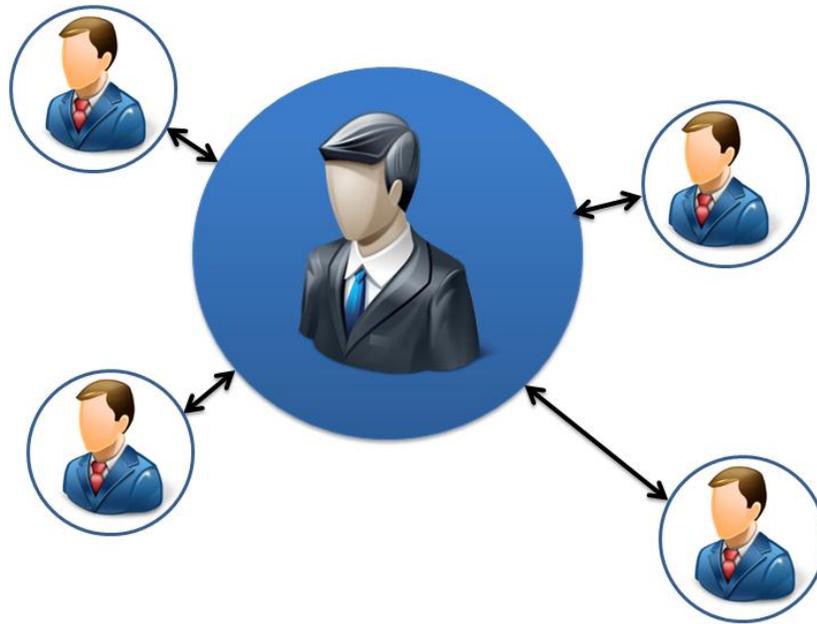


Entrepreneurial Strategy in the System Context

Strategies to develop the biomaterial business in the Netherlands



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January 23rd 2011
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Abstract

The transition towards a bio-based economy necessitates far-reaching changes in the micro-economical structure of firms, but also the macro-economical structure of the entire system context. Entrepreneurs that innovate are thought to be able to contribute to this transition by creating a new system with their sustainable innovations. Although much attention has been given as to how entrepreneurs innovate, it is much less known how innovating entrepreneurs introduce changes in the system context. This research aims to address this issue, by investigating the strategies of entrepreneurs to change the system context for the successful introduction and diffusion of sustainable innovations. Interviews have been held with 8 entrepreneurs introducing bioplastics, a sustainable alternative to traditional petroplastics, in the Netherlands. The influences and strategies mentioned by the interviewed entrepreneurs are analyzed by using an innovation system framework that distinguishes between the *type* of system interaction and the *actor* from the system context with whom the interaction occurs. The results show that the strategies used by entrepreneurs can be classified by the type of firm they run. With different approaches for interacting with the system context entrepreneurs aim to connect with existing actors in the system and depend on other actors for creating changes in the institutional environment. Because bioplastics is still a developing niche market, most of the entrepreneurs experience similar influences from the system context but on the other hand entrepreneurs have different strategies to interact with the system context. These insights can help in the understanding of the interactions between entrepreneurs and the system context in order to more effectively stimulate and support innovating entrepreneurs to contribute in changing the system towards sustainability.

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1. Introduction

Today, society is becoming more aware of environmental issues and imposes a need to move towards a cleaner economy. The extensive dependence on the current fossil fuel system brings uncertainty with regard to the security of supply and has a negative impact on the environment due to increased carbon emissions leading to global warming and climate change (IEA, 2008).

There are many scientific fields that address environmental issues. One of today's research fields offering some of the best opportunities to create more eco-friendly products is biotechnology. Applications range from new sources of energy, new materials for consumer and industrial use and high quality agricultural products. Yet, to be truly called eco-friendly, these applications should be both good for the environment and the society, but also should have real economic value. These three dimensions form have become the pillars, also called the triple bottom line, of sustainability (Elkington, 1998). In other words, business favoring a green economy should increase their responsibility to include these dimensions.

The concept of the innovation systems, which is the perspective of this study, stresses that the diffusion of technology among people, enterprises and institutions is key to an innovative process. It implies the interaction between the actors who are necessary in order to turn an idea into an implemented product or service on the market. The structure of an innovation system around a technology can be seen as the fulfillment of certain functions of this innovation system. A number of key processes that need to be fulfilled to analyze the dynamics of innovation systems are identified by Hekkert (Hekkert, Suurs, et al., 2007).

It is interesting to look at system transitions from a sustainability point of view, because they emphasize the significance of environmental benefits through developing new systems that are intrinsically more environmentally friendly. This study is aimed to give more insight of the position of the entrepreneur in such a system and how a transition towards a sustainable innovation system can be achieved. The emergence of such a system does not take place in a vacuum. It requires the interaction between various actors which is a central idea behind the Innovation System approach (Jacobsson, 2002). The earlier discussed Innovation System stresses that innovation is the result of both the individual and the collective action that are related and coordinated rather from independent or single actions (Edquist, 2005). Individual entrepreneurs are at the micro-level of the Innovation System. Yet, it is important to keep in mind that they act in a larger context of the Innovation System at a macro-level.

One of the most important elements in an emerging innovation system is the entrepreneur. Drucker (1985) stresses in his classical book *Innovation and Entrepreneurship* the important link between innovation and entrepreneurship. Entrepreneurship remains central in discussing innovation systems. The process of transforming an idea into a commercial success depends on the capacity to transcend, a capacity manifest in entrepreneurial activity. Entrepreneurs are at the heart of new

technology development (Tidd et al., 2006). Innovative entrepreneurs can leverage important momentum to set system transitions in motion (Geels, 2004; Hekkert et al., 2007). According to Schumpeter, entrepreneurs are a driving force for realizing fundamental change in society through “the process of creative destruction” (Schumpeter, 1934) which involves the discovery and exploitation by entrepreneurs of new combinations of technologies, products, markets, processes and organizational forms that create (revolutionary) changes in the economy. These ‘Schumpeterian entrepreneurs’ are able to overthrow and change the current structures around them and force the innovation process into new directions by shaping a new path towards renewal of the sector (Garud & Karnoe, 2001; Hekkert et al., 2007). Due to their ability to spawn variety and experiment with innovations in terms of new technologies and new organizational forms, entrepreneurs are thought to be in the right position to combine a contribution to the transition towards sustainability with an increase in economic competitiveness through the generation of value-adding sustainable innovations.

This study aims to investigate the entrepreneur in the midst of system change where sustainability plays a central role. An example of a technological field that offers sustainable alternatives to fossil based products is the production of biomaterials. Biomaterials can support the reduction of green house gas emissions. Relevant fields are for example the use of biomaterials in the production of high value biobased products, biorefinery and the isolation of components with added value from algae or animal waste. One interesting application to look at is the production of bioplastics. The production process of bioplastics consumes less energy in comparison to using fossil fuels and in the arena of sustainability it promises recycling. One of the successful applications of bioplastics is in biodegradable packaging. Biodegradable packages used for example in packaging fruit and vegetables are 100% compostable and consume less energy. It is such a growing market that in 2006 more than 45% of the Dutch supermarkets containing bioplastics in their shelves (Bioplastics Magazine, 2006). This was possible after policy was devised and stakeholders made compromises to set up a workable roadmap. For example, in 2005 the government supported demonstration projects and in 2008 the Dutch government issued a call for innovative entrepreneurs in biomaterials to submit their proposals. The companies with the best project proposals will be assigned to conduct a feasibility study. Eventually these projects must lead to the transition from a fossil based economy to a biobased economy.

To pave the way for this transition, around 2006 the Dutch government began supporting small businesses. An example of this support is the Small Business Innovation Research (SBIR) program. The SBIR is a pilot program to develop innovations in small businesses that give answer to social issues concerning the environment. The SBIR program consists of three phases: feasibility, research and development and commercialization. In the first phase entrepreneurs must conduct a feasibility study wherein they elaborate on several questions for example whether there is a market for the innovation, who are the stakeholders in the realization of this innovation and the social impact. Several firms took part of this two years program under the project name “Bioplastics: doorbraak naar zelfstandige groei” referring to supporting an autonomous growth of the bioplastics market. According results the project gained a positive evaluation.

