of aspects to look at and thereby reduces the risk of policy myopia – seeing those problems for which policy instruments exist or political support is easy to get, and hence attacking 'problems' where no true bottleneck for change exists.

Second we conclude that in the eyes of the entrepreneurs in this study, the government seriously lacks in a) providing guidance and direction on the level of having a 'vision' as to in which direction our society and our industries should develop, and b) in providing a coherent and consistent policy framework that supports such a vision. Entrepreneurs are confronted with unclear and variable goals, and policy instruments that are often conflicting between different government bodies (e.g. local vs. national level) making it nearly impossible for them to implement long-term strategies and invest accordingly.

Our recommendations therefore are that the government should pick up its role where they can act as a facilitator for change in that role that individual entrepreneurs and companies cannot take. Entrepreneurs made a clear choice not to invest in trying to convince the masses / change the values and beliefs of society to sell their products. This seems a wise choice; single actors, even in collaboration, are not strong enough to change such set institutions. It is the government that can and should pick up this role, either by persuasion (e.g. using public media to influence mindsets, to provide information etc.) or by rules and regulation (e.g. standards, norms, etc.). The government can in this way slowly move the 'rules of the game' and provide a clear vision on the playing field the entrepreneurs are acting upon.

Closely related to that is the alignment of the actions that follow from this vision. As a result of this clear vision, there should be an alignment of government instruments between governmental bodies horizontally (e.g. between the Ministry of Economic Affairs and the Ministry of Housing, Spatial Planning and Environment) and vertically (e.g. between the ministries, the provinces and the communities with regards to planning issues such as solar panels, water management etc.).

We realize that these recommendations would require very substantial adjustments in the current functioning of the government in promoting sustainability, but we believe that the necessity for change justifies such serious measures.

8 References

8.1.1 Interviews:

1. Entrepreneur, co-founder and director, start-up company, <10 employees, photo-voltaics & solar thermal, interviewed on 27-1-2009.
2. Entrepreneur, marketing director, growth company, 50-100 employees, photo-voltaics & solar thermal & urban wind & biomass, interviewed on 18-2-2009.
3. Entrepreneur, founder and CEO, start-up company, <10 employees, photo-voltaics, interviewed on 17-2-2009.
4. Entrepreneur, intrapreneur, maturity company, >100 employees, heat collection & storage, interviewed on 29-1-2009.
5. Entrepreneur, founder and CEO, start-up company, <10 employees, solar thermal & water power, interviewed on 2-2-2009.
6. Entrepreneur, director, growth company, 50-100 employees, solar thermal & wind & heat pump & storage, interviewed on 4-3-2009.
7. Entrepreneur, founder and CEO, start-up company, <10 employees, urban biowaste, interviewed on 26-2-2009.
8. Entrepreneur, co-founder and CFO of growth company, >100 employees, photo-voltaics, interviewed on 9-2-2009.
9. Entrepreneur, founder and CEO, start-up company, <10 employees, electricity & electronics, interviewed on 19-2-2009.
10. Entrepreneur, founder and CEO, start-up company, <10 employees, urban wind power, interviewed on 25-2-2009.
11. Entrepreneur, commercial director, growth company, 10-49 employees, climate systems & electronics, interviewed on 2-3-2009.
12. Entrepreneur, founder and CEO, growth company, 10-49 employees, electricity & wireless electronics, interviewed on 23-2-2009.
13. Entrepreneur, co-founder and managing director, growth company, >100 employees, wind & solar thermal & photo-voltaics & heat storage, interviewed on 2-3-2009.
14. Entrepreneur, founder and director, growth company, 10-49 employees, heat exchange, interviewed on 24-3-2009.
15. Entrepreneur, founder and CEO, start-up company, 10-49 employees, solar thermal, interviewed on 18-3-2009.
16. Entrepreneur, founder and CEO, start-up company, <10 employees, mechanics & photo-voltaics, interviewed on 2-4-2009.

