

# **How do sectors change?**

The role of incumbents as institutional  
entrepreneurs

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# **How do sectors change?**

## The role of incumbents as institutional entrepreneurs

### **Hoe veranderen sectoren?**

De rol van gevestigde bedrijven als institutionele ondernemers

(met een samenvatting in het Nederlands)

### **Proefschrift**

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# 1. Introduction

## 1.1 Background

Our society is facing significant challenges in the shift away from the use of fossil resources towards more sustainable energy and material use, as the use of fossil resources is deeply entrenched in our society (EC, 2015; Natural Resource Defense Council, 2015). While the use of fossil resources has strongly contributed to global economic growth, it is simultaneously responsible for the largest share of CO<sub>2</sub> emissions. The cumulative emission of CO<sub>2</sub> is seen as a key cause of climate change (Stocker et al., 2013). Due to the strong dependence of almost all economic processes on fossil resources, it is difficult to shift away from these resources.

In order to reduce our dependency on fossil resources without endangering our wealth and economic growth, a societal transition is needed. A societal transition implies large changes in the way important societal functions such as transportation, housing, and energy, food and water provision are organized. Such a transition involves major, long-term changes in technologies and technical artifacts, as well as in user practices, policies, markets, industrial networks, supporting infrastructures and culture (Geels, 2002; Markard and Truffer, 2008a). Since societal functions are often provided by established sectors such as the agricultural sector and the energy sector, societal transitions require sectoral change.

Various definitions of sectors are used in various research fields. In industrial economics sectors are generally delineated by similarities in technologies, demand, and strategic interdependence. In this approach the focus is on firms and their interactions in terms of strategic behavior (Malerba, 2002). Malerba (2002) suggests a broader definition of sectors that also captures the interactions of firms with other organizations such as universities and government agencies. Furthermore, he suggests that organizations are not limited to interactions regulated by price mechanisms (i.e. market interactions) but can also be involved in non-market interactions that are related to learning, networking, and political and institutional effects.

A key driver for sectoral change is the process of innovation. The relation between innovation processes and societal transitions has often been studied from an innovation systems perspective (Markard and Truffer, 2008a). An innovation system consists of components, such as different actor types and institutions, and linkages between the components (Chaminade and Edquist, 2005; Markard and Truffer, 2008a). Institutions are taken-for-granted social rules that stabilize and pattern behavior (Meyer and Rowan, 1977; Oliver, 1991; Scott, 2008). Actors and institutions are related in a systemic way and influence the development, diffusion, and implementation of innovations (Bergek et al., 2008; Negro and Hekkert, 2008). A well-functioning innovation system is required to successfully develop and diffuse innovations (Negro and Hekkert, 2008).

A framework that captures both innovation and sectoral change is the concept of sectoral innovation systems (Malerba, 2002). This notion captures several elements that play a crucial role in enabling or constraining transformations of sectors. A sectoral innovation system is a set of new and established products and a set of agents in market and non-market interactions. The sectoral innovation system has a knowledge base, technologies, inputs, and an existing, emergent, and potential demand. Agents are firms and non-firm organizations that interact. Their interactions and other behaviors are influenced by the institutional setting within the sectoral innovation system. The sectoral innovation system captures two different aspects of innovation. First, it captures the production of established products and technologies. This encompasses the creation of incremental innovations aimed at improving existing processes and products in a given sector, which leads to changes that are in line with the current institutional setting and functioning of the sector. Second, it captures the creation and diffusion of new products and technologies. This encompasses the creation of more radical or discontinuous innovations. Discontinuous innovations can lead to significant transformations of the existing sector or the emergence of a new sector, as these innovations are not in line with the institutional setting and fundamental functioning of the existing sector (Malerba, 2002; Markard and Truffer, 2008a). Sectors are thus the emergent outcome of the interactions between and co-evolution of products, agents, knowledge, technologies, and institutions (Malerba, 2002). In the rest of this dissertation the concepts sector and sectoral innovation system are used interchangeably.

A societal transition requires fundamental changes in established mature sectors and the emergence of new sectors. Changing mature sectors is not easy. Due to path-dependent co-evolution processes, the elements of a sectoral innovation system develop over time towards a more stable system structure. This can lead to innovation systems with long traditions of strongly routinized practices that promote business-as-usual and not change. There are large vested interests and long histories of reinforcing developments. In a mature sectoral innovation system the knowledge base and institutional rules are perfectly aligned to support specific innovation processes. These are usually incremental, continuous process innovations. Transitions literature often captures this in the *regime* concept (Geels, 2002; Markard and Truffer, 2008a; Verbong and Geels, 2007). A regime “forms the ‘deep structure’ that accounts for the stability of an existing socio-technical system. It refers to the semi-coherent set of rules that orient and coordinate the activities of the social groups that reproduce the various elements of socio-technical systems” (Geels, 2011, p. 5). This illustrates that the institutional setting of existing sectors is of crucial importance for transition processes.

New, emerging sectors also face difficulties that are related to the institutional setting (or lack thereof). A crucial challenge for emerging sectors is obtaining legitimacy, i.e. creating a generalized perception that new technologies and products are desirable or appropriate (Dacin et al., 2007; Seo and Creed, 2002; Thornton and Ocasio, 2008). A well-functioning sectoral innovation system creates the conditions that lead to new innovations being viewed as legitimate. However, when the formation of this supporting innovation system is hindered, the chance of success for emerging sectors is reduced. Furthermore, due to actors being able to enter and leave with relative ease, the knowledge base not being fully formed, and technologies not having reached a dominant stage, the institutional setting within emerging innovation systems is often ambiguous (Greenwood et al., 2011). This ambiguity can lead to large uncertainties in the emerging innovation systems, as there are no institutional pressures regarding ‘the right thing to do’.

The discussion of the difficulties related to changes in mature sectors and the emergence of new sectors above clearly illustrates the potential blocking role of institutions in transition processes. Mature sectors often have stable, routinized institutional settings. Such institutional settings do not promote divergent

change, which is necessary for a transition. Emerging sectors often have more unstable institutional settings, in which different beliefs regarding the 'right thing to do' exist. Both existing and emerging institutional settings often do not provide strong support for emerging innovations in obtaining legitimacy. A societal transition therefore depends on changes in institutions within sectors.

In order to improve our understanding of the transformation of sectors, it is crucial to determine the possibilities and difficulties of institutional change in these sectors. Institutional theory provides a strong starting point, as it focuses on the taken-for-grantedness of social norms, routines, and rules, and thereby the difficulties in enacting change in sectors.

Institutional theory initially explained changes in institutions by pointing towards exogenous forces or jolts, such as social upheaval or new technological breakthroughs (Dacin et al., 2002; Greenwood and Suddaby, 2006). The general effect of jolts is that they disrupt the current institutional setting by raising awareness of alternative possibilities, thereby enabling change. This approach emphasizes the persistence of institutions and pays limited attention to the role of interest and agency in shaping institutions (Dacin et al., 2002; DiMaggio, 1988).

More recent work goes into institutional change triggered by the strategic behavior of organizations (Dacin et al., 2002; Greenwood and Suddaby, 2006; Oliver, 1991). When actors envision new institutional arrangements and undertake actions to realize this new institutional setup they function as institutional entrepreneurs (DiMaggio, 1988; Maguire et al., 2004; Greenwood and Suddaby, 2006).

Which actors take up the role as institutional entrepreneur in the process of sectoral change? Generally the innovation literature points at new innovative firms that try to enter an existing sector with new technologies that radically deviate from the existing knowledge base in the sector: so called discontinuous innovations. These discontinuous innovations, as opposed to incremental innovations, build on new knowledge, resources, and competences and are completely new to firms in the sector; they represent a break from the existing sectoral innovation system (Freeman, 1994). The innovative firms that develop these discontinuous innovations are labeled as outsiders (Chandy and Tellis, 2000), new entrants (Audretsch, 1995), challengers (Hargrave and Van de Ven,

2006), or entrepreneurs (Hekkert et al., 2007). Entrepreneurs experiment with new ideas, concepts, and innovations and they can turn the potential of new knowledge, networks and markets into concrete actions to exploit new business opportunities (Hekkert et al., 2007).

It is commonly not expected that insiders or incumbents are a source of discontinuous innovation. The arguments behind this expectation can be coined as the incumbent's curse (Chandy and Tellis, 2000). The general view is that incumbents have strong, vested interests in the existing sectoral innovation system and are therefore not looking for changes that can potentially overthrow this. The sectoral innovation system is a source of knowledge, resources, and competences for incumbents. Furthermore, it is argued that incumbents are strongly influenced by the institutional setting of existing sectoral innovation systems. Incumbents often develop certain organizational filters and routines that can lead to a lack of perceived incentives for institutional change (Chandy and Tellis, 2000; Christensen, 1997; Nelson and Winter, 1982). Institutions can thus be seen as major barriers for discontinuous innovation by incumbents, as they generally steer behavior towards isomorphism and incremental changes in line with the institutional pressures.

There are several findings indicating that the incumbents curse might be exaggerated. Depending on their resources and interests specific incumbents can develop discontinuous innovations. To make these innovations successful, institutional change is necessary and therefore these incumbents also need to function as institutional entrepreneurs (Wright and Zammuto, 2013). Resources related to institutional entrepreneurship are authority, power, legitimacy, economic and social capital, and knowledge and expertise (Battilana, 2006; Maguire et al., 2004; Wright and Zammuto, 2013). Contrary to the challengers, incumbents are more likely to possess these resources. In some cases incumbents can be in such a strong position with respect to quality and quantity of resources, access to market, and experience in the sector, that they lead the sector (Chandy and Tellis, 2000; Danneels, 2004; Greenwood and Suddaby, 2006; Van de Ven et al., 1999). In this case incumbents can force change, even without the need for a supporting innovation system. With these arguments in mind, it can even be argued that institutional entrepreneurship by incumbents has a higher probability of actually resulting in institutional changes and sectoral change (Greenwood and Suddaby, 2006).

Therefore this dissertation focuses on the potential role of incumbents in successfully impacting a societal transition towards sustainability. The actors of interest are thus incumbents that initiate changes that break with the institutionalized nature of doing business in a given sector. In other words, this dissertation investigates incumbents that behave as institutional entrepreneurs.

Instances of incumbents functioning as institutional entrepreneurs are not typical but exemplify interesting sources of change coming from within sectors, i.e. embedded agency. A key conceptual challenge in institutional entrepreneurship literature is labeled the paradox of embedded agency. When introducing interest and agents (i.e. deliberate change by actors) into institutional theory, difficulties are often encountered; a central assumption of institutional theory is that actors and interests are themselves institutionally constructed (Seo and Creed, 2002). The main issue is summarized in the following question (Seo and Creed, 2002): as the behavior, intention, and rationality of organizations is heavily influenced (or even conditioned) by the institutional setting in which they are embedded, how are they able to envision and enact changes to this same institutional setting?

By enhancing current insights regarding this conceptual question, the micro-level foundations of innovation processes and the role of agency in innovation systems can be further explored to understand the transformation of sectors. Institutions form incentives and obstacles for innovation (Edquist, 2004). By understanding why incumbents start to function as institutional entrepreneurs, possible answers to the paradox of embedded agency can be identified. Furthermore, this provides more insights into the potentially positive role incumbents can play in the transformation of sectors. It is therefore also useful to study how incumbents enact institutional change.

The interplay between institutions and actors is thus very relevant from both an empirical and theoretical viewpoint. It is the (at least temporary) stability of the taken-for-granted social context that is very difficult for entrepreneurial incumbents to change and a key challenge to overcome when introducing discontinuous innovations that are crucial for a societal transition. The interplay between institutions and actors is the main focus of this dissertation.

## 1.2 Aims and research question

This dissertation aims to enhance current insights into the interplay between the behavior of entrepreneurial incumbents and the institutional setting of the sector in which they are embedded.

The actor model used in this dissertation accounts for the institutional embeddedness of actors but also for their capacity to reflect on their embeddedness. In this way agency is not just an effect of the institutional embeddedness of actors, nor is agency separated from institutional embeddedness (Lawrence et al., 2010). Transition frameworks tend to have a structuralist approach, in line with earlier work regarding institutional theory. While institutional entrepreneurship emerged as an alternative approach, it has been criticized for completely ignoring institutional pressures on actors' behaviors; institutional entrepreneurs were often viewed as a particular species or as superheroes (Battilana et al., 2009).

In this dissertation, agency is therefore viewed as an ongoing activity whereby actors reflect on and strategically operate within the institutional context where they are embedded (Lawrence et al., 2010). There can be different degrees of agency (Battilana et al., 2009; Dorado, 2005) and agency is seen as a distributed phenomenon (Lawrence et al., 2010). This ensures that the hero-view of institutional entrepreneurs does not become dominant. Rather, institutional change follows from the efforts of different actors that promote specific institutional changes.

The focus is on incumbents that act as institutional entrepreneurs by discovering, creating, evaluating, and acting to exploit opportunities related to change in the form of discontinuous innovations. These can incorporate new technologies, new products, new business models, and/or institutional innovations with respect to the sector in which they are introduced. Instead of retrospectively studying institutional changes that have taken place in a field, the focus here is on the start or triggers of institutional change and the strategic actions of entrepreneurial incumbents aimed at influencing the institutional setting of a field.

The analysis is aimed at motivations for change, barriers that are encountered by incumbents that enter this difficult and potentially risky institutional change

process, and the way in which they are influenced by and influence the surrounding sectoral innovation system through strategic actions. These insights help in understanding possible micro-level change processes in the transformation of different sectors. The main research question of this dissertation therefore is:

*Why and how do incumbents act as institutional entrepreneurs?*

By understanding drivers and actions of incumbents as institutional entrepreneurs, it becomes possible to determine the role of incumbents as innovators that contribute to sustainable transitions of sectors.

The following section provides an overview of the key theoretical concepts used in this dissertation to analyze the main research question. The overview highlights several knowledge gaps in order to clarify the theoretical positioning of this dissertation.

### **1.3 Theoretical positioning**

This section starts with a more detailed explanation of the innovation systems perspective. Hereafter, the discussion moves to the concepts of entrepreneurship, institutions, and strategy. These are the central concepts recurring in each of the following chapters. Each of the concepts is discussed in relation to the transformation of sectors, thereby illustrating the knowledge gaps that need to be overcome to answer the main research question. The section is concluded with an analytical framework that presents the main theoretical concepts that are studied in the chapters that follow.

#### **1.3.1 Innovation systems**

The concept of innovation systems (IS) has been introduced by Freeman (1987). Innovation systems have been defined at several different levels depending on the analytical purpose, such as the national (NIS), the regional (RIS), sectoral (SIS), and technological level (TIS) (Freeman, 1987; Malerba, 2002; Smits and Kuhlman, 2004; Tödtling and Trippl, 2005). In innovation systems organizations and institutions are central components, with learning as the central activity (Edquist, 2004; Hekkert et al., 2007). Actors are located in several sub-systems: the production chain, governmental organization, intermediaries, knowledge infrastructure, and the market. Institutions are more passive, often referred to

as *the rules of the game*. Usually, a distinction is made between formal and informal institutions (e.g. codified and tacit rules). They shape interactions between actors but are also made/changed by these interactions (Markard and Truffer, 2008a). Specific institutional settings favor specific sets of activities and constrain others. The different actors and institutions are related in a systemic way and influence the development, diffusion, and implementation of innovations (Bergek et al., 2008; Negro and Hekkert, 2008). A well-functioning innovation system is required to successfully develop and diffuse innovations, although the way in which this is realized may differ over the life cycle of an innovation system (Alkemade et al., 2007; Negro and Hekkert, 2008).

The innovation system perspective puts the interactions between actors, institutions, and technologies at the forefront. As changes in actors, institutions, and technologies are needed in order to enact a transition, this framework fits the research objective of this dissertation.

This dissertation specifically focuses on the sectoral innovation system perspective. Malerba (2002) stresses the importance of products, actors, knowledge and learning processes, organizational interactions (both market and non-market), institutions, and transformation in sectors. He argues that a sectoral innovation system includes an innovation system, a production subsystem, and a distribution-market subsystem. A sectoral innovation system has a knowledge base, technologies, inputs and an existing, emergent and potential demand, and includes both actors and institutions. In this perspective, sectors are the emergent outcome of the interaction and co-evolution of products, agents, knowledge, technologies, and institutions (Malerba, 2002). This conceptualization allows for the study of incumbent firms that are looking for divergent change within existing sectors. However, in practice the concept tends to focus on incremental innovations (Markard and Truffer, 2008a). Furthermore, additional insights regarding the emergence of sectoral institutions are needed (Malerba, 2002).

The technological innovation systems perspective has traditionally focused on the emergence of more discontinuous innovations (Hekkert et al., 2007; Hekkert and Negro, 2009; Suurs and Hekkert, 2009). Comparable to the sectoral innovation system, a technological innovation system consists of the actors and institutions that influence the speed and direction of a new technological

innovation. The TIS literature argues that a well-functioning innovation system is needed to successfully develop and diffuse an innovation and is therefore important for societal transitions. The innovation system has to fulfill several key processes, such as entrepreneurial activities, knowledge development, knowledge diffusion through networks, guidance of the search, market formation, resource mobilization, and the creation of legitimacy (Hekkert et al., 2007). If these processes are positively fulfilled, they can reinforce each other. The result is a well-functioning innovation system.

The technological and sectoral innovation systems concepts share the same systemic view on innovation. In terms of system boundaries they complement each other. The TIS perspective focuses on specific technologies. These technologies may cross the boundaries of different sectors (e.g. ICT technology). It is also possible that sectors contain different technologies.

While both the SIS and TIS approach provide valuable insights for the study of transitions, they pay little attention to the micro-level (Autio et al., 2014; Markard and Truffer, 2008a). Generally in innovation system perspectives, entrepreneurs are assigned a crucial role, as they are argued to experiment with new ideas, concepts, and innovations, and they can turn the potential of new knowledge, networks, and markets into concrete actions to exploit new business opportunities (Chaminade and Edquist, 2005; Hekkert et al., 2007). However, there are relatively few studies that explore the link between the innovation system level and the level of innovating actors (Markard and Truffer, 2008b). As a consequence, our understanding of the motivation of different types of entrepreneurs to engage in the difficult process of introducing discontinuous innovations is limited. Furthermore, it remains unclear how they engage in this process using different strategic options available to them. In order to better understand the connections between micro-level behavior and the sectoral innovation system (the meso-level), and to better understand why and how actors might try to trigger institutional change, the discussion now turns to making the concepts of entrepreneurship, institutions, and strategy more explicit and relating them to societal transitions.

### **1.3.2 Entrepreneurship and innovation**

The concept of entrepreneurs is often used as a synonym for (the founders of) young start-up firms. While this seems to be a dominant view, there are some

signs that entrepreneurship can involve other actors. The entrepreneurship literature increasingly recognizes that entrepreneurial action can emerge in organizational arrangements other than start-ups, such as established firms (Autio et al., 2014). In innovation systems literature there are also some signs indicating that entrepreneurship goes beyond start-ups. Consider for instance Hekkert et al. (2007) who state that entrepreneurs can be either new entrants that exploit opportunities in new markets or incumbent companies who expand their business to exploit new developments.

In the entrepreneurship research field, entrepreneurship has been defined by innovation processes, risk-bearing processes, and market disequilibrium processes. The German Tradition (based mainly on the works of Von Thuenen and Schumpeter) probably has had the biggest impact on contemporary entrepreneurship literature (Audretsch, 2002) but also on the notion of entrepreneurs in transition frameworks (Autio et al., 2014). Schumpeter opposed the traditional views of the risk-bearing entrepreneur that functions as an equilibrium force; rather, Schumpeter sees entrepreneurship as a phenomenon that moves the economy away from a stable equilibrium. In his view, entrepreneurs are innovators that carry out one of the following tasks: creation of a new good or quality, the creation of a new method of production, the opening of a new market, the capture of a new source of supply, or the creation of a new organization or industry (Schumpeter, 1934). Entrepreneurs are therefore those individuals that identify new combinations and exploit these. Schumpeter further proposed a theory of creative destruction, where the innovative entrepreneurs displace the less innovative incumbent. These processes can lead to technological (paradigm) shifts and improve the economy in terms of economic growth. This view of entrepreneurship is clearly present in innovation system frameworks.

In innovation studies, several implicit assumptions are made about the distinction between entrepreneurs and incumbents. Innovation is directly associated with entrepreneurship. More specifically, discontinuous innovation - as opposed to incremental innovation - is often tied to entrepreneurship. Incremental innovation entails a small improvement of an existing phenomenon, while discontinuous innovation entails a large deviation from existing phenomena. Incumbents are associated with incremental innovation and the so-called incumbent's curse: incumbent firms are not expected to introduce

discontinuous innovations, mainly due to organizational filters, organizational routines, a lack of perceived incentives, and the lack of an innovation system that supports this introduction (Chandy and Tellis, 2000; Nelson and Winter, 1982). However, several studies have made clear that this curse has been overstated (Chandy and Tellis, 2000; Danneels, 2004). Market changes and potential competitive advantage can be attractive radical innovation opportunities for incumbents when they are in a strong position with respect to quality and quantity of resources, and experience in the sector (Chandy and Tellis, 2000; Danneels, 2004; Van de Ven et al., 1999). This dissertation therefore follows the approach of Shane and Venkataraman (2000) by defining entrepreneurs as individuals or organizations who discover or create an opportunity, evaluate this opportunity, and act to exploit it. These entrepreneurs can be incumbents.

The focus is specifically on entrepreneurs that discover or create opportunities for discontinuous innovations, i.e. innovations that build on knowledge, resources, and competences that are completely new to firms in the sector (Freeman, 1994). This implies that the discontinuous nature of an innovation needs to be judged with respect to a specific context. Discontinuous innovations also require new markets or significant changes in existing markets, new marketing skills for firms, and new business models to succeed (Borreau et al., 2012; Garcia and Calantone, 2002; McDermott and O'Connor, 2002). In this way, discontinuous innovations break from established components of an existing innovation system and have the potential to change the existing innovation system or trigger the build-up of a new innovation system. This view emphasizes that the entrepreneurs of interest in this dissertation can try to change the context in which they are embedded or shape a new one. Entrepreneurship literature has considered the context in which entrepreneurship occurs to some degree, but there is still a knowledge gap as the influence of context on entrepreneurial actions is generally only considered ad hoc, if at all (Autio et al., 2014). The field of institutional theory has recently focused precisely on the interplay between entrepreneurs and their context.

### **1.3.3 Institutional theory**

Institutional theory is strongly focused on explaining behavior with respect to specific contextual forces. Institutional theory argues that institutions determine behavior. Institutions are taken-for-granted social rules that stabilize and pattern

behavior (Meyer and Rowan, 1977; Oliver, 1991; Scott, 2008). They consist of normative, cognitive, and regulative elements (Scott, 2008). Early versions of institutional theory were primarily concerned with the taken-for-grantedness of social norms and rules and the impact of these rules or institutions on organizational behavior (Greenwood and Suddaby, 2006; Oliver, 1991). Through these taken-for-granted facets, behaviors are patterned and reproduced. This implies that conformity to existing institutionalized rules may lead to specific ways of doing and thinking (Garud and Karnøe, 2003).

This approach has increasingly been criticized as being used to explain persistence and homogeneity of phenomena (Dacin et al., 2002). Institutions can be created or changed over time, are not uniformly taken-for-granted, and are challenged and contested (Dacin et al., 2002). Scholars therefore face the challenge of explaining institutional change (Clemens and Cook, 1999). Initial studies focused on exogenous forces or jolts (Clemens and Cook, 1999; Greenwood and Suddaby, 2006). Examples of jolts are social upheaval, technological disruption, and regulatory change (Greenwood and Suddaby, 2006), i.e. sudden and unprecedented events (Meyer, 1982). The general effect of these jolts is that the existing institutional consensus is disturbed by an increased awareness of extant and alternative logics and a heightened uncertainty. This enables the emergence of new (and demise of old) actors, practices, organizational forms and rules, i.e. the possibility of change (Lounsbury, 2002).

More recent work goes into institutional change triggered by the behavior of organizations (Dacin et al., 2002; Greenwood and Suddaby, 2006; Oliver, 1991). However, when introducing interest and agents (i.e. deliberate change by actors) into institutional theory, difficulties are often encountered due to the central assumption of institutional theory that actors and interests are themselves institutionally constructed (Seo and Creed, 2002). This so-called paradox of embedded agency is a central challenge for institutional theory, specifically when trying to show why and how actors become motivated and enabled to change the institutions that simultaneously shape their behavior (Greenwood and Suddaby, 2006).

There are two main approaches to solving this paradox. The first approach centers on the idea that the determining power of institutions is clear and that

institutional change results from the accumulation of different acts that are not intentionally aimed at generating change (Dorado, 2005; Greenwood et al., 2011). The second approach argues that some actors become enabled to escape this determining power of institutions due to overlap of and conflicts between different institutional settings (Dorado, 2005; Greenwood et al., 2011). In line with the second approach, attention for institutional change triggered by organizations has increased, and the notions of institutional logics and institutional entrepreneurship have become very important.

Institutional logics are *“the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality”* (Thornton and Ocasio, 1999, p. 804). A core assumption of the institutional logics approach is that interests, values, and assumptions of actors are embedded in prevailing institutional logics (Thornton and Ocasio, 2008). An institutional logic prescribes goals (e.g. values and missions) and corresponding means (e.g. practices, technologies, organizational forms, courses of action) that are both viewed as legitimate (Pache and Santos, 2010). In this way logics prescribe organizational reality, appropriate behavior, and how to succeed, thereby forming a link between agency and cognition on the one hand and socially constructed institutional practices and rule structures on the other (Thornton, 2004; Thornton and Ocasio, 2008).

Logics influence the selection and legitimacy of innovations (Fuenfschilling and Truffer, 2014; Lounsbury, 2002). In order to obtain the resources to successfully develop and diffuse an innovation, actors must convince others of the legitimacy of their innovation relative to how the currently prevailing logics evaluate these activities (Greenwood et al., 2011; Thompson, 2013). The institutional logics approach is not so much focused on isomorphism but more on the effects of different logics on actors in different contexts (Thornton and Ocasio, 2008). Practices and structures are tangible manifestations of institutional logics (Greenwood et al., 2011). At the field level, normative criteria become encoded in field-level logics that are manifested in practices, rituals, and structures (Greenwood et al., 2011; Thornton and Ocasio, 2008).

An organizational or institutional field is described by DiMaggio and Powell (1983, p. 148) as *“those organizations that, in aggregate, constitute a*

*recognized area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products*". Surprisingly, little attention has been given to comparing institutional fields (Greenwood et al., 2011). An implicit approach to comparing fields is the distinction between mature and emerging institutional fields. Emerging institutional fields are often characterized by strong conflicts between logics, as actors battle to prioritize logics that support their interests and beliefs. This can create uncertainty, as institutional demands are not clear. In mature institutional fields it is more likely that stable priorities between logics have emerged. In this setting it is likely that institutional demands are more predictable. This distinction suggests that entrepreneurial actions in mature fields differ from entrepreneurial actions in emerging fields, as entrepreneurs face different institutional pressures and thus have to gain legitimacy in different ways. A transition can then be seen as a competition between mature institutional settings and emerging institutional settings (Buser and Koch, 2012).

The main contribution of the logics approach to solving the paradox of embedded agency is that it conceptualizes adherence to dominant institutions as probabilistic rather than deterministic (Thompson, 2013). It is argued that conflicting institutional pressures can open organizations' eyes with respect to possible alternatives. Actors can become motivated and enabled to try and change existing institutional settings. However, our understanding of organizational responses to different institutional settings remains selective (Greenwood et al., 2011; Pache and Santos, 2010). Competing logics by themselves are not an explanation for change in institutional logics but rather an antecedent or consequence (Thornton and Ocasio, 2008). Institutional change requires that some agents at least perceive and exploit the contradicting institutional logics. This is where institutional entrepreneurship comes into play. Contradicting institutional logics can create opportunities for institutional entrepreneurs to change the existing institutional setting (Thornton, 2004).

Institutional entrepreneurs are (organized) actors that can see the need for new institutions to advance their interests, while simultaneously being influenced by existing institutions (DiMaggio, 1988; Garud et al., 2002; Garud et al., 2007; Greenwood and Suddaby, 2006; Maguire et al., 2004). When actors envision new institutional arrangements and undertake actions to realize this new institutional setup they function as institutional entrepreneurs (DiMaggio, 1988;

Greenwood and Suddaby, 2006; Maguire et al., 2004). Battilana et al. (2009) argue that actors must fulfill two conditions to be regarded as institutional entrepreneurs: 1) actors must initiate changes that break with the institutionalized template for organizing in the context under study, and 2) actors must actively participate in the implementation of these changes by mobilizing resources. Institutional entrepreneurs thus use their resources and capabilities to create new or change existing institutions (Battilana et al., 2009; Garud et al., 2007; Maguire et al., 2004). However, the degree of intentionality can differ between entrepreneurs, i.e. actors do not need to intentionally change their environment through grand plans to be viewed as institutional entrepreneurs, as long as their actions contribute to change that breaks with the institutionalized template for organizing in the context under study (intentionally or unaware). Also, their change-oriented actions do not have to be successful (in overthrowing a mature innovation system or establishing a new one) in order to classify these actors as institutional entrepreneurs.

Institutional entrepreneurs can be individuals, organizations, or groups of individuals/organizations (Battilana et al., 2009; Garud et al., 2002; Maguire et al., 2004). The presented definition of institutional entrepreneurship also includes incumbents that initiate discontinuous innovations. However, this approach of institutional entrepreneurship has tended to frame institutional entrepreneurs as 'heroes' that singlehandedly change fields (Wright and Zammuto, 2013).

Recent studies have started to move away from this heroic view of individuals and have stressed the role of collective actors embedded in different contexts as institutional entrepreneurs (Battilana et al., 2009; Greenwood et al., 2011). Collective action allows institutional entrepreneurs to band together to overcome resistance from the status quo (David et al., 2013). Related research led to the insights that collaborations can give rise to proto-institutions, i.e. new rules, regulations, and technologies that diffuse beyond the boundaries of the collaboration and have the potential to become new institutions in the field (Lawrence et al., 2002; Phillips et al., 2000; Zietsma and McKnight, 2009). However, the motivations of incumbents behind engaging in collective efforts and their strategic actions remain unclear.

Actors and institutions are also central components in innovation system frameworks. Institutions are usually incorporated as the rules of the game. Institutional theory shows that institutions are essential for our understanding of how actor behavior is influenced by the environment in which they are located and vice versa. Institutional entrepreneurs are exactly those entrepreneurs that are of interest for transitions, as they exploit opportunities and attempt to introduce change that breaks with the existing innovation system. While an innovation system approach mainly focuses on the role of entrepreneurs in introducing technological innovations into the innovation system as a change mechanism, institutional entrepreneurship mainly focuses on the role of entrepreneurs in introducing or changing institutions. This dissertation combines the insights from both perspectives. In this way, the transformation of sectors (and ultimately society) is the result of both technological and institutional changes.

This discussion illustrates that the integration of insights from transition studies and institutional theory can be very fruitful, but the interplay between institutional forces and organization's motivations and actions requires further consideration. The analysis of actor strategies is therefore at the forefront of this dissertation.

#### **1.3.4 Strategy**

In innovation system frameworks, strategy is seen as a set of plans and actions of actors. When looking at the entrepreneurs in innovation systems, there seems to be an emphasis on interaction/cooperation and learning through strategy (Edquist, 2004; Hekkert et al., 2007). Using institutional theory Oliver (1991) explicitly discusses the behavior of organizations in direct response to their institutional environment, i.e. the link between motivations for change and the context. She argues that depending on the nature and context of institutional pressures organizational behavior can vary between passive conformity to active resistance. Five institutional factors are predicted to be of importance, namely cause (why the pressures are being exerted), constituents (who is exerting them), content (what these pressures are), control (how they are exerted), and context (where they occur).

Oliver (1991) identifies five strategic responses of organizations to institutional pressures: acquiescence (conform), compromise (balance and negotiate with

stakeholders), avoid (disguise or buffer against effects of nonconformity), defy (contest rules and assault sources of pressures), and manipulate (shape values and dominate institutional processes). While Oliver (1991) does not mention institutional entrepreneurship explicitly, defy, and manipulate correspond with institutional entrepreneurship, as they cover changes that break with the existing institutional setting. Clemens and Douglas (2005) show that compromise can also be considered as institutional entrepreneurship from an organization's perspective. This strategy covers tactics such as bargaining and balancing expectations, which could also trigger change.

Looking at the strategy concept at an aggregated level, it seems two aspects are of importance: 1) setting goals and 2) making decisions/undertaking actions to reach these goals. Both goals and decisions/actions can differ, leading to different notions of strategy. Based on Chandler (1962), Mintzberg (1978) and Hitt et al. (2001), in this dissertation strategy is defined as: the determination of goals and the set of commitments, decisions, and actions designed and executed to reach these goals.

The definition of strategy consists of two parts. The first part is related to the determination of goals. A classic trade-off in strategy goals for entrepreneurs is between profit and growth (Collis and Rukstad, 2008; Porter, 1996). Firms can differ in terms of the goals they set. Furthermore, goals can change over time; new firms likely have different goals than older firm. This can also be true for firms exploiting new technologies compared to firms exploiting old, established technologies or for firms located in rapidly changing environments (Anderson and Zeithamel, 1984; Baum and McGahan, 2004). The goals of firms are also interesting from a transition perspective; firms that explicitly include innovation system change as part of their goals could contribute to a transition and at the same time improve the financial performance of their firm (as their business can likely benefit from the innovation system's change). The second part of the strategy definition is related to commitments, decisions, and actions that are aimed at achieving the goals set by firms. Goals can be reached in different manners but always require the firm to undertake some action and make choices (for instance, a choice between competing and cooperating). The definition of strategy is intentionally broad in this respect, in order to include all possible commitments, decisions, and actions.

This dissertation focuses specifically on actions that are aimed at the external environment as opposed to actions that are internal to the firm. While the latter category is certainly part of strategy, the focal entrepreneurs in this dissertation face the difficulty of operating in environments that are not fully compatible with their innovation; the externally focused part of their strategy could improve their chances of success. If firms only pay limited attention to the external environment, this could hinder their own performance as well as a potential transition. Even when innovation system change is not part of a firm's goals, the firm can (be it intentional or not) undertake innovation system changing actions.

### **1.3.5 Overview of the analytical framework**

The interplay between incumbents and the context in which they are embedded lies at the heart of this dissertation. Figure 1.1 shows the general theoretical framework guiding this dissertation. The outer border represents society, while the inner border represents a sector embedded in society. The main focus of the dissertation is on, 1) specific actors, namely incumbents acting as institutional entrepreneurs (left circle), 2) specific institutions, namely new or changed beliefs, practices, rules, and standards (right dashed circle), and 3) the two-way interaction between incumbents and institutions (middle arrow). On the one hand, institutions influence and obstruct incumbents functioning as institutional entrepreneurs. Existing, mature sectors are likely to have mature institutional settings with strong pressures. Emerging sectors are likely to have emerging institutional settings but are not formed in some institutional void; institutional pressures from other fields influence actors' behavior in emerging sectors. On the other hand, incumbents functioning as institutional entrepreneurs can envision and enact institutional changes. The actors under study are incumbents that attempt to introduce discontinuous innovations (related to transformations towards a more sustainable sector).

By changing institutions or introducing new institutions, incumbents can influence the institutional setting of a sector. The enacted institutional changes are not immediately diffused to the level of the entire sector. The earliest enacted institutional changes are viewed as proto-institutions, i.e. new beliefs, practices, rules, and technological standards that have the potential to become actual institutions in the sector when social processes develop that entrench and diffuse the proto-institutions (Lawrence et al., 2002). Therefore, the border around changed institutions in figure 1.1 is dashed instead of solid.

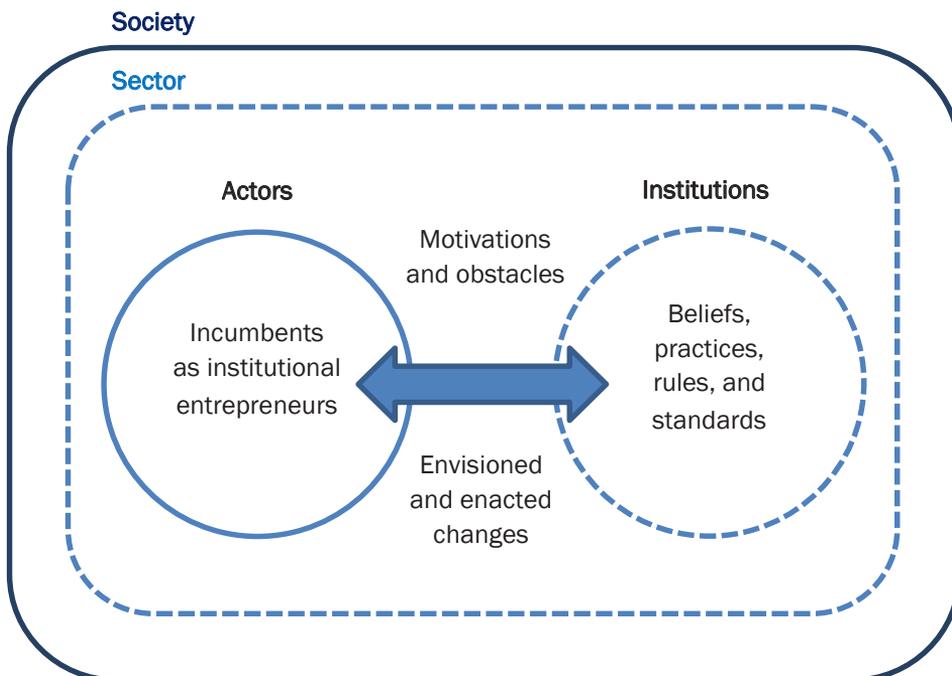


Figure 1.1: Overview of key concepts

While changes in society can influence actors and institutions in sectors and changes in the institutional setting of sectors can influence other sectors or society as a whole (as represented by the dashed border around the sector in figure 1.1), these interactions are not at the forefront of this dissertation. Earlier studies have often shown how societal changes can create opportunities for institutional change such as the emergence of new kinds of organizations (David et al., 2013; Sine and David, 2003). However, these studies often ignore the fact that actors must perceive these change opportunities and the subsequent work that actors must do to capitalize on them (David et al., 2013). Therefore, the focus in this dissertation intentionally is on the work actors must do to enact institutional change rather than on contextual changes or jolts that might create opportunities for change. Relevant societal trends or changes are discussed in the following chapters, but the analysis focuses on the way in which incumbents

use these changes to enact institutional change and the social processes which could lead to sectoral change.