Although much attention has been given as to how entrepreneurs innovate, it is much less known how innovating entrepreneurs create changes in the system context. The currently available literature on innovation and entrepreneurship fails to explain adequately how entrepreneurs can influence or even change the system context itself. Literature focused on the transition towards sustainability has so far disregarded the interactions between entrepreneurs and the system context and insufficiently explains how innovation can act as a driver for sustainability and economic growth of an industry simultaneously, with entrepreneurship as a method to reconcile both (Gerlach, 2003; Dijkema 2006; Cohen & Winn, 2007; Coenen & Diaz Lopez, 2008; Lepoutre, 2008).

1.1 Research question

The overall research aim is to expand the knowledge on sustainability through the context of bioplastics. Combining knowledge on sustainability and the bioplastics business will hopefully give more insight on sustainable entrepreneurship, the creation of businesses that have both social and environmental goals. Literature indicates the need to categorize and catalog case stories (Abrahamsson, 2007). The specific research aim is to examine entrepreneurial strategies in the development of biomaterials, mainly bioplastics, in the Netherlands. This strategy is formed by entrepreneurial activities. Because the transition to a new technology is not a static, but in the contrary a dynamic process, entrepreneurial activity will be studied through innovation system. In doing so, this study highlights the difficulties Dutch entrepreneurs face in developing bioplastics, specifically biodegradable packaging. As stated before, the Dutch government established financial programs to stimulate such entrepreneurs and indeed several entrepreneurs submitted their projects and got funding. This is an interested group to study, because it got certain legitimacy from the government. It is important to keep in mind that the acceptance of these firms does not yet mean the creation of an emerging market. Despite the earlier mentioned success of bioplastics, it is still an area on uncertainties and failures. The process of biodegradable packaging is complex and costly and consumers are not fully aware of the differences compared to fossil based plastics. These uncertainties can become a driver for entrepreneurs to innovate in this area.

Finally, the report traces government influence-both direct and indirect-on innovation and commercialization of emerging technologies. Also, in recent years, entrepreneurship was mainly studied with a focus on environmental characteristics affecting firm foundings (Aldrich, 2000) and the characteristics of entrepreneurial opportunities (Christiansen, 1997) but neglected the entrepreneurial activity in the development of radical innovations. For example, focusing on environmental activities and neglecting other issues like cost will likely push consumers away even how much they say they care about the environment. For change to occur existing institutions need to be reframed and this requires the development of strategies (Lawrence, 1999). This leads to the following research question:

Which strategies do entrepreneurs carry out in order to accelerate the development of the emerging field of sustainable biomaterials?

In addition, this study will bring more insight about sustainability issues related to bioplastics and whether there are possibilities to set up bioplastics business in the Netherlands. Entrepreneurial strategy takes form through the accumulation of entrepreneurial activities on the micro-level.

The approach of this study is based on a framework that lead to more understanding of entrepreneurial strategies in the system context (de Boer, 2009). This analytical framework provides a clear guidance to analyze a system and to detect the drivers and obstacles for innovation. The choice to reproduce this work is because entrepreneurial strategies from a system context is still an area that is not largely put under the microscope. Also by reproducing this earlier work, the results will help in gaining more insight on the applicability of this framework for other sectors. Although the focus of this study is to analyze entrepreneurial strategies in a system context, hopefully this framework will provide results to categorize the entrepreneurs participating in this research. De Boer (2009) identified two types of entrepreneurs that have different approaches for interacting with the system: *system following entrepreneurs* and *system building entrepreneurs*. Besides other possible categorizations of entrepreneurs, this research will attempt to identify these two types of entrepreneurs.

The next chapter highlights the theoretical framework in which the research on entrepreneurial activities is conducted. The first theoretical part discusses innovation systems and their elements. This chapter forms the basis for constructing an applicable framework. The theoretical section will then continue to discuss entrepreneurship in the system context by discussing entrepreneurial strategies mentioned in entrepreneurship and strategic management literature . Based on this theory a basic conceptual model will then be constructed. Chapter 3 will start by discussing the method used in this research, where after the background information forming the domain of the research and the conceptual model will be applied. Chapter 4 will contrast results from conducted interviews. In Chapter 5 these results will be analyzed to derive major attention points. In the concluding Chapter 6 an answer to the research question will be provided and further recommendations will be formulated.

2. Theory

2.1 Innovation systems

Innovation systems theory has been chosen for this study because the aim of this study is to investigate the dynamics of system interactions and how they lead to successful innovations. Thus this theory forms the delineation of this study. Innovation is rarely a result of an action that is taken by a sole individual or an organization. In fact, it is a result of many interactions by a group of actors that is often dispersed in the geographic and temporal sense. Scientists make new discoveries, engineers focus on developing new technology, venture capitalists fund research and development, skilled workers assemble new products and apply new processes, private and public organizations educate these various types of workers.

Because there are various factors that influence innovation, policymakers are interested in stimulating the commercialization of emerging technology that take into account the mechanisms by which firms develop certain products or services and the need for the creation and support of relevant institutions and institutional relationships. In contrast to many innovations that can make use of existing infrastructure, radical innovations often require completely new interactions and institutions. Many authors study innovation systems based on existing structures. Yet, to understand how new technology emerges, it is necessary to study the dynamics of the innovation system and how the innovation system around a new technology is built up. Although there are differences among nations in the structure of the innovation system, literature offers a general model to describe this innovation system (Smits and Kuhlmann, 2004; Alkemade, 2007). Figure 1 shows this model.

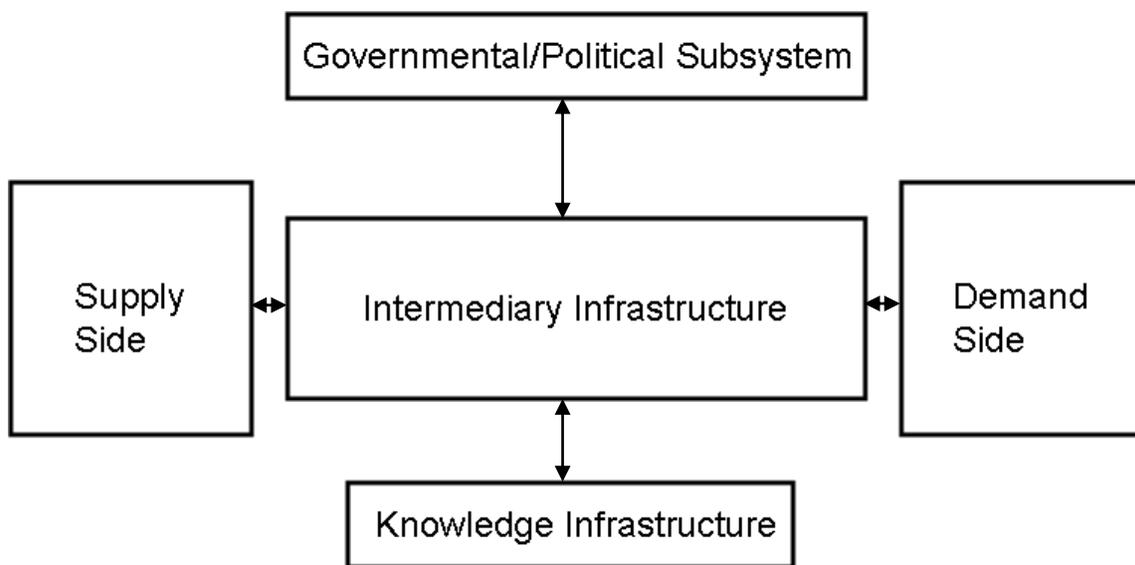


Figure 1: Elements of the innovation system – Generic framework.

A TIS consists of a supply side and a demand side. The supply side refers to actors related to the actual production of the technology. The demand side refers to technology users, in this case the end users of biomaterial products. The intermediary infrastructure refers to actors involved in the transfer process of technology. Intermediaries facilitate knowledge transfer among people, organizations and industries. They identify and select the needed supplier to make components for the technology and support collaboration between firms in terms of contractual and licensing arrangements. Hargadon and Sutton (1997) emphasize that intermediaries not only have the role of linking firms, but also help transforming knowledge that is being transferred. An example relevant for this study is the Dutch intermediary SenterNovem, which works as a facilitator in Energy Transition. Furthermore, SenterNovem works extensively with venture capital organizations and Innovation Centers. Biomaterial research is being funded by the government under subsidiary programs like the Unieke Kansen Regeling (UKR) and the Small Business Innovation Research.