8.1.2 Literature:

- Aragon-Correa, J. A., Sharma, S. (2003) A contingent resource-based view of proactive corporate environmental strategy. *Academy of Management Review*, 28(1): 71-88.
- Ashford, N.A. (2001) Innovation – the pathway to threefold sustainability. Published in *The Steilmann Report: The wealth of people: An intelligent economy for the 21st century*. Brainduct – digital edition, p.233-274
- Coenen, L., Diaz Lopez, F.J. (2008) Comparing systemic approaches to innovation for sustainability and competitiveness. Submitted to DIME international conference “Innovation, sustainability and policy”, 11-13 September 2008

- Cohen, B., Winn, M.I. (2007) Market imperfections, opportunity and sustainable entrepreneurship. *Journal of Business Venturing* 22 p.29-49
- Dean, T.J., McMullen, J.S. (2007) Toward a theory of sustainable entrepreneurship: reducing environmental degradation through entrepreneurial action. *Journal of Business Venturing* 22 p.50-76
- Dijkema, G.P.J., Ferrao, P., Herder, P.M., Heitor, M. (2006) Trends and opportunities framing innovation for sustainability in the learning society. *Technological Forecasting & Social Change* 73 p.215-227
- DiMaggio, P. J. & Powell, W. W. (1983) The Iron Cage Revisited - Institutional Isomorphism and Collective Rationality in Organizational Fields. *American Sociological Review*, 48(2): 147-160.
- DiMaggio, P. J. (1988). Interest and agency in institutional theory. In L. G. Zucker (Ed.), *Institutional patterns and organizations: Culture and environment* (pp. 3–22). Ballinger: Cambridge, MA.
- Edquist, C. (2001) *Innovation Systems and Innovation Policy: the state of the art*. in Invited Paper for DRUID's Nelson-WinterConference. Aalborg, Denmark.
- Edquist, C., Johnson, B. (1997) Institutions and organisations in systems of innovation, in: C. Edquist (Ed.), *Systems of Innovation-Technologies, Institutions and Organizations*, Pinter, London.
- Edquist, C., Lundvall, B.A. (1993) Comparing the Danish and Swedish systems of innovation, in: R. Nelson (Ed.), *National Innovation Systems*, Oxford University Press, New York.
- Edquist, C. (2005): *Systems of innovation: perspectives and challenges*. Ch. 7 *Oxford handbook of innovation...*
- Fagerberg, J., Godinho, M.M. (2005) Innovation and catching up. In: Fagerberg, J., Mowery, D., Nelson, R. (Eds.), *The Oxford handbook of Innovation*, pp. 514-542. Oxford University Press.
- Geels, F.W. (2004) From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. *Research Policy* 33(6/7), 897-920.
- Geels, F.W. (2005) Processes and patterns in transitions and system innovations: refining the co-evolutionary and multi-level perspective. *Technol Forecast Soc Change* 72:681–696
- Gerlach, A. (2003) *Sustainable entrepreneurship and innovation*. Centre for Sustainability Management (CSM), Univeristy of Lueneburg.
- Garud, R., Karnøe, P. (Eds) (2001). *Path Dependence and Creation*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Garud, R., Karnøe, P. (2003) Bricolage versus breakthrough: distributed and embedded agency in technological entrepreneurship. *Research Policy* 32, 277–300.
- Hall, D., Lobina, E. (2007) Profitability and the poor: Corporate strategies, innovation and sustainability. *Geoforum* 38: 772–785
- Hekkert, M.P., Suurs, R.A.A., Negro, S.O., Kuhlmann, S., Smits, R.E.H.M. (2007) Functions of innovation systems: a new approach for analysing technological change. *Technological forecasting and social change* 74 p.413-432
- Hekkert, M.P. (2008) Oratie: naar een duurzaam innovatieklimaat. Uitgesproken op 21 oktober 2008 te Utrecht
- IEA (International Energy Agency of the OECD, 2008) *World Energy Outlook 2008*, London
- Janssen, M. (2009) *Caring for healthcare entrepreneurs: Towards a better understanding of successful entrepreneurial strategies to develop and introduce sustainable healthcare innovations*. Master Thesis research report, MSc Science & Innovation Management, Utrecht University, April 2009.
- Jacobsson S. (2002) Universities and industrial transformation: an interpretative and selective literature study with special emphasis on Sweden. *Science and Public Policy*, Volume 29, Number 5, 1 October 2002 , pp. 345-365(21)
- Kemp, R. (1994) Technology and the transition to environmental sustainability—the problem of technological regime shifts, *Futures* 26, 101023–1046.
- Klein Woolthuis, R., Lankhuizen, M. and Gilsing, V. (2005) A system failure framework for innovation policy design, *Technovation*, Vol. 25, pp. 609-619.
- Larson, A.L. (2000) Sustainable innovation through an entrepreneurial lens. *Business strategy and the environment* 9, p. 304-317