The micro-meso-interaction between incumbents and institutions is studied by analyzing why incumbents become motivated to function as institutional entrepreneurs and by analyzing how these incumbents attempt to enact the institutional changes. This dissertation moves away from the hero-view of institutional entrepreneurs and attempts to enhance insights into how institutional transformations can be enacted by (groups of) incumbents acting as institutional entrepreneurs. As the societal transition discussed in the introduction is still underway, it is not possible to draw definitive conclusions on the relations between sectoral change and a societal transition. This meso-macro-interaction is highly relevant and interesting, but in order to study this interaction more insights into the described micro-meso-interactions are needed.

#### **1.4 Case selection and outline of dissertation**

In order to determine why and how incumbents act as institutional entrepreneurs in different institutional settings, three different sectors are studied: the greenhouse horticulture sector, the built environment sector, and the bio-plastics sector.

The greenhouse horticulture and built environment sectors are selected as they can be viewed as strongly institutionalized, mature settings. Due to their long historical developments, both sectors have established clear rules and regulations as well as a clear way of doing business. At the same time, both sectors struggle with several issues that are common in the mature stage, such as diminishing profits and an emphasis on incremental process innovation. In both sectors several attempts to change the sector from within by embedded incumbent organizations are observed. As argued above, endogenous change is not expected in highly institutionalized settings. The paradox of embedded agency is at its most forceful in these cases (Greenwood and Suddaby, 2006). Therefore, these cases are likely to provide insight into strongly motivating forces and intentional change actions, which is in line with the main research question of this dissertation.

In order to more fully understand why and how incumbents function as institutional entrepreneurs, it is important to consider different institutional settings. The bio-plastics sector is selected as it represents an emerging sector where technological developments and institutional change are at the forefront. In this emerging sector there are no clear and/or dominant institutional pressures yet, which creates uncertainties (for instance with respect to the likely path of technological development) and opportunities (as there is relatively more institutional room for actors to operate in). Therefore, drivers and strategies of incumbents functioning as institutional entrepreneurs in this emerging sector likely differ from their drivers and strategies in mature sectors.

Additionally, the agriculture, built environment, and plastics sectors are all large consumers of energy and materials, and transformations in these sectors are crucial in order to facilitate a societal transition. A transition can be seen as the result of transformations in existing sectors and the emergence of new sectors. Therefore, this dissertation covers both mature and emerging sectors.

The following chapters present the studies performed on these sectors. While there are some methodological differences between the chapters, the overall research design follows a qualitative case study approach. The use of a qualitative approach is justified, as the causal dynamics behind the observed changes were not clear beforehand (Stake, 1994; Greenwood and Suddaby, 2006). In general, each chapter employs two broad research steps. In the first step, a general historical analysis of the sector under study is performed in order to understand the roles of different actors and the institutional pressures in the sector. The second step entails a more detailed analysis of selected incumbents in order to determine their motivations and actions with respect to the sector in which they are embedded.

Each chapter is based on an analysis of a variety of data sources including newspaper articles, industry journal articles, press releases, policy reports, websites of key actors, and interviews. The written sources are mostly used to identify the general pressures of the institutional setting under study. Semi-structured interviews with key actors, including managers from entrepreneurial incumbents, university experts, and supporting organizations (such as trade associations and knowledge institutes) are used to verify and complement the

historical analysis and to gain a more in-depth understanding of drivers and actions of institutional entrepreneurs.

While these data sources often contain some bias, these data sources reflect the attention of specific populations and their situated perspectives (Hoffman, 1999), making these sources ideal for the analysis of the influence of and impact on institutional pressures. Consider for instance articles from industry journals and newspapers, which present views aimed at a certain public or with a certain effect in mind. The use of different types of data sources enhances the credibility of the results; the wide range of used informants and written sources allows for the triangulation of results based on the different viewpoints (Shenton, 2004). By interviewing different types of actors within each case a more complete understanding of motivations and triggers for institutional change is obtained. The overall conclusions of this dissertation are based on a comparison of the results in the different chapters against the general overview in figure 1.1.

Table 1.1 provides the title of each chapter, the studied sector, and shortly discusses how the chapter is related to the overall aims and research question of this dissertation. Below each chapter is introduced by discussing the studied sector in more detail and explaining how each of the studies on these sectors contributes to answering the main research question.

The Dutch greenhouse horticulture sector is known for its global competitiveness (Berkers and Geels, 2011; Porter, 1990). The success of this sector is remarkable when one considers that the primary inputs, land and climate, are far from optimal in the Netherlands. This illustrates the importance of innovation in the sector (Berkers and Geels, 2011; Porter and Van der Linde, 1995). Today, the sector is in the mature phase of the lifecycle. Historical developments have created strong support in the sector for incremental technological process innovations. However, currently the sector is facing difficulties. Profits have been decreasing, international competition has increased, and many firms go bankrupt. Several incumbents have emerged that try to break from this trend by introducing discontinuous innovations. The discontinuous nature of their innovations is primarily related to new business models. In chapter 2 – *Discontinuous innovation by incumbents in the Dutch greenhouse horticulture sector* – the introduction of discontinuous innovations by several incumbent actors in the greenhouse horticulture sector is studied. The main question is:

Table 1.1: Overview of chapters

| <b>Chapter</b>  | <b>Studied sector</b>                | <b>Link to overall research question</b>  |
|---|--------------------------------------|---|
| <i>2 - Discontinuous innovation by incumbents in the Dutch greenhouse horticulture sector</i>                               | Dutch greenhouse horticulture sector | Analyzes why incumbents become motivated to act as institutional entrepreneurs and how they strategically act as a consequence.<br><br>Focuses on a mature institutional setting in an existing, mature sector.   |
| <i>3 - Institutional change from within: the emergence of proto-institutions in the Dutch built environment sector</i>      | Dutch built environment sector       | Analyzes why incumbents become motivated to act as institutional entrepreneurs, how they use collaboration to enact institutional change as a consequence and how this can lead to sector-wide changes.<br><br>Focuses on a mature institutional setting in an existing, mature sector. |
| <i>4 - How institutional complexity enables and blocks sustainable innovations: the field of bio-plastics</i>               | Global bio-plastics sector           | Analyzes how a complex, emerging institutional setting influence incumbents to act as institutional entrepreneurs and what type of strategic activities they perform as a consequence.<br><br>Focus on an emerging institutional setting in a new, emerging sector.                     |
| <i>5 - The role of strategic alliances in creating technology legitimacy: a study on the emerging field of bio-plastics</i> | Global bio-plastics sector           | Analyzes how strategic alliances of incumbent firms are used to obtain legitimacy and enact institutional changes.<br><br>Focus on an emerging institutional setting in a new, emerging sector.   |

*What are the strategies used by incumbent firms to introduce discontinuous innovations within the boundaries of an existing mature innovation system?* This chapter explicitly relates the strategies of these firms to the context in which they are located. Additionally, strategy differences between incumbents developing discontinuous innovations that include sustainable technologies and incumbents developing discontinuous innovations that do not include sustainable technologies are studied. This chapter establishes which barriers are present in this existing, mature sectoral innovation system according to the studied incumbents and how this influences or drives the incumbents in developing their discontinuous innovations. This chapter thus focuses on the micro-meso-interaction depicted at the center of figure 1.1.

In chapter 3 – *Institutional change from within: the emergence of proto-institutions in the Dutch built environment sector* – incumbents introducing discontinuous innovations in the built environment sector are studied. This sector is also in the mature phase. For several years the economic and environmental performance of this sector has been criticized. It is argued that changes in regulations, technologies, and culture are needed, as the sector is not structurally profitable and is a large source of energy- and material consumption. However, many studies have established that the sector is very risk-adverse and incentives for change and innovation are missing. In this rigid institutional setting, several innovative projects have emerged. Led by incumbent organizations, these projects strive to break from the traditional way of doing business, while supporting a change to a more sustainable sector. These projects contain both technological innovations and organizational innovations. This chapter looks into *why* incumbents in this sector act as institutional entrepreneurs and *how* collaborations in this sector lead to the emergence of new institutions. The production process in this sector is project-based which makes some form of collaboration within projects necessary. Several innovative projects are identified in which incumbent organizations try to develop innovations and enact transformations together. This chapter provides more insights into the process of triggering institutional transformations through collective acts of entrepreneurship. Furthermore, it goes into the social processes that influence the diffusion of institutional changes to the sector level.

The following two chapters present studies on the bio-plastics sector. The global plastics sector has steadily grown since the 1950s and shows no signs of slowing

down. Plastics represent the largest field of application for crude oil. Today, plastics are increasingly being linked to several environmental issues, including issues of waste, fossil resource depletion, and climate change. Due to these new pressures for sustainability, the plastics sector came under pressure to develop sustainable innovations. During the time when these sustainability pressures were starting to influence the plastics sector, the agricultural sector was also experiencing pressures to change. Due to a massive production surplus in the 1980s and the related rising policy costs, arguments arose that the agricultural sector needed to look for the application of their products in non-food markets. It was envisioned that this could help both the economic and environmental performance of the sector. At the intersection of these sectors, the bio-plastics sector emerged. Bio-plastics are bio-degradable and/or bio-based. The institutional field surrounding bio-plastics is still taking shape, and organizations in this sector face the challenge of dealing with pressures from both mature sectors, as well as the lack of established institutions in this emerging sector.

Chapter 4 – *How institutional complexity enables and blocks sustainable innovations: the field of bio-plastics* – looks at the formation of the institutional setting in the emerging bio-plastics sector. The main research question is: *What is the role of institutional complexity in the development and diffusion of bio-plastics?* This chapter establishes how a new sector can emerge from shifting institutional pressures in existing sectors. The main focus of this chapter is on the influence of an emerging institutional setting (as opposed to the mature institutional settings studied in the previous chapters) on the actions of incumbents, by studying how established firms from the involved mature sectors undertake actions to develop bio-plastics and enter the emerging sector. The chapter further presents how this complex institutional setting can trigger and hinder sustainable innovations. This provides insights into the motivations and actions of incumbents becoming institutional entrepreneurs in relation to an emerging institutional context as opposed to a highly institutionalized setting.

Many experts argue that the development of bio-plastics depends on capabilities and resources that are spread over organizations from different sectors. Therefore, strategic alliances are seen as crucial for the success of this emerging sector. Chapter 5 – *The role of strategic alliances in creating technology legitimacy: a study on the emerging field of bio-plastics* – zooms in on the strategic action of forming alliances in an emerging field as a manner in which

institutional change is enacted. In this way the collaboration strategies studied in chapter 3 are revisited in an emerging setting. While a general view is that alliances are formed in order to obtain and/or share resources, this chapter looks at the way in which alliances are used to gain legitimacy in this emerging field. As argued before, gaining legitimacy is crucial for the success of discontinuous innovations. This chapter therefore provides insights into collective actions that can contribute to enhancing the legitimacy of innovations or the legitimacy of the field in general.

Finally, chapter 6 concludes this dissertation. The chapter starts with an overview of the main findings of the previous chapters. Hereafter, five overall conclusions are drawn from the previous chapters. The chapter ends with a discussion of limitations and provides several recommendations for incumbents and policy makers.



## 2. Discontinuous innovation by incumbents in the Dutch greenhouse horticulture sector<sup>1</sup>

### 2.1 Introduction

Well-performing, innovative sectors are an important source of national competitiveness and sectors continuously need to innovate to sustain their competitive advantage (Porter, 1990). This is especially challenging for mature sectors. Life cycle perspectives on sectoral change state that while early in their life cycle sectoral systems can be adequately described as *sectoral systems of innovation* the focus shifts towards production as the sector matures (Malerba, 2002; Markard and Truffer, 2008a; McDermott and O'Connor, 2002; Van den Hoed, 2006). In this mature phase, costs become the main basis for competition and innovations are mainly incremental, process oriented, and developed by suppliers (Klepper, 1997; Utterback, 1994). Actors, technologies, and institutions in this phase are all perfectly aligned making it difficult to introduce novelty into the sectoral innovation system. Consequently these mature systems are often characterized by inertia.

In some cases mature sectors break out of this inertia and a new wave of innovation starts. Such innovations are often labeled discontinuous innovations (Lynn et al., 1996) to indicate that the existing competences, production skills, and knowledge poorly fit with the new innovation (Utterback, 1994) or that technological trajectories are changing due to the introduction of the innovation (Dosi, 1982). Common sources of discontinuous innovations in mature industries identified in the fields of industrial dynamics, strategic management, and innovation systems are: exogenous shocks, technological developments, market changes, and new entrants (Bessant and Tidd, 2007; Christensen, 1997; Utterback, 1994; Van den Hoed, 2006). Incumbent firms are not expected to

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<sup>1</sup> This chapter is based on Kishna, M., Negro, S., Alkemade, F. and Hekkert, M. (2014). Discontinuous innovation by incumbents in mature innovation systems (under review after resubmission at Industry & Innovation) and on Kishna, M., Negro, S., Alkemade, F. and Hekkert, M. (2012). Radical innovation strategies of environmental-technology entrepreneurs in the Dutch greenhouse horticulture sector, *Social and sustainable enterprise: changing the nature of business*, p. 25-47.

introduce these innovations mainly due to organizational and environmental factors. This is coined as the incumbent's curse (Chandy and Tellis, 2000). The organizational factors hindering incumbent firms to engage in discontinuous innovation include organizational filters, organizational routines, and a lack of perceived incentives (Chandy and Tellis, 2000; Christensen, 1997; Nelson and Winter, 1982), while environmental factors relate to the sectoral system of innovation and production in which the incumbent firm is embedded (Malerba, 2002). This sectoral innovation system is an important source of innovation inputs but can be ill-aligned with innovations that differ from the competence/knowledge base and technological trajectories that characterize the sector, as these innovations build on new knowledge, resources, and competences and require institutional change (Freeman, 1994). These organizational and innovation system factors explain that discontinuous innovation often has large effects on industry structure; the exit of incumbent firms and the entry of new entrants (Breschi et al., 2000).

However, several recent studies argue that the incumbent's curse has been overstated (Danneels, 2004). Indeed, literature on innovation persistence illustrates that incumbents can be an important source of discontinuous innovation (Cefis, 2003; Clausen et al., 2012). Market changes and industry competition can provide attractive innovation opportunities for incumbents when they are in a strong position with respect to quality and quantity of resources and experience in the sector (Chandy and Tellis, 2000; Danneels, 2004; Van de Ven et al., 1999). Apparently in these cases the sectoral innovation system does not withhold incumbents from the development of discontinuous innovations.

In this chapter we focus on how incumbents deal with the existing, mature sectoral innovation system when developing and commercializing discontinuous innovations. Our overall research question is therefore: *What are the strategies used by incumbent firms to introduce discontinuous innovations within the boundaries of an existing mature innovation system?*

Additionally, we investigate if strategies differ between discontinuous innovations related to sustainable technologies and discontinuous innovations not related to sustainable technologies. Several studies argue that sustainable innovations encounter more barriers than non-sustainable discontinuous innovations. According to Rennings (2000), markets do not punish harmful

environmental impacts, thereby distorting the competition between environmental and non-environmental innovation. Furthermore, the regulatory framework (especially environmental policy) has a strong impact on sustainable innovation, as sustainable innovations are normally not self-enforcing.

In the literature on discontinuous innovation by incumbents the focus is traditionally on large and powerful incumbents that are able to change sectoral technological trajectories. Much less attention is given to sectors, like the agricultural sector, that are characterized by a very large number of incumbent firms with limited size, resources, and power. We expect that these firms need specific strategies to deal with opposing forces in the innovation system. For this reason, we study the innovation patterns in the Dutch horticulture sector that can be characterized by a large number of incumbent firms.

The Dutch horticulture sector has a strong innovation tradition and stands out for its global competitiveness as well as its innovative incumbent firms (Berkers and Geels, 2011) and was selected by Michael Porter (1990) as a success case of an industrial cluster. Today, the sector faces typical problems associated with the mature phase of the lifecycle as profits have been decreasing and many firms go bankrupt.

Using a multiple case study method, we analyze ten cases of incumbent entrepreneurs introducing discontinuous innovations in this sector in order to break the negative trends in the sector. The incumbent firms under study are all diversifying incumbents that have many years of experience in the sector. The discontinuous nature of their innovations is primarily related to new business models, but the innovations incorporate some new technologies or new applications of existing technologies. These innovations build on completely new competences that are currently missing in the sectoral innovation system (Utterback, 1994). The used qualitative approach allows us to make a detailed analysis of the interplay between entrepreneurial incumbents and the innovation system. These insights are important for understanding why and how incumbent firms break out of existing sectoral institutional structures and start discontinuous innovation.

## 2.2 Discontinuous innovation and incumbents

### 2.2.1 Sectoral systems of innovation and production

The innovation system concept highlights the collective nature of innovation and the interdependencies between organizations and institutions in the development and diffusion of innovation. A system in general consists of *components* and *linkages* between the components (Chaminade and Edquist, 2005; Markard and Truffer, 2008b). The components are actors and institutions. Actors are located in several sub-systems: the production or value chain, governmental organization, research and education organizations, and the market. Institutions are more passive; they shape the behavior and interactions between actors but are also made and changed through actor behavior and interaction (Markard and Truffer, 2008a). Innovation is primarily understood as emerging from actors that interact in an institutional context (Hekkert et al., 2007). Three types of institutions are identified: regulative, normative, and cognitive institutions (Scott, 2001). Institutions favor specific sets of activities and constrain others. The different actors and institutions are related in a systemic way and influence the development, diffusion, and implementation of innovations (Bergek et al., 2008; Negro and Hekkert, 2008). A well-functioning innovation system is required to successfully develop and diffuse innovations, although the way in which this is realized may differ over the life cycle of an innovation system (Alkemade et al., 2007; Negro and Hekkert, 2008).

Innovation systems can be delineated in different ways: at the national, regional, sectoral, and technological level (Freeman, 1987; Hekkert et al., 2007; Lundvall, 2007; Malerba, 2002; Tödtling and Tripl, 2005). This chapter focuses on the Dutch horticulture sector and we therefore use the sectoral innovation system as our theoretical framework. A sectoral innovation system is “*a set of new and established products for specific uses and the set of agents carrying out market and non-market interactions for the creation, production, and sale of those products*” (Malerba, 2002, p. 248). The elements of a sectoral system include its knowledge base, technologies, inputs and demand, the organizations and individuals, and the interactions between them. These interactions are shaped by institutions that are also included in the system definition. As these elements co-evolve the sector changes over time and lead to stable system structures for mature sectoral innovation systems. Major changes in the innovation pattern of the sector are usually the result of major market and technological

discontinuities and have a disruptive effect on the sector since existing institutions, practices, and knowledge bases are poorly aligned with the discontinuity (Breschi et al., 2000).

### **2.2.2 Discontinuous innovation in innovation systems**

The process of breakthroughs and discontinuous innovation is a central topic in innovation studies (Markard and Truffer, 2008a). Discontinuous innovations, as opposed to incremental innovations, build on new knowledge, resources, and competences and are completely new to firms in the sector (Freeman, 1994). Discontinuous innovation may also require new markets or significant changes in existing markets, and/or new marketing skills for firms (Borreau et al., 2012; Garcia and Calantone, 2002; McDermott and O'Connor, 2002). Therefore, these innovations often require new business models to succeed in the marketplace; new business models can even be considered a crucial part of discontinuous innovation, illustrating that discontinuous innovations go beyond just technological advances (Borreau et al., 2012; Teece, 2010).

The development and commercialization of discontinuous innovations is far more difficult compared to sustaining innovations within mature innovation systems (Van de Ven et al., 1999). The knowledge base and institutional rules in mature innovation systems are perfectly aligned with sustaining innovations while they may be a poor match with discontinuous innovations. Also, the influence of sustaining innovations on the innovation system is limited while discontinuous innovations have major impacts on the structure and functioning of mature systems of innovation and production (Garcia and Calantone, 2002).

Ideally, firms developing discontinuous innovations can use innovation systems as a source of new knowledge, resources, and competences. However, in mature industries, the existing innovation system can be ill-aligned with discontinuous innovations (Freeman, 1994; Van de Ven et al., 1999). There is often little knowledge and experience regarding discontinuous innovation processes in existing innovation systems since the required knowledge, resources, and competences differ significantly from those that are in place in the current innovation system. Additionally, there can be an unwillingness to change current practices or to support discontinuous innovations by other actors. This can be related to the aforementioned lack of knowledge, resources or competences but can also be the result of more strategic behavior. Actors with large vested

interests in the current system will likely protect their position, which could be overthrown by discontinuous change. However, despite the unlikely appearance of discontinuous innovation in mature systems, it still occurs.

### **2.2.3 Incumbents as a source of innovation**

The literature generally states that outsiders introduce discontinuous innovation. Incumbents are not expected to introduce discontinuous innovation. However, several instances of incumbents as developers of discontinuous innovation have been identified. These studies have identified three main factors that explain why incumbents can become a source of discontinuous innovation. First, large incumbent organizations often have strong technological capabilities. Their R&D and human resources can help in developing, absorbing, and marketing of discontinuous innovations (Chandy and Tellis, 2000; Dewar and Dutton, 1986; Ettlie et al., 1984). Second, dynamic organizational structures and competences can prevent the barriers created by organizational filters and routines mentioned earlier (Chandy and Tellis, 2000; Dewar and Dutton, 1986; Ettlie et al., 1984; Nelson and Winter, 1982). Large incumbent firms can have a large diverse workforce, and also a division in competing business units that innovate. Finally, market changes and industry competition can provide attractive discontinuous innovation opportunities for incumbents (McDermott and O'Connor, 2002). Discontinuous innovations can form the foundation of a strong competitive advantage (Veryzer, 1998). If large existing markets demand discontinuous innovation, incumbents can be in a resource position to meet this demand (Danneels, 2004; Greenwood and Suddaby, 2006). In fact, in some cases incumbents can be in such a strong position with respect to quality and quantity of resources, access to market, and experience in the sector, that they lead the sector (Chandy and Tellis, 2000; Danneels, 2004; Greenwood and Suddaby, 2006; Van de Ven et al., 1999). In this case incumbents can force change, even without the need for a supporting system. However, not all sectors are characterized by the presence of large incumbents that are in such a strong position to force change.

Focusing on incumbents without the power/resource position that can force change, we expect that it is even harder for these incumbents to withstand the forces of inertia within mature innovation systems. Under what circumstances incumbents in this position are likely to start discontinuous innovation and what strategy they deploy is an unresolved issue in the literature.

### 2.2.4 Additional challenges for sustainable innovations

Incumbents developing discontinuous innovations related to sustainable technologies can have an even greater challenge ahead of them. Literature on sustainable or eco-innovations emphasizes that sustainable innovations encounter more barriers than non-sustainable innovations, as markets do not punish environmental harmful impacts, thereby distorting the competition between environmental and non-environmental innovation (Rennings, 2000). Formal institutions such as laws and regulations also strongly impact the development of sustainable innovations. Barriers for sustainable innovations can be classified as follows:

- Technological barriers: There are often issues in the switch to sustainable innovations and incompatibilities with existing technologies (Arundel and Kemp, 2009).
- Financial barriers: There is a lack of available financing, due to the perceived high risk associated with sustainable technologies (Calleja et al., 2004; Smith, 2001). Banks and investors are often geared towards short-term objectives; this is incompatible with the nature of sustainable technologies.
- Market barriers: Market prices often do not reflect external costs of products or services and are high due to the lack of available capital (Arundel and Kemp, 2009). Sustainable technologies are often bought by consumers with a high degree of environmental awareness, but this group is not very large in most markets, demonstrating a general lack of demand (Arundel and Kemp, 2009; Calleja et al., 2004).
- Regulatory barriers: While regulations and standards can be a stimulus for sustainable technologies, regulations can become barriers when they are unclear or too detailed (Arundel and Kemp, 2009). Heavily subsidized markets are risky, as these markets might disappear once policy priorities change. Furthermore, regulations could be heavily aligned with existing technologies, hindering the diffusion of new sustainable technologies.

We therefore expect that incumbents have an even harder time when developing discontinuous innovations that incorporate sustainable technologies. These

incumbents could therefore employ different strategies compared to incumbents introducing discontinuous innovations that are not related to sustainable technologies.

### **2.3 The Dutch horticulture sector**

The Dutch greenhouse horticulture sector is a sector that is characterized by a large number of incumbent firms with a relatively modest size; in 2013 there were around 5,000 firms with an average of 30 employees (LEI Wageningen UR, 2014). The sector contributes approximately 10% added value and employment to the Dutch economy (Berkhout and Roza, 2012).

The sector is known for its innovativeness; after World War II Dutch greenhouse farmers became world leaders, especially in tomatoes and flowers (Berkers and Geels, 2011). This is remarkable when one considers that the primary inputs, land and climate, are far from optimal in the Netherlands (Berkers and Geels, 2011; Porter and Van der Linde, 1995). Berkers and Geels (2011) show that the success of the sector can be attributed to its innovativeness.

A main innovation is the development of efficient closed greenhouses that substantially increased production. Porter and Van der Linde (1995) argue that the sector responded to its environmental problems by implementing strict regulations and highly efficient closed-loop systems that limit energy and land use. Organizational innovations contributed to the emergence of a cooperative culture with farmers as production managers of “*vegetable factories*”. Farmers saw each other as colleagues, not as competitors (Berkers and Geels, 2011). Furthermore, there were important technological and organizational innovations in logistics and auction houses. The innovations implemented in the auction systems increased productivity, structured competition and markets, and provided an international competitive advantage due to reduced transaction costs. The innovations in the value chain created a highly specialized value chain that characterizes the sectoral innovation system.

The value chain starts with specialized technology suppliers of equipment and seeds. The next step consists of breeding firms. Breeding firms employ greenhouses to create the final products of the sector (such as fruit, vegetables, and flowers). The third step consists of auction houses and seller associations, followed by wholesale and retail businesses in the final two steps. Supermarkets

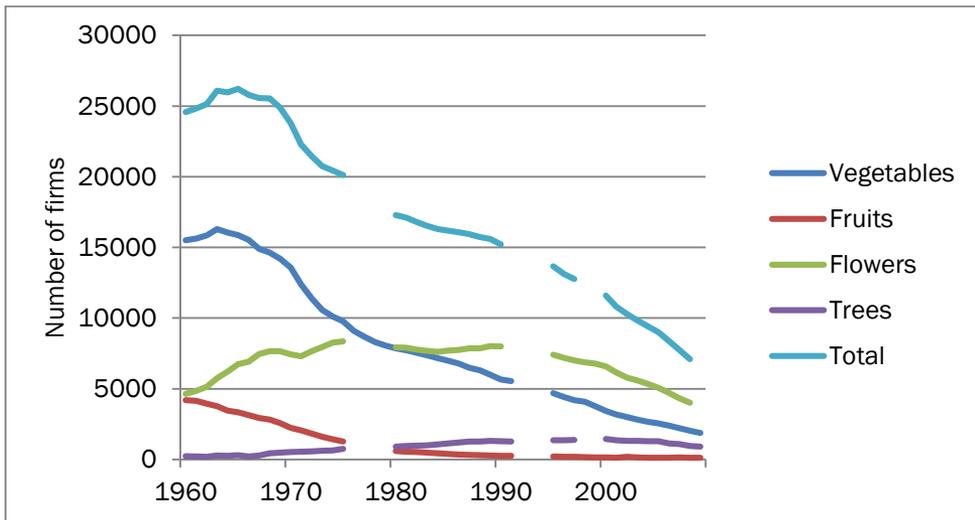


Figure 2.1: Decreasing number of firms in sector (Alkemade et al., 2010)

are the most prominent actors at the end of the value chain. The value chain is highly linear and interactions between actors in the value chain are highly institutionalized. Breeders, the primary producers, only have direct contact with their suppliers and seller associations/auction houses but not with the market.

The retail step is the only part of the value chain that has direct contact with consumers. As a result of this structure, supermarkets have relatively more power compared to breeder firms. Most products from this sector are not differentiated by brand names.

The government and research organizations played crucial roles in the innovation trajectories that dominate the sector (Berkers and Geels, 2011). The government influenced innovation processes by means of support in the form of innovation programs, subsidies for energy efficient technologies, and voluntary agreements with the sector to reduce energy. Research organizations, especially the well-known agricultural university of Wageningen, played a central role by actively participating in the development and implementation of many radical

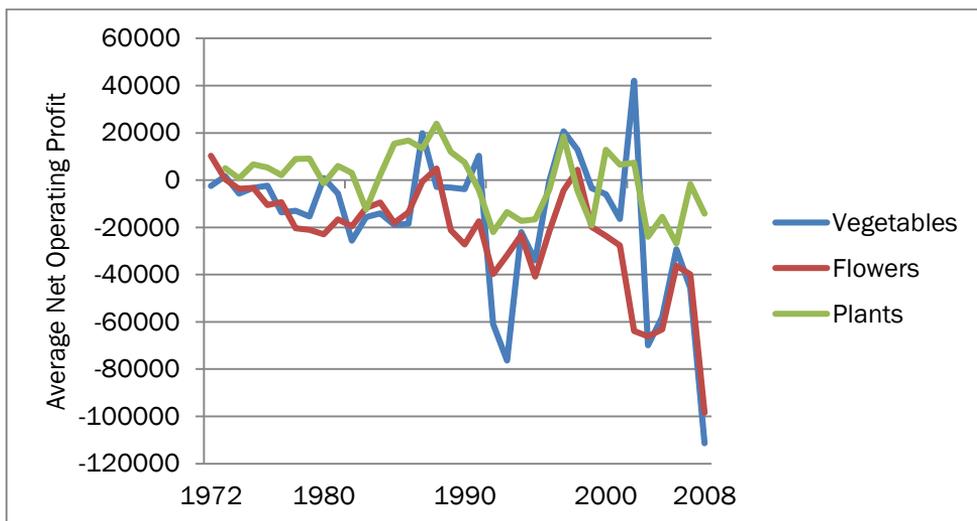


Figure 2.2: Decreasing average net operating profit of firms in sector (Alkemade et al., 2010)

technological innovations related to the construction and functioning of greenhouses, providing the sector with a strong knowledge base regarding process technology (Berkers and Geels, 2011).

Currently, the Dutch greenhouse horticulture is experiencing tough conditions. The number of firms in the sector is expected to decrease in the next 10 years from 6,000 in 2010 to 1,500 in 2020 (see figure 2.1). While the average size of firms in terms of greenhouse surface area has increased since 2000, the total amount of greenhouse surface area in the Netherlands has decreased from 10,500 hectare in 2000 to 9,800 hectare in 2013 (LEI Wageningen UR, 2014). A large drop in the average net operating profit of firms in the sector is also observed (see figure 2.2). Both trends are not uncommon for a mature sector but are problematic with respect to long-term economic performance.

## 2.4 Methods

This chapter employs a qualitative approach to determine what strategies are used by incumbent firms to introduce discontinuous innovations in the Dutch greenhouse horticulture sector. Furthermore, this approach is used to

investigate if strategies differ between firms that use sustainable technologies and the other innovations. This chapter aims to use the selected cases to extend theory inductively, by recognizing patterns of relationships among constructs within and across cases (Eisenhardt and Graebner, 2007). The use of a qualitative approach in this chapter is justified as the motivations behind the observed changes were not clear beforehand (Stake, 1994). This qualitative approach allows us to obtain the detailed information necessary to grasp the discontinuous nature of the innovations under study with respect to the context.

This chapter applies a mixed method approach to answer the research question. In order to determine what innovations can be labeled as discontinuous we first assessed the dominant innovation focus of the sector. We used data obtained from desk research on several innovation awards and sectoral innovation programs to assess what type of innovations are considered important in the sector. These outcomes were validated during a workshop with key players in the sector. Hereafter, we identified a set of 17 discontinuous innovations for in-depth study with the help of the Foundation for Innovation in the Greenhouse Sector (Stichting Innovatie Glastuinbouw - SIGN), a government sponsored sector-supporting organization. These innovations were selected as they build on knowledge and technologies that are new to the sector and/or employ new types of business models. One innovation was eventually not included as it was more related to plastics production instead of horticulture. Section 2.5.2 discusses the selected innovations in more detail.

In order to effectively contribute to theory development, it is important that the individual cases are comparable. We therefore only focus on firms that are responsible for the production of the final products (i.e. flowers, fruit and vegetables). The selected firms are breeding firms – they produce the final product that is sold on the market. This choice eliminated three previously identified firms from the sample. The remaining firms were contacted. Eventually, ten cases were included in the performed study (a response rate of 77%).

Five of the studied firms developed discontinuous innovations that include sustainable technologies and are labeled as sustainable-technology entrepreneurs (STEs). The greenhouses in which their production takes place are constructed (with technologies from outside the sector) in order to reduce their

energy consumption to a minimum level. Implemented technologies include special lighting, special glass, heat pumps, and the use of aquifers. Furthermore, biological pest control and fertilization measures are used. These technologies are combined in ways that are radically new for the sector. Energy savings are as large as 50% compared to traditional greenhouses. Furthermore, these technological innovations are combined with product and/or marketing innovations in order to deliver a complete innovation package that is new for the sector.

We used semi-structured interviews with the owner/director of the firms that developed the selected discontinuous innovations. While the data gathered for each case through interviews with owners/executives represents a single point of view for that firm, the collective view of all interviewees allows for the identification of patterns (Walker, 1997). Furthermore, the studied organizations are relatively flat, implying that the interviewees' view is highly likely to coincide with the strategic view of the company as a whole. Data from each interview was initially coded broadly in terms of motivations, barriers and actions. In subsequent coding rounds several patterns emerged within each broad code, allowing for further specification of the findings. The barriers code was further specified by identifying the actors to which the barriers were attributed by the interviewees. The actions code was further specified by identifying innovation system strategies, while more internal actions were related to general innovation strategies. The interviews consisted of three parts. First, we asked about the characteristics of the discontinuous innovation. Then, we focused on the motivation for the innovation and, finally, we focused on the innovation strategy and how it relates to the sectoral innovation system. More specifically, we asked what components of the sectoral innovation system were involved in contributing to the innovation and what components were hindering the innovation process. To adequately discuss all components of the innovation system we explained the innovation system concept and we brought an abstract graphical illustration that shows the structure of the Dutch horticulture innovation system including supply chain, research and education organizations, and rules and regulations. After the interviewees discussed the most important actors and institutions, questions about the remaining components were asked to determine if these components did not impact the innovation strategy or were overlooked by the interviewee.

The studied firms have all been active in the sectoral innovation system before they started the development and implementation of their discontinuous innovation. They have many years of experience in the sector and either branched out to develop their discontinuous innovation or sold their original firm in order to start over with their discontinuous innovation as primary focus.

## 2.5 Results

### 2.5.1 Dominant innovations

What type of innovation is dominant in the horticulture sector? The sector can be characterized by many small firms with weak R&D capabilities (Berkers and Geels, 2011). Technological innovations therefore mainly arise from supplier-dominated dynamics, where breeders depend on specialized suppliers such as equipment/material suppliers and seed firms. Research organizations are also important sources of technological innovations. Furthermore, competition is cost-based due to the large amount of firms in a homogenous, price sensitive market (Berkers and Geels, 2011). Therefore, process innovations that focus on reducing costs are likely to be dominant in the sector. Our analysis of the Hortifair Innovation Award (one of the largest innovation awards in the sector) confirms this. Between 2005 and 2009, 61 out of the 91 award winning innovations were process innovations. Our study of Dutch subsidy grants in this sector presents the same pattern. Six out of seven subsidy programs that we studied only focus on supporting process innovation. Only one (Flowers and Food) explicitly mentions other types of innovation like product innovations. Furthermore, there are six additional large subsidy programs aimed at energy-reducing innovations, which can be categorized as process innovations from the breeders' perspective.

The Dutch greenhouse horticulture innovation system has steadily evolved into a system that focuses on price-based competition, mass production, and process innovations to cut costs and improve efficiency. The many technology suppliers that are present in the sector support this innovation direction. Also, knowledge developed by universities and research organizations is mainly focused on efficiency improvements. Even the financial system favors investments in scale improvements and cost reducing innovations. This innovation direction ensured that the sector remained competitive and highly innovative during many years.

### 2.5.2 Description of discontinuous innovations

Given the focus on process innovations in the Dutch horticulture sector and price-based competition between homogenous products we consider innovations that break out of this trajectory. In this case such discontinuous innovations can be innovations that have distinctive product characteristics, are aimed at different market segments, use new business models, or create value through branding and marketing.

Table 2.1 presents an overview of the discontinuous innovations in our sample. The interviewed entrepreneurial incumbents are labeled E1-E5 and STE1-STE5. Firm sizes are difficult to assess in a single number. The number of fulltime employees ranges from 0-10 (for E1, E3, E4 and E5) to 50-100 (for STE1 and STE5). However, many firms employ part-time employees, especially students, and this number is generally large during peak season moments. E1 and E2 developed new types of snack vegetables (“*snack veggies*”), such as small tomatoes, cucumbers, and peppers. They opened a new type of market for vegetables by offering healthy alternatives for, for example, candy bars. STE1 sells new vegetable types that are sold to top chefs in restaurants. These vegetables are produced in small quantities, have very distinctive characteristics in terms of taste, color, and texture. They are so unique that they led to the creation of a new high-end market segment. STE2 and STE3 developed sustainably produced high-quality tomatoes that are sold under newly created brand names. Here, the marketing aspect of these innovations is crucial, as the added value (sustainability) needs to be clear to consumers. E3, E4 and STE5 focus on new flower types that are sustainably produced and sold through new channels under unified brand names. Again the marketing aspects of these innovations are crucial. E3 and STE5 offer sustainable orchids to garden centers in combination with stands, posters, and other marketing information that can be used by garden centers to profile these products. E4 organized his innovation in such a way that it competes with postcards and other mail gifts. By developing special packaging material the flower bouquets fit through regular mailboxes, which dramatically reduces transport costs and time. Finally, E5 offers a platform for breeders to sell high quality flowers and food directly to local end-consumers. The platform is organized in such a way, that online orders can be customized and that it allows breeders to market the added value of their products.