The Knowledge infrastructure refers to the set of all organizational activities, rules and guidelines that support the other subsystems through managing knowledge within organizations. These vary from public and private research institutes and educational organizations (Hekkert et al, 2007). Finally, part of the innovation system is the governmental subsystem. In this specific study of bioplastics especially local governmental agencies like municipalities play an important role, because it is up to individual municipalities to take part in accepting bioplastics in their area by signing contracts with waste facilities to collect bioplastics.

To understand this model it is important to keep in mind that this study is about the nature of technological change. Therefore it is appropriate to use the concept of Technological Innovation System, because it was developed within the scientific field of innovation studies to explain the nature of emerging technologies (Smits, 2002). A TIS can be defined as (Carlsson & Stanckiewicz, 1991):

“a network or networks of agents interacting in a specific technology area under a particular institutional infrastructure to generate, diffuse, and utilize technology.”

The innovation system approach can be implemented on three levels of analysis: to a technology as knowledge field, to a product or a set of related products with the goal of satisfying societal issues (Jacobsson & Johnson, 2000). This makes the latter approach most appropriate for this study to explain why and how biomaterials have diffused or failed to diffuse in society. TIS also stresses that knowledge flows in an innovation system are not enough to induce technological change. Knowledge needs to be exploited to create new business opportunities. This emphasizes the role of the individual as a source of innovation, something that is sometimes overlooked in macro-oriented innovation system approaches (Hekkert et al, 2007).

Innovation systems literature emphasizes the central role of entrepreneurs for well functioning innovation systems through their ability to translate new knowledge into concrete actions that eventually become business opportunities (Hekkert et al., 2007). Yet, literature leaves open the explanation of the entrepreneur's innovative role on the micro-level. Although the innovation system approach investigated how the interaction between actors can influence entrepreneurs, this approach lacks insight on how the dynamics of innovation systems work out on the micro-level (Hekkert, 2008). The innovation system approach provides no adequate framework on how an entrepreneur reorganizes system structures to create new directions in his favor (Hekkert et al., 2007). To understand how entrepreneurs interact with the system, a link between the entrepreneurial micro-level and the system's macro-level perspectives need to be achieved. To reach such an understanding, three branches of entrepreneurship literature are investigated in the following paragraphs to give a possible explanation on how entrepreneurs rearrange the system context that exists around them: sustainable entrepreneurship, institutional entrepreneurship and collective entrepreneurship. Strategic literature will also be used to explain how entrepreneurs choose a certain strategy. But first the general notion of entrepreneur will be described in further detail.

2.2 Entrepreneurship from a system context

2.2.1 Entrepreneurs

As discussed in the previous paragraph the emergence of innovations is not an isolated process, but rather dynamic in nature wherein various actors such as firms, universities and government bodies interact (Jacobsson, 2002; Hekkert et al., 2007). This interaction is the underlying idea behind the Innovation System approach. In implementing their innovation strategies, entrepreneurs cannot simply ignore the national system of innovation in which they are embedded (see Figure 2).

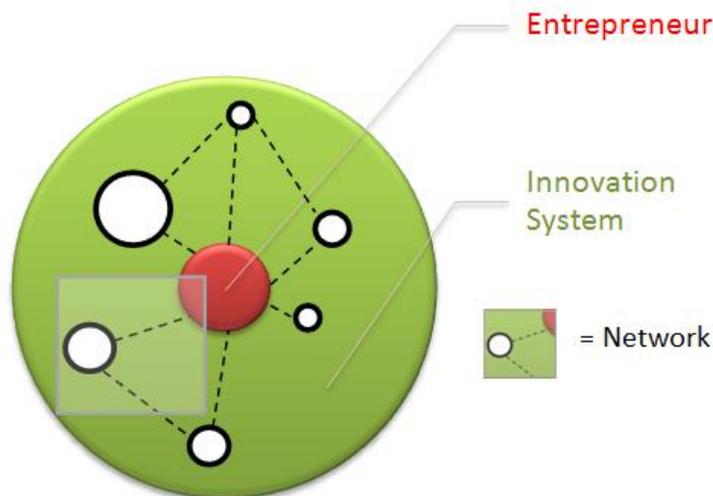


Figure 2: The entrepreneur as part of the system.

Through influencing demand and the competitive environment, national systems of innovation can drive or hinder what firms can do. Yet, it is important to note that though the system can influence entrepreneurial innovation, it is not completely determined by that system (Tidd, 2005, p. 163).

The entrepreneur is a micro-level actor in the innovation system, but interacts with this innovation system on the macro-level (Markard & Truffer, 2008). As various actors could exert a pressure on entrepreneurs on the micro-level, interdependencies come forth with multiple stakeholders, processes of competition and cooperation, governmental policies, regulations, societal norms, values etc. These pressures or influences from the system context can enable or constrain sustainable entrepreneurial action (Leca et al., 2008). These enabling or constraining influences from the system context could be explanatory elements for why in some settings entrepreneurs are able and willing to develop sustainable innovations while in other situations they are not.

Schumpeter introduced the entrepreneur as an individual who introduces new combinations in terms of new products and production methods thus shakes the economy from its existing equilibrium. Schumpeter went even further by specifying the entrepreneur as the source of economic change (Schumpeter, 1934). Although Schumpeter laid the foundation of the revolutionary entrepreneur, scholars today

emphasize the interaction of this revolutionary entrepreneur with his surroundings. An example is the multi-level perspective where actors shape innovation under the influence of institutions (Geels, 2005; Markard & Truffer, 2008; Coenen & Diaz Lopez, 2008).

Entrepreneurs are always taking risk in venturing their ideas, but this is a greater burden for an entrepreneur who's trying to introduce a new technology. Entrepreneurs have to calculate the influence of the system context. To understand where the influence comes from, a clear distinction between "players" and the "rules of the game" should be made (Klein Woolthuis et al., 2005). The players can range from actors like universities, governmental agencies, large firms and start-ups. The rules of the game refer to taken-for-granted understandings like standards, social norms and rules that set up the interaction field for the players (Berger and Luckman, 1967). Institutions can be dynamic in the sense that they can change in time but also can change interactions between actors. But most research assumes the stability of institutions. This study questions this stability by addressing change in existing institutional arrangements as a form of entrepreneurship.

Entrepreneurial activity encompasses all individual endeavors to start a new firms and entrepreneurs deciding to invest additional resources in new market opportunities. When an industry is regulated entrepreneurial activity could become difficult. For example, Fonseca et al. (2001) show that fewer people become entrepreneurs when start-up costs go higher. Arguably, for some entrepreneurs regulation could provide clear rules and predictable enforcement of those rules for example regulations that support financial access by protecting investors and intellectual property.

Research on entrepreneurial activity and how entrepreneurs react to the system should not be neglected because this activity provides an important impetus to economic development. For example, it increases job opportunities (Storey, 1991), enhances the level of innovation and economic development (Audretsch and Fritsch, 1999). Especially in an emerging market, it is interesting to look at entrepreneurial activities to look for a strategy pattern in the system.

Klein Woolthuis studied strategies that sustainable entrepreneurs use to interact with their environment in the Dutch construction industry and identified two types of entrepreneurs: *system following entrepreneurs* and *system building entrepreneurs* (Klein Woolthuis, 2010). This means that entrepreneurs can not only deal with pressures from their environment, but they can also try to change existing conditions in their favor.

2.2.2 Sustainable entrepreneurship

Scientific evidence about climate change is growing worldwide and is becoming an inevitable truth. It is becoming clearer that organizations need to adapt and turn sustainability into innovation's new frontier. The challenge of sustainability has already started to transform the competitive environment, which will force firms to reshape the way they think about technologies and business models. By taking sustainability as a goal, early entrants will develop competencies that rival firms will find difficult to match.

But transition to new sustainable technologies does not come easy, because the existing system is characterized by stability and lock-in. Despite these characteristics, major transitions can occur. For example, the electricity sector in the EU shifted in the last two decades from a system dominated by engineers to a market based system run by managers. Rotmans et al. (2000) define transitions as "...transformation processes in which society or a complex subsystem of society changes in a fundamental way over an extended period." This refers to a change in the dynamics of the system in such that the existing equilibrium is shifted by a new one.

The concept of sustainable entrepreneurship, or sustainability driven entrepreneurship, is still in its infancy. Academics are just beginning to understand what the combination of the two terms mean. Just as traditional entrepreneurship research is conducted to justify the pursue of economic growth (Gibb, 1996), so is sustainable entrepreneurship research is conducted to justify the pursue of sustainable development (Jacobs, 1995). The combination of the terms sustainable entrepreneurship comes at a time when the agenda of sustainable development is growing reflecting environmental concern.