- Leca, Bernard; Battilana, Julie & Boxenbaum, Eva (2008) Agency and Institutions: A Review of Institutional Entrepreneurship. Working Paper 08-096.
- Lepoutre, Jan (2008), PROACTIVE ENVIRONMENTAL STRATEGIES IN SMALL BUSINESSES: RESOURCES, INSTITUTIONS AND DYNAMIC CAPABILITIES, Dissertation submitted to the Faculty of Economics and Business Administration Department of Management, Innovation and Entrepreneurship, Universiteit Gent
- Markard, J., Truffer, B. (2008) Technological innovation systems and the multi-level perspective: Towards an integrative framework. *Research Policy* 37 (4): 596-615
- NOI (2007): Werkplan Nederland Ondernemend Innovatieland, november 2007 – maatschappelijke vraagstukken oplossen door innovatie. Dutch Ministry of Economic Affairs.
- Nooteboom, B., Stam, E. (2008) Micro-foundations for innovation policy. Scientific Council for Government Policy (WRR), The Hague. Amsterdam University Press, Amsterdam 2008
- Oliver, C. (1991) Strategic responses to institutional pressures. *Academy of Management Review*, 16: 145-179.
- Sabatier, Paul A. (1988) An advocacy coalition framework of policy change and the role of policy-oriented learning therein. *Policy Sciences* 21:129--168 (1988), Kluwer Academic Publishers, Dordrecht
- Schumpeter, J.A. (1934) *The Theory of Economic Development*, Cambridge, MA: Harvard University Press.
- Scott, W. R. (2001) *Institutions and Organizations*. 2nd edn. Thousand Oaks, CA: Sage.
- Sharma, S. & Henriques, I. (2005) Stakeholder influences on sustainability practices in the Canadian forest products industry. *Strategic Management Journal*, 26(2): 159-180.
- Taminiau, Y., Oegema, D., Klein Woolthuis, R., Schouten, L. (2008) The dynamics of institutional pressures. VU University Amsterdam. Working paper.
- TNO (2008) Van de Lindt, M., Elkhuizen, B.: *Energiereductie U-bouw, knelpunten, kansen en versnelling*. Delft, juni 2008.
- Van de Ven, Andrew H. (2005) Running in packs to develop knowledge-intensive technologies. *Carlson School of Management, University of Minnesota, Minneapolis, MIS Quarterly Vol. 29 No. 2*, pp. 365-378/June 2005
- WCED (1987) *World Commission on Environment and Development: Our Common Future*. Oxford University Press, Oxford, UK.
- Yin, R. (1994), *Case study research: Design and methods* (2nd ed.). Beverly Hills, CA: Sage Publishing.