Table 2.1: Overview of studied discontinuous innovations

| Entrepreneurs | Sub-sector             | Innovation types   | Product competes with   |
|---------------|------------------------|--|---|
| E1            | Snack vegetables       | Product, marketing   | Snacks (candy-bars, potato chips)   |
| E2            | Snack vegetables       | Product, marketing   | Snacks (candy-bars, potato chips)   |
| E3            | Orchids                | Product, marketing   | Regular flowers but establishes high quality market segment                     |
| E4            | Flower delivery        | Product, process, marketing                                | Postcards and mail-gifts  |
| E5            | Vegetables and flowers | Marketing  | Traditional horticulture markets and retail                                     |
| STE1          | High-end vegetables    | Product, process, marketing<br><br>Sustainable technology  | Spices and specific flavors but also enters new high-end market segments        |
| STE2          | Tomatoes               | Product, process, marketing<br><br>Sustainable technology  | Regular tomatoes but also enters additional markets, such as catering and soup  |
| STE3          | Tomatoes               | Products, process, marketing<br><br>Sustainable technology | Regular tomatoes but tries to establish high quality sustainable market segment |

Table 2.1: Overview of studied discontinuous innovations (*continued*)

| Entrepreneurs | Sub-sector   | Innovation types   | Product competes with:  |
|---------------|--------------|--|---|
| STE4          | Strawberries | Product,<br>marketing<br><br>Sustainable<br>technology             | Regular strawberries but<br>tries to establish high quality<br>market segment and enters<br>additional markets, such as<br>jams |
| STE5          | Orchids      | Product,<br>process,<br>marketing<br><br>Sustainable<br>technology | Regular flowers but<br>establishes high quality<br>market segment   |

### 2.5.3 Motivations and innovation strategy

The prime motivation for the interviewed incumbents to depart from the existing innovation direction in the horticulture sector is a growing frustration and dissatisfaction with the current state of the sector. As E1 explains: *“I don’t want to have the biggest firm, I want to have fun [innovating] ... That’s a reason for why we transitioned from bulk production to new innovations”*. In his view, the price-based competition in mass produced tomatoes is so strong, that profit margins keep diminishing and innovations are only aimed at lowering costs. This general view arises from all interviews; breeders are dissatisfied with the lack of appreciation for quality and product innovation in the supply chain, small margins for breeders, and the power-imbalance in favor of supermarkets and retail. Furthermore, many breeders admitted that they took risks, as it was unclear from the start if there were attractive markets for their innovations. E1 argued that he became motivated to look for something new, when his previous innovation (a new type of tomato) transitioned to mass production. He sold off part of his firm and started with his new innovation, but it took 3 years before it became clear to him that there was demand. In a similar way E3 argued that in his case it became clear that there was some demand for the product after the

decision to start a new innovation trajectory had already been made; his decision was not based on market studies. Therefore, dissatisfaction with the current way of doing business is a fundamental trigger for discontinuous innovation by incumbents in this mature sector. This differs from the explanations that are dominant in the literature. It illustrates that incumbents can be a source of discontinuous innovations, which is an addition to the generally mentioned sources - exogenous shocks, technological developments, market changes, and new entrants. Furthermore, dissatisfaction as a trigger of discontinuous innovation is an addition to the triggers of innovating incumbents mentioned in literature, as the studied incumbents were not triggered by strong technological capabilities, a diverse workforce, or attractive opportunities.

While the innovations and incumbents in table 2.1 are diverse, they have several important similarities. As stated, all entrepreneurs in our sample either branched out to develop their discontinuous innovation or sold their original firm in order to start over with their discontinuous innovation as primary focus. Furthermore, the firms entered new markets or approached existing markets in a new way, demonstrating that marketing is an integral part of the developed innovations. Marketing is traditionally not part of breeder firm activities as there is no direct contact between breeders and customer or end-consumers. Due to the way in which the value chain is organized, marketing and product differentiation is difficult. Consider for instance the auction system where competition is strongly focused on price and branding difficult. Marketing is partly done by seller associations but mostly performed by supermarkets. However, supermarkets market the price or general quality of their greenhouse products and do not use specific brand names for these products. Consequently there are almost no strong brands in the fruits, vegetables, and flower businesses. The relation between breeders and customers is radically different in the studied cases. In many cases entrepreneurs seek direct contact with customers or consumers and circumvent auction houses and retailers who are not eager to trade these novel products. Finally, all innovations go beyond technological process innovations even though process innovations may still be part of these innovations as is the case for sustainable flowers and vegetables that require innovative sustainable greenhouses using new technologies.

All incumbents focus on moving away from the lowest cost strategy that dominates the innovation system. They focus instead on less price-sensitive

consumers, use unique characteristics of their innovation to serve the needs of these consumers, and focus heavily on marketing activities. Branding is a central strategic aspect of the studied innovations. The primary competitive advantages identified by the interviewees are the unique characteristics of their product innovation (such as appearance, nutrition value, and taste). This is contrary to the homogenous product quality in the sectoral innovation/production system and the absence of specific product brands. They also argue that their own marketing knowledge and skills, their personal networks, and their reputation are crucial advantages. STE3 even expressed this with the statement “*Relations are more important than transactions*”, arguing that, in contrast to products, a reputation as innovator/pioneer cannot be copied and is therefore a very valuable strategic asset.

The entrepreneurial incumbents target specific customer segments that have different, quality-related needs and are less price-sensitive. In this way they differ from the traditional supplier-push innovations triggered by seed firms or specialized suppliers. However, due to this new discontinuous approach the incumbents encounter several barriers.

#### **2.5.4 Innovation system barriers**

The existing innovation system is primarily perceived as hindering discontinuous innovation. The foremost systemic barrier, identified by nine entrepreneurs, is the functioning of the traditional supply chain. More specifically, they point to the role of auction houses, export companies, and supermarkets/retail. In short, these actors have no interest in the innovative products since they do not fit well with their current practices. E1 argues that his innovation process could have been finished significantly faster with support from his seller association. However, this association was not interested in new products or markets and ignored the innovation. This forced the entrepreneur to find an alternative route, “*as the chain is very difficult to change*” (E1). In some cases the influence of supply chain actors is even worse. The vested supply chain actors view these innovations as threatening to the existing system and use different strategies to stop entrepreneurs developing these innovations, such as refusing to handle regular products produced by the innovative entrepreneurs or by convincing other actors not to do business with the defiant entrepreneurs. For this reason, most of the firms studied try to get around auction houses and producer/seller associations and basically try to build a new supply chain by themselves. E4 for

example stated that “*the market is controlled by a few large import and export firms. These were instructed to not deliver flowers to me anymore*”. Entrepreneurs also argue that the largest issue with supermarkets/retail is their unwillingness to accept brand names for vegetables and flowers. Brand names could shift the balance of power away from retail organizations towards breeding firms, which is not in the interest of the supermarkets/retail firms.

The second barrier is a lack of knowledge regarding marketing and product differentiation strategy in the existing supply chain. In several cases cooperation between the entrepreneurs and other actors in the supply chain (such as export firms) did not arise due to the lack of this specific knowledge in existing chains. For instance, STE5 initially tried to sell his sustainable flowers and the attached marketing concept through regular export channels. However, the export firms lacked the marketing competences needed to sell the innovative flowers and to justify the higher price of the flowers, meaning that STE5 could not make use of the services of the export firm. This lack of knowledge was perceived by all entrepreneurs. This lack of marketing knowledge is inherent to the traditional focus of the sector on low priced bulk products.

The third issue is related to institutional incompatibilities and also strongly linked to the supply chain barrier. There are many institutional arrangements related to the organization of the supply chain that hinder innovations. A key example is that firms that are part of a producer’s association are not allowed to have direct contact with customers and they are obliged to sell all their products through the association. Diversifying incumbents can therefore not sell their original bulk products through a producer’s association while selling innovative products through other channels. In addition, membership of a producer’s association is required to receive several EU-level subsidies. Not being part of an association thus comes at a cost and puts the innovative incumbents who intend to sell their products directly to customers in a disadvantaged position. Several entrepreneurial incumbents also encounter problems with the regulative institutions related to patents. The process of obtaining protection for product innovations is difficult and ineffective due to the character of the innovations. It is for example not possible to patent a sustainable flower and the patents for new type of vegetables are held by seed companies. This makes it difficult to shield innovations from cheap imitations. Competing traditional incumbent firms are often seen as so-called *straddlers* (Porter, 1996): they copy aspects of the

product innovation without changing their business model or introducing other innovation types. For example, several firms have copied the snack vegetables that were developed by a few of our interviewees. These copied products are not branded and are produced and sold through the traditional supply chain. The brand names for snack vegetables are apparently not strong enough to compete with the no-branded, lower-price competitors. From a free market point of view this is all legitimate but the tragedy is that the sector falls back in the low cost bulk products strategy instead of producing higher-quality branded products with higher added value.

The barriers above illustrate the misalignment between the studied discontinuous innovations and the functioning of the sectoral innovation system. As one would expect, the existing system offers hardly any support for discontinuous innovations and in some cases even actively fights these innovations. Other actors in the system refuse to give support due to strategic reasons or are unable to give support due to a lack of relevant knowledge and due to the institutional setup of the system.

### **2.5.5 Innovation system strategies**

Developing and commercializing discontinuous innovations that are a poor fit with existing innovation system structure places the entrepreneurial incumbents (partly) outside the existing system. The entrepreneurial incumbents therefore mainly focus on using their personal networks to assemble and start new supply chains. In general, these chains include other breeders, specialized suppliers, and customers. The main difference with the existing innovation system is that the supply chain is much shorter. The incumbents have direct access to customers and organizations like auction houses and retailers are cut out. E1 for example convinced other breeders to join his snack vegetable concept and deliver to the market directly by establishing agreements with several (local) stores. He stated that setting up a reliable network in which he can work together with actors and make long-term arrangements is crucial for his innovation and business. In this way, new markets can be entered with combined efforts, shared learning generates new knowledge, there is less competition with other incumbents in these new markets, and the negative effects of imitation are reduced. STE1 explicitly took strategic actions to directly create demand in the highest market segments and “reverse” the functioning of the chain. Chefs and restaurants would demand his products at retailers, which led to

importers/exporters contacting STE1 to order the product. E4 established a formal collaboration with a Dutch postal company in order to deliver his goods, thereby removing his dependency on traditional transport actors in the greenhouse sector. The collaboration with actors from outside the sector to lessen or remove dependency on traditional chain actors and enter new markets is seen in almost all cases. The entrepreneurial incumbents try to avoid being associated with the (products of the) traditional incumbents.

New knowledge was generated by collaborating in the newly constructed networks. Surprisingly, only STE3 actively collaborated with a university. This is striking, considering the important role of universities as knowledge and innovation supplier in the traditional innovation system. The other entrepreneurs either intentionally avoided research organizations (E2: *"I would rather gather the knowledge myself"*) or did not know how to collaborate with them (STE5: *"I have no idea what they would have to offer"*). E4 had personal contacts with a packaging firm outside the sector that cooperatively developed a critical component of his innovation, while E1, E3, and STE2 contacted other breeders and actors in order to *"learn together"*. Another reason for not collaborating with agricultural universities and research centers in the innovation system is their knowledge base. These organizations are very well equipped to supply knowledge regarding process innovations and improved breeding conditions but lack knowledge related to marketing, business strategy, and sales. Through their networks our interviewees came in contact with business schools (who can supply this type of knowledge but are not part of the traditional innovation system) and other education organizations that supported them in obtaining relevant strategy knowledge.

Another interesting finding is that half of the entrepreneurs intentionally undertake activities to promote the sector in general; these entrepreneurs try to enlarge the market for all breeders and share knowledge throughout the system. Activities include: the establishment and management of educational centers, demonstration projects in which technologies and strategies are shared with other breeders, and the establishment of sustainability labels for the sector. Through these activities the incumbents put pressure on the existing system and try to let other breeders benefit from their knowledge and experience. Thus, the incumbents' strategies go beyond merely building personalized supply chains. By means of their activities they add components to the existing innovation

system and by involving other actors they purposefully try to change existing institutions. In the innovation systems literature these activities are labeled system-building activities (Hellsmark and Jacobsson, 2009; Musiolik et al., 2012). This active role in innovation system building also has a positive impact on the incumbents themselves, as it strengthens their marketing, networking, and lobbying position. For example, one of the incumbents invites policymakers to come to his educational center. Direct contact with policymakers allows him to enter new networks and enhance his visibility. Another incumbent argues that his activities in setting up an environmental label almost made him a celebrity within the sector, while at the same time he was able to enter many different networks. However, the incumbents stress that the main goal of these activities is improving the innovation system in general; the personal benefits are judged as a nice side-effect. STE1 describes this as *“making the pie bigger, instead of fighting for the same piece”*. This corresponds well with the motivations of the incumbents to engage in discontinuous innovations: frustration about the current state of the sector.

### **2.5.6 Strategy similarities and differences for STEs**

Strategy differences between STEs and the other studied incumbents were expected, as literature argues that STEs face more and different barriers compared to non-sustainable technology innovation entrepreneurs.

Technology barriers were not a big issue for the studied STEs. Both STEs and non-sustainable technology entrepreneurs experiment with new products, marketing, and strategies. All entrepreneurial incumbents were already part of the incumbent system (as opposed to start-ups) before they started the development of their discontinuous innovation. STEs mainly obtained sustainable technologies from actors outside the sector. Interestingly, the existing knowledge base in the sector proved to be more useful for STEs compared to the other studied incumbents. While the existing knowledge base does not provide marketing and strategy knowledge to the incumbents, this knowledge base is well-suited for supporting sustainable process technologies. This explains why STE3 was able to collaborate with universities in the sector. Incompatibilities with existing process technologies were minimal.

Market barriers were more pronounced. An often heard statement is that sustainable production will become a necessary condition, due to regulation by

the government and consumer demand. However, it will never become a factor that adds value to products in the Dutch market, because consumers do not want to pay extra for it. STEs strategically deal with this by attempting to avoid competition with existing greenhouse horticulture products by creating completely new products and entering new markets through cooperation with actors from outside the sector. Furthermore, none of the STEs stresses the greenness of their innovation as most important/unique characteristic. Quality-related characteristics play an equal or even larger role compared to the greenness of their innovation. STEs do not think that the greenness of a product is not enough to create added value. By linking sustainable technologies to market-oriented strategies it is possible to create added value according to the STEs.

Despite these market barriers, STEs do receive more support from existing subsidies; in some cases, the government even performed marketing activities for the STEs. Most of the sustainable technologies implemented by the STEs were related to reducing the use of energy and natural gas. The policies in the existing system that stimulate the use of sustainable technologies support STEs. STEs were able to obtain technology subsidies that reduce the payback time of their investments (all the STEs acknowledge that their innovations would have happened without the subsidies). Two of the STEs gained a large amount of publicity through government support. This support focuses on marketing the positive environmental effects of their innovations. While STEs could make more use of existing subsidies, non-STEs strategically tried to establish new networks to obtain additional resources. Governments identified sustainability as an important theme. By stressing the relevance of their innovation with respect to this theme STEs are able to gain government support. Surprisingly, regulatory and financial barriers thus seem to be smaller for STEs, which is completely opposite to what was expected.

Four STEs, compared to one non-STE, undertake the aforementioned system-building activities, such as the establishment and management of educational centers that promote the sector and demonstration projects in which technologies and strategies are shared with other breeders. These are clear strategic actions that contribute to marketing, networking, lobbying for the entrepreneurs, and stimulate knowledge diffusion at the system level. However,

these strategies were not determined based on the barriers that are specific to sustainable innovations mentioned in the literature.

This discussion shows that the greenness of innovations is not necessarily the cause of compatibility issues. Due to the strong link between energy reduction and cost reduction, a form of sustainable innovation is part of the traditional system. While literature focuses on the extra barriers for environmental innovations, there are clearly opportunities that partly offset the negative effects of these barriers. The main barriers encountered by all entrepreneurs were more related to the need for different value chain and networks, new markets, and new visions. In other words, the main challenge for the studied entrepreneurs was dealing with the established institutional pressures.

## **2.6 Conclusions**

The purpose of this chapter was to investigate the interplay between innovating incumbents and the sectoral innovation system in which they are embedded. More specifically, our goal was to uncover what strategies incumbent firms use to introduce discontinuous innovations within the boundaries of an existing mature sectoral innovation system. Our conclusions are threefold:

First, the main drivers for the innovation activities of these incumbents are the problematic characteristics of the existing innovation system. Dissatisfaction with current system functioning is the main trigger of discontinuous innovation development by incumbents, which is an additional insight to current literature. Second, but related, the innovating incumbents seek to circumvent the existing sectoral innovation system in their innovation processes, since the existing system has limited value to the entrepreneur and entrepreneurs even experiences negative impacts from defensive strategies by other organizations in the sectoral innovation system. This brings us to our third and main conclusion: the main barriers to discontinuous innovation as expressed by the firms in our sample are system-level barriers. More specifically, the institutions that co-evolved with the existing sectoral innovation system are an important source of inertia and lock-in and a main barrier to discontinuous innovation. In their strategies to deal with these barriers the entrepreneurial incumbents use existing networks to build new compact value chains and establish direct contact with customers. In some cases organizations from outside the sector are involved. Innovating incumbents start learning processes in this small network

and by doing this they create niches where the discontinuous innovation is further developed. This illustrates that besides exogenous shocks, technological developments, market changes, and new entrants, incumbents can be sources of discontinuous innovation.

When successful, the innovating incumbents do strive for sectoral change but do not attempt to change the existing system directly. Mainly the incumbents developing discontinuous innovations related to sustainable technologies undertake discursive activities to promote new business models to the sector, for instance through the establishment and management of educational centers, demonstration projects in which technologies and strategies are shared with other breeders, and the establishment of environmental labels for the sector. While there are some strategy differences between STEs and the other studied incumbents sustainability-specific barriers were less pronounced than expected; several STEs were even able to receive more support than non-STE. These findings illustrate that the main challenge for the studied incumbents is not technological in nature. Instead, the main challenge is dealing with the established system and its institutions.

At the moment it is too early to tell what the effect will be of these discontinuous innovations on the greenhouse innovation system in The Netherlands. Without doubt these brave entrepreneurs have received a lot of positive attention in the sector and are often portrayed as entrepreneurs who have managed to step out of the race to the bottom. This obviously shakes the foundations of current institutional structures as it casts doubts on whether the current innovation direction is sustainable. However, many reinforcing dynamics make change very difficult. Especially the highly specialized supply chain with very powerful retail organizations (who will not benefit from change) will surely slowdown change. It will be interesting to keep studying the process of change in this sector, as it can provide us with more insight on discontinuous innovation and change in mature innovation systems triggered by incumbents, which could be used to establish policy recommendation regarding rejuvenating mature sectors.



# 3. Institutional change from within: the emergence of proto-institutions in the Dutch built environment sector<sup>2</sup>

## 3.1 Introduction

In mature fields there are often long traditions of strongly routinized practices that promote business-as-usual, and rules and regulations often enforce these behaviors. Due to these institutions, i.e. taken-for-granted social rules that stabilize and pattern behavior (Meyer and Rowan, 1977; Oliver, 1991; Scott, 2008), it is therefore difficult to develop innovative ways of doing business in mature fields. However, change does happen in mature fields.

A central challenge for institutional theory is to explain why and how actors, whose behavior is shaped by their institutional environment, can envision and enact changes to the environment in which they are embedded (Scott, 2001; Seo and Creed, 2002). Explaining this type of change in mature fields is especially challenging, as shared meanings and rules for appropriate organizational behavior have become taken-for-granted (Greenwood and Suddaby, 2006; Scott, 2008; Wright and Zammuto, 2013).

Institutional theory initially explained change by exogenous forces or jolts (such as social upheaval or new technological developments) that can create opportunities for institutional change, but more recent work goes into institutional change triggered by the strategic behavior of organizations (Dacin et al., 2002; Greenwood and Suddaby, 2006; Oliver, 1991). Opportunities for change have to be perceived by actors that seize these opportunities to actually trigger changes (David et al., 2013). The manner in which actors seize these opportunities remains underdeveloped in the literature. When actors embedded within a field envision new institutional arrangements and undertake actions to realize these new arrangements, they function as institutional entrepreneurs (DiMaggio, 1988; Greenwood and Suddaby, 2006; Maguire et al., 2004). Earlier studies concluded that institutional entrepreneurs are often found at the fringes

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<sup>2</sup> This chapter is based on Kishna, M., Klein Woolthuis, R., Negro, S. and Hekkert, M. (2015). Institutional change from within: the emergence of proto-institutions in the Dutch built environment (under review after resubmission at Technological Forecasting and Social Change).

of or outside an organizational field (Creed et al., 2010; Greenwood and Suddaby, 2006; Wright and Zammuto, 2013). Central, incumbent actors are not expected to trigger institutional change as they have vested interests and their taken-for-granted ways of interpreting and enacting their environments prevents them from seeing new opportunities (Greenwood and Suddaby, 2006; Hargrave and Van de Ven, 2006; Wright and Zammuto, 2013).

Several studies have shown that incumbents can trigger change. Some studies emphasize how contradictions between institutional demands can trigger incumbents to question existing institutions and become institutional entrepreneurs (Greenwood and Suddaby, 2006; Seo and Creed, 2002). However, many questions still remain on why incumbents, with vested interests and institutionalized behaviors, still become active protagonists for change. The first question that we therefore address in our research is why incumbents in the Dutch built environment choose to become institutional entrepreneurs.

Another missing link in the research on institutional entrepreneurship is how the actions of actors actually lead to change. Recently, collaborations have been recognized as a potential route for change as collaborations can trigger the establishment of shared visions and frames, can build up trust and legitimacy for a group of organizations, can lead to reduced, shared risks, and shared resources (Gray 1989; Lawrence et al., 2002; Phillips et al., 2000; Trist, 1983). In this way, collaborations potentially give organizations the ability to overcome power, size, and resource limitations needed to change the institutional setting (Lawrence et al., 2002). In the literature it is argued that this mainly takes place in 'true' collaborations as opposed to (for instance) supplier relations, as true collaborations are argued to be more fundamental and complex and hence capable of forming new understandings, norms, and practices (Lawrence et al., 2002; Phillips et al., 2000). In order to conceptualize the link between collaborations and institutional change, the concept of proto-institutions emerged, which refers to new ways of working that emerge within the boundaries of collaborations and that have the potential to become widely institutionalized (Lawrence et al., 2002; Zietsma and McKnight, 2009). However, this research field is only nascent and many questions on how proto-institutions emerge and diffuse still remain. As a second question, we therefore address how collaborations in the Dutch built environment can lead to the emergence of proto-institutions.

The Dutch built environment is well-established and mature. Over the past decades the economic and environmental performance in the Dutch built environment has been criticized, as companies are not structurally profitable, have been involved in various forms of corruption, and represent a large source of energy- and material consumption. Several studies have argued the need for change to address these issues (Den Hertog and Brouwer, 2001; Kadefors, 1995; Klein Woolthuis et al., 2012; Pries et al., 2004; Pries and Dorée, 2005). However, the Dutch built environment is well-known for its risk-adverse nature, preference for established technologies, and resistance to change (Den Hertog and Brouwer, 2001; Dubois and Gadde, 2002; Kadefors, 1995; Pries and Dorée, 2005). Resistance to change in the built environment is mainly caused by the institutionalized practices and rules (Kadefors, 1995). Despite this institutional setting, several innovative projects triggered by incumbent organizations have seen the light (Klein Woolthuis et al., 2012). Therefore, this forms a good setting to study why incumbents are motivated to initiate change and how these efforts form seeds for change. By using a qualitative approach we obtain a detailed understanding of the motivations behind and changes within the studied projects. These motivations and changes are all related to the concept of proto-institutions.

This chapter makes three important contributions. While traditionally change in mature fields is envisioned to come from outsiders, we see change coming from within. Incumbents can trigger change from within due to their dissatisfaction with the current institutional setting. This dissatisfaction follows performance concerns but also comes from the multiple-embeddedness of actors. Second, we show how the studied projects lead to the emergence of proto-institutions, as they embody new practices, rules, and technologies that transcend particular collaborative relationships and may become new institutions in the built environment field. Finally, we show how proto-institutions can emerge in collaborations based on market and hierarchy mechanisms. Relatively powerful actors demand change within the projects but leave enough room for negotiation and mutual exchange of information. This is an addition to current proto-institution literature.

We present this chapter in six sections. The following section presents our theoretical framework. Our research method is discussed in section 3.3, which includes a detailed description of the research setting and studied projects. Our

findings are presented in section 3.4 by analyzing why incumbents become institutional entrepreneurs and how they are involved in proto-institution creation. Section 3.5 presents the discussion, and the concluding section 3.6 presents the answer to the main research question and our main contributions.

## **3.2 Theoretical framework**

### **3.2.1 Why do embedded actors envisage and enact institutional change?**

Institutional theory focuses on the taken-for-grantedness of social norms, routines, and rules and the impact of these taken-for-granted aspects on organizational behavior (Greenwood and Suddaby, 2006; Oliver, 1991). Therefore, institutional theory is a promising theoretical framework for understanding the difficulties of enacting change in established fields. Institutions are seen as the rules of the game and consist of normative, cognitive, and regulative elements (Scott, 2008). Through these taken-for-granted facets, behaviors are patterned and reproduced. This implies that conformity to existing institutionalized rules may lead to specific ways of doing and thinking (Garud and Karnøe, 2003).

This approach has increasingly been criticized for its emphasis on persistence and homogeneity of phenomena (Dacin et al., 2002), whereas institutions are also created, change over time, are not uniformly taken-for-granted, and are challenged and contested (Dacin et al., 2002). The main issue is summarized in the following question (Seo and Creed, 2002): as the behavior, intention, and rationality of organizations is heavily influenced (or even conditioned) by the institutional setting in which they are embedded, how are they able to envision and enact changes to this same institutional setting? This so-called paradox of embedded agency is a central challenge for institutional theory, specifically when trying to show how and why actors become motivated and enabled to change the institutions that simultaneously shape them (Clemens and Cook, 1999; Greenwood and Suddaby, 2006). Initial studies focused on exogenous forces or jolts (Clemens and Cook, 1999; Greenwood and Suddaby, 2006) as an explanation for change. Examples of jolts are social upheaval, technological disruption, and regulatory change (Greenwood and Suddaby, 2006), i.e. sudden and unprecedented events (Meyer, 1982). The general effect of these jolts is that the existing institutional consensus is disturbed by an increased awareness of extant and alternative logics, and a heightened uncertainty. This enables the

emergence of new (and demise of old) actors, practices, organizational forms, and rules, i.e. the possibility of change (Greenwood and Suddaby, 2006; Lounsbury, 2002; Sine and David, 2003).

These field conditions are often viewed as given and exogenous, rendering actors actions as a reaction to conditions. However, institutional entrepreneurship literature suggests that the actions of actors can generate field conditions that can be exploited to trigger change (Battilana et al., 2009; David et al., 2013). Institutional entrepreneurship literature deals directly with the paradox of embedded agency (Holm, 1995; Seo and Creed, 2002). Institutional entrepreneurs are organized actors that can see the need for new institutions to advance their interests, while simultaneously being influenced by existing institutions (DiMaggio, 1988; Garud et al., 2002; Garud et al., 2007; Greenwood and Suddaby, 2006; Maguire et al., 2004). Battilana et al. (2009) argue that actors must fulfill two conditions to be regarded as institutional entrepreneurs: 1) actors must initiate changes that break with the institutionalized template for organizing in the context under study, and 2) actors must actively participate in the implementation of these changes by mobilizing resources. Institutional entrepreneurs thus use their resources and capabilities to create new or change existing institutions (Battilana et al., 2009; Garud et al., 2007; Maguire et al., 2004). Institutional entrepreneurs are argued to be able to escape the power of institutions when different institutional pressures overlap and pose conflicting demands of various actors (Dorado, 2005; Greenwood et al., 2011). Still, actors can also become motivated to change institutions in highly institutionalized fields with clear pressures. Oliver (1991) argues that when organizations are skeptical about the social legitimacy or strategic utility of conforming to existing institutional pressures, and/or when they expect that conformity will lead to a loss of social legitimacy or economic efficiency, they are motivated to change the existing institutional pressures.

Institutional entrepreneurs are framed as wanting to serve their own interest by actively influencing institutions, by jumping on the bandwagon when opportunities for change arise, or by picking and choosing those institutional demands that fit best with internal requirements. Hence: actors do matter, but the question why they become institutional entrepreneurs remains underdeveloped in the literature. Is self-interest truly the real motivation to want to influence institutional constraints? Or when and why would actors be skeptical

about conforming to institutions? We wonder whether more motivations can be distinguished, e.g. as in the work of Bansal and Roth (2000) who found that next to economic reasons, also environmental concerns played a role and managers wanted to do 'the right thing'.

### **3.2.2 How do embedded agents envisage and enact institutional change?**

There are two competing ideas on how institutional change may come about. The first approach centers on the idea that institutional change results from the accumulation of different acts that are not intentionally aimed at generating change (Dorado, 2005; Greenwood et al., 2011). The second argument, as discussed above, argues that actors will try to influence institutions out of their own best interest and can in that way enact change. In this article we focus on this second stream of literature as we want to contribute to the insight how institutional entrepreneurs envisage and enact institutional change.

While the term entrepreneur is often used to refer to specific individual actors, institutional entrepreneurs can be individuals, organizations, or groups of individuals/organizations (Battilana et al., 2009; Garud et al., 2002; Maguire et al., 2004). Despite this, there is a tendency to focus on the efforts of single institutional entrepreneurs and almost present them as super heroes in the literature (Klein Woolthuis et al., 2013; Suddaby, 2010). While there are some rare instances of individual institutional entrepreneurs that impose institutional change, they more often require allies to develop, diffuse, and support a new vision (Battilana et al., 2009; Dorado, 2005). Institutional entrepreneurs should be viewed as agents that promote certain institutional transformations that might lead to field-wide change (Greenwood et al., 2002; Klein Woolthuis et al., 2013; Pacheco et al., 2010). Institutional entrepreneurship entails mobilizing actors and dealing with multiple constituents in combination with establishing shared visions and beliefs (Armenakis and Bedeian, 1999; Battilana et al., 2009). In this respect, institutional entrepreneurship can be framed as a collective process.

Our understanding of the relation between collaborations and triggering institutional change is still limited. While collaborations may reproduce existing institutional conditions, they can also act as sources of innovation and thereby could impact institutional fields (Lawrence et al., 2002; Phillips et al., 2000). Collaboration occurs within specific institutional contexts, where institutional

forces can shape, promote, or impede collaboration (Phillips et al., 2000). Furthermore, collaborations can trigger the establishment of shared visions and frames, can build up trust and legitimacy for a group of organizations, can lead to reduced, shared risks, and to shared resources (Gray 1989; Lawrence et al., 2002; Phillips et al., 2000; Trist, 1983). Lawrence et al. (2002) argue that 'true' collaboration, as opposed to cooperative relationships that are purchased (such as in supplier relations) or based on legitimate authority (such as in a relation between a local government and a firm operating in the region), can be the origin of institutional change. These true collaborations are argued to effect change in institutional fields in a different way than markets and hierarchies, as market transactions and hierarchical relationships are based on highly institutionalized governance mechanisms (Lawrence et al., 2002). Negotiations associated with true collaborations are argued to be more fundamental and complex. This can lead to the emergence of changes in the collaboration, such as the formation of new understandings, norms, and practices (Lawrence et al., 2002; Phillips et al., 2000).

In order to further conceptualize the link between changes within collaborations and institutional change in the field, the concept of proto-institutions emerged. Changes that emerge within true collaborations could be adopted beyond the boundaries of the collaborative process (Lawrence et al., 2002). When these changes have the potential to become institutionalized in the wider field, they are labeled as proto-institutions. More specifically, proto-institutions are defined as practices, technologies, and rules that are narrowly diffused but have the potential to become widely institutionalized (Lawrence et al., 2002; Zietsma and McKnight, 2009). However, what these practices, rules, and technologies entail is rather loosely described. In a review of institutional theory, Pacheco et al. (2010) argue that the majority of institutional types can be categorized as practices, standards, and policies. In order to use the proto-institution concept as basis for analysis, we further conceptualize the different dimensions.

*Practice:* A taken-for-granted way of working or working together. Practices are shared routines or recognized forms of activity that guide behavior, as they conform to certain social expectations (Pacheco et al., 2010; Zietsma and Lawrence, 2010). A practice is often tacit and informal.

*Rule*: A formalized and enforceable way of working or working together. Compared to practices, rules are more formal (Pacheco et al., 2010). Rules guide behavior, as non-conformity is punishable. This conceptualization captures explicit routines, and laws and regulations.

*Technology*: A taken-for-granted technological solution. This can be formalized in standards and/or entrenched in path dependencies. Standards are voluntary sets of rules that direct developments in specific industries and can be affected through trade associations or outside stakeholders such as activists (Pacheco et al., 2010).

Each type may form a seed for institutional change. These seeds can become institutions if social processes develop that entrench them in the field and enough members of the field adopt them. Within collaborations these seeds may become entrenched for the involved actors. Furthermore, through interactions with actors outside the project boundaries other members of the field come into contact with these proto-institutions. This institutionalization process would be strengthened if new practices would also become entrenched in rules: e.g. collaboration would become a condition in formal tendering contracts. In this way, changes are more enforceable.

The focus of this chapter is on organizations in innovative collaborative projects in the Dutch built environment. In order to understand how institutional change might occur in this setting, it is important to analyze why actors engage in change processes and how they attempt to enact change. We determine motivations for institutional entrepreneurship by analyzing the drivers actors give for initiating or collaborating in the project and actively pursuing change. The projects we examine in this chapter all gave rise to several proto-institutions. Using the definition of proto-institutions described above, we analyze how changes in practices, rules, and technologies are formed and diffused.

### **3.3 Methods**

#### **3.3.1 Research design**

This chapter employs a qualitative approach to determine why and how embedded actors trigger institutional change in the Dutch built environment sector based on the analysis of several projects. In this way, this chapter aims to use the selected cases to extend theory inductively, by recognizing patterns of

relationships among constructs within and across cases (Eisenhardt and Graebner, 2007). This is a cyclical process, where case data, emerging theory, and existing literature are continuously compared (Eisenhardt and Graebner, 2007). The use of a qualitative approach in this chapter is justified as the causal dynamics and motivations behind the observed changes were not clear beforehand, and this chapter contrasts existing understandings with observed events in order to extend theory (Greenwood and Suddaby, 2006; Stake, 1994).

### 3.3.2 Research setting

The Dutch built environment is a mature field that contains large organizations like the construction companies, housing corporations, and investors but also small actors like house owners and interest groups. The economic and environmental performance in the Dutch built environment has been criticized for some time. Companies typically are not structurally profitable and have been involved in various forms of corruption (Sminia, 2011). From an environmental perspective, the built environment is a large source of energy- and material consumption. Around 40 to 50% of raw earth materials are used in the construction industry (OECD, 2003), and around 40% of CO<sub>2</sub> emissions are attributable to the built environment (Klein Woolthuis et al., 2012). Despite many calls for changes, these issues still remain. The Dutch built environment is well-known for its risk-adverse nature, preference for established technologies, and resistance to change (Den Hertog and Brouwer, 2001; Dubois and Gadde, 2002; Kadefors, 1995; Pries and Dorée, 2005). There are several reasons for this.

*Practices:* Production in this sector is a project-based activity. In each construction project, different organizations come together, mostly via tendering procedures where price is a critical factor. Innovation is mainly initiated by suppliers that try to push their product with construction companies, architects, and whole-sellers (Den Hertog and Brouwer, 2001). Furthermore, architects produce the designs for the customers, which are highly specified with regards to materials, products, and working procedures. Contractors execute the plans, hiring suppliers and sub-contractors in the process, creating a temporary production chain (Den Hertog and Brouwer, 2001; Pries and Janszen, 1995), which is long and complex as none of the actors is able to produce the final product alone (Dubois and Gadde, 2002; Pries and Janszen, 1995). Typically, clients are not involved in the specifications or building processes. The same team very rarely works together in more than one project, and when they do work

together more than once their roles with respect to each other might differ (Dubois and Gadde, 2002; Pries and Dorée, 2005). This is a unique feature of the sector that can inhibit innovation, as long-term investments in innovation and collaboration cannot be recouped in one-off project collaborations (Den Hertog and Brouwer, 2001; Dubois and Gadde, 2002). Moreover, it has been argued that this can lead to a lack of trust or build-up thereof (Den Hertog and Brouwer, 2001; Dubois and Gadde, 2002; Klein Woolthuis et al., 2012; Pries and Dorée, 2005).

*Rules:* The construction sector is one of the most highly regulated sectors in Europe; there is a large number of laws, regulations, and governmental levels (from city-level to EU-level) involved (Den Hertog and Brouwer, 2001; Reichstein et al., 2008). This is for a large part due to the importance of safety and spatial planning responsibilities. The urban planning tradition in The Netherlands is characterized by a top-down approach, which entails controlling developments in detail and leaving little space for individual adaptations (Kadefors, 1995, Klein Woolthuis et al 2013). After World War II this way of planning was also adopted for large-scale developments (Salingaros, 2005). In the past half a century, the national government issued Reports on Spatial Development (1958, 1960, 1966, 1974, 1976, 1988, 1992 and 2001), defining policy for urban development that defined both the market and all legislation restraining it. The high degree of regulation is also present within tendering procedures. Principals often undertake detailed procurement and planning, where materials, technologies, and organizational concepts are selected beforehand.

*Technologies:* Unique technological aspects of buildings compared to other products are that they are location-bound, have long life cycles, high costs, and a large impact on the quality of life (Pries and Janszen, 1995; Reichstein et al., 2008). This reduces risk-taking behavior, as mistakes will likely linger for quite some time. Therefore, there is often a built-in preference for low-risk proven technologies and organizational concepts (Pries and Dorée, 2005). Furthermore, solutions for one specific location may be ill-transferable to others.

Despite this rigid institutional setting that does not entice innovation or change, many innovative projects in the built environment have seen the light in the past 20 years (Klein Woolthuis et al., 2012). We identified 11 recent projects that implemented several changes in practices, rules, and technologies. Major

embedded actors that are involved in these projects are housing corporations, construction firms, and local governments. We determine how projects function as institutional entrepreneurs. As such, this context enables us to analyze the emergence of institutional changes within projects, triggered by incumbent actors in a highly institutionalized setting.