Sustainable entrepreneurship is appropriate for this study because it links micro-level entrepreneurship research with macro-level sustainable development research (Parrish, 2008). Introducing and diffusing sustainable innovations necessitates far-reaching changes in the structure and organization of the entire system context. This system context consists of all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of sustainable innovations (Edquist, 2005). Entrepreneurs operate in this system context and are influenced by its policies, regulations, interactions, norms, societal pressures etc. (Jacobsson, 2002).

2.2.3 Institutional entrepreneurship

In the last years institutional theory has become one of the most salient theories in organizational analysis (Walsh, Meyer, and Schoonhoven, 2006). Institutional theory lays its emphasis on the behavior of organizations in leading change (Dacin, Goodstein, and Scott, 2002). Eisenstadt (1980) introduced institutional entrepreneurship to investigate how existing institutions are remade or reassembled to generate economic change. Works on institutional entrepreneurship is generally based on the tenets of institutional theory and mainly discuss the constraints on which actors operate. DiMaggio and Powel (1991) signaled a gap in institutional theory as they call for a coherent theory of action to explain change. Institutional theory needs to address the role of actors in creating new institutions. This study builds upon these works on institutional entrepreneurship to identify how entrepreneurs as individuals in a system generate structural change with respect to institutions.

Entrepreneurs are always taking risk in venturing their ideas, but this is a greater burden for an entrepreneur who's trying to introduce a new technology. Entrepreneurs have to calculate the influence of the system context. To understand where the influence comes from, a clear distinction between "players" and the "rules of the game" should be made

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Some researchers state that institutional entrepreneurship is mainly based on discursive strategies wherein the entrepreneur generates dialogue to affect the processes of social constructions that underlie institutions (Suddaby and Greenwood, 2005; Munir and Phillips, 2005; Phillips, Lawrence and Hardy, 2004).

The notion of discursion is explained by Rao et al. (2000: 244):

“Institutional entrepreneurs can mobilize legitimacy, finances, and personnel only when they are able to frame the grievances and interests of aggrieved constituencies, diagnose causes, assign blames, provide solutions, and enable collective attribution processes to operate (Snow and Benford, 1992: 150).”

This implies that institutional entrepreneurs iterate their projects in a manner that makes their projects resonate with the interest, values and problems of potential allies (Boxenbaum and Battilana, 2005; Fligstein, 2001; Suddaby and Greenwood, 2005). This justification of new projects to being superior to existing arrangements requires the institutional entrepreneur to de-legitimate the existing institutional arrangements that are supported by opponents (Suddaby and Greenwood, 2005; Creed et al., 2002) and legitimate the new project to potential stakeholders (Déjean et al., 2004; Demil and Bensédrine, 2005).

2.2.4 Collective entrepreneurship

A wide range of empirical research provides evidence for the idea that strategic alliances improve innovative output (Rothaermel and Hess, 2007). Because entrepreneurs seldom introduce change individually, entrepreneurs must detect allies (Boxenbaum and Battilana, 2005; Fligstein, 1997; Greenwood, Suddaby and Hinings, 2002) and develop a cooperative stance (Fligstein, 2001; Lawrence, Hardy and Phillips, 2002; Rao, 1998).

Two scholars explain the importance of taking a collective stance towards institutional change. Sabatier (1988) explains a collective strategy by forming an advocacy coalition consisting of a group of actors, including government agencies, societal organizations, academics, private businesses and individuals to exert pressures on the policy cycle to influence policy making. Such a coalition of actors with interrelated beliefs and values that have forged relationships with each other, are important enough to influence the policy domain to steer policy changes in the direction of their preference. Van de Ven (2005) describes that entrepreneurs can coordinate their innovation activities through the strategy of ‘running in packs’, since individual entrepreneurs lack the resources, power or legitimacy to generate institutional change individually. No single entrepreneur controls the innovation development process and small innovative players need to group together to combine their resources, competences and legitimacy to create critical, effective mass for changing the institutions to make a collective effort towards commercialization (Van de Ven, 2005). Both proposed strategies available to innovating entrepreneurs to change the system context are possible methods based on theoretical insights. However, there is no empirical evidence on the occurrence and effectiveness of these strategies in practice. Moreover, these methods are only two of the many potential strategies available to entrepreneurs to change the system context. More research is needed in order to find out which of the available strategies entrepreneurs actually use and whether strategies for collective entrepreneurial action are playing a vital role, which necessitates a detailed and comprehensive insight into the dynamic interaction between entrepreneurs and the system context.

Literature on strategic decision making identified strategies that can be applied by new as well as ongoing entrepreneurs (Lussier et al., 1998). For example, the Entrepreneurial Strategy Matrix takes innovation and risk of venturing into consideration. Risk is defined as the chance of a major financial loss. Combining the two variables of innovation and risk, a four-cell matrix can be generated (e.g. High Innovation/Low Risk; High Innovation/High Risk; Low Innovation/Low Risk and Low Innovation/High Risk). A venture can fall into one of these cells. Assuming bioplastic entrepreneurs fall in the High Innovation/High Risk cell, High Innovation because their products are truly innovative and High Risk because they require high initial financial investment and they face a well established plastic industry, patenting when entering the market raises the chances of a first mover advantage (Lussier et al., 1998). Patenting can also positively affect the perception of investors of start-ups quality (Hsu and Ziedonis, 2008).

Strategic-management literature and literature on entrepreneurship also suggest that barriers to entry are essential aspects that impact the business performance (Robinson et al., 2001). Before competing in a market, a firm has to be able to enter it. Many markets have at least some barriers that make it more difficult for a firm to enter a market. New entrants can learn from barriers of entry to form competitive strategies. For example, before entering the market a new firm will assess their opportunities and threats by analyzing the market structure and potential reactions of the incumbent firms. This is necessary because the target market could be very unattractive for new firms to enter.

2.2.5 Choosing a strategy

In his famous book *Competitive Strategy* Michael Porter (1980) starts with the following sentence: 'The essence of formulating competitive strategy is relating a company to its environment'. Strategy is about making choices. Taking into consideration the influence of institutional frameworks on firm behavior, any choice of strategy that a firm makes is inherently affected by the formal and informal constraints of a given institutional framework (North, 1990; Oliver, 1997). The strategic management literature acknowledges the large influence of technological change on strategic management (Baum and McGahan, 2004; Davenport et al., 2006). Strategic management involves developing a plan to guide a firm as it strives to reach its objectives. Hamel (2000) argues that innovation is the most important component of a firm's strategy. Porter (1980, 1985) presents several choices related to competitive and technology strategies. Entry strategies and marketing strategies are also a heavily researched topic (Porter, 1996; Baum and McGahan, 2004). Often the lines between these different types of strategies are blurry. Looking at the strategy concept at an aggregated level it is clear that all these choices are related to the goals of the actor, in this case the entrepreneur, making the choices. The purpose of strategy is to reach certain goals for example achieving profit, becoming socially responsible or technological leadership. Based on the works of Chandler (1962), Mintzberg (1978) and Hitt et al. (2001) strategy can be defined as determining goals and taking decisions and actions to reach the goals.

This definition has two parts. The first part is about the determination of goals. A classic perspective in considering strategy goals for entrepreneurs is between profit and growth (Porter, 1996; Mascarenhas et al., 2002; Collis and Rukstad, 2008). The success of the firm and its strategies is measured by the extent to which its goals are reached. However, the environmental entrepreneurship literature points out that some entrepreneurs could have completely different goals, such as protecting the environment or increasing environmental awareness (Schaper, 2002). Firms can thus differ in terms of the goals they set. Strategic goals can also change over time; young firms are likely to have different goals than older firms. This can also be true for firms applying new technologies compared to firms exploiting old, established technologies, or for firms situated in rapidly changing environments (Anderson and Zeithamel, 1984). While established firms can build upon optimized processes, established routines, developed competencies and past experiences to formulate their strategic orientation (Ginsberg, 1994; Ocasio, 1997), resource attraction and allocation (Bower, 1970; Burgelman, 1983a; 1983b; 1983c; Noda & Bower, 1996), and capability building (Teece, Pisano & Shuen, 1997), new firms must create and develop such strategic capabilities from the ground up and without well-established rationales.