9 Appendices

9.1 The System and Market characteristics influencing innovation

Market characteristics		Description
Structure	Enabling structures	Enabling infrastructures For innovation to take place, a physical infrastructure is needed such as roads, railways, harbors, and IT infrastructure (Smith 1997). Modernization of infrastructure can stimulate innovation.
Institutions	Regulative institutions (coercive pressures)	Written rules of the game Rules and regulations that are written down and can be enforced Intellectual Property Rights, Standards, European / national legislation
	Social institutions (normative pressures)	Unenforceable rules of the game Culture, routines, habits, norms, values, beliefs, desires, social capital, trust Procurement procedures (e.g. Bergek et al. 08) Vision & government policies (e.g. Bergek et al 08) Training, education, socialization (e.g. DiMaggio & Powel 1983) Emerging dominant designs (not laid down in official standards yet)
	Competitive institutions (mimetic pressures)	Industry best practices To cope with bounded rationality, actors mimic successful peers Copying of business strategies, copying of stakeholder dialogue Steering on shareholders' / stakeholders' expectations
Networks	Too much collaboration / too close network structures	Rigid and dense collaborative ties hinder innovation Too much interaction between existing partners can hinder innovation as parties are not open for new information etc. causing 'lock in' and blind spots (e.g. Klein Woolthuis et al 2005), lack of cognitive distance (e.g. Cohen & Levinthal) and structural holes (Burt, Granovetter) Lack of diversity and variation and as a result lack of 'trials' that can lead to selection of potential successes (ref evol economics)
	Too little collaboration / weak network ties	Absence of inter-actor ties hinders innovation If parties do not interact, information will not be exchanged and learning and change cannot occur Lack of learning (Polyani) Lack of new combinations and innovation (Shumpeter 1934)
Resources	Technical	Technological knowledge enables innovation Technological knowledge and know-how
	Organisational / Marketing	Organisational and marketing knowledge enables innovation Organisational and marketing knowledge and know-how to e.g. manage collaboration or get product/process to the market
Demand	Quality	Quality of demand: drive for newness and cleaner and more ethical manufacturing processes.
	Quantity	Quantity of demand: number of buyers that are willing to buy into new developments. Level of price sensitivity (elasticity) is important in this respect
	Split incentives (value chain) /	Investments and benefits lie in different links of the value chain, or benefits /costs resulting from the investment are delayed in time. Both cause that the direct relation between cause and consequence is lost. Split in value chain: A builder invests in solar panels in a new development but cannot sell its houses more expensive to the end user. The end-user benefits from low energy bills without sharing the investment.

<i>and market characteristics</i>	<i>Description</i>
<i>Externalities</i>	Split in time: Developing a building now without taking into account demolition costs in 60 years time. <i>Positive or negative externalities may corrupt the incentives for innovation</i> The market price does not account for the external effects of an economic activity on other individuals and the environment, e.g. pollution
<i>Transparency / perfect information</i>	<i>Lack of transparency and information make a market function sub-optimal</i> A lack of insight into prices and quality of products and lack of overview of alternative suppliers make it difficult for buyer to choose best price-quality product.
<i>Market concentration (power)</i>	<i>Dominant players can determine prices and output</i> Monopoly / oligopoly: a single or a small group of large manufacturers/ builders dominate the market (can determine or influence prices and quantities) Monopsomy: a single or small group of dominant buyers can determine or influence supply and prices (e.g. large supermarkets) Cartels: Collaborative agreements between players determine or influence prices and quantities
<i>Barriers to entry / economies of scale</i>	<i>High entry costs block of a market for new entrants</i> High initial investments in e.g. capital intensive plants, specialist knowledge, and/or patents can 'block of' the entry into a field (an industry).

9.2 List of influences from the system context mentioned by entrepreneurs

1. Public awareness of sustainability
2. Regulation
3. Subsidies
4. Guidance of the government
5. Networking & contacts
6. Politics
7. Competitors
8. Cost-focused market
9. Technology
10. Funding & investors
11. Financial crisis
12. Vested interests
13. Installers
14. Incentive of energy companies
15. Fear for innovation
16. Many stakeholders
17. Providers to consumers
18. Media attention
19. Suppliers
20. More assertive consumers
21. Climate for entrepreneurship
22. Energy price

9.3 List of tactics to influence the system context mentioned by entrepreneurs

1. Demonstration projects
2. Private persuasion
3. Direct sales

4. Finding customers
5. Connect with vested interests
6. Partnering & alliances
7. Coalitions and consortia
8. Running in packs
9. Information supply
10. The right people
11. Promoters & ambassadors
12. Emphasize other advantages
13. Agility
14. Branch organizations
15. Political lobbying
16. Connect with existing market
17. Niche markets
18. Intellectual Property Rights
19. Increase public awareness of sustainability
20. Internationalization
21. Training & education
22. Marketing & media
23. Internalize external dependencies