### 3.3.3 Data collection

The primary data is gathered through semi-structured interviews with different organizations active in the selected projects. We selected projects based on two criteria: 1) successful development of sustainable innovations and 2) the successful implementation of new organizational models. The criterion on sustainable innovation ensures that technological change is taken into account. We employ a broad view of sustainable innovation: all technological innovations that reduce energy and material consumption are considered. The second criterion ensures that the selected projects have already implemented some strategic decisions and organizational models that can be considered a break from the traditional way. Based on these criteria we identified 11 relevant, comparable projects.

In total we performed 43 interviews spread over the 11 projects. Within each project actors from different parts of the production chain are interviewed, such as construction firms, housing corporations, local governments, and financiers. This enhances the credibility of the findings; the wide range of used informants allows us to triangulate findings based on the different viewpoints (Shenton, 2004). By interviewing different types of actors within each case we are able to obtain a more complete understanding of motivations and triggers for institutional change. The selected interviewees mostly have management/coordinating positions within the involved organizations or project. These interviewees are selected, as their positions entail decision making power related to the goals of organizations and projects. Additionally, several advisors/experts are interviewed. While these actors have less decision making power, they are aware of the changes emerging within the projects. Table 3.1 presents an overview of the selected projects, a summary of the main differences between these projects and the research setting described above, the interviewees of each project, and an indication of the actor in each project that can be seen as the main initiator.

Table 3.1: Overview of studied projects

| Nr | Project description  | Breaks with institutional context  | Interviews  | Change demanding actor     |
|----|--|--|---|----------------------------|
| 1  | <p>De Kroever: Passive houses renovation project</p> <p>This project to renovate houses in an urban area was triggered by a housing corporation in Roosendaal. The housing stock needed updating, and the corporation was interested in reducing energy consumption at the same time, making it easier to rent them out. However, residents demanded a more sustainable alternative. In the end these demands led to the realization of passive homes. Instead of a main contractor hiring sub-contractors the project involved organizations that become co-contractors that share knowledge and responsibilities in the early stages of the project. This change was seen as important by involved organizations as it allows for better collaborations that reduce costs: <i>“it’s about using more of each other’s knowledge and expertise”</i> (Interview 1.6).</p> | <p>Residents demand change, leading to an innovation pull.</p> <p>Not the traditional routines related to main contractor and sub-contractors, but co-contractors that learn from each other.</p> <p>Determining a new standard for passive home renovation, by renovating a house in only a few days.</p> | <p>Project manager (1.1)</p> <p>Project manager of housing corporation (1.2)</p> <p>Project manager of housing corporation (1.3)</p> <p>Director of installer (1.4)</p> <p>Project advisor (1.5)</p> <p>Project coordinator (1.6)</p> | <p>Housing corporation</p> |

Table 3.1: Overview of studied projects (continued)

| Nr | Project description  | Breaks with institutional context   | Interviews  | Change demanding actor  |
|----|--|---|---|-------------------------|
| 2  | <p>Sun City: Complete urban area on renewable energy</p> <p>The local government and a visionary architect played a crucial role in realizing a vision on a new way of designing and constructing a completely sustainable city in Heerhugowaard with the use of solar and wind energy, passive houses, and rainwater treatment facilities. “Sun City started as almost an <i>idyllic idea</i>” (Interview 2.1). For the realization actors agreed that the desired level of sustainability could only be achieved by close collaboration and knowledge sharing. The collaboration was facilitated by a new legal entity that guided the project. This entity was jointly established by the local government, the province, constructors, and an energy supplier. An external manager was hired as director. Furthermore, the project led to the creation of a sustainability team as part of the local government.</p> | <p>Not the traditional routines related to main contractor and sub-contractors but collaboration and knowledge sharing.</p> <p>New legal entity to help the project/collaboration to succeed.</p> <p>Not innovations through industry push but through pull of local government for change.</p> | <p>Project advisor (2.1)</p> <p>Project advisor (2.2)</p> <p>Municipal councilor (2.3)</p> <p>Author of book on project (2.4)</p> | <p>Local government</p> |

Table 3.1: Overview of studied projects (*continued*)

| Nr | Project description  | Breaks with institutional context   | Interviews  | Change demanding actor  |
|----|--|---|---|---|
| 3  | <p data-bbox="370 962 427 1522">New Leyden: Developing urban area in private tender</p> <p data-bbox="478 962 1130 1522">Leiden had a heavily polluted and deprived inner city area. A young inspired architect in the local government helped realize a plan for the re-development of the area in close collaboration with current and future residents. For the project, no restrictions were posed for esthetical aspects of the buildings: residents were trusted to make it beautiful as they would feel attached to "their" area. Local government officials and a housing corporation collaboratively set up a new legal entity that guided the project. An external expert was hired as director. This new entity ensured that costs and benefits were fairly divided between residents that jointly developed the area and that the core values of user-interaction, cooperation, and learning were always enforced. By forming a close connection to end-users, several technological innovations were conceived and implemented.</p> | <p data-bbox="370 709 498 935">Not main contractor, but residents design and build their own houses.</p> <p data-bbox="545 709 709 935">Not strict application of the law but exception from law to give freedom of design.</p> <p data-bbox="756 709 884 935">No tendering, but collaboration in new legal entity to ensure success.</p> | <p data-bbox="370 469 431 657">Director housing corporation (3.1)</p> <p data-bbox="478 469 534 657">Municipal councilor (3.2)</p> <p data-bbox="581 469 639 657">Author of book on project (3.3)</p> | <p data-bbox="370 284 465 413">Mix of firm and local government</p> |

Table 3.1.: Overview of studied projects (continued)

| Nr | Project description  | Breaks with institutional context  | Interviews   | Change demanding actor  |
|----|--|--|--|-------------------------|
| 4  | <p>ESCO Rotterdam: Energy efficient public swimming pools</p> <p>This project was focused on the sustainable renovation of existing swimming pools triggered by the local government in Rotterdam. This project was part of the government's goal of increasing the sustainability level of its property, as formulated in the city's Climate Initiative. The government demanded that the contractors become responsible for exploitation and maintenance, while guaranteeing a certain level of energy savings. This triggered two construction firms to collaborate before the tendering procedure, leading to both technological innovations and business model innovations (in the form of a new legal entity - an energy service company (ESCO)). The two construction firms established a new legal entity during the tendering procedure, in order to share knowledge. They argued that "the more responsibility you have, the more room you get [...] to innovate" (Interview 4.1).</p> | <p>Collaboration and knowledge sharing by firms already in tender phase.</p> <p>New financial model in which the realized energy savings determine profits.</p> <p>Guaranteed energy savings for 10 years as responsibility of construction firms.</p> | <p>Project manager construction firm (4.1)</p> <p>Utilization manager construction firm (4.2)</p> <p>Advisor project manager (4.3)</p> | <p>Local government</p> |



Table 3.1: Overview of studied projects (continued)

| Nr | Project description   | Breaks with institutional context  | Interviews   | Change demanding actor           |
|----|---|--|--|----------------------------------|
| 5  | <p>WAIFER: One million sustainable houses project</p> <p>This project aims to make 1 million existing houses more sustainable through integral renovation, starting from a pilot project in Rotterdam. <i>“The goal of WAIFER is to realize energy reduction in the construction of residential buildings. This is not a technological problem, but a social, economic, and organizational challenge”</i> (Interview 5.1). Triggered by a knowledge institute, this project connects residents and housing corporations at several different locations. This project is related to the establishment of a new hybrid-type of organization that partly finances the renovation and triggers renovators to collaborate and look for integrated solutions. As a franchise organization, local corporations, governments and constructors can unify under the overall project. A requirement is that the renovation activities can be completed within 24 hours. Profit is determined by the realized energy savings.</p> | <p>Not industry-push but public private partnership.</p> <p>New business/financial model: not upfront specification, but profit on basis of realized energy performance.</p> | <p>Director WAIFER (5.1)</p> <p>Bank ambassador (5.2)</p> <p>Legal advisor (5.3)</p> <p>Founder energy company (5.4)</p> | <p>Intermediary organization</p> |

Table 3.1.: Overview of studied projects (*continued*)

| Nr | Project description   | Breaks with institutional context  | Interviews          | Change demanding actor |
|----|---|--|---------------------|------------------------|
| 6  | <p><i>Bomenbuurt Uft</i>: Realization of 61 energy-neutral houses</p> <p>Triggered by the vision of the involved housing corporation, the usual tendering procedure was changed. Several targets related to sustainability and costs were set, but methods, materials, and technologies were left open. Contractors were required to find complementary partners that could collaboratively find a way to reach these targets. Complementary partners set up new legal entities and were supervised by process coaches in order to stimulate the formation of a collaborative culture that enables shared learning. The local government was also included in the project to speed up permit procedures and provide more support.</p> | <p>Collaboration and knowledge sharing by firms already in tender phase.</p> <p>Method selection not determined beforehand, freedom for contractors.</p> <p>Exemptions from regulations.</p> | Project leader(6.1) | Housing corporation    |



Table 3.1: Overview of studied projects (*continued*)

| Nr | Project description   | Breaks with institutional context   | Interviews   | Change demanding actor                                       |
|----|---|---|--|--|
| 7  | <p data-bbox="370 962 431 1526"><i>E.now</i>: Collaboration to provide integral customer solution</p> <p data-bbox="478 962 1029 1526">This project is initiated by a knowledge institute in cooperation with two industry associations and entails the establishment of local consortia of construction firms and installers that can provide an integral solution for energy savings in construction. The collaborating local constructors are members of the umbrella organization E.now, a new legal entity that provides a marketing and coordination platform. This enables direct contact with clients, shared learning, and the build-up of experience and trust as these local consortia are enabled to work together in consecutive projects. In this view the traditional sub-contractors become “<i>value chain partners</i>”. <i>In old fashioned terms these are sub-contractors, but we are trying to get rid of that [term]</i>” (Interview 7.5).</p> | <p data-bbox="370 694 465 935">Not project based but continuous collaboration.</p> <p data-bbox="545 694 787 935">No price competition between sub-contractors, but integral, cooperative solutions and cross-selling, knowledge sharing, and learning.</p> | <p data-bbox="370 473 431 657">Director heating installer (7.1)</p> <p data-bbox="478 473 538 657">Director industry association (7.2)</p> <p data-bbox="579 473 639 657">Director industry association (7.3)</p> <p data-bbox="680 473 740 657">Chairman E.now (7.4)</p> <p data-bbox="780 473 854 657">Chairman E.now (7.5)</p> <p data-bbox="895 473 995 657">Entrepreneur from knowledge institute (7.6)</p> | <p data-bbox="370 269 431 417">Intermediary organization</p> |

Table 3.1: Overview of studied projects (continued)

| Nr | Project description   | Breaks with institutional context   | Interviews   | Change demanding actor     |
|----|---|---|--|----------------------------|
| 8  | <p><i>Het Mooie Plan</i>: Construction of new high quality houses in Rotterdam</p> <p>The involved housing corporation and construction firm jointly decided to establish an integrated production chain based on trust. Under the supervision of a university expert the firms started to collaborate with each other and other firms. Partners were selected based on their ability to contribute to cooperation through openness, complementary knowledge and skills. Furthermore, these partners were involved in an early phase of the project. They agreed to use this organizational model in three projects, enabling longer-term learning effects.</p> | <p>Collaboration and knowledge sharing by firms already in tender phase.</p> <p>Not short term, but collaboration over various project to stimulate knowledge sharing and learning.</p> | <p>Project manager from housing corporation (8.1)</p> <p>Project leader builder (8.2)</p> <p>Manager chain collaboration builder (8.3)</p> <p>University expert(8.4)</p> | <p>Housing corporation</p> |



Table 3.1: Overview of studied projects (*continued*)

| Nr | Project description  | Breaks with institutional context  | Interviews  | Change demanding actor |
|----|--|--|---|------------------------|
| 9  | <p data-bbox="369 1071 396 1533"><i>Solids</i>: Flexible real estate in Amsterdam</p> <p data-bbox="436 960 1061 1533">The construction of a large building based on a flexible use concept in Amsterdam. The housing corporation behind this project was triggered by the lack of attention for sustainability and the desire to change the way of doing business. The project is based on a new business model. Executing construction firms could only participate if they actively contributed to knowledge sharing and innovation. The core of the <i>mixed and flexible use concept</i> is provided by a main construction (skeleton with roof, foundation, and facades) in which various functions can be accommodated simultaneously. The first <i>Solids</i> building was developed in the center of Amsterdam in 2011, and was rented out within one day in an Internet auction. The building incorporates functions including social housing, commercial penthouses, hotels, restaurants, and a hair dresser.</p> | <p data-bbox="369 711 470 933">New business model: internet auction to sell parts of the building.</p> <p data-bbox="510 711 645 933">Not upfront specialization, but knowledge sharing and learning.</p> <p data-bbox="685 711 853 933">Exemptions from regulations in order to allow a building to contain several functions.</p> <p data-bbox="860 711 1061 933">New vision regarding sustainability of buildings (people should feel connected).</p> | <p data-bbox="369 545 470 656">Former director housing corporation (9.1)</p> <p data-bbox="510 545 577 656">Municipal councilor (9.2)</p> <p data-bbox="611 545 645 656">Legal advisor (9.3)</p> <p data-bbox="685 545 752 656">Project developer (9.4)</p> | Housing corporation    |

Table 3.1.: Overview of studied projects (*continued*)

| Nr | Project description   | Breaks with institutional context   | Interviews  | Change demanding actor   |
|----|---|---|---|--|
| 10 | <p data-bbox="368 957 431 1522">Park20 20 Hoofddorp: Cradle to cradle business park</p> <p data-bbox="475 957 1063 1522">The project led to the construction of the first full service Cradle to Cradle (C2C) business park in the Netherlands (Haarlemmermeer). The C2C concept focuses on closing material-, energy-, waste-, and water-loops. Human factors (nature in the area, possibilities to take walks, etc.) also played a crucial role in the design, in order to create an attractive and stimulating environment. An active city council member and large developer wanted to realize this vision. However, as there was little knowledge about C2C business park construction, they collaborated intensively with several partners and clients to develop the vision, knowledge, and products. Instead of becoming sub-contractors, involved firms were treated as experts, and the same group of partners was used to construct several buildings.</p> | <p data-bbox="368 704 431 931">Establishment of C2C standards.</p> <p data-bbox="475 704 677 931">Not the traditional routines related to main contractor and sub-contractors but collaboration and knowledge sharing.</p> <p data-bbox="721 704 817 931">Exemptions from and flexibility in regulations.</p> | <p data-bbox="368 537 431 657">Project developer (10.1)</p> <p data-bbox="475 537 538 657">Municipal councillor (10.2)</p> <p data-bbox="583 537 646 657">Project manager (10.3)</p> <p data-bbox="690 537 713 657">Builder (10.4)</p> <p data-bbox="758 537 780 657">Tenant (10.5)</p> | <p data-bbox="368 273 431 408">Mix of firm and local</p> <p data-bbox="440 273 467 408">government</p> |



Table 3.1: Overview of studied projects (*continued*)

| Nr | Project description   | Breaks with institutional context   | Interviews   | Change demanding actor |
|----|---|---|--|------------------------|
| 11 | <p>EVA Lanxmeer: Autarkic urban development</p> <p>This is a small-scale, self-organized, sustainable-conceptualized urban development initiated and managed by Marleen Kaptein, a concerned citizen. It is internationally recognized as an example where social and urban quality is interwoven with smart development with nature. The project realized between 1994 and 2009 consisted of 250 houses for 800 residents, (collective) permaculture gardens, 40.000 m<sup>2</sup> ecological office buildings, a biological city farm, and the “EVA Centre for education, information, and advice”.</p> | <p>Not industry-push, but bottom-up citizen development.</p> <p>Public-private partnership between citizens, businesses and local government.</p> <p>Knowledge sharing by specialists (including users, producers, evaluators, and regulators).</p> | <p>Entrepreneurial citizen (11.1)</p> <p>University professor (11.2)</p> <p>Permaculture expert (11.3)</p> <p>Building expert (11.4)</p> | Citizen                |

The semi-structured interviews focus on the motivation of organizations to change the way of working in the project, the barriers and opportunities for this change as perceived by the interviewees, and the main recommendations of organizations towards other actors to stimulate this change.

In order to further enhance the credibility of our findings, we also triangulated by using different data collection strategies. Interview results are compared with information found during desk research on each case (such as media publications, project web sites, etc.) as an additional means to determine the reliability of the responses. For five of the projects a public report or book detailing the process was available for study (projects 1, 2, 3, 6 and 9). No additional findings or contradictions were found when comparing interview data with desk research data. The combination of different data collection strategies further contributes to the credibility of the findings, as it allows us to verify different viewpoints against other sources (Shenton, 2004).

### **3.3.4 Project descriptions**

The innovative projects examined for this research are all innovative with respect to the used technologies and their organizational model and are all related to sustainability. Table 3.1 shortly describes the aims and structure of the studied projects, specifically describing those aspects that can be considered a break from the traditional setting.

### **3.3.5 Data analysis**

The interviews were transcribed and consequently coded. We coded according to two broad focus points: motivations for change and changes established within the projects. The coding is therefore directly in line with the main line of questioning in each interview. We compared the data segments obtained from different organizations within individual projects. Hereafter, we established aggregated motivations for each project and made a cross-case comparison. In this comparison a pattern of motivations emerged. We structured the sources of dissatisfaction according to practices, rules, and technologies, as defined in section 3.2.2. Based on Klein Woolthuis et al. (2013) we identified several dimensions of practices, rules, and technologies that are common in the built environment field.

Changes that emerged within projects were also structured according to practices, rules, and technologies. Table 3.2 illustrates some coding examples for each of the three institution types. In line with the methods used by Lawrence et al. (2002) we then determined which of the observed changes have started to diffuse beyond the project level, in order to identify those changes that qualify as proto-institutions. This can be the case when partners within projects change their practices and rules governing their behavior towards others, when changes have diffused to other contexts (such as new law interpretations adopted by other cities or regions), or when changes have diffused to the macro level, e.g. national policy.

Table 3.2: Coding example

| <b>Institutions</b> | <b>Dimensions</b>                                 | <b>Coding examples</b>  |
|---------------------|---|---|
| Practices           | Ideas, beliefs, visions                           | Construction should take the future of the planet into account                  |
|                     | Norms and values                                  | Collaboration before entering tender process                                    |
|                     | Manner of communication/interaction               | Involvement of citizens and experts as stakeholders from the start of a project |
| Rules               | Application of rules/stretching legal constraints | Interpreting existing building permit rules in a different way                  |
|                     | Urban plans                                       | Changing zoning plans   |
|                     | Property rights                                   | Contract change from owning to lease  |
|                     | Contractual arrangements                          | Change incentive structure in contracts   |
|                     | Legal structure                                   | New organizational form started   |
| Technologies        | Technological solutions                           | Integrated energy-saving innovations  |
|                     | Technological standards                           | Developing C2C certification for construction materials                         |

## 3.4 Results

This section presents the results by first addressing why incumbents envisage and enact change. Second, we address how change is initiated within the projects and what changes have started to diffuse beyond the boundaries of the projects.

### 3.4.1 Dissatisfaction with traditional way of working

In the description of the field, we explained that construction companies mainly work on routine and are generally speaking not used to customers involved in the projects. Several firms became increasingly frustrated with this traditional way of doing business. This was clearly discussed by a senior of a large construction firm (Interview 4.1) in the ESCO project. He explained that when his company was not selected to work on a large railway project (while his firm is in the top 3 of railroad construction firms in the Netherlands), the company was stunned and took time to uncover why this happened. Missing the project increased their frustration with the current way of doing business: *“We wanted to get rid [...] of the more-for-less work, the disagreements, the negativity, failure costs, and actually the lack of professionalism of the sector. [...] We saw these issues and wanted change”*. The senior stressed that they made the explicit, intentional choice to connect to clients more directly; *“This made our work much more interesting [...] It led to more opportunities for us to innovate”*. In the ESCO case, it was argued that one of the largest barriers was the culture in the field: *“we have been doing this for years, why would we do things differently?”* (Interview 4.3).

Customers themselves can also become frustrated by the way of working. Housing corporations and local governments are clients of construction companies. In projects 1, 2, 4, 6, 8, 9, and 11 clients explicitly demand that the executing parties work together in a different manner in order to facilitate that innovation and learning take place. A good illustration of a client demanding change in the way of working is Bomenbuurt Uft. The involved housing corporation had a strong vision that different tender procedures were necessary in order to stimulate innovation. The project leader was convinced that a different approach was necessary to make construction more sustainable; he was strongly motivated to contribute to European targets regarding energy-neutral buildings. Motivated to change the routines in the sector, this client firm

used a more open procedure, where interested construction firms could determine their own methods to reach the project goals (i.e. developing energy-neutral houses), as opposed to using the traditional procedures in which technological and organizational choices are pre-determined. Furthermore, construction firms were asked to form coalitions with complementary specialized partners and develop their plans collaboratively. As this process was very new for involved construction firms, and in order to stimulate real collaboration, each coalition was coached by an external expert. This project is thus based on very different ways of working and tried to stimulate the build-up of new collaborative routines. Interestingly, even the construction firms that were not awarded further contracts were very positive about the process. They perceived this new process as more transparent and fair compared to the traditional way.

Another example of a client demanding change driven by dissatisfaction with the current way of doing business is Het Mooie Plan. The involved corporation and construction firm have met each other in many projects over the past 40 years but often came into strong conflicts that even went to court. These conflicts started to have a negative impact on the performance of these organizations. This motivated them to change, not only themselves, but also the way in which they interact with other actors in the sector. As argued by a project manager of the corporation: *“I was in construction and I didn’t know better than the traditional way. The first time we met [the construction firm in this project] we immediately discussed signing a waiver. That is not how you want to start if you are trying to achieve chain integration”* (Interview 8.1). Motivated by an increased feeling that the current way of working is not how it should be, these organizations started to look more towards partnering instead of only competing on lowest price. They determined that in future projects their collaboration with other firms should be based on learning and trust, not on risk-reduction and cost-reduction.

Additionally, we identified several instances in which motivations for change are related to doing ‘the right thing’. This is related to a more fundamental dissatisfaction with beliefs on which current practices are based. In Sun City the involved architect and construction firm were convinced of the importance of sustainability. Given the fact that the built environment uses so much energy, they envisaged a new city development standard completely based on renewable energy. This became the leading design criterion in all decisions. In Park 20|20

the involved developer became a father, which changed his view on project development: he suddenly felt responsible for their future and the future of our planet. He realized that he could play a role in reducing environmental impacts of buildings. In Solids, the involved former CEO of a large housing association in Amsterdam saw how cheaply built, post-war living quarters deteriorated fast: poor architectural design with inferior building materials made these neighborhoods unattractive, with low rents, high pollution, and low maintenance as a result. As a result these neighborhoods typically got demolished long before the economic life span of the buildings was reached which implied a big environmental impact. On the Amsterdam canals, where he himself lived, he saw the opposite: wonderful architectural design with high quality building materials leading to timeless attraction (400 years) to all sorts of renters and buyers, leading to continuing maintenance and upgrading of the buildings. He concluded that for a truly sustainable development, we should focus on quality: *“By making real estate that can accommodate various function so that people can use their premises as they wish, one can create attachment and emotion between the object and its user. Second, dearness, a collective quality that real estate has to unite people”* (Interview 9.1). The Lanxmeer project is also based on a personal wish to contribute to a more sustainable and environmentally friendly society, as well as to increase the involvement of the general public with global, environmental, and social issues. Sustainability goals are formalized, and when buying or building a house in Lanxmeer, there are strict rules regarding limiting energy use, car use, and the commitment to actively participate in social activities.

### 3.4.2 Dissatisfaction with rules and regulations

There was only one project that was actually started based on dissatisfaction with rules and regulations. The E.now project was triggered by dissatisfaction regarding current regulations. *“[The project] originated from frustration. [...] The covenant ‘More with less’ was signed. However, nothing happened”* (Interview 7.2). This covenant was signed by several ministers and industry associations and aims to reduce energy consumption and CO<sub>2</sub> emissions of the built environment by stimulating innovation. Following the dissatisfaction with the manner in which this covenant was enforced, the involved partner decided to start an innovative project that would contribute to energy reductions in the built

environment, while simultaneously providing installers and builders incentives to collaborate in longer-term processes.

In other projects dissatisfaction with regulations emerged during the projects. For instance, in the ESCO project and in Het Mooie Plan the involved firms had issues with several specific laws regarding investments and maintenance costs: “*That is one of those rules, maintenance costs are very much stuck in strong regulations*” (Interview 8.3). Government officials were approached in order to discuss regulation changes. In the case of Sun City the Dutch subsidy policies for solar panels were called “*indecisive*”. The organizations turned to the EU for subsidy support but also established a fund that was governed by the project partners in case subsidies were not obtained. In Park 20|20 a new government official who was working on demand-driven residential development was frustrated by the methods and regulations used for land allocation and the related business model for the municipality, as they lead to “*unrealistic expectations*” (Interview 10.2). The developer was looking to be involved in more sustainable projects. These separate developments coincidentally became change opportunities. In this project the local government official was strongly looking to change rules and regulations to facilitate the projects.

### **3.4.3 Dissatisfaction with technologies**

In Park 20|20, the business consortium soon realized that the C2C concept was more of a philosophy than a concrete and actionable way of working. They concluded that 1) there was very little known and available regarding C2C construction materials and standards and 2) that even less was known about an integrated approach of the entire process to achieve energy-neutrality. Because of this, the consortium started collaborating with Braungart and McDonough, the founding fathers of the C2C concept. Together they developed, tested, and certified materials, methods and processes to develop C2C buildings and areas. This was the only case in which dissatisfaction with a specific technological standard was (partly) driving the project.

### **3.4.4 How is change initiated: The development of proto-institutions**

The sources of dissatisfaction as described above were mainly with the institutional context in which these incumbent firms are embedded. This dissatisfaction forms a strong motivation to experiment and innovate in projects.

The next question is how these projects and the actions of dissatisfied actors accumulate to seeds for change.

In the theory section we distinguished between the proto-institutions of practices, rules, and technologies. In this section we discuss how the changes as described previously, started to move beyond the boundaries of the specific project. For change to take place in the built environment, aspects of the innovative projects have to become entrenched in the field's institutions. We therefore describe which changes within the projects were transferred outside the direct boundaries of the project. Through this transfer, the proto-institutions can form seeds for change.

Table 3.3 below provides an overview of the changes in rules, practices, technologies, and beliefs within projects that were observed and have started to diffuse beyond the boundaries of these projects.

### *Practices*

We see how new ways of working evolved in several projects and how these practices spread to other projects. The role of clients in several projects changed compared to the traditional way of working. There are instances of citizen participation within several projects. The inclusion of citizen participation can be seen as a proto-institution, as it has started to diffuse beyond the boundaries of several projects. For instance, citizen participation has been included in follow-up projects throughout the Netherlands. The same goes for the new ways in which firms and governments are collaborating. The interviewed city council member involved in Park 20|20 argued that it is not the entire project setup that is being copied by external actors *“but the collaboration between municipality and developer is”* (Interview 10.2).

There are also examples of projects in which clients demand change, which triggered changes within involved project partners. For instance, while the change demanding corporation in Bomenbuurt Uft was very much convinced that the current way of doing business needed to change and that new buildings needed to be energy-neutral, the involved construction firms entered with a different motivation; construction firms are interested in big projects and this project had a €12 million budget. Similarly, a construction firm involved in Het Mooie Plan stated that they got involved in the project *“because we wanted a*

*project. It was that simple*" (Interview 8.3). However, the firm was surprised that the selection procedure did not focus on costs and lowest price. The firm stated: "We did not know what [this new form of integrated collaboration] was. We didn't know anything about it, but we were awarded the project. Perhaps because we honestly explained that we didn't know what it was but that it felt right and we wanted to collaborate in this direction". This project made it clear to the construction firm that "being involved in chain integration with the outside world helps to remove barriers between organizations, but at the same time you realize that these barriers are still present within your own organization. [...] we are currently making internal changes". This illustrates a mechanism for changes to go beyond the boundaries of a project; as partners within a project start making internal changes, their future interactions in the field can be different, potentially leading to further changes.

Another way in which the changes have started to diffuse beyond the project boundaries is by actors sharing insights and experiences at conferences, trade fairs, and other network events and by communication via websites, (social) media, magazines, and (local) television. Exposure in this way is important to enable diffusion; as strikingly put in the WAIFER case "*Unknown, unloved*" (Interview 5.3). Therefore, from our cases we learn that whereas some projects remain relatively isolated events, in which new ways of working are shared amongst project members and direct stakeholders, in other case we see how proto-institutions are formed.

Interestingly, in most cases new practices that emerged led to the establishment of changed rules within the project. Consider for instance that in De Kroeven the original plan of working together with citizens was rather informally organized. However, due to prolonged discussions formal changes were made so that the envisioned solutions were more strict, clear, and enforceable. It therefore seems that practices are not necessarily diffused beyond project boundaries but become encoded within rules that are more easily diffused beyond the project. This is discussed further in the next section.

### *Rules*

Most of the observed changes within projects relate to rules. In the cases where governments were leading customers (2, 3, 4, and 10), local regulative institutions were influenced and changed. These changes cover spatial and

urban planning policy, construction permits, formal tendering criteria, guarantees for energy savings, and public-private partnership regulations. In Bomenbuurt Uift, Het Mooie plan, and Solids, governments were cooperatively involved. In the Solids project it was argued that government officials were intentionally, cooperatively involved in the project, which created commitment and trust: *“Instead of ‘no, unless...’ the local government changed to a ‘yes, and we will solve it together’ attitude”* (Interview 9.1). These changes persisted after the project and have started to diffuse to locations outside the project. Other large cities such as Eindhoven have adopted this idea and also take the new interpretation of the law as their official guideline.

In several cases, new contractual forms and property rights were developed. This is especially clear in the ESCO case. A new way of contracting was introduced, where the building company became the actor responsible for the energy management of the swimming pool. Whereas traditionally the swimming pool would have purchased the machinery, now the building company started the so-called ESCO and remained owner of the equipment. They remained responsible for its functioning. This also led to a new business model in which the revenues of the building company were dependent on the performance of its equipment. Over time, many ESCO's have emerged in other locations such as Amsterdam, Utrecht, and Eindhoven following this example. As the involved construction firm argued: *“firms are jumping on this integral approach”* (Interview 4.1).

As argued above, there are many examples of changed practices leading to changed rules and regulations that diffuse beyond the project. Changes in the selection of partners based on complementarity and willingness to collaborate, led to formal changes in the tendering procedures in for instance the Solids project. Construction firms were asked to form coalitions with complementary partners before entering the tendering procedure. This forced participating firms to change their behavior even before the project. A similar process is present in ESCO Rotterdam, where two construction firms formed a coalition before entering the tendering process based on formal demands of the local government. The cases of Bomenbuurt Uift and De Kroeven experiment with new ways of working in the tendering process. The tendering process is made more transparent and done solely on costs, energy performance (O-energy usage), and as short as possible renovation period rather than the traditional tendering on

Table 3.3: Overview of emerged proto-institutions

| <b>Project</b>         | <b>Rules</b>   | <b>Practices</b>   | <b>Technologies</b>                                       |
|------------------------|--|--|---|
| <i>De Kroeven</i>      | Cluster tender   | 0-energy renovation in 2-5 days through collaboration and pre-fabrication<br>Citizen participation | Replacing object's shell with pre-fab insulation solution |
| <i>Sun City</i>        | Obligatory use of renewable energy<br>Long term energy contract (tender on performance rather than price)                    |  |   |
| <i>New Leyden</i>      |  | Citizen participation  |   |
| <i>ESCO Rotterdam</i>  | Long term energy contract (revenue dependent on performance)<br>From purchase to lease contract<br>Collective tender process | Collaboration in tender process  |   |
| <i>WAIFER</i>          | Long term energy contract (revenue dependent on performance)   | Citizen participation  |   |
| <i>Bomenbuurt Uift</i> | New tendering process stretching the existing tendering rules  | Collaboration in tender process  |   |
| <i>E.now</i>           | Long term collaboration contracts  | Collaboration on customer requests<br>Long term, cross-project collaboration                       | Certification of E.nu partners                            |

Table 3.3: Overview of emerged proto-institutions (*continued*)

| Project               | Rules   | Practices                              | Technologies                             |
|-----------------------|---|--|--|
| <i>Het Mooie Plan</i> | Official procedure to collaborate in multiple rounds in start phase     | Long term, cross-project collaboration |  |
| <i>Solids</i>         | New interpretation and application of existing rules.                   | Long term, cross-project collaboration |  |
| <i>Park 20 20</i>     | Suppliers retain ownership materials<br>From purchase to lease contract | Development of C2C building practices  | Certification of C2C building materials. |
| <i>EVA Lanxmeer</i>   | Shared ownership guiding principle                                      | Citizen participation                  |  |

detailed specification. In the Ulft case, when asked if this way of working has been copied, one of the interviewees responded: “*not by local governments, corporations [outside the project] did copy it*” (Interview 6.1). Due to his direct involvement in other projects, this interviewee is able to share his experiences. Furthermore, he is involved in a follow-up project that aims to show that the Ulft approach can be used on a larger scale (in the renovation of 500 houses). This basic change in formalized rules of working together is present in all projects and is starting to diffuse, primarily via follow-up projects. A clear example is a new project The Rapids. Several individuals involved in the studied projects have initiated The Rapids in which four large construction firms and six large corporations agreed (under supervision of national ministry officials) to renovate 111,000 buildings following a new way of working as co-contractors.

### *Technologies*

Three projects entail the co-creation of new technological standards. The strongest illustration of this is Park20|20, the business park that works closely together with Braungart and McDonough on research, application, and certification of the use and re-use of building materials. In the development of the business park, the developer found that the C2C concept was more of a

philosophy than a concrete guideline. Whereas in some other countries the C2C concept might be better developed with concrete materials and building practices, in The Netherlands the practical application is still in its infancy. The developer reported: *“We truly did not know how to realize the C2C philosophy in practice. We had only three C2C certified products: a carpet, chair, and window frame. How we had to take it from there was a complex search process between us and our partners”* (Interview 10.1). The approval of new materials (like a novel light weight concrete) could take years to pass Dutch building and safety regulations. It was in this uncertain field that the project partners had to invent their own approach to making the philosophy operational. They then worked towards defining new constructions and installations that were compatible with the philosophy. A partner program was established on the basis of the willingness of companies to learn about C2C, adjust products and practices to this philosophy, and to work to maximum achievable quality and long term learning. Close collaboration was sought with customers to jointly formulate these demands. Through this program and customer interactions the technological standard started to diffuse beyond the boundaries of the project.

### **3.5 Discussion**

Dissatisfaction with the institutional context was a strong driver for the formation of the studied projects and for innovations within these projects. In most projects, dissatisfaction was related to practices, such as the relation between projects and customers, the culture in the field, and the manner in which tendering processes and collaboration are organized. Additionally, we find that dissatisfaction with practices also comes from differences in fundamental ideas of how things should be, rather than how they are. These beliefs were often inspired by other institutional contexts. For instance, the contrast between the manager’s own living quarters (Amsterdam canals) and the ones observed at work inspired a new way of viewing urban development. This brings us to a new insight into why actors envisage and enact change. Whereas previous literature has indicated that conflicting institutional demands can make actors escape the power of existing institutional pressures (Dorado, 2005; Greenwood et al., 2011) or that actors from outside an industry can introduce change (Creed et al., 2010; Greenwood and Suddaby, 2006; Wright and Zammuto, 2013), we observe that the multiple embeddedness of incumbent actors within the industry can also cause them to pursue change. Their multiple-embeddedness is in their work

environment but also in their families, living environments, and in their travels can inspire actors to reflect on taken for granted ways of doing things. In these cases, the multiple-embeddedness motivated actors to take action and become institutional entrepreneurs, actively promoting sustainability in the built environment. We also observed dissatisfaction with rules, such as indecisive subsidy policies. However, while dissatisfaction with rules led organizations to look for changes, it was less of a trigger for these projects compared to the aforementioned dissatisfaction.

Dissatisfaction triggers actors to generate new practices, rules, and technologies in collaborative projects. Current literature on proto-institutions argues that newly emerging practices, rules, and technologies may become full-fledged institutions if social processes entrench them (Lawrence et al., 2002; Zietsma and McKnight, 2009) but does not provide much insight into these processes. We observed several mechanisms that can cause emerging proto-institutions to become seeds for change. New practices are diffused when organizations involved in the studied projects change their internal practices that guide their behavior towards external actors. Furthermore, new practices are diffused via network events. A stronger mechanism is that changes in practices lead to changes in rules and regulations. These new regulations are often copied by local governments in other locations or in follow-up projects.

Our results also illustrate how collaborations that are initiated based on market transactions (e.g. housing corporations or citizens demanding change) and hierarchical relationships (e.g. local governments demanding change) can lead to the emergence of proto-institutions. This view is a contribution to our current understanding, where only 'true' collaborations are seen as being able to generate proto-institutions due to being more fundamental and complex (Lawrence et al., 2002; Phillips et al., 2000). Markets and hierarchies function partly as familiar institutional mechanisms but simultaneously become more complex, negotiated, and dependent on mutual exchange of information due to their different structure. These are exactly the characteristics that are argued to belong to true collaboration in existing theory (Lawrence et al., 2002; Phillips et al., 2000). Markets and hierarchies can provide incentives for collaboration, especially when there are little to no institutional incentives to collaborate in the field that embeds these collaborations. It can be argued that due to these more formalized demands, the proto-institutions that emerged are primarily

formalized rules. It is the collaboration within the studied projects that underlies the potential institutional change in this highly institutionalized sector.

Note that we do not claim that our study shows institutional change, as this requires a longitudinal research design. However, we feel that the projects contribute to the build-up of proto-institutions that can possibly open the embeddedness of the sector. The further diffusion of these proto-institutions depends on the willingness and ability of several different actor types. One issue is that many of the clients in the studied projects are rather location-bound. Roughly speaking, if a corporation has renovated all the houses it owns, it has no further demand for these projects. Even if the involved construction firms changed their way of doing business, willing and able clients are required in future projects in order to further diffuse this new way of doing business.

Finally, it is remarkable that whereas all projects were innovative, there were very few changes in technology. This illustrates the idea that there are technological solutions to different (sustainability) issues, but institutional pressures are limiting their application.