An interesting perspective to look at the goals of firms is from a transition perspective; firms that explicitly include a system change as part of their goals could support a transition and at the same time improve the financial performance of their firm because their business can likely benefit from the overall transition in the system. Forming an entrepreneurial strategy is closely related to the personality of the entrepreneur and the imaginative power of taking decisions under uncertainty and ambiguity. While this might

work in an early phase, the transformation of entrepreneurship into an organizational characteristic beyond individual personality will be inevitable in later growth phases.

The goal-setting part of entrepreneurs' strategies is analyzed by looking at their strategy statements. Collis and Rukstad (2008) state three essential elements of a strategy statement: objective, scope and advantage. An example of a good strategy statement is also provided. Edward Jones' strategy statement (a brokerage firm) is: *"To grow to 17,000 financial advisers by 2012 by offering trusted and convenient face-to-face financial advice to conservative individual investors who delegate their financial decisions, through a national network of one-financial adviser offices."* Because this statement provides a clear delineation of the firm's objective, scope and advantage, it also determines trade-offs and such trade-offs are what distinguish individual firms strategically. In the above strategy statement, the focus is on individual investors, not on larger organizations or companies. Also, a strategy statement can indicate if a firm has a transition-related goal. Collis and Rukstad (2008) illustrate that it is possible that firms might not have a clear or even any strategy statements. They argue that this has negative effect on the firms' performance.

The second part of the strategy definition is related to making commitments, decisions and actions that support the goals set by firms. Goals can be reached in different ways, but actions undertaken by the firm will always be required. For example, if a firm has the objective to grow a certain percentage in the next few years, it has several choices, one of them being between competition and cooperation. The definition of strategy is intentionally broad in this respect, in order to include all possible commitments, decisions and actions. This study focuses on entrepreneurial actions that are aimed at the system context as opposed to actions from the system towards the entrepreneur. While the latter category is certainly part of strategy, new and environment focused entrepreneurs face the difficulty of operating in environments that are not fully compatible with their technology; the externally focused part of their strategy could improve their chances of success. Considering a firm that aims to achieve a certain profit level, it is not hard to imagine that this firm will benefit from governmental support programs related to the specific technology this firm exploits. There are also trade-offs that need to be taken into consideration. In the case of taking the strategic choice to grow, the trade-off would be to settle for less profit.

Taking into consideration the theoretical aspects of entrepreneurial strategies and the importance of strategy formulation a list of strategies were identified in strategy literature and presented to respondents participating in this research (see Appendix I). Incumbents and entrants can pursue these strategies. It is not expected that all the listed strategies will be present, but likely some combinations of these strategies.

2.3 *Conceptual model*

From the discussed literature it became clear that theory is especially focused on entrepreneurial behavior but lack to link this behavior to changing systems. Literature

does not provide specific strategies that entrepreneurs take to engage in a system change. This gap is addressed from the theories of institutional entrepreneurship and sustainable entrepreneurship. The works on how a system influence entrepreneurs and visa versa need to be integrated to identify which kind of interaction leads to an effective system change.

This research aims to address the literature gap through the theories on entrepreneurship discussed in the previous sections. In order to do this, a framework based on the theory is constructed. A framework provides a structured way to approach the issue on the interaction between entrepreneurs and the system context and to identify the influences from the system context on entrepreneurs and the strategies of entrepreneurs to influence the system context. The influences from the system context and the strategy approach of the entrepreneur can vary widely, ranging from direct and specific actions to established arrangements accepted by many actors in the system. In order to create a framework around the intricate theory of influences and strategies, some conceptual distinctions for analyzing and mapping the influences and strategies need to be made. Based on current literature perceptions, some concepts are depicted in this section to provide a clear structure and categorize the interactions between entrepreneurs and the system context. First, in looking at the interactions with the system context, an important characterization can be made based on the *type* of system interaction at the one hand and at the other hand the *actor* from the system context with whom the interaction occurs (Klein Woolthuis et al., 2005). The type stands for the systemic origin of the interaction, based on the different elements of the system's structure, such as the networks, institutions or technology (Edquist & Johnson, 1997). The actor refers to the specific individual or organization with which the entrepreneur interacts, which can be seen as the direction where influence is coming from and where strategy is directed at. De Boer (2009) has constructed a conceptual model based on the work of Klein Woolthuis et al. (2005) and Edquist & Johnson (1997). However, where Klein Woolthuis uses the term 'system failures' as a rationale behind the different types of system interactions, this study will adopt the term 'category of system interaction, because the word "failure" has negative association while this study approach the issues of systemic interaction from a positive point of view.

De Boer (2009) combine the theoretical concepts from the work of Klein Woolthuis et al. (2005) and Edquist & Johnson (1997) to construct a conceptual model the he uses to study the construction sector. This model is reproduced in this study to test its application in the bioplastics sector. By combining the earlier mentioned framework of Klein Woolthuis et al. (2005) and the insights from the structural components of innovation systems by Edquist & Johnson (1997), two different *categories of system interactions* can be depicted:

1. **Network interactions:** interactions resulting from relations and collaboration with and between other actors and the whole organization of the network of actors around the entrepreneur. This category of system interactions is related to strong and weak network failures mentioned by Klein Woolthuis et al. (2005). For example, strong network failure occurs when actors in the system are interacting too much becoming

'blind' for, possibly highly or better related, outside developments due to excessively close linkages, which results in inertia, internal dependences and lock-in into current technological trajectories eventually making it difficult to break-out from a taken path. At the other hand, weak network failures may occur when interactions between actors are inefficient resulting in insufficient use of technology complementarities, lack of shared vision and no interactive knowledge creation (Klein Woolthuis et al., 2005). Both strong and weak network failures have the same effect for the network interactions: it hampers innovation through the reluctance to let new entrants in and through the blocking of renewal from outside.

2. **Institutional interactions:** institutions, or the rules of the game (e.g. standards, behaviors, 'normal' practices, norms, rules, values etc.), are constantly arranged and rearranged and modified due to the interactions of the different actors involved in the process (Leca et al., 2008). Institutions are crucial when it comes to guiding or hampering the introduction of innovations (DiMaggio & Powell, 1983; Scott, 2001; Lepoutre, 2008). The purpose of institutions is to provide guidance, allow routines to develop and eventually reduce the uncertainty of social interaction. These functions are all faces of the same coin but can be analytically distinguished to better flesh out the role institutions play. Institutions can be categorized into three types, also called the three pillars (Scott, 2001): *regulative* institutions (formal rules, legal requirements, governmental or industrial regulations, that can be enforced through legal means and sanctions), *normative* institutions include values and norms. Values are understandings of what is normally preferred or the desirable (e.g. creating employment, making profit) and norms dictate how things should be done (e.g., informal expectations for how the game is to be played, common fair business practices) and *cognitive* institutions include common beliefs and routines, mutually developed and understood mental models and shared actions of logic. These three types of institutions result in institutional interaction. Failures in institutional interaction could hamper the exchange of knowledge and even bring the introduction and diffusion of innovations within industries to a halt (Klein Woolthuis et al., 2005). Institutional interactions that are repeated can also result in transactional trust, because an accumulated reputation for honesty is valuable to attract future transactions (Fogel et al., 2006).

These two categories define the way an entrepreneur interacts with the system context. An entrepreneur, seen from a system context, interacts with the system according these categories (see Figure 3). These categories give both the entrepreneur and the system to influence each other.



Figure 3: Interaction between the entrepreneur and the system context.

Besides these two categories of system interactions, each interaction of an entrepreneur also occurs with a specific actor or actor group in the system. Thus, each influence on an entrepreneur belongs to a specific *category of system interactions*, and comes from a specific *actor*. Both these two dimensions can be used to construct the following conceptual model to analyze the interaction between the entrepreneur and the system context (see Table 1).

Table 1: The conceptual framework (de Boer, 2009).

		<i>Actor</i>		
		Government (national, local)	Industry (large firms, SMEs, competitors, suppliers)	Consumers (households, retailers)
<i>Category of system interactions</i>				
Network interactions				
Institutional interactions	Regulative			
	Normative			
	Cognitive			

Each strategy of an entrepreneur addresses a specific category of system interactions, and is directed at a certain actor or actor group. These two theoretical dimensions of interactions with the system context – actors and categories of system interactions – provide for a structured way of analyzing the gap in literature.

The following interview question is an example to clarify how the conceptual model should be regarded. An entrepreneur is asked “What kind of activities are being done towards governmental regulations?” Based on the first dimension of the conceptual model (Category of system interactions), this question belongs to the first form of institutional interactions, which is regulative interactions. Looking at the second dimension (Actor), this question relates to an interaction with the government. Answers to this question are analyzed and summarized as entrepreneurial strategies to influence the system context.