### **3.6 Conclusions**

Incumbents in the Dutch built environment decide to become institutional entrepreneurs as they are dissatisfied with the current institutional setting. Traditionally the literature argues that changes come from outside or can emerge due to conflicting institutional demands. This chapter shows change from inside. The current practices in the field are a main source of dissatisfaction. This frustration is intensified when actors have different fundamental ideas of how things should be. The envisioned alternatives were a result of the actors' multiple embeddedness.

Due to their dissatisfaction with the current way of doing business, incumbent actors were intentionally looking to change institutional pressures that guide collaborative behavior. There was an important role for large clients, primarily housing corporations and local governments, in this respect. They are relatively powerful actors that can demand change within projects. The studied cases show that projects can represent an important opportunity for change, as they can function as temporary settings in which there is room to experiment with new practices, rules, and technologies. In essence, large clients form a market for

change but are also actively involved in the enactment of this change within projects. When changes within projects influence the relations between actors outside of projects (for instance when a city adopts new regulations that change the role of the local government in future collaborations or when a firm adopts new practices that change the way they collaborate with other firms), they can form seeds for change.

This chapter makes three contributions. First, we enhance our understanding of institutional change coming from within instead of outside. We demonstrate how dissatisfaction triggers both firms and governments to act as institutional entrepreneurs, as they initiate changes that break with the traditional setting and participate in the implementation by organizing projects in an innovative way. This dissatisfaction follows performance concerns but also comes from the multiple-embeddedness of actors. These drivers of change have not received much attention in literature.

Second, we show how proto-institutions emerge in these projects. Our findings show changes in practices, rules, and technologies within projects and different mechanisms that allow for the diffusion of these changes beyond the project level. The main mechanism in the studied field is the formalization of different beliefs and practices in new rules and regulations that are consequently copied by several other municipalities.

Finally, we find that collaborations based on market transactions and hierarchical relationships can also form proto-institutions. Collaboration within the studied projects is structured in such a way that innovation, learning, and trust are stimulated. Collaborations took on different forms, ranging from new types of contracts and business models to different types of organizational entities being established as a result of the combined efforts of different organizations (such as a government, a firm and a knowledge institute). Several of these changes have started to diffuse beyond the boundaries of projects.



## 4. How institutional complexity enables and blocks sustainable innovations: the field of bio-plastics<sup>3</sup>

### 4.1 Introduction

Worldwide, the plastics sector has steadily grown since the 1950s, and it is expected that demand will continue to rise (PlasticsEurope, 2013). Plastics are seen as crucial materials in the production and consumption of products, due to their beneficial properties and performance benefits compared to other materials such as wood, glass, and paper. Especially the durability of plastics is a valued property (Álvarez-Chávez et al., 2012; EC, 2011). Plastics are produced mainly from petroleum and represent the largest field of application for crude oil (Shen, 2011; Siracusa et al., 2008). However, the durability of plastics and the use of oil as feedstock are causing severe environmental problems related to waste, depleting resources, and climate change (Chadha, 2011; Ren, 2003; Shen et al., 2009). With the prospect of feedstock supply insecurities (both in terms of availability and in terms of price) and demands from public and policy to lessen the environmental impact, the plastics sector came under pressure to develop sustainable innovations.

Sustainable innovations in the plastics sector can take different forms, such as making existing manufacturing processes more efficient, developing new environmentally-friendly technologies, or imposing environmental performance standards (Iles and Martin, 2013). In recent years, bio-plastics have been presented as sustainable innovations. There have been high expectations regarding the market potential of bio-plastics. Also, the technical substitution potential of bio-plastics replacing their petrochemical counterparts is estimated to be around 90% of total polymers that were consumed in 2007 worldwide (Shen et al., 2009). Large players such as BASF, Dow Chemical, and DuPont have been involved in bio-plastics production.

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<sup>3</sup>This chapter is based on Kishna, M., Negro, S., Niesten, E. and Hekkert, M. (2015). How institutional complexity enables and blocks sustainable innovations: the field of bio-plastics (under review after resubmission at Journal of Cleaner Production).

Despite these positive factors, bio-plastics still only represent a small part of the market – just 0.5% of the world plastics consumption (Shen et al., 2009). High production costs and technological issues in scaling up are seen as the main barriers for the further diffusion of bio-plastics (Iles and Martin, 2013; Rosentrater and Otieno, 2006; Shen et al., 2009). However, there are also challenges that go beyond the economic and technology dimensions, as the success of sustainable innovations strongly depends on institutional changes in addition to technological progress (Rennings, 2000).

Institutions are taken-for-granted social rules that stabilize and pattern behavior (Meyer and Rowan, 1977; Scott, 2008). Innovations that are not in line with the existing institutional setting have to establish legitimacy in order to potentially become dominant (Garud et al., 2002). In the case of bio-plastics it is likely that different institutional obstacles, such as improper or fragmented policies and regulations, lack of standards and guidelines, consumer behavior, and lack of consumer awareness, need to be overcome in order to increase their market share (Ren, 2003). The emergence of sustainability demands in a sector may give rise to a complex setting in which multiple institutional opportunities and challenges emerge that were not traditionally part of a sector. This calls for an approach that takes the complexity of the institutional dimension into account. The institutional logics approach is an approach that is able to address and analyze the sector-level consequences of institutional complexity (Greenwood et al., 2011).

The institutional environment may consist of one or more institutional logics, which are “*the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality*” (Thornton and Ocasio, 1999, p. 804). In this way, logics influence the selection and legitimacy of innovations (Fuenfschilling and Truffer, 2014; Lounsbury, 2002). When organizations are faced with the complex task of dealing with (incompatible) prescriptions from multiple institutional logics, they face so-called institutional complexity (Greenwood et al., 2011). Organizations have to respond to this complexity; when faced with highly incompatible prescriptions it is probable that organizations prioritize some interests at the expense of others (Greenwood et al., 2011). Depending on the chosen response, the resources and legitimacy for specific sustainable

innovations are influenced. While a link between logics and sustainable innovations is expected, it has received only limited attention. Most studies on institutional logics focus on service-providing sectors and the adoption of new organizational forms but not on new technologies (see Greenwood et al., 2011 for an overview).

This chapter addresses this gap by focusing on exploring the interactions between the institutional setting and organizations, in order to understand how institutional complexity and organizational responses influence sustainable innovation processes. The bio-plastics field is particularly interesting and relevant case for studying the role of institutional complexity in sustainable innovation, because a complex and diverse set of logics surrounds bio-plastics, i.e. logics related to traditional plastics production, green chemistry, and agriculture. The main research question is: *what is the role of institutional complexity in the development and diffusion of bio-plastics?*

## 4.2 Theoretical background

A key assumption of the institutional logics approach is that interests, values, and assumptions of actors are embedded in prevailing institutional logics (Thornton and Ocasio, 2008). More specifically, an institutional logic prescribes goals (e.g. values and missions) that are viewed as legitimate and means (e.g. practices, technologies, organizational forms, courses of action) that are viewed as legitimate to reach these goals (Pache and Santos, 2010). As such, an institutional logic describes how to interpret organizational reality, what constitutes appropriate behavior, and how to succeed (Greenwood et al., 2011; Heiskanen, 2002; Thornton et al., 2012).

In order to obtain the resources to successfully develop and diffuse an innovation, actors must convince others of the legitimacy, appropriateness, and desirability of their innovation relative to how the currently prevailing logics evaluate these activities (Greenwood et al., 2011; Thompson, 2013). When multiple and/or incompatible goal-means prescriptions are present, for instance when there are simultaneous pressures from an environmental logic and a profit-based logic, organizations face institutional complexity. When faced with institutional complexity it may become more difficult for organizations to convince others of their innovations' legitimacy (Greenwood et al., 2011).

Institutional complexity is shaped by processes in organizational fields, as fields are centers of debates in which competing interests negotiate over issue interpretation (Heiskanen, 2002; Hoffman, 1999; Scott, 2008). An organizational field is described by DiMaggio and Powell (1983, p. 148) as: *“those organizations that, in aggregate, constitute a recognized area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products”*. At the field level normative criteria become encoded in field-level logics that are manifested in practices, rituals, and structures (Greenwood et al., 2011; Thornton and Ocasio, 2008). As a result of this reconfiguration process, a single logic might become dominant, there can be enduring competing, coexisting logics, or logics can interact in more complex ways by blending, changing, or reinforcing each other (Goodrick and Reay, 2011; Greenwood et al., 2011; Raaijmakers, 2013). Logics can also change as field-level frames gain and lose dominance over time (Ansari et al., 2013). The bio-plastics field currently does not have a single dominant logic; logics from the traditional plastics field are present in the bio-plastics field, as well as logics coming from the agriculture field and logics related to green chemistry, creating institutional complexity for actors in the bio-plastics field.

#### **4.2.1 Organizational responses and complexity**

Organizations experience complexity to varying degrees and can therefore differ in how they respond to complexity. When there are multiple logics, and these logics are perceived as compatible or reinforcing, complexity facing organizations may be diminished. In this case, organizations are expected to act in line with those pressures that are similar. When complexity is amplified by incompatibilities between different prescribed goals and means, it becomes more difficult for organizations to pick the correct response (Greenwood et al., 2011; Pache and Santos, 2010). Organizations can become uncertain about what to do, and complexity can even facilitate resistance to change (Greenwood et al., 2011; Seo and Creed, 2002). Possible responses are that organizations ignore specific pressures or keep acting in line with the historically dominant logic (Greenwood et al., 2011; Seo and Creed, 2002). However, being in contact with multiple conflicting logics simultaneously can also open organizations' eyes with respect to possible alternative institutional settings. Furthermore, when widely shared norms do not exist or are contested, actors also have relatively

more unconstrained spaces to work in and promote their own interests (Battilana et al., 2009; Maguire et al., 2004). This can motivate organizations to act as institutional entrepreneurs – i.e. actors that envision new institutional arrangements and undertake actions to realize these arrangements (Greenwood and Suddaby, 2006; Maguire et al., 2004) – in order to reduce the tensions of complexity (Greenwood et al., 2011; Seo and Creed, 2002).

Organizational responses also have feedback effects on institutional complexity at the field level. Through their responses interactions between logics play out over time. For instance, in response to institutional complexity organizations can develop hybrid practices where pressures from different logics are combined. These can radiate to the field level and trigger changes in logics (Smets et al., 2012). In this way organizations can give rise to a more institutionally complex situation and intensify or de-intensify pressures of complexity at field level (Greenwood et al., 2011).

#### **4.2.2 Sustainability logic**

The expectation is that the emergence of sustainable innovations is related to logics that encompass sustainability-related goals and/or means. Sustainability is a multidimensional concept, covering topics such as efficiency in consumption, scarcity of resources, impossibility of sustaining current consumption, human rights, poverty, and child mortality. There are many different definitions of sustainability. In the most holistic perspective sustainability is viewed as the integration of economic prosperity, environmental quality, and social equity, in the short-, long-, and longer term (Lozano, 2008). This implies that sustainability logics can include prescriptions related to one or several of these dimensions; e.g. a sustainability logic could emerge that only prescribes goals and means related to environmental quality, while another sustainability logic could emerge that prescribes goals and means related to all dimensions. The prescriptions from these two sustainability logics are not necessarily compatible, which can therefore lead to institutional complexity. Furthermore, the field becomes a center of debate not only between different sustainability logics but also between the historically dominant interests and interests related to the emerging sustainability logics. As organizations in the bio-plastics field come from different, wider contexts with distinct logics (including the traditional chemistry sector and the agriculture sector), their individual frames about field-level issues, such as sustainability issues, will likely differ

(Ansari et al., 2013), potentially also leading to institutional complexity as different actions are preferred. As such, this chapter does not focus on a specific definition of sustainability beforehand. Instead, this chapter tries to determine how sustainability is translated and reconfigured into field-level logics by organizations in the bio-plastics field over time.

Sustainable innovations often compete with already existing technologies and products. For organizations developing sustainable innovations a crucial challenge is thus to convince others of the legitimacy, appropriateness, and desirability of these innovations relative to how the currently prevailing logics evaluate the innovations. Organizations that develop sustainable innovations may enhance their legitimacy by linking their sustainable innovation to sustainability logics at the field level. Some organizations might even try to enhance the legitimacy of their sustainable innovation by trying to change the institutional pressures in the field. Indeed, the success of sustainable innovations is linked to institutional changes (Rennings, 2000). By applying an institutional logic perspective it is possible to examine the institutional context in which sustainable innovations are developed.

### **4.3 Methods**

This section discusses the research design, data collection, operationalization of concepts and data analysis.

#### **4.3.1 Research design**

This chapter employs a qualitative approach to determine the role of institutional complexity for sustainable innovations by analyzing the European bio-plastics sector as a case study. The use of a qualitative approach in this chapter is justified, as the causal dynamics behind the observed changes were not clear beforehand (Greenwood and Suddaby, 2006; Stake, 1994). In order to understand the origin of the institutional setting of the case under study, a general historical analysis of the content of past field logics was performed as a first step, using various archival sources, such as policy reports, websites of key stakeholders, and scientific articles. In a first analytical step, the gained insights are categorized and labeled according to different prescriptions regarding goals and means. This analysis is used to identify those logics that are related to the emergence of the bio-plastics field. The identified logics differ from each other in terms of prescribed means, goals, and/or field of origin.

The second step analyzes how these logics have historically influenced actors in the field but also how the interplay between these logics has changed over time. The main method used for this step is discourse analysis, as it can be used as interpretive method to analyze the content, meaning, and change in institutions (Fuenfschilling and Truffer, 2014; Phillips et al., 2004; Thornton and Ocasio, 2008). Following Phillips et al. (2004), discourse analysis views language as a tool for actors to (re)produce institutions and construct reality, as actors mostly use text to formulate their beliefs and ideas. There is a continuous dynamic of actions that generate texts embedded in discourse to produce institutions, while institutions constrain and enable actions (Phillips et al., 2004). High discursive activity around topics suggest that (de-)institutionalization is happening and negotiated; it indicates contestation among actors as it reveals where institutions are defended or criticized (Fuenfschilling and Truffer, 2014). The discourse analysis was primarily based on newspaper articles, articles from industry journals, scientific journals, and different policy reports. The discourse analysis was used to further evaluate the logics as identified in the first step. By identifying topics (related to prescribed goals and means) with high discursive activity, it is possible to analyze how institutional logics change over time and how this change is related to institutional complexity.

#### **4.3.2 Data collection**

Data were collected in three main steps. First, general background information on the plastics and bio-plastics sectors was obtained from various scientific journal articles, research reports, and policy reports on plastics, bio-plastics, and the bio-based economy. This information was used to construct a first timeline that covered major trends and changes in the sectors during the period 1980-2014 (this time-period coincides with the first wave of bio-plastics after the dominance of petro-based plastics was established). In the second step, 16 semi-structured interviews with different stakeholders were conducted. The interviews were used to gain in-depth knowledge of the field, improve the general history analysis, and identify starting points for the analysis of discourse and complexity. The expert interviews were used to verify the initial timelines as previously established and to identify potential topics for the discourse analysis. In the final step Dutch newspaper articles (from the LexisNexis database) and industry journals in the period of 1990-2014 (LexisNexis only allows searches from 1990 onwards) were collected and used in the main discourse analysis.

The main search terms used were (varieties of) *bio-plastic*, *bio-polymer*, *bio-based plastic*, *sustainable plastic*, and *renewable plastic*. Each article title and/or abstract was scanned in order to determine relevance. In total, 606 articles from industry journals and 597 newspaper articles were analyzed. Articles from industry journals and newspapers can present somewhat biased views. However, in this way they reflect the attention of specific populations and their situated perspectives (Hoffman, 1999), making these sources ideal for the analysis of institutional logics.

### **4.3.3 Operationalization**

Two broad dimensions of institutional logics were taken into account. First, the goals belonging to specific institutional logics were determined by looking at values (important to realize), missions (specific task or duty), and policy objectives that are present in the field. These aspects are regularly used in the study of logics (Fuenfschilling, 2014; Thornton and Ocasio, 2008). Second, the means belonging to specific institutional logics were determined by looking at which technologies, organizational interactions, and other actions (such as collaborations, lobby actions, education activities, and marketing activities) were perceived as legitimate in the data sources. If certain technologies or (inter)actions were condemned, this is seen as an attack on other logics. The goals and means are viewed as being related to sustainability logics when they contain aspects from environmental quality and/or social equity. Goals and means related to economic prosperity are only linked to sustainability logics, when there is a simultaneous link to environmental quality and/or social equity.

Institutional complexity was determined by identifying the number of logics at the field level and describing the (in)compatibility between the prescriptions of the different logics. Organizational responses were described by looking at changes in market demand for bio-plastics and by identifying what strategic activities and innovation processes organizations related to bio-plastics development undertake.

### **4.3.4 Data analysis**

The initial institutional complexity related to the emergence of bio-plastics is determined based on the general history analysis. The focus here is on analyzing the different logics that have been present in the bio-plastics field from the start. Over time several institutional battles emerged, and the initial prescriptions in

the identified logics changed. The discourse analysis focuses on how these different debates evolved over time and how the interaction between this shifting institutional setting and organizational responses played out. The initial step in the discourse analysis was the identification of topics that were perceived as hindering or stimulating bio-plastics development, i.e. topics with relatively high discursive activity. Initial coding labels were selected as closely to the original text as possible. In the following steps, data analysis was approached in an iterative manner to ensure continuous reflection on different data sources, perspectives, and theoretical concepts. Initial codes were combined and reorganized in order to identify specific topics related to prescribed goals and means of the institutional logics in play and arguments supporting or rejecting the legitimacy of these goals and means. References to data sources in the results are presented in appendix II.

## **4.4 Results**

The results are presented in two main parts. The first part presents the results of the general history analysis and addresses the institutional complexity that influenced the emergence of bio-plastics. The second part addresses the changes in institutional complexity over time and links this to organizational responses.

### **4.4.1 Institutional complexity and the emergence of bio-plastics field**

Originally, most plastics-innovations were focused on bio-based raw materials (Shen, 2011). The transition from bio-based feedstock to crude oil started in the early 20<sup>th</sup> century. Between the 1930s and 1950s many of today's most important synthetic polymers were introduced. Due to this strong rise of petro-based polymers, many of the bio-plastics inventions in this time period were never used for commercial production (Shen et al., 2009). Most of the early bio-based plastics were replaced by the end of the 1960s. Worldwide plastics production increased from 1.5 Mt (metric tons) in 1950 to 30 Mt in 1970.

In the period 1960-1970 environmental concerns began to enter the general chemical sector (Hofmann, 1999). In 1973 the first oil crisis raised public concern over limited fossil resources. Plastics represent the largest field of application for crude oil (Siracusa et al., 2008). Price fluctuations of crude oil have a strong influence on the plastics sector (Chadha, 2011; Siracusa et al., 2008). With the prospect of feedstock supply insecurities (both in terms of

availability and in terms of price) the plastics sector became interested in alternative feedstocks, such as biomass. The Brundtland report of 1987 introduced sustainable development to the political agenda (Shen, 2011). In the period 1980-1990 environmental concerns related specifically to plastics came to the forefront. Attention was drawn to rapidly increasing amounts of waste and limited landfill capacities (Shen et al., 2009). Following these events, bio-based plastics gained attention again as possible renewable alternatives. In the early 1990s waste and recycling became even bigger issues due to the fast increase in production of plastics. Also, the notion of green chemistry gained attention in the 1990s. Green chemistry refers to chemical production that aims to reduce environmental and health hazards and to advance sustainability (Anastas and Kirchoff, 2002; Iles and Martin, 2013). In 1997 the Kyoto protocol was adopted, putting climate change on the agenda of the plastics sector.

The regained attention for bio-plastics was also caused by events outside of the chemical sector. A key difference between the production conventional plastics and bio-plastics is the feedstock. As the production chain of bio-plastics generally starts with agricultural crop production, harvest, and processing (Chadha, 2011), bio-plastics are intrinsically linked to the agriculture sector. In the 1980s production from agriculture became so massive that there was a growing surplus of basic products such as sugar and grain (Bos, 2008). As the EU had to buy these products at a relatively high price, this policy became extremely expensive. The envisioned solution was the use of agricultural products in non-food markets. The European policies aimed at stimulating applications of agricultural products outside the food sector were termed agrification policies. During the 1990s there was an increasing focus on the environmental benefits of these new products. The development of bio-plastics from agricultural products was seen as a way to reduce policy costs for the European Union, increase income for farmers and increase the sustainability of the agricultural sector (Bos, 2008).

The events in the 1980s and 1990s led to a first wave of bio-plastics being introduced to the market. These plastics were made in part from plant starches and would theoretically degrade once in the waste stream. Unfortunately, potentially toxic residues were left behind and products did not perform as advertised. Bio-plastics became associated with misleading environmental claims and sub-par performance (Iles and Martin, 2013). Related to the attention for climate change at the end of the 1990s and technological

developments, a second wave of bio-plastics started in the 2000s (Iles and Martin, 2013).

The above mentioned events can be related to three different *field-level logics* that influenced the emergence of bio-plastics: 1) a historically dominant field-level plastics sector logic, labeled as 'Traditional Logic', 2) a new logic related to the sustainability concerns in plastics, labeled as 'Green Plastics Logic', and 3) a new logic related to the sustainability of the agriculture sector, labeled as 'Agrification Logic'.

The Traditional Logic is primarily related to the conventional plastics field. Legitimate goals and means are primarily related to bulk production of petro-based plastics for as much applications as possible. As described earlier, plastics production has strongly grown over the years in part because plastics find more applications, which is often at the expense of other bulk materials. Plastics are argued to “*enable modern lifestyles*” (PlasticsEurope, 2013). Like many mature sectors, the plastics sector has a strong focus on incremental process-oriented innovations (Chadha, 2011). Competitive advantage in large polymer businesses is mainly achieved by reducing production costs and increasing reaction yields (Iles and Martin, 2013). Bio-plastics developments are directly influenced by the Traditional Logic. Consider for instance that while bio-plastics can have different characteristics compared to conventional plastics (such as antistatic properties and high degree of water permeability), most products made from bio-plastics look like their counterparts made from conventional plastics due to market demand. There is a strong search for bio-plastics that can be produced using conventional production technologies.

The Green Plastics Logic is related to actors from the chemical sector. Legitimate goals and means are related to environmental concerns (waste and diminishing resources) and economic concerns (reducing dependency on oil). Bio-degradable plastics (partly) based on bio-based feedstock were seen as the solution to all these concerns.

The Agrification Logic is related to actors from the agriculture sector. Legitimate goals and means are related to environmental concerns (replacing fossil feedstock with renewable feedstock) and economic concerns (reducing policy expenses and providing alternative sources of income for farmers). The development of bio-plastics as non-food applications for agriculture products

was seen as the solution to these concerns. Several of the first starch-based plastics producers came from the agriculture sector.

The Green Plastics Logic and Agrification Logic are sustainability logics that are directly related to the emergence of the new bio-plastics field. Both logics focus on a combination of environmental sustainability and economic considerations in prescribed goals and means. However, neither of these logics captures the full range of sustainability dimensions discussed in 4.2.2. These sustainability logics appear to be strongly complementary with respect to the prescribed goals and means. Both logics contain goals with an environmental focus and an economic focus. In both logics, it is assumed that the use of renewable biomass is inherently more sustainable than the use of oil as feedstock. Also, both logics prescribed the development of bio-degradable plastics, which helps explain the strong focus on this type of bio-plastic. When following these logics, there is a large shift away from a core strength/value of traditional plastics, as traditional plastics are valued and marketed exactly for their ability to resist degradation. In this sense, organizations faced institutional complexity as multiple logics were present. While prescriptions of the Traditional Logic are different from both sustainability logics, complexity was somewhat diminished due to the complementarity of the Green Plastics Logic and Agrification Logic.

### **4.4.2 Institutional complexity over time**

The discourse analysis revealed that the field became the center of debate for several topics related to the legitimacy of goals and/or means prescribed by the different logics, indicating changes within the bio-plastics field-level logics over time. Topics of high discursive activity were identified. These topics were grouped into two categories labeled *definition of bio-plastics* and *added value of sustainability*. Below both categories are discussed in relation to changes in institutional complexity over time. Hereafter, organizational responses to the complexity are presented and related to the logics described in the previous section.

### **4.4.3 Definition of bio-plastics**

As argued above, a main driver for the start of bio-plastics development was the need to solve waste issues of the plastics sector through bio-degradability (Shen et al., 2009). In the media the term bio-plastic became almost synonymous with bio-degradability and compostability: “...*bio-plastic, bio-degradable plastic made*

from potatoes” (Trouw, 1992). However, already in 1998 (De Volkskrant, 1998) it was mentioned that bio-degradable cups do not simply disappear when left in nature; it is only when the cups are placed in a warm compost pile that they disappear after two months. This contradictory view of degradability and compostability of bio-plastics is one of the topics with major discursive activity. The view of bio-plastics as inherently degradable and/or compostable persisted over the years, illustrated by this quote: *“Especially packaging and disposable products such as plastic cups, cutlery and plates are made from bioplastics. This degradable plastic has advantages compared to traditional plastics...They are completely compostable”* (AD, 2006). In this view, compostability is a solution to waste issues related to landfill capacity. However, the concepts of degradability and compostability were debated. In Bioplastics Magazine (2006a) it was argued that bio-degradability is complete assimilation by microorganisms in the disposal system. In order for a plastic to be called compostable, a time factor has to be taken into account. In Bioplastics Magazine (2007a) bio-degradation was described as having *“no meaning unless you define the environment and time for complete biodegradation”*. The time to complete bio-degradation in the disposal environment is essential as breakdown fragments that do not disappear within short time frames can have serious environmental consequences. In a Dutch newspaper (Trouw, 2013), bio-degradability is called a catch-all word; it is described as a confusing term as nearly everything is bio-degradable, but that does not mean it is also compostable.

This shows that while bio-degradability was often viewed as synonymous with bio-plastics and seen as a legitimate means to reduce environmental impacts, the concepts of bio-degradability and compostability have become debated topics. Furthermore, the concepts of bio-degradability and compostability are related to different environmental sustainability goals. Bio-degradability is more related to solving litter issues, while compostability is more related to solving landfill capacity issues. These discussions are primarily related to the Green Plastics Logic, as they are directly focused on the prescribed goals of this logic.

Following the oil crisis, another major driver for bio-plastics development was related to the need for alternative feedstock, which is also a topic related to high discursive activity. Initially, bio-based bio-plastics were based on food crops, as farmers had experience with these crops (and some of them were overproduced). However, fears of world-wide food shortages and increasing use

of biomass for bio-fuel production triggered discussions: “...the agrification process is a dead-end. On one hand, there are signs of a food shortage and at the same time there are many efforts to make cars run on food” (Het Financieele Dagblad, 1996). Arguments arose that bio-plastics should not compete with food security. As a result, the search for new non-food crops as feedstock was seen by some as more promising (Het Financieele Dagblad, 2007), triggering a search for other bio-based raw materials such as agricultural residues, wood, and algae. However, due to unfamiliarity with these new crops, it was unclear how much bio-plastics could be obtained from a given quantity of crops. Furthermore, there were also arguments against using feedstock from agricultural sources altogether, as it would use land that could be used for the production of (scarce) food (Bioplastics Magazine, 2007b). Despite these latter arguments, the view of farmers that grow sugar beets and corn as “oil sheikhs of the future” still persists (Boerderij, 2010).

There are thus contrasting views of what feedstock options are legitimate means for the production of bio-plastics. Discussions regarding food security never took place in the chemical sector; these debates are primarily related to the Agrification Logic. This logic initially prescribed non-food applications of agricultural products as legitimate means. Over time, this legitimacy became contested. This enhanced institutional complexity in the bio-plastics field, as it became less clear what the ‘correct’ way to act is.

Over time the term bio-plastics has been used for different types of bio-plastics, namely 1) bio-degradable plastics based on renewable resources, 2) bio-degradable plastics based on fossil resources (also called oxo-degradable), and 3) non-biodegradable plastics based on renewable resources. This implies that when ‘bio-plastics’ are prescribed as means to achieve sustainability goals, these prescriptions are not necessarily uniform and compatible. The legitimacy of bio-degradability and bio-based feedstocks were challenged, implying that it became harder for bio-plastics innovations to obtain resources. As the prescriptions of logics in the field changed over time, incompatible institutional prescriptions (i.e. institutional complexity) regarding the legitimacy of bio-degradability and bio-based feedstocks for bio-plastics production entered the field. In this way institutional complexity is increased over time, as the earlier prescriptions from both sustainability logics were clearly related to bio-plastics as starch-based bio-degradable plastics but later became more diverse and

conflicting. More specifically, it shows that the sustainability goals of reducing dependency on oil, solving litter issues, and solving landfill capacity issues have very different implications for legitimate means that are not necessarily compatible. Due to these debates, *“...a clear definition of ‘bioplastics’ that would be agreed upon by all parties involved worldwide does not exist”* (Bioplastics Magazine, 2006b). There is still no consensus definition for bio-plastics in 2012 (Álvarez-Chávez et al., 2012), making it difficult for clear prescriptions to emerge.

#### 4.4.4 Added value of sustainability

Bio-plastics were initially seen as a means to simultaneously improve environmental and economic performance, due to the added value of sustainability. The general perception was that bio-plastics have environmental benefits, because they are compostable and can be made from natural resources. The term environmentally-friendly bag became synonymous with bio-plastic bag. Different environmental benefits were mentioned, such as waste reduction due to bio-degradability and a reduction of CO<sub>2</sub> emissions due to the use of bio-based raw material (De Stem, 1996). The assumed environmental benefits of bio-plastics were seen as an added value with high business potential: *“...the most important ‘green’ aspect of starch-based plastic is its bio-degradability”* (Trouw, 1997) and *“Improving the environment and at the same time improving the outlook of the agriculture sector can go hand in hand”* (AD, 1999). Over time, bio-plastics were related more often to the word “sustainability” instead of “environmentally friendly”; *“The environment might not be a popular theme, sustainability is”* (Pakblad, 2005). However, the used arguments rarely incorporate additional dimensions of sustainability besides the environmental dimension, and bio-degradability is most often mentioned as signifying the sustainability of bio-plastics, as illustrated by: *“...with the introduction and development of bio-degradable plastics. The organization has been developing this sustainable plastic since last year”* (Boerderij Vandaag, 2005).

The legitimacy of bio-plastics as means to reach sustainability goals became contested. Arguments arose that sustainability of bio-plastics can only be determined by examining the entire life cycle (consisting of raw material feedstock, production process, and end-of-life treatment). Furthermore, several actors argued that bio-degradability and/or sustainability does not provide enough added value to offset the possible higher price of bio-plastics (Pakblad,

2005). In 2007, bio-plastics are still described by some as *“fully bio-degradable and CO<sub>2</sub>-free and therefore have less impact on the environment than regular plastic from nafta-oil”* (Dagblad Tubantia, 2007) and this is seen as an added value that can justify a higher price: *“As soon as it becomes clear that this is an environmentally friendly bottle, that seals the decision for most people”* (Bioplastics Magazine 2007c). In 2009, it is argued that even though bio-plastics might be more expensive than regular plastics, this price difference is offset by environmental benefits: *“Waste disappears by itself. Bioplastics do not place a burden on the scarce oil resources and do not emit extra CO<sub>2</sub> into the atmosphere”* (De Stem, 2009). Simultaneously, opposing views argued that bio-plastics need additional characteristics to have added value (PZC, 2009). This discursive debate is still ongoing. The view that bio-plastics are inherently sustainable and provide added value remains; *“Whilst the economic downturn may have affected demand, interest in added value, convenience and eco-friendly products will return”* (Bioplastics Magazine, 2011 – 02), while the opposing view is also still expressed; *“A garbage bag made from renewable materials is not by definition more environmentally friendly than a garbage bag made from oil”* (NRC NEXT, 2013).

This illustrates that there has been an increase in the number of conflicting prescriptions. The Green Plastics Logic and Agrification Logic were originally related to the perception that bio-plastics are inherently sustainable compared to conventional plastics and that this provided an added value; especially the Agrification Logic strongly related the environmental benefits of bio-based bio-plastics to contributing to environmental sustainability while simultaneously providing framers with stable income. While the original prescriptions can still be seen in some views, other pressures have emerged that challenge the legitimacy of bio-plastics as a means to reach sustainability goals. Not only the environmental sustainability of bio-plastics is questioned but also the way in which bio-plastics can have added value. As the original prescriptions became more contested, institutional complexity increased and made it more difficult for bio-plastics firms to convince others of the legitimacy and desirability of bio-plastics.

#### **4.4.5 Organizational responses to institutional complexity**

One of the main organizational responses to both the definition issue and added value issue is the establishment of legal standards and certification logos, such

as the Compostable Logo of European Bioplastics. Certification logos are viewed as crucial for the communication towards consumers, primarily as a means of differentiation due to the fact that many bio-plastics look identical to their counterparts made from conventional plastics (Bioplastics Magazine, 2006c). Currently, there are a large number of different logos in the marketplace; different organizations have created their own independently certified logos and countries have different sets of logos (Bioplastics Magazine, 2006c; Bioplastics Magazine, 2012; Interview Shen, 2014). Logos and standards can be seen as practices that materialize in order to deal with institutional complexity; they primarily serve to improve the legitimacy of bio-plastics to reach specific environmental sustainability goals. It can even be argued that several organizations acted as institutional entrepreneurs by being the first to try to establish legitimate new standards and logos for the sector.

However, due to their abundant numbers, inconsistency, and even misuse, logos have confused consumers (Bioplastics Magazine, 2012; Interview API, 2013; Interview Corbion Purac, 2013; Interview Shen, 2014). *“Everything from inadvertent greenwashing to intentional misrepresentation is now commonplace”* (Bioplastics Magazine, 2009), which hurts the legitimacy of bio-plastics as prescribed means. So while the institutional complexity surrounding bio-plastics enabled organizations to promote their own interests, this did not clearly increase the legitimacy of bio-plastics or solve complexity issues.

Another important organizational response to complexity that was observed is the development of non-degradable plastics based on different bio-based feedstocks. In just a few years the production capacity of these plastics has passed the production capacity of bio-degradable bio-plastics (European Bioplastics, 2014). With respect to institutional complexity, this can be seen as a response that combines pressures from the Traditional Logic and both sustainability logics. Popular non-degradable bio-plastics are (almost) identical in characteristics to their petro-based counterparts with the exception of being bio-based and can be used in existing production processes. Through this response organizations can try to stay away from debates regarding biodegradability and compostability as they are not labeling their innovations as such, thereby reducing institutional complexity.

These findings demonstrate that organizations are likely to act in line with compatible pressures. The Green Plastics Logic and Agrification Logic originally

had compatible goals and means, steering organizations to the development of bio-degradable plastics based on starch. However, when complexity increased different responses were observed. There were organizations acting more like institutional entrepreneurs by strategically using the absence of clear pressures, while the development of non-degradable bio-based plastics can be seen as a hybrid practice that combines pressures from the Traditional Logic and sustainability logics.

## **4.5 Discussion and conclusions**

The main contribution of this chapter is the insight that institutional complexity may be a precondition or trigger of sustainable innovation, as well as a barrier. Bio-plastics development gained significant attention when values and goals that deviated from the norm challenged the logic of the traditional plastics field. The Green Plastics Logic and Agrification Logic that emerged originally reinforced each other, as they prescribed compatible goals and means, for instance the goals of limiting waste and reducing dependency on oil. In this way, institutional complexity enhanced the legitimacy of bio-plastics as sustainable innovations. Despite the incompatibility between the sustainability logics and the Traditional Logic, organizations were still triggered to develop sustainable innovations and the bio-plastics field started to take shape.

However, over time the reinforcing pressures that were part of the Green Plastics Logic and Agrification Logic changed. The bio-plastics field became a center of several debates. These debates involved the core aspects that set bio-plastics apart from their petro-chemical counterparts and that were initially seen as inherently sustainable and adding value. While the original prescriptions of the Green Plastics Logic and Agrification Logic are still somewhat present in the field, there are many more conflicting prescriptions regarding legitimate sustainability goals and means as a result of the different debates. Furthermore, the compatibility between different sustainability prescriptions has decreased. This has significantly increased institutional complexity in the field.

In this extremely institutionally complex setting, different organizational responses are visible. On one hand organizations had room to promote their own interests, for instance by trying to establish their own certification standards and logos. On the other hand organizations started to move away from one of the original strengths of bio-plastics, by developing non-degradable bio-plastics.

While organizations intend to reduce complexity through their responses, their actions also led to intentional and unintentional misuse of concepts, creating confusion among various actors. Market acceptance of bio-plastics is negatively affected by several discussions, as customers and consumers are confused and do not understand bio-plastics, which leads to limited market demand (Interview Corbion Purac, 2013; Interview Shen, 2014). In this way, several organizational responses increased complexity and decreased the legitimacy of bio-plastics.

The challenge for organizations in the bio-plastics field is to translate the general notions of sustainability and bio-plastics into legitimate practices and structures. This requires establishing some consensus regarding definitions of these concepts. However, rather than sticking to these broad umbrella concepts, a more fruitful approach would be to make specific links between goals and means. Bio-plastics producers (and practitioners of sustainable innovation in general) could lessen the impact of institutional complexity by selecting specific dimensions of sustainability as goals/means, instead of making claims on the general sustainability level. As sustainability triggers many (unexpected) debates, the innovation process also entails navigating these issues.

While institutional complexity provides actors with room to promote their own interests, sustainable innovations would benefit if some collective efforts to overcome complexity and enhance legitimacy are undertaken. This is especially important, as there seems to be a large emphasis on critically judging new sustainable innovations without taking their newness or the old technology they are replacing into account. New sustainable innovations are judged on a large amount of dimensions, while the old technology is often not subject to similar discussions. As strikingly put by Synbra (interview, 2013): *“You have to explain ten things when you work with bio-polymers. But when you just use regular polyethylene from Saudi Arabia that is transported by road and causes earthquakes in oil fields, nobody cares; you don’t have to explain anything”*.

This chapter provided some first insights into the triggering and hindering role of institutional complexity for sustainable innovations. However, there is still a need to explore what types of complexity stimulate or hinder sustainable innovation. Furthermore, as collective action appears to be important, more insights on how organizations deal with complexity in inter-firm relations are needed.