It is important to keep the following statements in mind for a good understanding of how the conceptual model is implemented. Referring back to the literature gap mentioned at the start of this paragraph, there is a need to investigate interactions between entrepreneurs from the micro-level and the macro-level of the system context. But this research cannot give a final answer to how these interactions occur due to the aim of this research. This means that although the model is appropriate to look at both interaction from micro-level of entrepreneurs towards the system context and vice versa, the aim of this research, as stated in the research question, is to only investigate entrepreneurial strategies towards the system context. Influences from the system context will be investigated but from the entrepreneur’s perspective. Other actors not participating in this research like governmental agencies and retailers need to be included in further research to validate system influences that are mentioned by the participating entrepreneurs.

Summarizing, the previous chapter discussed the elements on the applied conceptual framework. The next chapter will discuss the methodology and how the data was collected.

3. Method

3.1 Research method

3.1.1 Research strategy

In particular, this research is primarily qualitative in nature, not quantitative, where the former relates to studying ‘things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them’ (Denzin and Lincoln, 1994), whereas the latter is more likely to be used in the natural sciences, although quantitative research can often employ research techniques within social context and be used in combination with qualitative methods (Myers, 1997).

The research strategy that will be used is a case study. This approach is chosen because it facilitates the observation of the still unclear interaction between the entrepreneur and the

system. This research also attempts to compare what was discovered in the literature with the results of the case study to provide a source of new hypotheses.

3.1.2 Data collection

By adopting a qualitative perspective, this research aims to find insights rather than statistical interpretations on this subject. This is the central goal of this research: to understand what the entrepreneur is doing in an institutional environment, why the system influences the entrepreneur and above all the interaction between the entrepreneur and the system.

Qualitative data will be obtained by means of interviewing. This will provide the opportunity to discuss, with the various stakeholders, entrepreneurial issues in depth. However, in order to set up a framework around the interviews, and to focus on specific issues with different interviewees, the interviews will be structured with questions assembled beforehand.

The sample in this research exists of firms in the field of bioplastic packaging. The process of selection started by finding firms who requested governmental subsidies for their bioplastics research and firms who are part of bioplastics associations. Finally, the selected firms were categorized according the following supply chain of the bioplastic market (see Figure 4).



Figure 4: The supply chain of biodegradable packaging.

Interviewing firms and a bioplastic association in the field of bioplastic packaging will allow for cross-comparison of responses. The interviews will be recorded where possible. Eventually, after inviting 12 firms 8 participated and individuals in these firms were interviewed using a semi-structured interview. The interview is structured into the following three themes.

Theme A: This theme is an introduction to the entrepreneurs to assess their profile and the type of company they are running.

Theme B: This theme investigates entrepreneurial strategies to influence the system context.

Theme C: This theme investigates how respondents perceive the influences from their environment.

By selecting a variety of bioplastics stakeholders starting from those involved in the production of basic materials for making bioplastics, wholesalers that provide bioplastic packaged foods, and an association that speaks for the industry, it is expected that an enriched understanding of entrepreneurship in the system context will emerge.

Although this research is about entrepreneurs, some of the chosen firms are too large, consisting of more than 450 employees, to be called SMEs or starting entrepreneurs. But upon consideration, these firms were selected for the following reason. To remain competitive in the long run, large firms need to be ambidextrous. They need to be evolutionary and revolutionary at the same time (Tushman and O'Reilly, 1996). This means they cannot neglect innovation. Thus, because innovation is closely related to entrepreneurship, these large firms, from this perspective, can also be seen as entrepreneurs. Of course, incumbents have more resources than smaller sized firms, but neglecting new technology and change can decrease the incumbents' hold of the market and sometimes lead to a possible fall of the incumbent.

4. Results

The theoretical dimensions discussed in chapter 2 will be used to analyze the data gathered from the interviews. The categories of system interaction, discussed in paragraph 2.3, are possibilities of interaction that can be mentioned by the interviewed entrepreneur. Besides assigning a strategy to one of the categories of system interactions, the strategy also was tracked back to an actor or actor group where it is specifically located. Concerning the actor with whom the entrepreneur interacts, a distinction is made between 3 groups of actors where interactions are mentioned to be present: governments, industry, consumers. Sometimes influences or strategies are perceived to be specifically located with a single actor, whereas sometimes they seem to be coming from all actors.

4.1 *Biomaterials background*

In 1967 actor Dustin Hoffman took the role of the young Benjamin Braddock in the movie *The Graduate*, where he walks through a cocktail party given by his parents. He encounters a wealthy man who gives him a career advice in one sufficient word: plastics. If the movie was remade today he would rather likely mention bioplastics.

The increasing environmental concern had revived interest in developing materials from renewable resources and bioplastics are one of these innovations to emerge (Stevens, 2002). These renewable resources, also called biomaterials, are extracted from living organisms like plants, animals and their by-products.

Bioplastics differ from conventional plastics. Like plastics, bioplastics are polymers except bioplastics carbon may be derived from 100% renewable resources. However, manufacturing of bioplastic materials is often still make use of petroleum as an energy and materials source (Sustainable Biomaterials Collaborative, 2007). Basically, there are two main categories of bioplastics. The first category are the biobased plastics that are manufactured from renewable raw materials. The second category refers to biodegradable plastics that are biodegradable and compostable and are manufactured from renewable or fossil raw materials or the mixture of both (Matsuura et al, 2008).

The first category encompasses biodegradable plastics that degrade upon disposal by the action of microbial organisms. Technically, all bio and petroplastics are biodegradable. Biodegradable plastics, unlike traditional plastics that degrade very slow, are manufactured to decompose fast. The acceleration of the degradation is achieved by gradually decreasing the toughness of the plastic material. In some cases biodegradable petroplastics are used as additives to improve the performance of commercial bioplastics.

The second category are compostable bioplastics that, by legal standards, should biodegrade and disintegrate up to 90% into carbon dioxide, water and biomass in a compost system during the composting process which is around 12 weeks, the same rate as paper, at temperatures over 50°C. The produced compost should pose no ecotoxicity to plant life, and no obvious distinguishable residues caused by the breakdown of the polymers. Compostable plastics are a subset of biodegradable plastics.

An important issue is the performance and functionality of the end product. For example, the toughness of it is determined by monomers, molecular subunits existing of hydrogen and carbon. Monomers can form long chains, called polymers, that can break into natural by-products like carbon oxygen and hydrogen which is the biodegradation process. Biobased plastic, the first category, is not necessarily biodegradable.

Also, like conventional petroleum-based plastics, there are different types of bioplastics since no single bioplastic type can meet the requirements of every application. Since the focus of this study is on compostable bioplastic packaging, this section will be limited to a bioplastic type used for this end, namely Polylactic Acid (PLA). Currently PLA is considered the most commercially successful biodegradable material used to make bioplastic end products and its demand is still increasing in the bioplastic market (Theinsathid et al, 2009). PLA is often mixed with starch to increase biodegradability and reduce costs.

PLA is a polymer produced from lactic acid, a waste product that bacteria and certain fungi make during fermentation. The process starts by extracting starch from corn. The extracted starch is processed to produce glucose which is then fermented to produce lactic acid. Lactic acid produces a monomer, lactide, which finally is polymerized to produce the polymer PLA (see Figure 5).

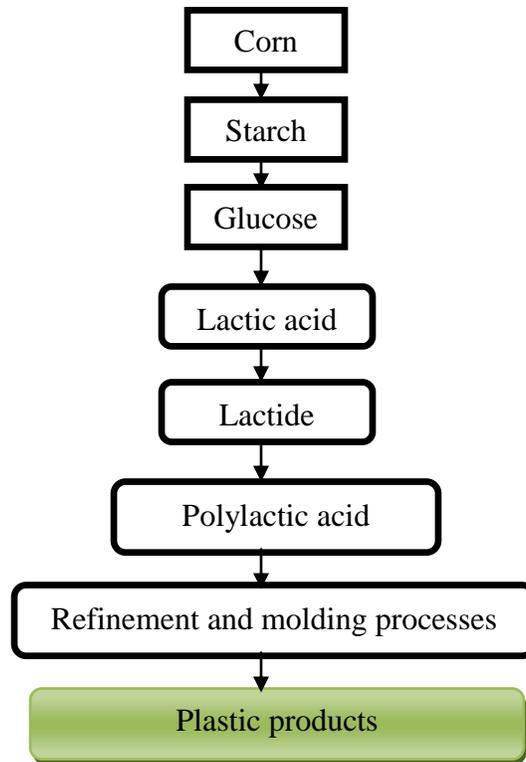


Figure 5: The synthesis of Poly(lactic Acid) (PLA).

Furthermore, the manufacturing of plastics used for packaging food require strict adherence to European guidelines regarding food contact. Plastics for food packaging should for example maintain structure, have optical clarity to see the product within, prevent water absorption and resist heat.

4.2 Market

The innovation system approach can be applied to the bioplastics system to grasp common actors in the playing field of this industry (see Figure 6). Arrows represent information flow. It is not the aim of this study to investigate how information flows take place, thus the arrows in figure 2 give a basic representation.

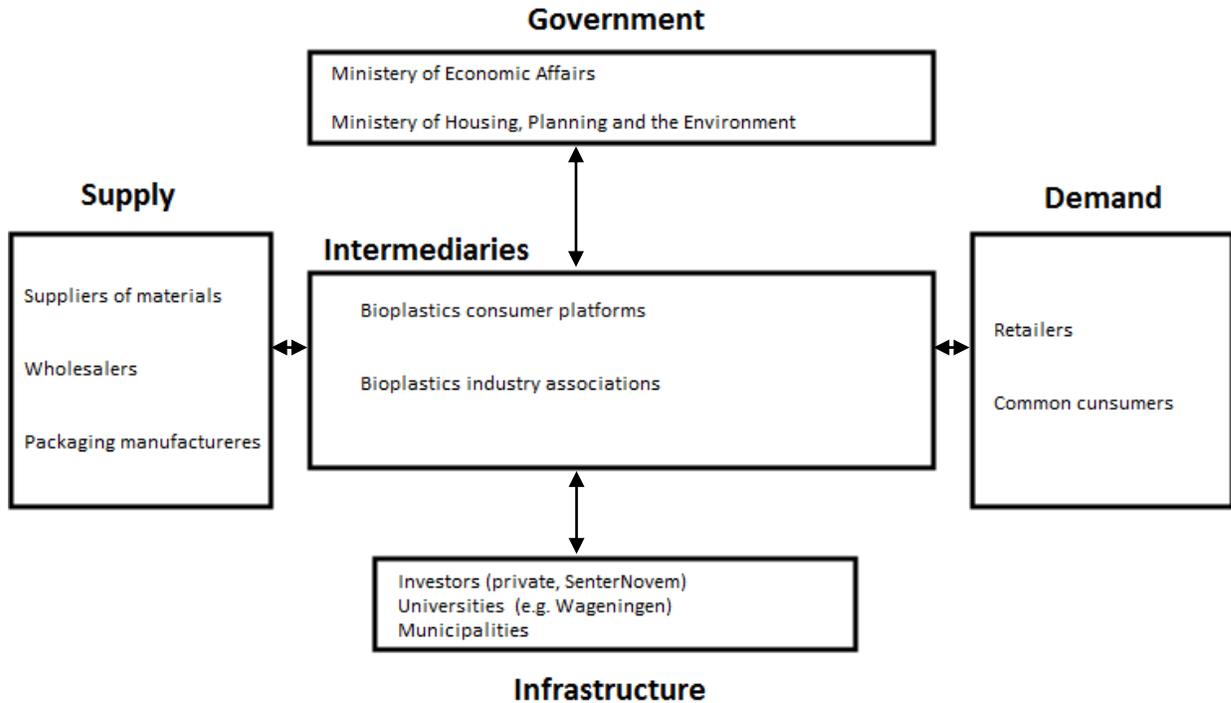


Figure 6: Bioplastics innovation system.

In 2006 PIRA International, a UK based packaging consultancy, conducted a study and found that more than 42,000 tonnes of biodegradable packaging were produced in 2006, and Western Europe came out to be the biggest consumer. The prediction is a growth rate of 22% annually to achieve 116,000 tonnes by 2011 (Nerac Industry Report, 2007). The bioplastics market is still a niche market but is growing. Issues like the increasing oil price are driving the plastic packaging industry to search for alternatives. Dutch firms have started the race around 2003 and are expected to innovate to reach the performance and level of diversity of traditional fossil based plastics.

As the market continues to anticipate for environmentally-friendly plastics, a number of companies have dedicated their efforts to develop commercial and sustainable food packaging plastic using starch produced biopolymers. A few examples of these companies are listed in the table in the methodology section.

Because PLA is raising international competition, some Dutch firms specializing in the production of PLA show high ambitions in leading the market. One these firms, PURAC, opened a facility in Thailand, recognizing the land's sufficient raw materials, to produce lactic acid trying to boost the firm's position as the world's largest manufacturer of lactic acid based on starch as the main raw material. PURAC even successfully managed to produce D-Lactide in order to make stereocomplex PLA, a better form of PLA that overcomes some previous technical issues like poor resistance to high temperatures and a lack of strength and translucence compared with traditional plastics (Theinsathid et al, 2009). Furthermore, PLA has a high transpiration capacity to water damp and oxygen which makes PLA particularly recommended for fruit and vegetable packaging and fresh foodstuffs in general.

The industry still faces some challenges like the high price of bioplastics compared to conventional plastics. This is because economies of scale haven't been fully exploited yet. To the packaging industry it is important that their clients, the supermarkets, are supportive. PLA is relatively still in its infancy period of market development. Thus, it will take some time to replace conventional plastics (Theinsathid et al, 2009). In the end making a shift to packaging based materials that are biodegradable is an important step to start improving consumer overall perception of plastics.

4.3 Government

As said in the previous paragraph, the consumer perspective towards plastics is an important step in the transition. This is exactly what the Dutch government was aiming at for bioplastics eventually be taken for granted. Because the number of biodegradable products is increasing, the government started to communicate the residential disposal of bioplastics early in 2004. The goal was to make the public aware of the compostability of bioplastics to introduce bioplastics to the public as environmentally better than traditional plastics and to improve the image of the plastic industry in general.

One of the actions undertaken collectively by industrial associations and governments is to protect consumers from false and misleading advertising about bioplastic products. Thus, standards for bioplastics have been promoted through bioplastics labeling systems (see Table 2). Labeling is also required to ensure that the consumer will throw bioplastics in the biodegradable waste container so not to contaminate these containers with traditional plastics, a requirement prioritized strongly by incineration and waste facilities. However, awareness of bioplastics among consumers is still low and they often do not understand its societal role. Therefore there is an urgent need to assess the sustainability of bioplastics.

Table 2: Label design and standards for bioplastic products (Sources: European Bioplastics 2007; JBPA 2007; US Composting Council 2007; BMG 2007).

Label design	Standards
	<ul style="list-style-type: none"> • Disclosure of all material properties • Biodegradability; at least 90% of the organic material must be converted into CO₂ within 6 months • Disintegration; no more than 10% residue may remain, as compared to the original mass • Practical test of compostability • No negative influence on the composting process • Compost application (agronomic test and ecotoxicity test)

To test the commercial viability of biodegradable packaging, the Dutch bioplastics association BCPN started a two years market introduction project in 2004 that is also supported by a governmental subsidy program called “Unieke Kansen Regeling” (SenterNovem, 2006). The results were positive. In 2005, the Dutch supermarket Albert Heijn started packaging all its non-cooled biological foods in biodegradable plastics. This was able to happen because the customer explicitly demanded biodegradable plastics out of environmental considerations and didn’t want to buy food packaged in traditional plastic. The sale of bioplastics went so good that Albert Heijn decided to pack all non-cooled fruits and vegetables in bioplastics. Because the reason behind this success was good communication and involvement of the complete chain from producer to consumer, the government started website (www.bioplasticsplaza.nl) as a platform to keep the public aware of the bioplastics development. The bioplastics packaging industry is also exempted till 2012 from the Packaging Agreement, a legislation that started in 1988 to decrease the use of packaging (SenterNovem, 2006).

By following the development of the Dutch biomaterials market it became clear that the Dutch government was trying to financially support entrepreneurs in this market by initiating the Small Business Innovation Research Program (SBIR) program in 2008. This program is covered by the Energy Transition Platform. The goal of this platform is to replace fossil fuels with alternative raw materials with 30% by 2030 (Kern and Smith, 2008). To reach this goal, innovative approaches to the application of biomaterials are supported and this includes the conversion from petrochemical plastics to bioplastics. Entrepreneurs were invited by the government to submit their project proposals for possible funding and some of these proposals were accepted.