## 5. The role of strategic alliances in creating technology legitimacy: a study on the emerging field of bio-plastics<sup>4</sup>

### 5.1 Introduction

The plastics industry has been under pressure to develop sustainable innovations since the 1990s (Hoffman, 1999). Plastics are produced mainly from petroleum and represent the largest field of application for crude oil (Shen, 2011; Siracusa et al., 2008). The durability of plastics and the use of oil as feedstock are causing environmental problems related to waste, use of non-renewable resources, and climate change (Chadha, 2011; Ren, 2003; Shen et al., 2009). In response to these concerns, different bio-plastics have emerged as sustainable innovations (Iles and Martin, 2013). Bio-plastics are biodegradable and/or are made from bio-based raw materials (Álvarez-Chávez et al., 2012; Iles and Martin, 2013). They can reduce the dependency of plastics production on oil and can contribute to solving environmental issues.

Recent studies highlight the importance of collaboration and strategic alliances for the success of sustainability innovations, including the transition to bio-plastics (e.g. Lozano, 2008a). Strategic alliances are voluntary collaborations between organizations that involve the exchange, sharing or co-development of products, technologies, and services to pursue a common set of goals or meet critical business needs (Gulati, 1998; Lin, 2012). Key advantages of alliances include the acquisition and exchange of complementary resources, and entry into new markets and technologies (Jolink and Niesten, 2012; Rothaermel and Boeker, 2008). Alliances facilitate the development of sustainable innovations, because these innovations depend on capabilities and resources that are spread over organizations from different industries (Van Tulder et al., 2015). The widespread adoption of bio-plastics in consumer goods will require alliances between firms from the chemical and food industries.

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<sup>4</sup> This chapter is based on Kishna, M., Niesten, E., Negro, S. and Hekkert, M. (2015). The role of strategic alliances in creating technology legitimacy: a study on the emerging field of bio-plastics. *ISU working papers*, 15-03.

In the emerging field of bio-plastics, it is not only important that firms enter into alliances, but these alliances also need to create legitimacy for the new technology in order to facilitate the transition. Legitimacy is a generalized perception that organizations or activities are desirable or appropriate within an institutional setting (Dacin et al., 2007; Seo and Creed, 2002; Thornton and Ocasio, 2008). Innovations require legitimacy to succeed, and this is especially relevant for sustainable innovations (Hekkert et al., 2007; Rennings, 2000). As sustainable innovations often compete with existing technologies, a crucial challenge for organizations developing sustainable innovations is to convince others of the desirability and appropriateness of these innovations within the existing institutional setting (as shown in chapter 4; Rennings, 2000). This is difficult in emerging fields, because technological standards that evaluate the sustainable innovation have not yet emerged (Garud and Rappa, 1994).

Firms can attempt to obtain legitimacy through collaborations, for instance by connecting to firms with a legitimate image or by collaboratively establishing social norms (David et al., 2013). The performance and survival of firms is strongly dependent on securing legitimacy (DiMaggio and Powell, 1983; Ruef and Scott, 1998), and public benefits will only be realized when sustainable innovations obtain legitimacy and are diffused throughout society. Dacin et al. (2007) have categorized different types of legitimacy that firms can obtain by entering into alliances, including market, social, investment, alliance, and relational legitimacy. The source of legitimacy is often the alliance partner's legitimacy in a market or the social image of the partner. These types of legitimacy address the legitimacy of a firm, but the legitimacy of technologies has not received much attention in the literature (Dacin et al., 2007; Lin, 2012; Wassmer et al., 2014).

In this chapter we combine insights on alliances and institutional theory in order to enhance our understanding of the legitimating roles of alliances in the context of sustainable technologies. The main contribution of this chapter lies in the identification and definition of three new types of legitimacy: technology-sourced market legitimacy, technology-sourced social legitimacy and technology legitimacy. In the first two types of legitimacy, firms aim to enhance their legitimacy in a market or their legitimacy as a socially responsible firm. They use the sustainable technologies of the alliance as a source of legitimacy and not

the image, reputation or experience of a partner. In the case of technology legitimacy, alliance partners do not aim to enhance their own legitimacy but the legitimacy of the sustainable technology.

In order to study these types of legitimacy, we have built a database on alliances in the field of bio-plastics using data from press releases and industry journals. The database contains information on 105 alliances over the period 1990-2013. The results show how alliances aim to obtain the three forms of legitimacy in the context of the sustainable technology. We also demonstrate that alliances that stimulate these forms of legitimacy differ from other alliances in terms of the organizational background of alliance partners, the number of alliance partners and the business functions of the alliance in the value chain.

The following section discusses the literature on legitimacy and alliances. Section 5.3 presents the research setting and the data collection methods. Section 5.4 discusses our results, and section 5.5 concludes this chapter.

## **5.2 Theoretical framework**

### **5.2.1 Legitimacy of organizations in an institutional context**

The success of organizations depends on their legitimacy, and thus on their desirability and appropriateness as judged by others. For instance, the ability of organizations to get access to markets and critical resources is strongly influenced by their legitimacy (Dacin et al., 2007; Greenwood et al., 2011; Seo and Creed, 2002). Whether organizations are judged to be legitimate or not depends on the institutional context that surrounds the organizations and in particular on the dominant values, norms, and beliefs that are present in the institutional context (Greenwood et al., 2011).

In mature organizational fields, institutional demands are predictable, and legitimacy is gained from complying with well-known institutional pressures. However, organizations often introduce innovations in emerging fields, and this makes it especially challenging to obtain legitimacy for new technologies. Emerging fields are characterized by a large degree of uncertainty, because institutional demands are not clear, making it difficult to determine how to obtain legitimacy (Greenwood et al., 2011). These fields portray strong conflicts between institutions, as organizations battle to prioritize institutions that support their interests and beliefs. Organizations that envision new institutional

arrangements and undertake actions to realize these new arrangements are often referred to as institutional entrepreneurs (Battilana et al., 2009; DiMaggio, 1988). These organizations undertake actions aimed at generating institutions in order to become legitimate.

However, our understanding of organizational responses of institutional entrepreneurs to different institutional settings remains selective (Greenwood et al., 2011; Pache and Santos, 2010). Institutional entrepreneurship entails diffusing new institutional visions and is a collective process. Despite this, there is a tendency in the literature to focus on the efforts of individual institutional entrepreneurs as heroes of change (Klein Woolthuis et al., 2013; Suddaby, 2010). There has been some attention for the relation between collaborations and institutional entrepreneurship (Lawrence et al., 2002; Phillips et al., 2000). We attempt to expand on these insights by looking at strategic collaborations as a potential source of legitimacy and institutional entrepreneurship.

### **5.2.2 Strategic alliances and legitimacy**

The legitimacy-based functions of alliances have not received much attention (Dacin et al., 2007; Lin, 2012), but it has been argued that legitimacy can be an outcome of alliances. By enhancing legitimacy, alliances can yield other benefits, such as an increased access to markets, the ability to attract resources and improvements in firm and alliance performance. Dacin et al. (2007) propose that five distinct types of legitimacy needs of firms play an important role in alliance formation, as is shown in table 5.1. A strategic alliance may provide market, relational or social legitimacy for a focal firm, investment legitimacy for a firm's activities, and alliance legitimacy for the alliance in general. Firms can enter into an alliance with one or several of these five legitimacy goals in mind.

First, a firm can enter into an alliance to enhance its rights or qualifications to operate in a specific market. This need for market legitimacy can be driven by a lack of experience, reputation or performance of a focal firm. Market legitimacy differs from entering into an alliance to access a market; the former is related to being perceived as having the right to operate in a specific market by connecting to a partner with a legitimate image, while the latter is related to using distribution or marketing channels from a partner to gain access to specific markets. Second, a firm can be motivated to enter an alliance to demonstrate it

Table 5.1: Legitimizing roles of strategic alliances from Dacin et al., 2007

|                                     | <b>Market legitimacy</b>   | <b>Relational legitimacy</b>                   | <b>Social legitimacy</b>                                    | <b>Investment legitimacy</b>  | <b>Alliance legitimacy</b>                         |
|-------------------------------------|--|--|---|---|--|
| <b>Definition</b>                   | Rights and qualifications to conduct business in a particular market | Worthiness to be a partner                     | Conformity of the firm to societal rules and expectations   | Worthiness of the business activity   | Validity or appropriateness of strategic alliances |
| <b>Motive for entering alliance</b> | To increase one's legitimacy in geographical or product markets      | To increase one's legitimacy as a good partner | To increase one's legitimacy as a socially responsible firm | To increase the legitimacy of the business activity                         | To legitimate alliance use                         |
| <b>Source of legitimacy</b>         | Partner's legitimacy in the market                                   | Relationship with partner                      | Partner's social image                                      | Partner's support and confidence in the business activity                   | Isomorphism  |
| <b>Target</b>                       | Governments, suppliers, customers                                    | Potential ties                                 | Public interest groups, local communities, customers        | Board of directors, corporate executives, venture capitalists, shareholders | Other organizations, parent firms                  |

is a worthy partner. This need for relational legitimacy can be driven by a lack of history as a good alliance partner and a necessity of alliances in the future to enhance the firm's performance. Third, firms may enter into alliances to increase their image as a socially responsible organization by partnering with firms that have a good social image. Fourth, an alliance can serve to legitimate the business activities of participating firms in the eyes of corporate insiders. This need for investment legitimacy will be high when the business activity has not been adopted by the focal firm or by other organizations in the past. Finally, in some circumstances the legitimacy of alliances as a form of business transaction needs to be established. This need for alliance legitimacy will likely

be strong in fields that do not have a history of alliance use while acceptance of the alliance form is important for achieving other types of legitimacy.

### 5.2.3 Alliances and legitimacy of sustainable technologies

The framework by Dacin et al. (2007) focuses on creating legitimacy for firms, but it underemphasizes two crucial aspects of legitimacy in the context of sustainable technologies. First, when firms aim to enhance their legitimacy in a specific market or their social image by entering into an alliance, the increase in the firm's legitimacy is directly and specifically linked to the sustainable technology (section 5.2.4). Second, it is not only relevant to enhance the legitimacy of firms and alliances but also the legitimacy of the sustainable technology itself (section 5.2.5).

### 5.2.4 Technology-sourced market and social legitimacy

As sustainability has economic and social/environmental dimensions (Lozano, 2008b), we expect that market legitimacy and social legitimacy are especially important in the context of sustainable technologies.

When an innovative sustainable technology is developed, new markets need to be created to sell the technology. As these new markets are being formed, firms may lack some of the relevant experience and reputation, and they may enter into alliances to overcome these shortcomings and increase their market legitimacy. In the case of bio-plastics, large food companies may enter into alliances with firms from the chemical industry with access to technologies to develop, improve, and produce bio-plastics. When we compare this type of market legitimacy in the context of sustainable technologies to the framework by Dacin et al. (2007), we expect that the motive of firms is the same, but the source of legitimacy may be different. Firms aim to increase their legitimacy in a geographical or product market (i.e. motive) but do not use the overall experience or reputation of the partner as a source of market legitimacy. Instead, firms may relate their right and qualifications to conduct business in a specific market to the technology of the partner or to the technology developed in the alliance. We may refer to this type of legitimacy as ***technology-sourced market legitimacy***.

In addition to market legitimacy, social legitimacy is likely to be relevant in the context of sustainable technologies. Firms may wish to enter the business of

sustainable technologies to increase their legitimacy as a socially responsible firm, and again they may use alliances to pursue this motive. For instance, firms that sell products and services to end users may wish to improve the sustainability of their supply chain, by including more sustainable inputs in the production process or by increasing the sustainability of the products' packaging. They improve their social legitimacy by entering into alliances with firms that possess the technologies to produce sustainable inputs and packaging. In this way, firms can relate conformity to social rules and expectations to the technology of the partner or to the technology developed in the alliance. The adoption or development of sustainable innovations can signal that a firm is being responsible and is complying with social expectations. We may refer to this type of legitimacy as **technology-sourced social legitimacy**. While the motive of this type of legitimacy is the same as in the framework by Dacin et al. (2007) (i.e. increase one's legitimacy as a socially responsible firm), the source of the social legitimacy is different: the source is not necessarily the partner's social image but the sustainable nature of the partner's or the alliance's technology.

### 5.2.5 Technology legitimacy

In the context of innovative sustainable technologies, it is not only important that firms increase their legitimacy but also that the new technology obtains legitimacy by being perceived as legitimate by a broad spectrum of actors. Innovation studies stress the importance of legitimacy creation for innovations in the eyes of outsiders and increasing legitimacy of a new field in general (Hekkert et al., 2007). It is, however, very challenging for sustainable innovations to obtain legitimacy in an emerging field. In mature fields firms can use the field's standards, norms, and technologies to obtain legitimacy (Aldrich and Fiol, 1994; Zimmerman and Zeitz, 2002). In emerging fields, technological standards are often unclear, and innovations compete with existing technologies that are adapted to the institutional setting (Eisenhardt and Schoonhoven, 1996; Garud et al., 2002). A crucial challenge for organizations developing sustainable innovations is to convince others of the appropriateness and desirability of these innovations relative to how the currently prevailing logics evaluate the innovations (Rennings, 2000).

We expect that firms use alliances to demonstrate the worthiness of a sustainable technology to outsiders. Through their signaling role, alliances can support and promote certain technologies, increasing the legitimacy of these

technologies. This implies that legitimacy battles between new and old technologies will take place but also between alternative technological trajectories within a field (Garud et al., 2002; Tushman and Anderson, 1986). Alliances can also function as institutional action takers. They can try to establish new institutions, such as specific standards, that provide guidance with respect to evaluating technologies and can thereby improve the legitimacy of these technologies (Garud et al., 2002). In this way, alliances take the role of champions, trying to influence the nature of institutional pressures through collective action that supports specific technologies. As such, alliances function as institutional entrepreneurs when they envision new institutional arrangements and undertake actions to realize this new institutional setup (DiMaggio, 1988; Garud et al., 2002; Greenwood and Suddaby, 2006). We therefore argue that alliances can increase **technology legitimacy**, i.e. the desirability and appropriateness of the technology as perceived by actors outside of the alliance.

## 5.3 Methods

### 5.3.1 Research setting

The global plastics industry has steadily grown since the 1950s, and demand is likely to continue to rise (PlasticsEurope, 2013). Plastics are produced mainly from petroleum and represent the largest field of application for crude oil (Shen, 2011; Siracusa et al., 2008). The first oil crisis in 1973 raised public concern over limited fossil resources (Siracusa et al., 2008). The prospect of feedstock supply insecurities was a first trigger for the plastics industry to start looking for alternative raw materials suited for plastics production. In the period 1980-1990 other environmental issues emerged, and attention was drawn to rapidly increasing amounts of waste and limited landfill capacities (Shen et al., 2009). Two crucial aspects of plastics (i.e. petro-based production and durability) are directly related to these environmental problems (Chadha, 2011; Ren, 2003; Shen et al., 2009).

Following these events, bio-based plastics gained attention as possible sustainable innovations. Bio-plastics are bio-degradable and/or made from bio-based raw materials (Álvarez-Chávez et al., 2012; Iles and Martin, 2013). They are viewed as having the potential to reduce the dependency of plastics production on oil and to contribute to solving environmental issues. A first wave

of bio-plastics was introduced to the market in the early 1990s. However, these plastics did not perform as advertised, and bio-plastics became associated with misleading environmental claims and sub-par performance (Iles and Martin, 2013). Related to the attention for climate change at the end of the 1990s and technological developments, a second wave of bio-plastics started in the 2000s (Iles and Martin, 2013). Firms from many different industries, including agriculture and food products, have entered this field.

### **5.3.2 Case selection**

Within this field, we focus on bio-plastics that are produced for consumer markets and are thus consumed by end users. We also include inputs that are developed to produce these bio-plastics, such as succinic acid or 1,4-butanediol. We focus on these markets, because the issue of legitimacy is especially relevant in markets in which consumers are deciding on whether the technology is appropriate and desirable. The majority of these bio-plastics are used for durable consumer goods and packaging of consumer durable and nondurable goods. We exclude bio-polymers related to fibers, yarn, and textile, as these are related to different markets. Bio-plastics in medical applications have been excluded for the same reason. We also exclude so-called oxo-degradable plastics. These plastics have been marketed as bio-plastics in the past but are essentially petro-based plastics with additives that enable them to degrade under certain conditions into micro-plastics. However, these plastics have been criticized for not being truly bio-degradable and/or bio-based.

In this chapter, we study alliances in the field of bio-plastics and consider a diverse set of alliances, including joint ventures, contractual alliances, consortia, associations, and public-private partnerships. The alliance partners retain their own legally autonomous firms or organizations, meaning that we do not consider mergers and acquisitions as part of alliances (Jolink and Niesten, 2012; Ménard, 2004).

### **5.3.3 Data collection and analysis**

The data on alliances in the field of bio-plastics is collected from several sources. Following the research suggestion from Wassmer et al. (2014), our secondary data sources are European industry journals, Dutch newspaper articles, press releases, and corporate websites. Data is collected for the period 1990-2013. The starting-point is in line with the first commercial wave of bio-plastics that

emerged after petro-based plastics became dominant. Alliances that started but also ended within the time period were also recorded.

It can be argued that many of the data sources, such as industry journals and press releases, present a biased interpretation of events and issues (Hoffman, 1999). However, this output directly influences perceptions of actors in the field. Consider for instance that an alliance is formed with specific goals in mind, but in the press release the only motivation mentioned is obtaining market legitimacy. As this message influences issue interpretation in the field, this bias reflects the attention of the alliance partners (Hoffman, 1999) and is thus exactly the data we need to study. In order to fully capture these effects, multiple news items on each alliance have been studied.

The data sources were scanned for alliances in the field of bio-plastics. The main search terms used were (varieties of) *bio-plastic*, *bio-polymer*, *bio-based plastic*, *sustainable plastic*, and *renewable plastic* and were combined with terms such as *collaborate*, *cooperate*, *partner*, *joint venture*, and *alliance*. These search terms were used in LexisNexis, Bioplastics Magazine (the only independent trade magazine worldwide dedicated to bio-plastics) and the Green Chemicals blog (a leading blog documenting green developments in the chemical industry). For each alliance that is in line with our definitions of alliances and bio-plastics, we recorded the alliance year, names of alliance partners (and alliance name if applicable), type of alliance, organizational background of partners, business function of the alliance, and types of legitimacy. Two researchers coded the variables used in this chapter. In a few instances the coding differed between the two researchers, which was resolved by discussing the details of the alliance and collecting more information about the alliance on companies' websites.

#### **5.3.4 Coding legitimacy**

The data sources were scanned for the motives for obtaining legitimacy (i.e. the explicitly mentioned legitimacy that partners want to increase) and the sources of legitimacy (i.e. the aspects of the partners that are perceived as providing legitimacy). After a first analysis of all the alliance descriptions, we found types of legitimacy that differ from the ones in the framework by Dacin et al. (2007): the alliances have the same motive (increasing market and social legitimacy of the firm) but use the technology and not the reputation or experience of the partner as a source of legitimacy.

In the case of **technology-sourced market legitimacy**, firms enter into alliances to increase their market legitimacy by using a sustainable technology as the source of legitimacy. We coded alliances as characterized by this type of legitimacy when:

- A firm enters into an alliance to access the technology of its alliance partner, which enables the firm to move into the market.
- The alliance partner provides the technology of a firm with access to more markets/consumers or production capacity.
- Alliance partners collaboratively develop or sell a new technology to access a new market.

In the case of **technology-sourced social legitimacy**, firms enter into alliances to enhance the firm's social legitimacy via a sustainable technology. They often refer to sustainability as part of the firm's strategy, values, vision, objectives, and even their business model. Social legitimacy arguments are related to visibility, impact, or image outside of the direct market and are related to public benefits in general. We code alliances as characterized by technology-sourced social legitimacy when firms use alliances to increase their social legitimacy by:

- Collaboratively developing a sustainable technology
- Accessing the sustainable technology of the alliance partner
- Improving the sustainable technology so that an increasing number of customers can access the technology
- Providing the alliance partner with a sustainable technology access to the firm's production capacity or customer base.

Additionally, we encountered alliances that attempted to increase the legitimacy of specific technologies towards external actors. These have been labeled as alliances that stimulate **technology legitimacy**. This type of legitimacy differs from the technology-sourced market and social legitimacy but also from the types proposed by Dacin et al. (2007): it is not aimed at increasing the legitimacy of the firm or the alliance but at increasing the legitimacy of the technology itself. We coded alliances as stimulating technology legitimacy when:

- They stimulate the development and production of multiple applications of the technology to facilitate the adoption of the technology in entire supply chains and across different sectors. This may include references to broad technology categories (for instance all PLA plastics, and not one specific brand), implying that other firms using comparable technologies can benefit from the efforts of the focal alliance.
- They aim to expand the geographical market in which the technology is produced and sold.
- They exercise their signaling role by, for instance, referring to a partnership with a large and well-known company that has adopted the technology or by informing and educating the public on the importance of the technology.
- They act as institutional entrepreneurs by developing and implementing standards, certificates or labels for the technology, or by lobbying for new legislation and regulation.

### **5.3.5 Coding alliance attributes**

We also coded attributes of the alliances that promote the different forms of legitimacy, such as the type of alliance (whether it is bilateral or not), the organizational background of the partners and the business function of the alliance, in order to understand whether differences exist between alliances that stimulate legitimacy and those that do not.

Bilateral alliances are alliances with two alliance partners, and multilateral alliances involve more than two alliance partners.

For each alliance we examined the types of organizations involved. The alliance was coded as inter-firm when only private firms are part of the alliance. Alliances that included a state, (local) government, university, NGO, and/or a state-owned firm were coded as inter-organizational alliances.

We coded the three business functions of the alliance, which include R&D, manufacturing, and marketing (Kim et al., 2003). During the coding process, we discovered that several alliances do not pursue any research or develop a new technology, nor do they manufacture or market a product. We refer to these alliances as alliances that are in the pre-competitive stage of business activities.

0. Pre-competition: alliance does not pursue R&D, manufacturing or marketing
1. R&D: alliance carries out research or develops a technology that is specific for the alliance and used in production
2. Manufacturing: alliance starts with the establishment of production capacity
3. Marketing: alliance starts after production phase, focused on bringing products to specific markets

## 5.4 Legitimacy in the field of bio-plastics

This section presents the results on alliances that stimulate technology-sourced market legitimacy (section 5.4.1), technology-sourced social legitimacy (section 5.4.2) and technology legitimacy (section 5.4.3) in the field of bio-plastics. In section 5.4.4, we discuss how alliances that stimulate the different types of legitimacy differ from other alliances in our dataset in terms of the organizational background of alliance partners, the number of partners, and the business functions of the alliance in the value chain. Appendices III and IV offer a short description of the data sources and the firms that are referred to in the results.

### 5.4.1 Technology-sourced market legitimacy

In 40 alliances in our dataset firms aim to obtain market legitimacy by using technology as a source of their legitimacy. We identified three ways in which firms pursue technology-sourced market legitimacy.

First, they aim to increase their legitimacy in a market by accessing the technology of their alliance partner. An example of this type of legitimacy is the alliance between Bayegan and Myriant, in which Bayegan accesses Myriant's technology. The CEO of Bayegan comments on the alliance: *"Increasingly, our customers are seeking high-performing, renewable chemicals, like bio-succinic acid. Through our partnership with Myriant, Bayegan can reliably deliver an innovative, in-demand product that adds significant value for our customers"* (Myriant, 2013). Another example is the alliance between packaging producer Oerlemans Plastics BV and FKUR (a company that has developed packaging based on PLA blends), through which Oerlemans can better serve a market by accessing the technology of FKUR. The press release on the alliance mentions

the following: *“Responding to the increase in the demand for biodegradable and compostable films and packaging Oerlemans Plastics is cooperating with FKUR in Germany in order to better serve the upcoming organic market”* (Bioplastics Magazine, 2009a).

Second, a firm may aim to increase its market legitimacy by providing the technology of its alliance partner with access to markets or production capacity. In September 2012 Sulzer Chemtech entered into an alliance with NatureWorks: *“This project has been a natural marriage of each company’s assets, focused on a subset of NatureWorks’ patented process technology to bring both new capacity and new products to the market”* (NatureWorks, 2012a). By offering production capacity Sulzer could increase its legitimacy with this alliance: *“Additional work was done in our test center with two primary benefits in focus – increased capacity and product extension. The project development provided an exciting professional and technical opportunity for us to show our capabilities for this type of application”* (NatureWorks, 2012a).

Third, alliance partners may also increase their legitimacy by collaboratively developing or selling a technology to access a market. For instance, Altuglas International and NatureWorks have signed a global co-marketing agreement. *“Through the collaboration, Altuglas International and NatureWorks will pool resources to accelerate the introduction of these new high performance biopolymer alloys into the market. By combining our respective reputations and strengths in biopolymers and acrylics, NatureWorks and Altuglas International will co-market clear materials that offer a complete package of innovative product performance”* (NatureWorks, 2012b).

#### **5.4.2 Technology-sourced social legitimacy**

In 41 alliances in our dataset firms attempt to obtain social legitimacy based on a sustainable technology. In several alliances, firms pursue social legitimacy by collaboratively developing a sustainable technology or by accessing the sustainable technology of the alliance partner. BASF and Purac have collaboratively developed a technology that can serve as an input in the production of bio-plastics. The research director of BASF comments on the alliance with Purac and emphasizes BASF’s sustainability goals: *“Our strategy clearly focuses on innovations for a sustainable future. The development of a succinic acid production process based on fermentation in cooperation with*

*Purac is a good example of this strategy being put into practice*” (BASF, 2012). In the alliance between H.J. Heinz and The Coca-Cola Company, Heinz obtained access to the PlantBottle technology developed by Coca-Cola for use in its own products. Heinz argues that *“this partnership is a great example of how businesses are working together to advance smart technologies that make a difference to our consumers and the planet we all share”* (Bioplastics Magazine, 2011). Heinz links the use of Coca-Cola’s technology to making a difference for the planet. A similar line of reasoning is found in other alliances. De Ster, a Belgian firm producing plastic cutlery for the aviation industry, argues that they entered into an alliance with Biotec based on *“a desire to work on our social responsibility”* (NRC Handelsblad, 1996). De Ster refers to the compostable technology of Biotec as a means to be socially responsible; the company reinforces this by stating that the technology is currently more expensive than conventional plastics.

Firms may also obtain social legitimacy by increasing the number of customers that can access their sustainable technology or by offering production capacity and a customer base to the sustainable technology of an alliance partner. The alliance between BASF and Purac illustrates this: *“Our cooperation with Purac to produce biobased succinic acid is a perfect example of how we enable our customers in many industries to develop sustainable solutions”* (BASF, 2012). Another example is the alliance between The Coca Cola Company and Avantium, which is a company that has developed a technology to produce PEF bottles. Avantium can improve its legitimacy with its sustainable technology by entering into an alliance with Coca Cola that offers large production capacity and a large number of customers: *“PEF is 100% biobased and when commercialized will be fully recyclable. We are very excited about the co-development phase we are entering with The Coca-Cola Company to continue the development of PEF and make this new material ready for mass production and recycling. Their leadership and experience in commercializing biobased materials make them a great partner to work with as we commercialize this exciting new material”* (Avantium, 2011).

### **5.4.3 Technology legitimacy**

Establishing technology legitimacy plays a prominent role in alliance formation in the bio-plastics field. In total, we identified 63 alliances with a technology

legitimacy driver. These alliances aim to support or demonstrate the desirability or appropriateness of a sustainable technology to actors outside the alliance.

The majority of these 63 alliances stimulate technology legitimacy by developing or producing multiple applications of the technology, thereby allowing for an increased adoption of the technology. The press releases refer to alliances that allow *“for bio-based product solutions in applications that were previously difficult to address”* (NatureWorks, 2012c) and that *“elaborate on the application of bio-plastics for the entire life cycle”* (Bioplastics Magazine, 2009b). A research analyst of Frost & Sullivan commented on the alliance between Purac and Sulzer Chemtech and mentioned that *“The companies are lauded for their efforts at realizing a novel, economical polymerization process and their commitment toward commercializing this technology for varied high-performance applications”* (Frost & Sullivan, 2008). This new process will *“enable a more efficient production of different PLA products and will reduce the process and product development time. In addition, the new process requires limited investment and will, therefore, be more affordable, significantly lowering the entry barrier for PLA production”* (Frost & Sullivan, 2008). This example shows that creating legitimacy for the new technology does not only benefit the alliance partners but also firms that wish to start producing PLA.

Several other alliances promote technology legitimacy by expanding the markets in which the technology can be sold, thus expanding the number of firms that can produce and sell the technology. The purpose of a collaboration between Avantium and Alpla is *“to create a market pull for PEF, which will de-risk the value chain for other partners like feedstock suppliers, chemical companies, resin producers and recyclers, which are essential to put a new polyester on the market”* (Bioplastics Magazine, 2013). The CEO of Metabolix commented on the alliance between his company and ADM: *“This agreement is a major advance toward our goal of making an array of renewable, eco-friendly alternatives to traditional petrochemical plastics widely available to the global marketplace”* (Metabolix, 2004). These examples illustrate that the alliance partners do not aim for legitimacy of their own firm but for legitimacy of the technology by creating opportunities that also benefit other firms (e.g. lower entry barriers, de-risking the value chain).

A few press releases refer to the signaling role of alliances in which famous alliance partners promote the legitimacy of a new technology. Gevo and The Coca-Cola Company entered into an alliance to develop the PlantBottle, which is packaging made from plant-based materials. The CEO of Gevo mentioned that *“New technologies need champions. The Coca-Cola Company is in a unique position to drive and influence change in the global packaging supply chain with this development. You cannot ask for a better champion than one of the world’s most respected and admired consumer brands”* (Gevo, 2011). This example clearly shows that the image of the partner is a source of legitimacy for the technology.

In addition to this signaling role, alliances also build technology legitimacy by promoting discussion on the technology and by spreading knowledge on how the technology can be used. Two examples can be given of alliances with the explicit aim to create awareness of the technology. *“The Bioplastic Feedstock Alliance was formed by some of the world’s leading consumer brand companies as a precompetitive, multi-stakeholder forum focused on increasing awareness around the environmental and social performance of potential feedstock sources for bio-based plastics”* (Bioplastic Feedstock Alliance, 2015). *“DPI [The Dutch Polymer Institute] provides a unique platform for generating awareness of new technology, in which participating industrial companies, competitors in the market place, communicate on a pre-competitive basis to trigger innovation”* (Dutch Polymer Institute, 2015).

Finally, alliances may act as institutional entrepreneurs by lobbying for new legislation, regulation, standards and certificates for the technology. For instance, *“European Bioplastics closely monitors, discusses and contributes to relevant EU legislation concerning the European bioplastics industry”* (European Bioplastics, 2015). *“The Belgian BioPackaging association obtained with targeted lobbying work some important modifications to the local waste legislation and supported the creation of the first law in Europe that defines the terms compostable, home compostable and degradable in the soil”* (nova-Institute, 2015). The promotion of technologies towards external actors and the creation of supporting institutions are also observed in several brand-owner alliances. The most prominent ones are the Plant PET Technology Collaborative (partners: Coca-Cola, Ford, Heinz, Nike, Procter & Gamble) and the Bioplastic Feedstock Alliance (partners: Coca-Cola, Danone, Ford, Heinz, Nestle, Nike,

Procter & Gamble, Unilever, WWF). The first builds on Coca-Cola's PlantBottle technology. This alliance "seeks to drive the development of common methodologies and standards for the use of plant-based plastic including life cycle analysis and universal terminology. The brands will then promote these standards with the expectation that they will be endorsed and used worldwide by both PTC and non-PTC members" (PlasticsToday, 2012). In other words, this alliance tries to legitimate technologies by establishing institutions. These institutions may influence how actors outside the alliance evaluate the desirability and appropriateness of the technologies.

#### 5.4.4 Attributes of alliances that stimulate legitimacy

Tables 5.2 and 5.3 illustrate that alliances aimed at technology-sourced market legitimacy and technology-sourced social legitimacy are more often inter-firm alliances (i.e. alliances between private firms), and bilateral alliances (alliances between two firms). These alliances often focus on business functions that are characteristic of later stages of the value chain, such as manufacturing and marketing. We have compared these two groups of alliances to the remaining set of alliances in our dataset and find that the two groups differ significantly from the other alliances. An analysis of variance shows that there are significant differences (at the 1% level for each of the three attributes) between alliances that stimulate technology-sourced market legitimacy (n=40) and the remaining alliances (n=65) as shown in table 5.2.

Table 5.2: Alliances that stimulate technology-sourced market legitimacy

|                                  | <b>Technology-Sourced Market Legitimacy (n=40)</b>                          | <b>NO Technology-Sourced Market Legitimacy (n=65)</b>                            |
|----------------------------------|---|--|
| <b>Organizational background</b> | Inter-firm alliances: 95%<br>Inter-organizational alliances: 5%             | Inter-firm alliances: 66%<br>Inter-organizational alliances: 34%                 |
| <b>Alliance type</b>             | Bilateral: 90%<br>Multilateral: 10%   | Bilateral: 65%<br>Multilateral: 35%  |
| <b>Business function</b>         | Pre-competition: 0%<br>R&D: 30%<br>Manufacturing: 37.5%<br>Marketing: 32.5% | Pre-competition: 12.3%<br>R&D: 49.2%<br>Manufacturing: 23.1%<br>Marketing: 15.4% |

An analysis of variance also shows that there are significant differences between alliances that stimulate technology-sourced social legitimacy (n=41) and the other alliances (n=64) at the 1% level for organizational background and alliance type and at the 5% level for the business function as shown in table 5.3. This means that we can identify alliances that promote technology-sourced market or social legitimacy as separate groups of alliances that differ from other alliances.

Table 5.3: Alliances that stimulate technology-sourced social legitimacy

|                                  | <b>Technology-Sourced Social Legitimacy (n=41)</b>                            | <b>NO Technology-Sourced Social Legitimacy (n=64)</b>                            |
|----------------------------------|---|--|
| <b>Organizational background</b> | Inter-firm alliances: 95%<br>Inter-organizational alliances: 5%               | Inter-firm alliances: 66%<br>Inter-organizational alliances: 34%                 |
| <b>Alliance type</b>             | Bilateral: 88%<br>Multilateral: 12%   | Bilateral: 66%<br>Multilateral: 34%  |
| <b>Business function</b>         | Pre-competition: 0%<br>R&D: 34.1%<br>Manufacturing: 41.5%<br>Marketing: 24.4% | Pre-competition: 12.5%<br>R&D: 46.9%<br>Manufacturing: 20.3%<br>Marketing: 20.3% |

Alliances that stimulate technology legitimacy differ in certain respects from alliances that do not stimulate legitimacy of a technology in the field of bio-plastics (see table 5.4). They are more often multilateral and inter-organizational alliances, meaning that the number of alliance partners is higher and the partners include governments (at state or local level), universities and research institutes, and NGOs. They often take the form of associations, consortia, or public-private partnerships. The alliances that stimulate technology legitimacy also differ from other alliances, because they are formed in a pre-competitive stage, meaning that they do not only pursue R&D, manufacturing or marketing. In this pre-competitive stage, the alliances are concerned with lobbying for new legislation, regulation, standards, and certification for the new technology. They also aim to increase awareness and inform consumers of the benefits of the new technology. An analysis of variance shows that there are significant differences between the two groups of alliances (those that stimulate technology legitimacy

Table 5.4: Alliances that stimulate technology legitimacy

|                                  | <b>Technology Legitimacy</b><br>(n=63)   | <b>NO Technology Legitimacy</b><br>(n=42)                                     |
|----------------------------------|--|---|
| <b>Organizational background</b> | Inter-firm alliances: 75%<br>Inter-organizational alliances: 25%                 | Inter-firm alliances: 81%<br>Inter-organizational alliances: 19%              |
| <b>Alliance type</b>             | Bilateral: 68%<br>Multilateral: 32%  | Bilateral: 83%<br>Multilateral: 17%   |
| <b>Business function</b>         | Pre-competition: 12.7%<br>R&D: 41.3%<br>Manufacturing: 23.8%<br>Marketing: 22.2% | Pre-competition: 0%<br>R&D: 42.9%<br>Manufacturing: 35.7%<br>Marketing: 21.4% |

and those that do not) but only at the 10% level for alliance type and business function.

## 5.5 Conclusions

This chapter focused on the role of alliances in creating legitimacy for sustainable technologies. On the basis of an analysis of 105 alliances in the field of bio-plastics over the period 1990-2013, we identified three new types of legitimacy.

In technology-sourced market legitimacy, firms enter into alliances to access a sustainable technology and thereby increase the firm's legitimacy in a market. In technology-sourced social legitimacy, firms use a sustainable technology in an alliance to improve their image as a socially responsible firm. These two types of legitimacy differ from existing types, because they explicitly use a technology and not a partner's reputation or experience as a source of legitimacy. Firms aim to obtain these two types of legitimacy in different ways: by accessing the sustainable technology of an alliance partner, by collaboratively developing the technology, or by providing the technology of the partner with access to customers and production capacity. These alliances are often bilateral and inter-firm alliances that operate in later stages of the value chain, such as production and marketing.

A third form of legitimacy is technology legitimacy, with which alliance partners aim to enhance the legitimacy of the sustainable technology itself and not necessarily the legitimacy of the firm. Our results show that alliances promote the desirability and appropriateness of a technology to others (i.e. technology legitimacy) by developing and producing multiple applications of the technology for an expanding number of markets, by exercising their signaling role, and by acting as institutional entrepreneurs. Alliances that stimulate technology legitimacy differ from other alliances, because they are more often multilateral and inter-organizational alliances. They operate in the pre-competitive stages and focus on promoting standards, certificates, labels, and legislation for the new technology.



## 6. Discussion and conclusions

The transition towards a more sustainable society requires institutional change. Actors that purposefully change institutions are labeled institutional entrepreneurs in the literature. The process of institutional entrepreneurship is currently underdeveloped in existing theory on sustainability transitions. This holds even more so for the process of institutional entrepreneurship by incumbent actors. Incumbent actors are often described as deeply embedded in and supported by existing institutional settings and are therefore not seen as potential sources of transformation in sectors. A common argument is that even if incumbents would have the power to trigger change, they lack the motivation to do this, and lack the ability to envision new settings.

However, empirical observations show that incumbents do act as institutional entrepreneurs and play a crucial role in enabling sectoral changes towards sustainability. Therefore, this dissertation aims to answer the question: *why and how do incumbents act as institutional entrepreneurs?*

The goal of this dissertation is to enhance our understanding of the micro-level of transition processes, by looking at the interplay between incumbents' motivations, their strategies, and the institutional setting in which they are embedded. In this dissertation three sectors are analyzed in which incumbents set out to change institutions with different strategic actions. The previous chapters show that the specific institutional setting in which actors are located creates specific challenges and opportunities for institutional change by incumbents, and that the institutional setting has a strong impact on incumbents' strategic actions. At the same time, the chapters show that incumbents' strategic actions impact institutional pressures in the field. In all chapters incumbents envision new institutional setups and act to promote these institutional transformations. There is also a clear role for collaborative or collective institutional entrepreneurship. This chapter presents an overview of the main findings of each chapter, followed by the main conclusions of this dissertation. The chapter ends with a discussion of several limitations of this dissertation and recommendations.

## 6.1 Overview of main findings

Chapter 2 addressed the question: *what are the strategies used by incumbent firms to introduce discontinuous innovations within the boundaries of an existing mature innovation system?* This chapter presented an analysis of the Dutch greenhouse horticulture sector. This sector is mature and has a highly institutionalized setting; historical developments have created a sectoral innovation system that supports incremental technological process innovations. Facing difficulties with respect to decreasing profits and increased international competition, several incumbent firms emerged that try to break from this setting. They introduced discontinuous innovations that build on visions, knowledge, and business models that are new to this sector. Five of the ten studied incumbents were labeled as sustainable-technology entrepreneurs (STEs), as their discontinuous innovations included new sustainable technologies that reduce energy and pesticide use. This distinction is interesting from a sustainable transition perspective, as many studies argue that sustainable technologies encounter specific barriers that hinder their success. These embedded, incumbent entrepreneurs became motivated to look for change due to personal dissatisfaction. This dissatisfaction went beyond declining economic performance; on the contrary, many of the studied entrepreneurs had rather successful firms but felt that the institutional setting of the sector did not give them room to be truly innovative, and they felt that the current sectoral innovation system would not last in the long-run. The strategic actions of these entrepreneurs were intentionally focused on circumventing the existing institutional pressures in the sectoral innovation system, primarily by establishing new networks. They chose these strategic actions since the main barrier they encountered was the institutional setting of the sector. The entrepreneurs did not attempt to directly influence the institutional setting of the sector. Rather, they established new networks in which the discontinuous innovations could be developed further. They argued that the success of their new networks would put pressure on the existing sector to change and could demonstrate to other firms that there are possibilities for change, even by incumbent firms. This illustrates a potential mechanism for sectoral change. Additionally, there were some strategic differences between STEs and the other incumbents. STEs were able to receive more support from the mature innovation system. They were able to obtain existing subsidies and several local governments performed marketing activities for these incumbents. Due to the

strong link between energy reduction and cost reduction, environmental technologies fit with the institutional pressures in the existing sectoral innovation system. This chapter therefore showed that the greenness of innovation is not necessarily the main challenge for entrepreneurs. Rather, more challenging was finding ways to deal with the existing institutional settings which did not provide room for business model changes. Another strategy difference is that primarily the STEs undertook discursive activities to promote new business models to the sector, for instance through the establishment and management of educational centers, demonstration projects in which technologies and strategies are shared with other breeders and the establishment of environmental labels for the sector.

Chapter 2 concludes that incumbents can become motivated to act as institutional entrepreneurs following personal dissatisfaction with the existing institutional pressures in a sector. Following this dissatisfaction, incumbents employ strategies in which they fundamentally change their firm, set up new networks, and undertake activities that promote the sharing of new knowledge.

The main research question addressed in chapter 3 was: *why and how is institutional change potentially triggered by embedded organizations in the Dutch built environment sector?* The built environment sector is known for having a risk-adverse, rigid institutional setting, and for several years the economic and environmental performance of this sector has been criticized. Therefore, changes in regulations, technologies, and culture are viewed as being crucial but difficult to trigger. Recently, several innovative projects led by incumbent organizations emerged. These projects strived to break from the traditional way of doing business, while supporting a change to a more sustainable sector. Several different organizations, including housing cooperatives and local governments, became motivated to look for change due to dissatisfaction with the current institutional setting of the sector. The main source of dissatisfaction was formed by the institutional practices in the sector, such as practices governing the relation between projects and customers and the fundamental beliefs of how things should be. These beliefs were inspired by other institutional contexts, for instance the contrast between a manager's personal life and his work environment. The studied incumbents started projects that explicitly aim to structure the collaboration differently. These projects incorporated several changes, such as new contractual forms, new visions,

different interpretations of regulations, and new technological standards. Within the projects, these changes obtained support and were shared in a group of involved actors. These projects led to the creation of proto-institutions – i.e. new rules, regulations, and technologies that started to diffuse beyond the boundaries of the projects and have the potential to become new institutions in the field. New practices, such as including citizens in construction projects, diffused when incumbents involved in the project changed their own internal practices which govern their relations with others following the project. However, a stronger process of diffusion of changes beyond the project level was the formation of new rules following changes in practices, such as new interpretations of existing laws and new tendering procedures, which were later copied by governments in other cities. Several incumbents who triggered the studied projects have started a series of follow-up projects with the explicit aim to further diffuse and entrench the emerged proto-institutions. This illustrates how actions of incumbents in strategic collaborations can lead to institutional change in a mature sectoral innovation system.

Chapter 3 concludes that, in line with chapter 2, incumbents can become motivated to act as institutional entrepreneurs based on frustration and dissatisfaction stemming from the current institutional pressures in the sector. The incumbents are able to envision institutional alternatives due in part to their multiple embeddedness. Relatively powerful incumbents can force or demand changes in rules, practices, and technologies within the boundaries of collaborative projects, leading to the emergence of proto-institutions.

Chapter 4 focused on an emerging sector with the question: *what is the role of institutional complexity in the development and diffusion of bio-plastics?* Due to the rise of sustainability demands, the plastics sector came under pressure to develop sustainable innovations. During the time when these sustainability pressures were starting to influence the plastics sector, the agricultural sector was also experiencing pressures to change. It was envisioned that this sector needed to look for the application of their products in non-food markets to improve its economic and environmental performance. In this complex set of institutional pressures from existing sectors, the bio-plastics sector emerged. Bio-plastics are bio-degradable and/or bio-based. The institutional field surrounding bio-plastics is still taking shape, and organizations in this sector face the challenge of dealing with the lack of established institutions in this emerging

sector. The results showed that the emerging field of bio-plastics is institutionally complex, as there are institutional pressures originating from the agriculture field, the traditional chemicals field, and pressures towards sustainable development. Institutional complexity presented both opportunities and challenges for institutional entrepreneurs. Incumbents from related mature sectors entered the emerging sector and acted as institutional entrepreneurs. The lack of dominant institutional pressures motivated incumbents to attempt to establish institutions that promote their own interests. For instance, firms established new certification standards and logos to build legitimacy for their innovations. Due to the lack of institutional logics that can act as a source of legitimacy, incumbents saw the necessity of creating institutions that could provide legitimacy. However, prolonged institutional complexity made it difficult for new innovations (or the emerging field as a whole) to obtain legitimacy. Discussions intensified and due to the different proposed institutional arrangements, complexity increased and the legitimacy of bio-plastics as solution to sustainability issues decreased. The sheer number of individually established certification methods and logos in the field confused consumers and made it more difficult for the emerging sustainable innovations to gain legitimacy as it became more difficult to assess the legitimacy of the innovations.

Chapter 4 concludes that continued institutional complexity is a crucial aspect that hinders the development of bio-plastics as sustainable innovations. Institutional complexity can function as a trigger for the development of sustainable innovations, but a continuously high level of institutional complexity over time reduces the legitimacy of sustainable innovations as solutions to specific (sustainability) issues. It is very difficult for incumbents (and other actors) to navigate this complex set of institutional pressures.

Chapter 5 zoomed in on the occurrence of a specific strategic action with respect to the institutional context, namely the formation of alliances in the emerging field of bio-plastics. While it is often argued that alliances are formed to gain access to markets and/or resources, there has been some recognition that alliances can be sources of legitimacy. In emerging institutional fields actors have to undertake actions aimed at generating institutions in order to become legitimate. Alliances can play a role in this regard, as their signaling role can influence the direction of institutional development and alliances can themselves be institutional action takers, combining resources of partners

towards a common goal. The results showed that strategic alliances can use shared or developed technologies as source of market and social legitimacy, as technologies can for instance allow partners to access more markets, and produce more sustainable products. These alliances were often bilateral, inter-firm alliances that operated in production and marketing stages. Furthermore, the results showed that strategic alliances played a crucial role in demonstrating the worthiness of innovations to actors outside the alliance. In other words, strategic alliances enhanced technology legitimacy. Through expanding markets in which technologies are sold, their signaling role, and by acting as institutional entrepreneurs (for instance by developing and implementing standards and certificates for technologies) alliances promoted specific bio-plastics innovations and influenced institutional pressures in the field. These alliances were more multilateral and inter-organizational (including governments, universities, and NGOs as partners), operating in pre-competitive stages. These legitimating roles are not usually considered in literature. In general, the organizations involved in these alliances were established firms in related mature sectors. In contrast to the hero-view of institutional entrepreneurship that has been (implicitly) dominant, this chapter illustrated that incumbents can influence an institutional setting through collective strategic actions.

Chapter 5 concludes that strategic alliances are a valuable strategic option for institutional entrepreneurs as they can contribute to obtaining legitimacy in an emerging institutional setting. There is an interesting relationship between the legitimating role of alliances and technology. Technology shared or developed in an alliance can be a source of legitimacy for partner firms by supporting the partners' worthiness in markets or enhancing their social image. Alliances can also create legitimacy for technologies by exercising their signaling role and acting as institutional entrepreneurs.

## **6.2 Main conclusions**

This dissertation focused on analyzing what drives incumbents to start looking for institutional changes and what actions these incumbents use in order to enact their envisioned institutional changes. The short answer to the overall research question is that incumbents act as institutional entrepreneurs partly because their view on what constitutes legitimate behavior changes and partly because there are no clear or dominant pressures determining what constitutes legitimate behavior in certain settings. Furthermore, incumbents act as

institutional entrepreneurs by (un)intentionally pressuring the existing system through collective actions. The findings presented in this dissertation contribute to innovation systems literature, as it details the process of institutional change by incumbents and shows why and how incumbents can overcome the incumbent's curse. This dissertation thereby addresses the relative lack of attention for the micro-level in innovation system studies, and sheds more light on the potential role of diversifying incumbents as innovation system builders. These actors are not usually considered as a source of discontinuous change. Furthermore, the findings contribute to institutional theory by providing more insight into the paradox of embedded agency by highlighting the role of multiple embeddedness, institutional complexity, and collective institutional entrepreneurship. These topics have recently gained more attention in studies of institutional change, but are rarely linked to sustainable innovations.

Below, this short answer is further specified in five conclusions, each followed by a discussion of its relevance for theory and empirical recommendations where possible. The first conclusion is related to the view of incumbents as institutional entrepreneurs in transition studies. The second conclusion focuses on the meso-micro-interaction between institutions and their impact on the motivation for incumbents to act as institutional entrepreneurs. The third conclusion focuses on the micro-meso-interaction between incumbents and their strategies used to initiate changes in institutions. The fourth conclusion addresses the micro-meso-interaction between the enacted institutional changes and the mechanisms through which these changes impact sector-level institutions. Finally, the fifth conclusion focuses specifically on the role of institutions in sustainable innovations.

*1. The dominant perception in the literature regarding incumbents in transition processes needs to change.*

The role of agency has not received enough attention in transition frameworks. Together, the presented chapters show that it is important to consider the micro-level motivations and actions of entrepreneurs in relation to their institutional context, in order to understand transformations in sectors. In transition frameworks, incumbents should be seen as potential institutional entrepreneurs that can promote certain changes based on the interplay between agency and structure. Each chapter shows incumbents functioning as institutional

entrepreneurs. These incumbents attempt to change sectors from within towards being more sustainable and innovative. This differs from conventional insights in innovation systems literature in which new entrants are primarily seen as sources of change. This also illustrates that the incumbents' curse is overstated. Incumbents are often viewed as unwilling to change, unable to change, and even as actors that intentionally block change processes in sectors. This dominant view of incumbents in innovation studies is incomplete and needs to change, as incumbents can function as institutional entrepreneurs and can play a crucial role in the speed and success of sectoral transformations.

### 2. Legitimacy-related issues motivate incumbents to act as institutional entrepreneurs.

Legitimacy is crucial for the success of firms and is institutionally determined. Two legitimacy-related issues that motivate incumbents to start looking for possibilities to enact institutional change are identified. This conclusion reinforces the view that the transformation of sectors towards sustainability is not just a technological issue but, maybe even more so, a social, institutional challenge.

First, incumbents' view on what is legitimate behavior or business can change. This change can follow from their multiple embeddedness in different institutional fields, such as the general institutional setting of an incumbent's sector and a different institutional setting in a collaborative project in which an incumbent is involved. Furthermore, the multiple embeddedness of incumbents is also present on a more personal level, for instance due to incumbents' managers being embedded in both a (business) sector and in their personal family life. Following their multiple embeddedness incumbents can become aware and open to alternatives. When there is a mismatch or conflict between institutional pressures in the sector and the incumbents' view regarding legitimacy, dissatisfaction emerges. This dissatisfaction also manifests at a very personal level, where incumbents' managers feel that they cannot be innovative and change is needed based on personal beliefs. The decision of incumbents to start acting as institutional entrepreneurs is not only based on dissatisfaction with financial performance. The decision follows more from dissatisfaction with a perceived lack of attention for sustainability in the sector and from a feeling that true innovation is hindered by the institutional setting of the sector. In this

sense, one could even argue that dissatisfaction is a stronger driver for institutional entrepreneurship than market opportunities. Consider for instance that incumbents start acting as institutional entrepreneurs and change their current organizational structure and business model without having knowledge on potential new market opportunities beforehand (as shown in chapter 2). Furthermore, incumbents undertake system building activities from which other actors can benefit and take risks as a sort of first movers. Actors driven by financial dissatisfaction are not necessarily triggered to go against the established system or perform system building activities from which other actors can benefit. While dissatisfaction with performance concerns has been mentioned as a driver of embedded institutional change, this dissertation shows that dissatisfaction is a starting point for incumbents to become motivated, open, and aware regarding institutional change. Performance concerns play a role in dissatisfaction but are not enough to explain the financial risks taken by many of the studied incumbents and the efforts they undertake to enact changes that benefit the sector as a whole.

Therefore, this dissertation emphasizes the role of dissatisfaction as a trigger for institutional change by incumbents in mature institutional settings. This is an additional insight to earlier studies in the field of institutional change that show how incumbents can become institutional entrepreneurs when they have strong resources, strong capabilities that help overcome organizational filters, and when change is seen as attractive market opportunity. Dissatisfaction is a strong driver and is a clear result of the micro-meso-interaction of incumbents and institutions. There is thus an important role for agency in enabling a societal transition, even though this role is underdeveloped in innovation system perspectives.

The second legitimacy-related issue motivating incumbents to act as institutional entrepreneurs is the lack of clear pressures as source of legitimacy. Institutional complexity in an emerging institutional setting makes it difficult for actors to evaluate the legitimacy of actions and innovations as shown in chapters 4 and 5. The studied incumbents in the emerging bio-plastics sector do not decide to act as institutional entrepreneurs based on personal dissatisfaction with the current institutional pressures. Rather, the incumbents feel that they need to act as institutional entrepreneurs in order to obtain legitimacy. In the bio-plastics sector, institutional pressures are ambiguous. Therefore, obtaining legitimacy by

adherence to institutional pressures is not straightforward. The institutional ambiguity provides an incentive for incumbents to try to promote or establish institutions that fit with their own interests. For instance, many incumbents develop certification methods and logos in order to communicate the legitimacy of their innovations towards others.

However, obtaining legitimacy in a developing institutional field is a challenging process for incumbents acting as institutional entrepreneurs. Many actors in the sectoral innovation system of bio-plastics became confused regarding the legitimacy of bio-plastics, especially regarding their usefulness in solving sustainability issues, following the large amount of different institutions being promoted (as shown in chapter 4). In this way strategic actions of incumbents aimed at promoting certain institutional arrangements can increase institutional complexity. Prolonged institutional complexity can make it very difficult for innovations to obtain legitimacy. In a way, the focus on promoting own interests within this institutional setting enhances the competition between discontinuous innovations, which makes the competition with conventional plastics even more difficult. The existing literature on institutional complexity rarely studies complexity in relation to discontinuous innovation or sustainability transitions. Also, this literature only recently started to investigate the possibility of persisting institutional complexity over time. This dissertation addresses both points. Combining this conclusion with the previously discussed conclusion, it becomes clear that the specific institutional setting in which actors are located creates specific legitimacy-related challenges and drivers for incumbents to act as institutional entrepreneurs.

### *3. Collective action is a crucial aspect of the strategies used by incumbents for the enactment of institutional changes.*

Incumbents acting as institutional entrepreneurs are not superheroes and have to rely on others to enact changes. In other studies of incumbents as institutional entrepreneurs there often is a tendency to view these incumbents as powerful actors that force field-wide changes based on their resources and expertise. This dissertation presents a more nuanced view where there is distributed agency and even powerful incumbents need other actors to enact institutional changes.

In all studied sectors, collective actions are used to develop and start diffusing new or changed institutions. Incumbents theorize about new institutional

arrangements following their dissatisfaction or following institutional complexity. They envision and set new goals related to changing practices, rules, and technologies. The studied incumbents attempt to enact the envisioned changes through collective action. Relatively powerful actors are able to create conditions for institutional change in projects but do not force field wide change, as for instance shown in chapter 3. While their power and resources allow incumbents such as local governments and housing corporations to demand institutional change within projects, institutional change in the sector requires further collective action. Through various processes (such as the creation of follow-up projects) these changes start to diffuse to the level of the sector. This illustrates the role of distributed agency and moves away from the hero-view of institutional entrepreneurs.

However, while earlier studies on institutional entrepreneurship have argued that institutional entrepreneurs in mature institutional fields should work through existing collective actors, such as industry associations and standards councils, the studied incumbents do not see working with existing collective actors as a viable possibility. Instead, they start their own collaborations and networks that share their vision and collectively legitimize their discontinuous innovations. These networks, collaborations, and alliances are used to collectively signal support for certain changes and establish new institutions that support sustainable innovations.

The institutional setting thus has a clear impact on the challenges institutional entrepreneurs face. In all sectors there are trends taking place in the broader societal context, such as a general trend towards increased demand for sustainability or certain jolts (like the housing crisis). However, it is up to institutional entrepreneurs to recognize these trends or jolts and translate them into opportunities for change. Trends or jolts can function as certain windows of opportunity. However, they are not guarantees for the success of firms or transformations in sectors. This even holds for emerging institutional fields. Emerging sectors do not develop in some institutional void. Rather, institutional pressures from the original sectors of incumbents entering emerging sectors influence their actions and the establishment of institutions and legitimacy in the emerging sector. Collective actions facilitate the establishment of institutions and legitimacy, making them a crucial aspect of strategies used by institutional entrepreneurs.

4. Institutional change of sectors can follow from two different mechanisms.

The question how institutional change occurs within sectors remains an empirical one. There are strong sectoral differences and there is no single way in which institutional change of sectors can be enacted. This dissertation puts forward two mechanisms that illustrate how discontinuous innovations can lead to sector-wide institutional changes. These mechanisms have not been fully developed in literature and are an addition to the perspective that focuses on the role of exogenous forces or jolts as sources of change. While jolts can create windows of opportunity for change, this dissertation shows that exogenous forces cannot fully explain how institutional changes at the sector level emerge.

First, independent discontinuous innovations can coincidentally amount to discontinuous sector-level change in a similar direction. For instance, the studied incumbents in the greenhouse horticulture sector are mostly focused on establishing their own new networks and value chains. However, they argue that their networks, when becoming successful, will put pressure on the existing sectoral innovation system and/or open the eyes of other actors interested in change. All the newly formed value chains and related business models required similar institutional changes in order to become successful. In this way, the independent results of incumbents' efforts to create new collaborations and networks can cumulatively put even more pressure on the existing sector to change. The phenomenon of competing or independent institutional innovations is only sparsely mentioned in institutional studies but should attract more attention. Chapter 3 shows a similar story. Consider for instance that in all projects laws and regulations need new interpretations, new financial models and property rights models need to be endorsed, and the build-up of institutions that enhance trust is needed to start the construction projects. While sector-level institutional change is not (yet) observed, the separate discontinuous innovations aim for changes in a similar direction, thereby pressuring existing institutional arrangements.

Second, intentional actions can trigger a diffusion process of institutional changes to the sector level. Proto-institutions that originate within projects can diffuse beyond the project boundaries, as for instance discussed in chapter 3. By formalizing new beliefs and practices in new regulations, proto-institutions

are more easily copied in other locations. Furthermore, incumbents can start follow-up projects with the explicit aim of diffusing newly developed proto-institutions of earlier projects. These follow-up projects are performed in different locations or with a larger set of partners to extend the reach of the changes. While the involved, relatively powerful, actors cannot necessarily force sector-wide institutional change, they can undertake actions to intentionally promote and implement institutional changes in other projects or locations. Alliances (including new collective actors, such as industry associations) facilitate the process of promoting institutional changes and bringing other actors into contact with the envisioned changes. In more abstract terms, institutional entrepreneurs can intentionally undertake actions that bring more actors into contact with newly envisioned institutions, which can contribute to the diffusion of these institutional changes. This mechanism of change is more agency-oriented than the aforementioned mechanism, but both mechanisms can lead to larger changes in the institutional setting of sectors.

#### 5. Sectoral changes towards sustainability are mainly an institutional challenge.

The studied discontinuous innovations are (partly) related to sustainability and sustainable technologies. While the sustainability of technologies presents certain challenges (for instance related to market demand), sustainability on its own is not necessarily discontinuous but is institutionally shaped. That is, 'sustainability' is not easily legitimated. Sustainability covers many different dimensions and does not automatically translate to added value and success. In the built environment sector, several entrepreneurs intentionally try to shape the meaning of 'sustainability' in buildings by relating their innovations to values and beliefs. In the bio-plastics sector, which emerged based on a strong demand for sustainability, entrepreneurs face the issue that it is difficult to define sustainability. By relating to sustainability in general, bio-plastics came under fire from many different directions, such as food security, the dangers of genetic modification, and even ethical concerns: does the introduction of bio-degradable products not encourage unwanted behavior? Strikingly, conventional plastics are far less affected by these discussions, while they are clearly the cause of many environmental issues.

Sectoral changes towards sustainability are thus strongly related to institutional arrangements. Influencing the institutional setting of both mature and emerging

settings is therefore crucial for the success of incumbents that develop discontinuous sustainable innovations and for the possibility of a societal transition towards more sustainable sectors.

### **6.3 Discussion of limitations**

This dissertation mainly focuses on the micro-meso-interaction between incumbents and the institutional context of the sectoral innovation system in which they are embedded. The causal micro-meso-macro-interactions, that explain how micro-level changes can lead up to macro-level societal change, are therefore not clear. Additionally, it could be argued that the actions of the studied incumbents are the result of more than just their motivation but are also based on macro-influences such as societal trends. This dissertation does not attempt to decouple motivations and actions of institutional entrepreneurs from the broader societal context. Earlier studies have often examined how societal trends or jolts can create opportunities for institutional entrepreneurs. However, these studies normally do not explain how (specifically) incumbents become motivated by these trends to act as institutional entrepreneurs and through which actions they are able to capitalize on these trends. Therefore, this dissertation is mainly concerned with understanding the emergence of sectoral change triggered by incumbents. As a result of this focus however, the manner in which these changes facilitate an actual societal transition is not considered.

Furthermore, all chapters focus on the emergence of institutional change attempts by incumbents, but conclusions on the successfulness of these changes cannot be drawn from them. While the used approach allowed for an in-depth analysis of triggers of change and actions to establish change, it is difficult to say which motivations and actions are crucial for the success of institutional change attempts. This is also related to the previous limitation, as it is not clear if sectoral change will be successful in the first place. As discussed in the previous section, several mechanisms of institutional diffusion to the sector level are observed. However, the result of these change processes still needs to materialize.

The analysis of institutional change remains highly context-specific (as argued before, it remains an empirical question). A general comment regarding case-study research is that the generalizability of findings to other contexts is problematic, as findings are specific to a small number of particular settings.

This dissertation addresses this concern by providing detailed information regarding the boundaries of the performed studies (such as the studied institutional settings, the participants and data sources, and the data collection methods). This allows the readers to develop a proper understanding of the case studies. This enables readers to relate the presented findings to their own positions and make their own generalizations where possible.

Naturally, the generalizability of these findings could be improved by performing similar studies (using similar methods) in different sectors and institutional settings. In this respect, there is a need for comparing different institutional settings beyond the 'mature versus emerging' dichotomy. Consider for instance that strong differences between the studied mature settings were present. In the greenhouse horticulture sector there historically has been a culture of viewing other firms as colleagues rather than competitors. In the built environment there historically has been a culture of risk-aversion and a lack of trust between firms. In this sector new practices and rules had to be established to change the nature of project work. In the greenhouse horticulture sector, incumbents set up demonstration greenhouses and invited competitors to learn and develop innovations with them. This illustrates that there are differences between institutional pressures in mature settings that can trigger different kinds of behavior and change attempts. It is unclear if the distinction between 'mature' and 'emerging' is more important than distinctions based on different dimensions.

## 6.4 Recommendations

All chapters demonstrate that sustainable, discontinuous innovations can benefit from collective actions. As strikingly argued by one of the incumbents in the greenhouse horticulture sector, the focus of firms developing discontinuous innovations should be on "*making the pie bigger, instead of fighting for the same piece*". Established technologies and products (like conventional plastics) are surrounded by a strong supporting sectoral innovation system. While it looks as if sustainability pressures reduce the legitimacy of this old technology, it is very difficult for discontinuous innovations to enhance their legitimacy. If strategic actions are only aimed at the competition between transformations within a sector, competition with the established products and institutions is hindered.

Collective action can help firms obtain legitimacy, not only for themselves but also for more general categories of technologies and even the sector as a whole. Furthermore, through collective action institutional entrepreneurs can play a more active role in diffusing proto-institutions beyond the local boundaries in which they emerge.

For firms developing sustainable innovations it is important to discuss different dimensions of sustainability with respect to both old and new innovations. In all chapters it seemed that the sustainability of an innovation was primarily compared to the sustainability of other emerging alternatives. These discussions often intensified due to the multidimensional nature of sustainability. To give an example, some bio-plastics were developed with the aim of reducing litter issues, while others were developed with the aim of reducing CO<sub>2</sub> emissions. These goals are related to different environmental issues. When both types are marketed as 'sustainable' while clearly targeting only a specific dimension of sustainability, the legitimacy of these innovations is easily questioned. Sustainability should be seen as a concept that is institutionally established along different dimensions. Innovating firms should act on this by relating their innovation to more explicit sustainability goals. Therefore, the evaluation of sustainable innovations should involve the multi-dimensional nature of sustainability.

For policy makers it is important to start recognizing incumbent players that are dissatisfied and undertake efforts to trigger change processes in sectors. These incumbents can be approached to help diffuse relevant knowledge to other actors in sectors. Other organizations in mature sectors might share the incumbents' sense of dissatisfaction but might not have the motivation or ability to act on it. By diffusing relevant knowledge and using pioneering institutional entrepreneurs as examples, policy makers can facilitate or inspire further changes, as this will help build legitimacy for discontinuous innovations.

As collective actions are important for establishing and diffusing new institutions, there should be legal room for such actions. However, this is not a straightforward recommendation. There are examples of collective actions of firms leading to unfair competition. However, there are also examples of collective actions aimed at enhancing the sustainability of sectors that have been halted due to fear of unfair competition. When deciding to allow or support

collective actions, it is crucial to view these actions in light of their contribution to specific sustainability dimensions and to determine whether these actions are discontinuous in nature rather than incremental changes in line with the current system.

In this way, removing institutional barriers (i.e. creating a level playing field) is more important than establishing new subsidies or other regulations to support innovation. Many incumbents stress that they do not need additional subsidies or explicit support. Rather, they argue in favor of leveling the playing field by removing subsidies that only support business as usual, by not solely evaluating the sustainability of different emerging technologies without considering the traditional, vested alternatives, and by being open to interpreting existing laws in new ways. Herein lies a crucial role for policy makers



## Summary

This dissertation focuses on the potential role of incumbents in successfully impacting a societal transition towards sustainability by studying the motivations and actions of incumbents acting as institutional entrepreneurs in specific sectors.

In order to improve our understanding of the transformation of sectors, it is crucial to determine the possibilities and difficulties of institutional change in these sectors. Institutional theory provides a strong starting point, as it focuses on the taken-for-grantedness of social norms, routines, and rules, and thereby the difficulties in enacting change in sectors. Recent work goes into institutional change triggered by the strategic behavior of organizations. When actors envision new institutional arrangements and undertake actions to realize this new institutional setup they function as institutional entrepreneurs.

Which actors take up the role as institutional entrepreneur in the process of sectoral change? Generally the innovation literature points at new innovative firms that try to enter an existing sector with new technologies that radically deviate from the existing knowledge base in the sector: so called discontinuous innovations. It is commonly not expected that insiders or incumbents are a source of discontinuous innovation, as incumbents have strong, vested interests in the existing sectoral innovation system and are therefore not looking for changes that can potentially overthrow this. A sectoral innovation system encompasses all actors and institutions that influence the development, diffusion and use of innovations within a sector.

Incumbents are strongly influenced by the institutional setting of existing sectoral innovation systems. They often develop certain organizational filters and routines that can lead to a lack of perceived incentives for institutional change. However, these assumptions might be exaggerated. Depending on their resources and interests specific incumbents can develop discontinuous innovations. To make these innovations successful, institutional change is necessary and therefore these incumbents also need to function as institutional entrepreneurs. Resources related to institutional entrepreneurship are authority, power, legitimacy, economic and social capital, and knowledge and expertise. Contrary to the challengers, incumbents are more likely to possess these

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resources. In this view it can even be argued that institutional entrepreneurship by incumbents has a higher probability of actually resulting in institutional changes and sectoral change.

The main research question of this dissertation therefore is: *why and how do incumbents act as institutional entrepreneurs?*

In order to determine why and how incumbents act as institutional entrepreneurs in different institutional settings, four case studies have been performed in three different sectors: the greenhouse horticulture sector, the built environment sector (as mature sectors with strongly institutionalized settings) and the bio-plastics sector (as an emerging sector with an emerging institutional setting).

In mature institutional settings temporary stable priorities between institutional pressures result in relatively clear prescriptions guiding behavior. However, when these institutional pressures become very rigid, they hinder discontinuous innovation. Emerging institutional fields are often characterized by strong conflicts between institutional logics, as actors battle to prioritize logics that support their interests and beliefs. This can create uncertainty, as institutional demands are not clear. This distinction suggests that entrepreneurial motivations and actions in mature fields can differ from those in emerging fields, as entrepreneurs face different institutional pressures and thus have to gain legitimacy in different ways. A transition can then be seen as a competition between mature institutional settings and emerging institutional settings. Therefore, both settings are studied in this dissertation.

While there are some methodological differences between the chapters, the overall research design follows a qualitative case study approach. In general, each chapter employs a general historical analysis of the sector under study and a more detailed analysis of selected incumbents in order to determine their motivations and actions with respect to the sector in which they are embedded. Each chapter is based on an analysis of a variety of data sources including newspaper articles, industry journal articles, press releases, policy reports, websites of key actors, and interviews.

Chapter 2 addressed the question: *what are the strategies used by incumbent firms to introduce discontinuous innovations within the boundaries of an existing mature innovation system?* This chapter presented an analysis of the Dutch

greenhouse horticulture sector. Facing difficulties with respect to decreasing profits and increased international competition, several incumbent firms emerged that try to break from this setting. They introduced discontinuous innovations that build on visions, knowledge, and business models that are new to this sector. Five of the ten studied incumbents were labeled as sustainable-technology entrepreneurs (STEs), as their discontinuous innovations included new sustainable technologies that reduce energy and pesticide use. These embedded, incumbent entrepreneurs became motivated to look for change due to personal dissatisfaction. This dissatisfaction went beyond declining economic performance; on the contrary, many of the studied entrepreneurs had rather successful firms but felt that the institutional setting of the sector did not give them room to be truly innovative, and they felt that the current sectoral innovation system would not last in the long-run. The entrepreneurs did not attempt to directly influence the institutional setting of the sector. Rather, they established new networks in which the discontinuous innovations could be developed further. They argued that the success of their new networks would put pressure on the existing sector to change and could demonstrate to other firms that there are possibilities for change, even by incumbent firms. Additionally, there were some strategic differences between STEs and the other incumbents. STEs were able to receive more support from the mature innovation system. They were able to obtain existing subsidies and several local governments performed marketing activities for these incumbents. This chapter therefore showed that the greenness of innovation is not necessarily the main challenge for entrepreneurs. Rather, more challenging was finding ways to deal with the existing institutional settings which did not provide room for business model changes.

The main research question addressed in chapter 3 was: *why and how is institutional change potentially triggered by embedded organizations in the Dutch built environment sector?* Recently, several innovative projects led by incumbent organizations emerged. These projects strived to break from the traditional way of doing business, while supporting a change to a more sustainable sector. Several different organizations, including housing cooperatives and local governments, became motivated to look for change due to dissatisfaction with the current institutional setting of the sector. The main source of dissatisfaction was formed by the institutional practices in the sector. The studied incumbents started projects that explicitly aim to structure the

## Summary

collaboration differently. These projects incorporated several changes, such as new contractual forms, new visions, different interpretations of regulations, and new technological standards. These projects led to the creation of proto-institutions – i.e. new rules, regulations, and technologies that started to diffuse beyond the boundaries of the projects and have the potential to become new institutions in the field. New practices diffused when incumbents involved in the project changed their own internal practices which govern their relations with others following the project. However, a stronger process of diffusion of changes beyond the project level was the formation of new rules following changes in practices which were later copied by governments in other cities. Several incumbents who triggered the studied projects have started a series of follow-up projects with the explicit aim to further diffuse and entrench the emerged proto-institutions. This illustrates how actions of incumbents in strategic collaborations can lead to institutional change in a mature sectoral innovation system.

Chapter 4 focused on an emerging sector with the question: *what is the role of institutional complexity in the development and diffusion of bio-plastics?* Bio-plastics are bio-degradable and/or bio-based. The institutional field surrounding bio-plastics is still taking shape, and organizations in this sector face the challenge of dealing with the lack of established institutions in this emerging sector. The results showed that the emerging field of bio-plastics is institutionally complex, as there are institutional pressures originating from the agriculture field, the traditional chemicals field, and pressures towards sustainable development. Institutional complexity presented both opportunities and challenges for institutional entrepreneurs. Incumbents from related mature sectors entered the emerging sector and acted as institutional entrepreneurs. The lack of dominant institutional pressures motivated incumbents to attempt to establish institutions that promote their own interests. For instance, firms established new certification standards and logos to build legitimacy for their innovations. Due to the lack of institutional logics that can act as a source of legitimacy, incumbents saw the necessity of creating institutions that could provide legitimacy. However, prolonged institutional complexity made it difficult for new innovations (or the emerging field as a whole) to obtain legitimacy. Discussions intensified and due to the different proposed institutional arrangements, complexity increased and the legitimacy of bio-plastics as solution to sustainability issues decreased. The sheer number of individually established certification methods and logos in the field confused consumers and

made it more difficult for the emerging sustainable innovations to gain legitimacy as it became more difficult to assess the legitimacy of the innovations.

Chapter 5 zoomed in on the occurrence of a specific strategic action with respect to the institutional context, namely the formation of alliances in the emerging field of bio-plastics. While it is often argued that alliances are formed to gain access to markets and/or resources, there has been some recognition that alliances can be sources of legitimacy. In emerging institutional fields actors have to undertake actions aimed at generating institutions in order to become legitimate. Alliances can play a role in this regard, as their signaling role can influence the direction of institutional development and alliances can themselves be institutional action takers, combining resources of partners towards a common goal. The results showed that strategic alliances can use shared or developed technologies as source of market and social legitimacy, as technologies can for instance allow partners to access more markets, and produce more sustainable products. These alliances were often bilateral, inter-firm alliances that operated in production and marketing stages. Furthermore, the results showed that strategic alliances played a crucial role in demonstrating the worthiness of innovations to actors outside the alliance. In other words, strategic alliances enhanced technology legitimacy. Through expanding markets in which technologies are sold, their signaling role, and by acting as institutional entrepreneurs (for instance by developing and implementing standards and certificates for technologies) alliances promoted specific bio-plastics innovations and influenced institutional pressures in the field. These alliances were more multilateral and inter-organizational (including governments, universities, and NGOs as partners), operating in pre-competitive stages. These legitimating roles are not usually considered in literature. In general, the organizations involved in these alliances were established firms in related mature sectors. In contrast to the hero-view of institutional entrepreneurship that has been (implicitly) dominant, this chapter illustrated that incumbents can influence an institutional setting through collective strategic actions.

The short answer to the overall research question is that incumbents act as institutional entrepreneurs partly because their view on what constitutes legitimate behavior changes and partly because there are no clear or dominant pressures determining what constitutes legitimate behavior in certain settings. Furthermore, incumbents act as institutional entrepreneurs by (un)intentionally

pressuring the existing system through collective actions. This short answer is further specified in five conclusions.

1. The dominant perception in the literature regarding incumbents in transition processes needs to change.

The role of agency has not received enough attention in transition frameworks. Together, the presented chapters show that it is important to consider the micro-level motivations and actions of entrepreneurs in relation to their institutional context, in order to understand transformations in sectors. In transition frameworks, incumbents should be seen as potential institutional entrepreneurs that can promote certain changes based on the interplay between agency and structure.

2. Legitimacy-related issues motivate incumbents to act as institutional entrepreneurs.

Legitimacy is crucial for the success of firms and is institutionally determined. Two legitimacy-related issues that motivate incumbents to start looking for possibilities to enact institutional change are identified. This conclusion reinforces the view that the transformation of sectors towards sustainability is not just a technological issue but, maybe even more so, a social, institutional challenge.

First, incumbents' view on what is legitimate behavior or business can change. This change can follow from their multiple embeddedness in different institutional fields, such as the general institutional setting of an incumbent's sector and a different institutional setting in a collaborative project in which an incumbent is involved. Following their multiple embeddedness incumbents can become aware and open to alternatives. When there is a mismatch or conflict between institutional pressures in the sector and the incumbents' view regarding legitimacy, dissatisfaction emerges. Dissatisfaction is a strong driver and is a clear result of the micro-meso-interaction of incumbents and institutions. There is thus an important role for agency in enabling a societal transition, even though this role is underdeveloped in innovation system perspectives.

The second legitimacy-related issue motivating incumbents to act as institutional entrepreneurs is the lack of clear pressures as source of legitimacy. Institutional

complexity in an emerging institutional setting makes it difficult for actors to evaluate the legitimacy of actions and innovations. Therefore, obtaining legitimacy by adherence to institutional pressures is not straightforward. The institutional ambiguity provides an incentive for incumbents to try to promote or establish institutions that fit with their own interests. However, obtaining legitimacy in a developing institutional field is a challenging process for incumbents acting as institutional entrepreneurs. Strategic actions of incumbents aimed at promoting certain institutional arrangements can even increase institutional complexity. Prolonged institutional complexity can make it very difficult for innovations to obtain legitimacy. Combining this insight with the previously discussed conclusion, it becomes clear that the specific institutional setting in which actors are located creates specific legitimacy-related challenges and drivers for incumbents to act as institutional entrepreneurs.

*3. Collective action is a crucial aspect of the strategies used by incumbents for the enactment of institutional changes.*

Incumbents acting as institutional entrepreneurs are not superheroes and have to rely on others to enact changes. In other studies of incumbents as institutional entrepreneurs there often is a tendency to view these incumbents as powerful actors that force field-wide changes based on their resources and expertise. This dissertation presents a more nuanced view where there is distributed agency and even powerful incumbents need other actors to enact institutional changes.

*4. Institutional change of sectors can follow from two different mechanisms.*

The question how institutional change occurs within sectors remains an empirical one. There are strong sectoral differences and there is no single way in which institutional change of sectors can be enacted. This dissertation puts forward two mechanisms that illustrate how discontinuous innovations can lead to sector-wide institutional changes.

First, independent discontinuous innovations can coincidentally amount to discontinuous sector-level change in a similar direction. While sector-level institutional change is not (yet) observed, the separate discontinuous innovations aim for changes in a similar direction, thereby pressuring existing institutional arrangements. Second, intentional actions can trigger a diffusion process of institutional changes to the sector level. Proto-institutions that

originate within projects can diffuse beyond the project boundaries and follow-up projects with the explicit aim of diffusing newly developed proto-institutions of earlier projects can be started.

5. Sectoral changes towards sustainability are mainly an institutional challenge.

The studied discontinuous innovations are (partly) related to sustainability and sustainable technologies. While the sustainability of technologies presents certain challenges (for instance related to market demand), sustainability on its own is not necessarily discontinuous but is institutionally shaped. That is, 'sustainability' is not easily legitimated. Sustainability covers many different dimensions and does not automatically translate to added value and success. Sectoral changes towards sustainability are thus strongly related to institutional arrangements. Influencing the institutional setting of both mature and emerging settings is therefore crucial for the success of incumbents that develop discontinuous sustainable innovations and for the possibility of a societal transition towards more sustainable sectors.

All chapters demonstrate that sustainable, discontinuous innovations can benefit from collective actions. As strikingly argued by one of the incumbents in the greenhouse horticulture sector, the focus of firms developing discontinuous innovations should be on "*making the pie bigger, instead of fighting for the same piece*". As collective actions are important for establishing and diffusing new institutions, there should be legal room for such actions. However, this is not a straightforward recommendation. There are examples of collective actions aimed at enhancing the sustainability of sectors that have been halted due to fear of unfair competition. When deciding to allow or support collective actions, it is crucial to view these actions in light of their contribution to specific sustainability dimensions and to determine whether these actions are discontinuous in nature rather than incremental changes in line with the current system.

# Samenvatting

De focus van dit proefschrift is de potentiële rol van gevestigde bedrijven in het succes van maatschappelijke transitie naar duurzaamheid. Hierbij wordt vooral gekeken naar de motivaties en acties van gevestigde bedrijven die optreden als institutionele ondernemers.

Om ons begrip van de transformatie van sectoren te verbeteren, is het cruciaal om vast te stellen wat de mogelijkheden en moeilijkheden voor institutionele veranderingen in sectoren zijn. Institutionele theorie is hiervoor een goed beginpunt. Deze theorie richt zich namelijk op het verklaren van de vanzelfsprekendheid van sociale normen, routines en regels, en daarmee de moeilijkheden voor het veranderen van dergelijke regels in sectoren. Recent onderzoek in dit veld bekijkt hoe strategische acties van organisaties voor institutionele verandering kunnen zorgen. Actoren die veranderingen in instituties voor ogen hebben en actie ondernemen om deze visie werkelijkheid te maken worden institutionele ondernemers genoemd.

Welke actoren vervullen de rol van institutioneel ondernemer in sectorale veranderingen? De innovatieliteratuur wijst over het algemeen naar nieuwe toetreders die bestaande sectoren veranderen met radicaal nieuwe technologieën die afwijken van de kennisbasis in de sector: zogenaamde discontinue innovaties. Normaal gesproken gaat men er niet vanuit dat gevestigde bedrijven een bron van discontinue innovaties zijn, omdat deze bedrijven gevestigde belangen hebben in het bestaande sectorale innovatiesysteem. Ze zijn daarom dus niet op zoek naar verandering die hun belangen teniet kunnen doen. Een sectoraal innovatiesysteem bevat alle actoren en instituties die de ontwikkeling, verspreiding en het gebruik van innovaties binnen een sector beïnvloeden.

Ook wordt aangenomen dat gevestigde bedrijven sterk beïnvloed worden door de institutionele omgeving van het sectorale innovatiesysteem waarin ze zich bevinden. Deze bedrijven hebben in de loop der tijd bepaalde filters en routines ontwikkeld die kunnen leiden tot een gebrek aan drivers voor het zoeken naar mogelijkheden tot institutionele verandering. Er zijn echter aanwijzingen dat deze aannames overdreven zijn. Bepaalde gevestigde bedrijven kunnen op basis van hun resources en vaardigheden instaat zijn om discontinue innovaties te

ontwikkelen. Om deze innovaties succesvol te maken is institutionele verandering nodig. Hierdoor kan het voorkomen dat gevestigde bedrijven toch als institutioneel ondernemer optreden. Resources die nuttig zijn voor institutionele ondernemers zijn autoriteit, macht, legitimiteit, economisch en sociaal kapitaal, en kennis en expertise. In tegenstelling tot nieuwe toetreders zijn het vaak juist gevestigde bedrijven die in grotere mate over deze resources beschikken. Dit zou erop kunnen wijzen dat institutioneel ondernemerschap van gevestigde bedrijven een hogere kans heeft op het daadwerkelijk teweeg brengen van succesvolle institutionele veranderingen in sectoren.

De onderzoeksvraag van dit proefschrift is daarom: *waarom en hoe functioneren gevestigde bedrijven als institutionele ondernemers?*

Om vast te stellen waarom en hoe gevestigde bedrijven optreden als institutionele ondernemers in verschillende sectoren zijn vier case studies uitgevoerd in drie verschillende sectoren: de glastuinbouw sector, de gebouwde omgeving (beide sectoren zijn volwassen en sterk geïnstitutionaliseerd), en de bio-plastics sector (een opkomende sector waar instituties nog vorm moeten krijgen).

In een volwassen institutionele omgeving zijn duidelijke voorschriften voor gedrag en interactie tussen bedrijven als gevolg van een (tijdelijke) stabiele verhouding tussen verschillende instituties. Echter, op het moment dat deze instituties zeer rigide worden, vormen ze een barrière voor discontinue innovaties. In een opkomende institutionele omgeving zijn vaak conflicten tussen verschillende instituties. Actoren strijden hier om instituties te promoten die aansluiten bij hun belangen en idealen. Dit kan leiden tot onzekerheid, aangezien er in een dergelijke setting geen duidelijk voorschrift voor gedrag en interactie is. Dit onderscheid tussen volwassen en opkomende institutionele omgevingen suggereert dat de motivaties en acties van institutionele ondernemers kan verschillen afhankelijk van het veld waarin de ondernemer zich bevindt. Deze ondernemers krijgen te maken met verschillende barrières en moeten hun legitimiteit op verschillende manieren proberen te verkrijgen. Een maatschappelijke transitie kan gezien worden als een strijd tussen deze volwassen en opkomende institutionele omgevingen. Daarom worden beide omgevingen bestudeerd in dit proefschrift.

Er zijn een paar methodologische verschillen tussen de verschillende hoofdstukken, maar over het algemeen wordt in elk hoofdstuk gebruik gemaakt van een kwalitatieve case studie. In elk hoofdstuk wordt gebruik gemaakt van een historische analyse van de sector en een meer gedetailleerde analyse van geselecteerde gevestigde bedrijven om hun motivaties en acties vast te stellen. Ook wordt er in ieder hoofdstuk gebruik gemaakt van een aantal verschillende databronnen, zoals krantenberichten, artikelen uit vakbladen, persberichten, beleidsrapporten, websites en interviews.

Hoofdstuk 2 bekijkt de vraag: *welke strategieën gebruiken gevestigde bedrijven bij het introduceren van discontinue innovaties in een volwassen sectoraal innovatiesysteem?* Het hoofdstuk presenteert een analyse van de Nederlandse glastuinbouwsector. Deze sector is van oorsprong erg innovatief, maar worstelt al een tijd met afnemende winsten en toegenomen internationale concurrentie. Een aantal gevestigde bedrijven probeert de traditionele manier van werken (gericht op bulkproductie en kostenverlaging) te veranderen door discontinue innovaties te introduceren. Deze innovaties zijn gebaseerd op visies, kennis en businessmodellen die compleet nieuw zijn voor deze sector. Vijf van de tien bestudeerde gevestigde bedrijven zijn geïdentificeerd als duurzame technologie ondernemers ("sustainable-technology entrepreneurs", oftewel STEs), omdat hun innovaties gebruik maken van duurzame technologieën die gebruik van energie en pesticiden verminderen. De gevestigde bedrijven werden door persoonlijke onvrede gedreven om te zoeken naar mogelijkheden voor institutionele verandering. Deze onvrede ging verder dan onvrede met de financiële prestaties van hun bedrijf. Een aantal van de onderzochte bedrijven was zelfs relatief succesvol, maar voelde zich beperkt door de institutionele omgeving en had het idee dat de sector niet lang op deze manier door kon gaan. Deze bedrijven konden niet zo innovatief zijn als ze graag zouden willen. De onderzochte bedrijven probeerden niet direct de gevestigde instituties te veranderen. In plaats daarvan creëerden zij nieuwe netwerken om hun discontinue innovaties verder te ontwikkelen. Hun idee was dat deze netwerken vanzelf druk zouden leggen op de bestaande sector op het moment dat zij succesvol werden. Hiermee konden zij namelijk aan andere bedrijven laten zien dat het ook anders kan. Naast deze algemene strategie zijn er ook verschillen in strategie tussen STEs en non-STEs vastgesteld. De STEs werden namelijk sterker ondersteund door het bestaande systeem door middel van subsidies en marketing door lokale overheden. Dit hoofdstuk laat hiermee zien dat het niet

zozeer de duurzaamheid van innovaties is die barrières creëert, maar dat deze barrières meer voortkomen uit de gevestigde institutionele omgeving die geen plaats biedt aan veranderingen in businessmodellen.

De hoofdvraag van hoofdstuk 3 is: *waarom en hoe wordt institutionele verandering mogelijk gestart door gevestigde bedrijven in de Nederlandse gebouwde omgeving?* Er zijn recentelijk een aantal innovatieve projecten gestart door gevestigde partijen. Deze projecten hebben allen als doel om los te breken van de traditionele manier van werken in deze sector en om een overgang naar duurzaamheid in de sector te starten. Verschillende soorten organisaties, waaronder woningbouwcorporaties en lokale overheden, werden gedreven om naar verandering te zoeken door onvrede over de huidige manier van functioneren van de sector. De geïnstitutionaliseerde gewoontes van samenwerking in de sector vormden de grootste bron van onvrede. De gevestigde bedrijven startten daarom projecten waarin onder meer de samenwerking volledig anders opgezet werd. Denk verder aan veranderingen in contractvormen, visies, interpretaties van bestaande regelgeving en het vaststellen van nieuwe technologische standaarden. Deze projecten leidden daarmee tot de creatie van proto-instituties – nieuwe regels, wetgeving en technologieën die kunnen verspreiden buiten de samenwerking en in potentie nieuwe instituties in het veld kunnen worden. Het hoofdstuk laat zien dat nieuwe gewoontes zich kunnen verspreiden buiten projecten op het moment dat gevestigde bedrijven hun interne gewoontes die interacties met anderen aansturen veranderen. Een andere manier waarop nieuwe gewoontes zich verspreiden is door opgenomen te worden in aangepaste regelgeving door lokale overheden (in andere steden). Verschillende gevestigde bedrijven zijn ook betrokken bij vervolprojecten die expliciet als doel hebben om nieuwe gewoontes, zoals burgerparticipatie, verder te verspreiden in de sector. Dit laat zien op welke manieren strategische acties van gevestigde bedrijven tot institutionele veranderingen kunnen zorgen in volwassen sectoren.

Hoofdstuk 4 richt zich op een opkomende sector met de vraag: *wat is de rol van institutionele complexiteit in de ontwikkeling en verspreiding van bio-plastics?* Bio-plastics zijn bio-afbreekbaar en/of op basis van biomassa geproduceerd. Het institutionele veld rondom bio-plastics wordt momenteel nog gevormd, wat een uitdaging is voor bedrijven in dit veld. De resultaten laten zien dat het opkomende veld rondom bio-plastics institutioneel complex is, omdat er vanuit

verschillende velden, het agrarische veld, het traditionele chemische veld en het duurzaamheidsveld, institutionele druk wordt uitgeoefend op bio-plastics. Institutionele complexiteit zorgt voor zowel kansen als barrières voor institutionele ondernemers. Gevestigde bedrijven die dit veld betreden zijn gemotiveerd om als institutionele ondernemers op te treden, omdat er veel ruimte is om dit te doen. Zo kunnen deze bedrijven hun eigen belangen promoten door bijvoorbeeld nieuwe certificatie standaarden en logo's op te zetten, waarmee deze bedrijven hun legitimiteit hopen te vergroten. Echter, doordat de institutionele complexiteit al enige tijd voortduurt, is het moeilijker geworden voor de nieuwe bio-plastic innovaties om als legitiem gezien te worden. Er is bijvoorbeeld continu discussie over de duurzaamheid van deze innovaties, en deze discussies nemen als gevolg van de complexiteit alleen maar toe. Ook het aantal certificatiemethodes en logos is zo sterk toegenomen, dat het nu meer een verwarrende werking heeft op consumenten. Hierdoor is het moeilijker geworden om de legitimiteit van deze innovaties in te schatten.

Hoofdstuk 5 zoomt in op een specifieke strategische actie, namelijk het aangaan van allianties in het opkomende bio-plastics veld. Hoewel vaak verondersteld wordt dat allianties gevormd worden om toegang te krijgen tot bepaalde markten of resources is er recentelijk aandacht gekomen voor het idee dat allianties een bron van legitimiteit kunnen zijn. Actoren moeten acties ondernemen om instituties te vormen die als bron voor legitimiteit kunnen dienen in opkomende institutionele velden. Allianties kunnen dit ondersteunen, aangezien het vormen van allianties een signaal af kan geven die de formatie van instituties beïnvloedt. Daarnaast kunnen allianties zelf ook institutionele acties ondernemen, door resources van verschillende partijen te combineren en in te zetten voor een gezamenlijk doel. De resultaten laten zien dat allianties gedeelde technologieën kunnen gebruiken als bron van markt legitimiteit en sociale legitimiteit, omdat technologieën partners in staat stellen om meer markten te betreden en duurzamer te produceren. Dergelijke allianties zijn vaak bilateraal en worden tussen bedrijven afgesloten die bezig zijn in de productie of marketing fase. Daarnaast spelen allianties ook een grote rol in het vaststellen van de legitimiteit voor technologieën naar actoren buiten de alliantie, de zogenaamde technologie legitimiteit. Door de technologie in meer markten in te zetten, door signalen van vertrouwen te geven en door als institutionele ondernemers op te treden (bijvoorbeeld door het ontwikkelen van certificeringstandaarden) kunnen allianties de legitimiteit van specifieke innovaties vergroten en instituties in het

veld beïnvloeden. De allianties die zich richten op technologie legitimiteit zijn vaker multilateraal en er zijn verschillende soorten organisaties in de pre-competitieve fase betrokken als partners bij deze allianties (zoals overheden, universiteiten, bedrijven en NGOs). Deze legitimerende rollen van allianties worden normaal niet bekeken in de alliantieliteratuur. De betrokken organisaties waren over het algemeen gevestigde partijen. Hiermee laat dit hoofdstuk zien dat deze partijen niet alleen institutionele verandering afdwingen, maar dit door middel van collectieve acties proberen te doen.

Het korte antwoord op de onderzoeksvraag van dit proefschrift is dat gevestigde bedrijven als institutionele ondernemers functioneren omdat hun beeld van legitiem gedrag verandert en omdat het niet duidelijk is wat legitiem gedrag inhoudt in een specifiek veld. Gevestigde bedrijven functioneren als institutionele ondernemers door strategische samenwerkingen aan te gaan die (onbedoeld) druk zetten op gevestigde sectorale innovatiesystemen. Hieronder wordt dit korte antwoord verder uitgewerkt aan de hand van vijf conclusies.

*1. Het dominante beeld in de literatuur omtrent de rol van gevestigde bedrijven in transitie klopt niet.*

De rol van actoren in het bewerkstelligen van institutionele verandering heeft niet genoeg aandacht gekregen in transitietheorie. Dit proefschrift laat zien dat het van belang is om motivaties en acties van ondernemers in relatie tot hun institutionele context te bestuderen om veranderingsprocessen van sectoren te kunnen begrijpen. Gevestigde bedrijven zouden gezien moeten worden als mogelijke institutionele ondernemers die gericht invloed kunnen uitoefenen op de institutionele setting van sectoren.

*2. Legitimitetsproblemen motiveren gevestigde bedrijven om als institutionele ondernemers te functioneren.*

Legitimiteit is cruciaal voor het succes van bedrijven en wordt bepaald door de institutionele omgeving. Twee legitimiteitsproblemen motiveren gevestigde bedrijven om te kijken naar mogelijkheden voor institutionele verandering. Deze conclusie versterkt het beeld dat de duurzame transformatie van sectoren niet alleen een technologische uitdaging is, maar wellicht zelfs meer een sociaal, institutionele uitdaging.

Het eerste legitimiteitsprobleem is dat de opvatting van gevestigde bedrijven over wat legitiem gedrag inhoudt kan veranderen. Dit kan het gevolg zijn van het feit dat deze bedrijven ingebed zijn in meerdere institutionele velden, zoals het algemene veld van de sector en een ander veld als gevolg van een samenwerking waarin het bedrijf deelneemt. Hierdoor kan een gevestigd bedrijf zich bewust worden van en open staan voor institutionele verandering. Als er een verschil zit tussen de visie van gevestigde bedrijven omtrent legitiem gedrag en de institutionele voorschriften in de sector kan onvrede optreden. Deze onvrede is een sterke driver die ervoor zorgt dat gevestigde bedrijven zich richten op institutionele verandering. Er is dus een belangrijke rol weggelegd voor de acties van actoren in het bewerkstelligen van transities, een conclusie die nog onvoldoende aandacht heeft gekregen in innovatiesysteemliteratuur.

Het tweede legitimiteitsprobleem is het gebrek aan duidelijke institutionele voorschriften die een bron van legitimiteit kunnen zijn. Institutionele complexiteit in opkomende sectoren maakt het moeilijk voor actoren om de legitimiteit van innovaties en actoren in te schatten. Het is erg lastig om in een dergelijke situatie legitimiteit te verkrijgen door mee te gaan met institutionele voorschriften. Deze institutionele complexiteit biedt ruimte aan gevestigde bedrijven om als institutioneel ondernemer hun eigen belangen te promoten bij het opzetten van instituties. Echter, deze strategische acties kunnen zelfs complexiteit vergroten. Voortdurende complexiteit maakt het erg moeilijk voor innovaties om legitimiteit te verkrijgen. Tezamen met de voorgaande conclusie maakt deze conclusie duidelijk dat de specifieke institutionele omgeving van actoren specifieke legitimiteitsproblemen kan veroorzaken die als motivator dienen voor gevestigde bedrijven om als institutioneel ondernemer te functioneren.

3. Collectieve acties vormen een cruciaal onderdeel van de strategieën die gevestigde bedrijven gebruiken om institutionele veranderingen te bewerkstelligen.

Gevestigde bedrijven die als institutionele ondernemers functioneren zijn geen superhelden en hebben daarom anderen nodig om veranderingen te bewerkstelligen. In eerdere onderzoeken naar gevestigde bedrijven als institutionele ondernemers worden de bedrijven vaak neergezet als machtige actoren die sector-brede veranderingen kunnen afdwingen op basis van hun

resources en expertise. Dit proefschrift laat een genuanceerder beeld zien waarbij gevestigde bedrijven anderen nodig hebben.

#### 4. Institutionele verandering van sectoren kan het gevolg zijn van twee mechanismen.

Hoe institutionele verandering van sectoren plaatsvindt blijft een empirisch vraagstuk. Er zijn grote sectorale verschillen en er is meer dan één manier waarop deze verandering ingezet kan worden. Dit proefschrift laat twee mechanismen zien die weergeven hoe discontinue innovaties kunnen leiden tot sectorale verandering.

Ten eerste kunnen onafhankelijke discontinue innovaties toevallig optellen tot sectorale veranderingen in eenzelfde richting. Hoewel sectorale transformaties in de gepresenteerde hoofdstukken (nog) niet zijn waargenomen, is het duidelijk dat een aantal onafhankelijke discontinue innovaties zich richten op vergelijkbare veranderingen, waarbij ze druk uitoefenen op de gevestigde instituties. Ten tweede kan de verspreiding van nieuwe instituties binnen sectoren bewust gestart worden. Proto-instituties die ontstaan binnen projecten kunnen zich buiten deze projecten verspreiden, bijvoorbeeld in vervolgprojecten met als doel de verspreiding van deze proto-instituties.

#### 5. Sectorale veranderingen richting duurzaamheid zijn hoofdzakelijk een institutionele uitdaging.

De onderzochte discontinue innovaties zijn (deels) gerelateerd aan duurzaamheid en duurzame technologieën. Hoewel de duurzaamheid van technologieën ook bepaalde uitdagingen met zich meebrengt (bijvoorbeeld een mogelijk gebrek aan marktvraag voor duurzaamheid), is duurzaamheid op zichzelf niet noodzakelijk discontinu. Duurzaamheid wordt institutioneel bepaald en daardoor niet altijd even gemakkelijk gelegitimeerd. Het concept duurzaamheid omvat ook vele dimensies en wordt niet automatisch omgezet naar toegevoegde waarde en succes. Sectorale veranderingen naar duurzaamheid worden dus sterk beïnvloed door de institutionele omgeving. Het is voor het succes van gevestigde bedrijven die werken aan dergelijke innovaties dus van cruciaal belang om de institutionele omgeving in zowel volwassen als opkomende sectoren te vormen.

Alle hoofdstukken hebben laten zien dat duurzame, discontinue innovaties baat kunnen hebben bij collectieve acties. Een van de gevestigde bedrijven in de glastuinbouw beargumenteerde in heldere taal dat de focus van bedrijven bij het ontwikkelen van discontinue innovaties zou moeten liggen op *“het groter maken van de taart, in plaats van met elkaar om hetzelfde stukje vechten”*. Gezien het belang van collectieve acties zou hier wettelijke ruimte voor moeten zijn. Dit is echter niet eenvoudig te bewerkstelligen. Er zijn voorbeelden van collectieve acties die gericht zijn op transitie naar duurzaamheid die gestaakt werden uit angst voor oneerlijke concurrentie. Bij het besluiten om collectieve acties wel of niet toe te staan is het van belang om te bepalen of deze acties in lijn zijn met hoe de sector altijd gefunctioneerd heeft, of juist voor een omslag zouden kunnen zorgen doordat de collectieve acties uitgaan van institutionele veranderingen.



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# Appendix I – Abbreviations

This Appendix lists the abbreviations used in this dissertation.

Table A.I: List of abbreviations

|             |                                     |
|-------------|-------------------------------------|
| <b>ESCO</b> | Energy Service Company              |
| <b>IS</b>   | Innovation System                   |
| <b>NIS</b>  | National Innovation System          |
| <b>RIS</b>  | Regional Innovation System          |
| <b>SIS</b>  | Sectoral Innovation System          |
| <b>STE</b>  | Sustainable Technology Entrepreneur |
| <b>TIS</b>  | Technological Innovation System     |

## Appendix II – Data references chapter 4

This Appendix provides an overview of data references used in chapter 4.

Table A.II: Overview of data references of chapter 4

| Name                 | Type             | Year  | Title  |
|----------------------|------------------|-------|--|
| AD                   | Newspaper        | 1999  | Bioplastics goedkoper en beter voor milieu                   |
|                      |                  | 2006  | Bioplastics voortaan in GFT-bak                              |
| Bioplastics Magazine | Industry journal | 2006a | Degradable – Biodegradable - Compostable                     |
|                      |                  | 2006b | Definition of “Bioplastics”                                  |
|                      |                  | 2006c | Logos part I: The “Compostable” logo of European Bioplastics |
|                      |                  | 2007a | Letters to the editor  |
|                      |                  | 2007b | Bioplastics vs. Agricultural Land                            |
|                      |                  | 2007c | Five PLA bottle pioneers                                     |
|                      |                  | 2009  | PSM – The Renewing of a Brand                                |
|                      |                  | 2011  | Biopackaging for Beverages                                   |
|                      |                  | 2012  | Marketing Your Biobased Commitment to Consumers              |
| Boerderij            | Industry journal | 2010  | Meer winst uit gewas in biobased economy                     |
| Boerderij Vandaag    | Industry journal | 2005  | Eosta wil verpakkingsbranche veranderen                      |
| Dagblad Tubantia     | Newspaper        | 2007  | Bioplastic uit melkzuur                                      |
| De Stem              | Newspaper        | 1996  | Afbreekbaar plastic uit aardappelzetmeel                     |
|                      |                  | 2009  | ‘West-Brabant centrum bioplastics’                           |

Table A.II: Overview of data references of chapter 4 (*continued*)

| <b>Name</b>             | <b>Type</b>      | <b>Year</b> | <b>Title</b>   |
|-------------------------|------------------|-------------|--|
| De Volkskrant           | Newspaper        | 1998        | Een beker om in de berm te gooien                              |
| Het Financieele Dagblad | Newspaper        | 1996        | Groen Europa neemt zichzelf in houdgreep                       |
|                         |                  | 2007        | Nederland kan kop pakken in bioplastics                        |
| Interviews              | -                | 2013        | Applied Polymer Innovations Institute                          |
|                         |                  | 2013        | Corbion Purac  |
|                         |                  | 2013        | Synbra   |
|                         |                  | 2014        | dr. Li Shen  |
| NRC NEXT                | Newspaper        | 2013        | Next shopt   |
| Pakblad                 | Industry journal | 2005        | Biopolymeren moeten meer dan afbreekbaar zijn                  |
| PZC                     | Newspaper        | 2009        | C2C: hype of innovatief  |
| Trouw                   | Newspaper        | 1992        | Industriebond FNV vreest verlies van honderden arbeidsplaatsen |
|                         |                  | 1997        | Bioplastic   |
|                         |                  | 2013        | Koude champagne uit een koeler van aardappelzetmeel            |

## Appendix III – Data references chapter 5

This Appendix provides an overview of data references used in chapter 5.

Table A.III: Overview of data references of chapter 5

| Reference                           | Title   | Data source  |
|-------------------------------------|---|--|
| Avantium, 2011                      | Avantium and The Coca-Cola Company sign partnership agreement to develop next generation 100% plant based plastic: PEF. | <a href="http://www.avantium.com/news/2011-2/Avantium-and-The-Coca-Cola-Company-sign-partnership-agreement-to-develop-next-generation-100-plant-based-plastic-PEF.html">www.avantium.com/news/2011-2/Avantium-and-The-Coca-Cola-Company-sign-partnership-agreement-to-develop-next-generation-100-plant-based-plastic-PEF.html</a> |
| BASF, 2012                          | BASF and CSM establish 50-50 joint venture for biobased succinic acid.  | <a href="http://www.basf.com/documents/corp/en/news-and-media/news-releases/2012/10/P444_BASF_Purac_2012_Oct4_e.pdf">www.basf.com/documents/corp/en/news-and-media/news-releases/2012/10/P444_BASF_Purac_2012_Oct4_e.pdf</a>   |
| Bioplastic Feedstock Alliance, 2015 | Bioplastic Feedstock Alliance, 2015. Who we are.  | <a href="http://www.bioplasticfeedstockalliance.org/who-we-are/">www.bioplasticfeedstockalliance.org/who-we-are/</a>   |
| Bioplastics Magazine, 2009a         | Bioplastic films from the Netherlands.  | <a href="http://www.bioplasticsmagazine.com">www.bioplasticsmagazine.com</a>   |
| Bioplastics Magazine, 2009b         | Biodegradable bags project in Thailand.   | <a href="http://www.bioplasticsmagazine.com">www.bioplasticsmagazine.com</a>   |
| Bioplastics Magazine, 2011          | Ketchup in biobased PET.  | <a href="http://www.bioplasticsmagazine.com">www.bioplasticsmagazine.com</a>   |
| Bioplastics Magazine, 2013          | New partner joins PEF bottle development.   | <a href="http://www.bioplasticsmagazine.com">www.bioplasticsmagazine.com</a>   |

Table A.III: Overview of data references of chapter 5 (*continued*)

| Reference                  | Title  | Data source  |
|----------------------------|--|--|
| European Bioplastics, 2015 | European Bioplastics, 2015. Activities.  | <a href="http://en.european-bioplastics.org/about-us/activities/">en.european-bioplastics.org/about-us/activities/</a>   |
| Frost & Sullivan, 2008     | PURAC, Sulzer Chemtech and Synbra Technology jointly awarded Frost & Sullivan polylactic production technology innovation of the year award. | <a href="http://www.frost.com/prod/servlet/press-release.pag?docid=177397034">www.frost.com/prod/servlet/press-release.pag?docid=177397034</a>   |
| Gevo, 2011                 | The Coca-Cola Company and Gevo Partner to Develop and Commercialize 100% Renewable Plastic Bottles.  | <a href="http://ir.gevo.com/phoenix.zhtml?c=238618&amp;p=irol-newsArticle&amp;ID=1640177">ir.gevo.com/phoenix.zhtml?c=238618&amp;p=irol-newsArticle&amp;ID=1640177</a>   |
| Metabolix, 2004            | Metabolix and ADM Enter Strategic Alliance to Commercialize PHA Natural Polymers.  | <a href="http://ir.metabolix.com/releasedetail.cfm?releaseid=211091">ir.metabolix.com/releasedetail.cfm?releaseid=211091</a>   |
| Myriant, 2013              | Myriant and Bayegan Group Partner to Commercialize Renewable Chemicals.  | <a href="http://www.myriant.com/media/press-releases/myriant-and-bayegan-group-partner-to-commercialize-renewable-chemicals.cfm">www.myriant.com/media/press-releases/myriant-and-bayegan-group-partner-to-commercialize-renewable-chemicals.cfm</a>       |
| NatureWorks, 2012a.        | NatureWorks broadens Ingeo product portfolio with Sulzer proprietary production equipment.   | <a href="http://www.natureworkslc.com/News-and-Events/Press-Releases/2012/09-05-12-Sulzer-equipment-for-increased-Ingeo-production">www.natureworkslc.com/News-and-Events/Press-Releases/2012/09-05-12-Sulzer-equipment-for-increased-Ingeo-production</a> |

Table A.III: Overview of data references of chapter 5 (*continued*)

| Reference              | Title  | Data source  |
|------------------------|--|--|
| NatureWorks, 2012b     | NatureWorks, 2012b. Altuglas International and NatureWorks launch worldwide marketing collaboration for new high performance alloys incorporating Ingeo biopolymers. | <a href="http://www.natureworkslc.com/News-and-Events/Press-Releases/2012/12-11-12-Arkema-NatureWorks-collaborate-on-high-performance-alloys-with-Ingeo-biopolymer">www.natureworkslc.com/News-and-Events/Press-Releases/2012/12-11-12-Arkema-NatureWorks-collaborate-on-high-performance-alloys-with-Ingeo-biopolymer</a> |
| NatureWorks, 2012c     | NatureWorks and BioAmber form joint venture to commercialize new bio-based polymers.   | <a href="http://www.natureworkslc.com/News-and-Events/Press-Releases/2012/02-16-12-NatureWorks-BioAmber-Joint-Venture-AmberWorks">www.natureworkslc.com/News-and-Events/Press-Releases/2012/02-16-12-NatureWorks-BioAmber-Joint-Venture-AmberWorks</a>   |
| nova-Institute, 2015   | Belgian Biopackaging VZW/ASBL.   | <a href="http://www.bio-based.eu/iBIB/pdf/8.pdf">www.bio-based.eu/iBIB/pdf/8.pdf</a>   |
| NRC Handelsblad, 1996. | Disney composteert voedselafval.   | NRC Handelsblad, 1996  |
| PlasticsToday, 2012.   | Five major U.S. brands collaborating on plant-based PET.   | <a href="http://www.plasticstoday.com/articles/Five-major-US-brands-collaborating-on-plant-based-PET-0605201202">www.plasticstoday.com/articles/Five-major-US-brands-collaborating-on-plant-based-PET-0605201202</a>   |

## Appendix IV – Firm descriptions chapter 5

This Appendix provides an overview of the firms that are in an alliance and were quoted in the results of chapter 5.

Table A.IV: Overview of firms discussed in chapter 5

| Firm name              | Major industry<br>(based on SIC<br>code) | Short firm description   |
|------------------------|--|--|
| ADM                    | Food products                            | One of the world's largest agricultural processors and food ingredient providers; it also produces biofuels.   |
| Alpla                  | Paper                                    | Leading company in packaging. Sells plastic bottles, caps, and preforms.   |
| Altuglas International | Chemicals                                | Leading company in polymethyl methacrylate technology. Sells Plexiglas products (a sturdy transparent plastic).  |
| Avantium               | Research and development                 | Technology company specialized in the area of advanced catalytic research. Developed YXY technology to convert plant based materials into bioplastics.   |
| BASF                   | Chemicals                                | Largest chemical producer worldwide. Operates in different markets; has named its segments chemicals, plastics, performance products, functional solutions, agricultural solutions, and oil & gas. |
| Bayegan                | -  | International distributor and trader of petrochemicals, chemicals, steel products, and other commodities.  |
| Biotec                 | -  | Develops and produces sustainable bioplastics made from plant-based resources. Sells customized thermoplastic materials under the brand name BIOPLAST.   |

Table A.IV: Overview of firms discussed in chapter 5 (*continued*)

| <b>Firm name</b>      | <b>Major industry<br/>(based on SIC<br/>code)</b> | <b>Short firm description</b>  |
|-----------------------|---|--|
| The Coca-Cola Company | Food products                                     | Multinational beverage corporation. Manufacturer, retailer and marketer of beverage concentrates and syrups. Developed PlantBottle, bottle partially made from plants.                                     |
| De Ster               | Plastics products                                 | Supplies aviation and rail industry with packaging for beverages and hot meals. Also sells cutlery and trays.  |
| FKuR Kunststoff       | Rubber and plastics products                      | Leading producer of customized bioplastics. Sells a range of biobased and compostable resins under different brand names (such as Bio-Flex).   |
| Gevo                  | Chemicals   | Renewable chemicals and biofuels company. Developed bio-based alternatives to petroleum-based products using synthetic biology and chemistry.  |
| H.J.Heinz             | Food products                                     | Multinational food processing company. Mostly know for ketchup brand of the same name.   |
| Metabolix             | Plastics products                                 | Advanced biomaterials company. Sells sustainable solutions to plastics industry, including PHA biopolymers and biobased chemicals.   |
| Myriant               | Chemicals   | Produces bio-based chemicals. Sells different products, but most expertise in bio-succinic acid.   |
| NatureWorks           | Chemicals   | Started as Cargill research project looking for innovative uses of carbohydrates of plants as feedstock for plastics. One of the largest players in bioplastics. Sells bioplastics under Ingeo brand name. |
| Oerlemans Plastics BV | Rubber and plastics products                      | Producer of plastics and packaging. Sells films and packaging to horticulture, agriculture and retail.   |

Table A.IV: Overview of firms discussed in chapter 5 (*continued*)

| Firm name          | Major industry<br>(based on SIC<br>code)  | Short firm description   |
|--------------------|---|--|
| Purac              | Chemicals                                 | Currently operates under new name Corbion. Global market leader in lactic acid. Sells bioplastics in markets: packaging & disposables, consumer goods, consumer electronics, automotive.               |
| Sulzer<br>Chemtech | Industrial and<br>commercial<br>machinery | Leading player in fields of process technology and separating towers. Sells pumps and rotating equipment in industries such as chemical processing, oil and gas, power generation, and pulp and paper. |



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## Dankwoord

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## Curriculum Vitae

Maikel Kishna (1983) obtained a Bachelor's degree in Science and Innovation Management (2005) at Utrecht University. Following an internship at PwC (2007), Maikel obtained his Master's degrees in Science and Innovation Management (2008), and Economics and Geography (2010) in Utrecht.

In 2010 Maikel started his PhD project with the Innovation Studies Group of Utrecht University. He presented his work at several conferences and participated in projects with TNO. Next to his research, Maikel was strongly involved in teaching. He coordinated several courses, supervised bachelor students writing their thesis, and functioned as a tutor. Following these activities, Maikel obtained his BKO (teaching license) in 2015.

Starting October 2015, Maikel will start as a postdoc with the Athena Institute, VU Amsterdam. His research will focus on entrepreneurship in organizations and networks. Furthermore, he will teach in the Master's program Management, Policy Analysis and Entrepreneurship in the Health and Life Sciences.



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