4.4 Interview results

This section discusses the answers provided by the interviewed entrepreneurs. Many of these answers, especially to open questions, differ from entrepreneur to entrepreneur. As explained in the methodology the answers to the interview questions were assessed qualitatively.

The Dutch bioplastic market consists of about at least 40 companies ranging from suppliers, wholesalers and packaging firms and supermarkets that are voluntarily connected to a Dutch bioplastic organization. Due to time and resource limitations 8 companies out of the aimed 12 were interviewed (see Table 3). Although the target number was not achieved, assessment and comparison of the interview results gave considerably good qualitative insights into this yet not intensively explored sector. Some of these firms were already there before the introduction of bioplastics except for one young firm.

There is a clear distinction between a young firm and an incumbent firm in terms of resources and activities. The young firm participating in this research was run by one person and focused on selling bioplastic consumer products like biodegradable cups, cutlery and bags. Such firms have an important role in raising the awareness about bioplastics. The website of this firm makes bioplastic products easily accessible. Eventually, as the number of bioplastic products rises, more people will be aware of bioplastics which has a generally positive effect on the diffusion of bioplastics. Larger firms have more resources and facilities that enable them easy access to economies of scale. There is also a distinction between suppliers of materials and the food and packaging firms. Suppliers of materials have the advantage of supplying foreign markets to evade Dutch regulations when these regulations could get tighter. Suppliers of materials have production facilities in foreign countries to serve local markets.

The companies are strongly aware of the presence of each other and the possible capabilities. The interviewed entrepreneurs sense upcoming trends and struggle with obstacles that will be explained in the following chapter.

Table 3: Participating companies.

	Company Category	Number of Employees	Core Business	Respondent
1	● Supplier	15	Production of renewable raw materials for bioplastics	Owner / CEO
2	● Supplier	100	Production of renewable raw materials for bioplastics	Business Development Manager
3	● Food and Packaging	1	Wholesale of bioplastic bags and disposables	Owner / CEO
4	● Food and Packaging	4	Production of bioplastic packages based on renewable materials	Owner / CEO
5	● Food and Packaging	70	Wholesaler specialized in import and export of fruit and vegetables	New Packaging Development
6	● Food and Packaging	230	Production of packaging materials and flexible foils	Productmanager Industrial Packaging
7	● Food and Packaging	350	Wholesaler specialized in the production of packages, disposables and hygenic products	Senior Marketeer Corporate Marketing & Communication
8	● Food and Packaging	1100	Wholesaler specialized in import and export of fruit and vegetables	Manager Procurement & Distribution of Food Packages

The number of employees varies strongly per firm, but in most cases this number does not relate to the maturity of the firm. To illustrate this, one of the firms was run by a handful of persons, yet this firm played a leading role in the introduction of the Seed Plant logo for bioplastics in the Dutch market and has the biggest thermoforming facility in Europe. Another firm was run by more than a thousand of personnel and although this firm is trying to introduce bioplastics, its core business is the export and import of biological fruit and vegetables. This company also has no in-house R&D. The core business consumes the firm's time to concentrate fully on bioplastics, which makes such firms dependable on the available suppliers of bioplastics. There is a close relationship between suppliers and their buyers, because buyers often lack R&D facilities. The suppliers keep the buyers informed of technical issues and new developments.

The Dutch bioplastic market started to take shape some seven years ago in 2003 with the compostability concept. The compostability concept was a good starting point, because it brought the bioplastic market to a consensus to initially reduce plastic waste. Accordingly, all entrepreneurs had their bioplastics products certified by the EN13432 standard which means these products are compostable. Yet, there is a distinct upcoming

trend of renewable bioplastics which promise the use of biobased materials and various end of life scenarios for the bioplastic product like incineration, gasification or fermentation. This variety in materials gives the entrepreneur the flexibility to innovate in this market. Five of the eight respondents, including the supplier, mention their focus on renewable bioplastics instead of compostable bioplastics. One of these entrepreneurs in the food and packaging category even actively tries to convince retailers of renewable bioplastics. But as long as the demand side is asking for compostable bioplastics entrepreneurs will go along with demand. This entrepreneur is one of the prominent introducers of bioplastics in the Netherlands.

The entrepreneurs were presented a curve that describes the development of their bioplastics in four sequential stages: R&D exploration, take-off, acceleration and stabilization (Rotmans, Kemp et al. 2001). Although these stages describe socio-technological transformations, it was used here to get a general impression on how the entrepreneurs perceive the development of their products or technologies. All the interviewed entrepreneurs pointed out that their products and technologies are in the acceleration stage. This is because enough knowledge has been created in the last years and commercialization has taken place. Entrepreneurs are also past resistance from their environment particularly because stakeholders in their environment are convinced by the sustainable advantages of bioplastics. Yet, there is still no breakthrough. According the respondents, the development of bioplastics has reached an irreversible point, but it takes the production of bigger volumes of bioplastics to spin this development to the stabilization stage. This volumetric production is not present for reasons to be explained in the following sections.

Two of the interviewed entrepreneurs, one in the food and packaging category and the other in the material supply category, are members of the European Bioplastics organization that represents manufacturers and users of bioplastic materials. These entrepreneurs are characterized by running their business on the international scale by establishing production facilities internationally to serve local markets.

Entrepreneurs in the material supply category recognize that bioplastic materials are not fully technologically optimized to be compared with traditional plastic materials.

“Traditional materials are still cheaper than our materials. This has been one of the major obstacles until now. In terms of functionality, our material is not better than PP, PS or PET. The green advantages are often not important enough for firms. Most of the time it is all about profit.” *Entrepreneur in the material supply category*².

4.5 *Influence from the system context on the entrepreneur*

Entrepreneurs were presented a table that contains several system factors that could influence their activities and were asked to rank possible system influences as positive or negative. (see Appendix II; + = good influence, +/- = neutral, - = negative influence). The

findings from this table were combined to the answers given by the entrepreneurs to qualitatively discern major factors.

According to these findings and the answers given by the entrepreneurs, three common influences were detected: *market too price focused, lack of government support and no consumer awareness*. These influences were seen as barriers by the entrepreneurs and are discussed hereunder in order of importance. In the following table (see Table 4) these barriers were given a red color. Positive influences were given a green color.

Table 4: Influence from the system on the entrepreneur

		<i>Actor</i>		
		Government (national, local)	Industry (large firms, SMEs, competitors, suppliers)	Consumers (households, retailers)
<i>Category of system interactions</i>				
Network interactions		Lack of government support		No consumer awareness
Institutional interactions	Regulative			
	Normative			Market too price focussed
	Cognitive	Trend awareness		

4.5.1. Market too price focused

Although there is a decreasing trend of bioplastic prices due to a growing number of producers, biomaterials that are used in the manufacturing of bioplastics aren't reaching full cost parity with conventional fossil based materials. This has implications on the growth of the bioplastics market. Most of the interviewed entrepreneurs, whether working in the material production category or in the food and packaging industry have good relations with their venture capitalists and when possible they make use of supportive governmental subsidies. These investments, beside the increasing amount of alternative materials, gave a boost to the commercialization of bioplastics. Some Dutch supermarkets followed this trend closely and began to introduce fruit and vegetables packed in

bioplastic. This introduction was also backed by a small category of consumers who backed their supermarkets by demanding an environmental solution to packaging. Yet, despite these developments, bioplastic packages are not introduced by all or most supermarkets. To put it upfront, supermarkets have no objections to environmental solutions including bioplastics.

On the positive side, entrepreneurs recognize a slow narrowing of the price gap between bioplastics and conventional plastics, because efficiencies in the production of plant-derived raw materials is developing and oil costs continue on a sharp rise.

4.5.2 Lack of government support

In 2004 the government started to support bioplastics by communicating the composting possibilities of bioplastics to the consumer. This well-balanced approach represented the interests of both the industry and consumers. Although this was followed by providing subsidies, entrepreneurs feel neglected by the government. The regulations concerning bioplastics are sometimes vague and does not provide a solid shared point of view for all parties. For example, taxation of bioplastics was equal to conventional plastics. It was not until the bioplastic industry accompanied with associations that the government was convinced that it should lower taxation of bioplastics because bioplastics are indeed environmentally friendly. The government decided to make bioplastics equal to paper in terms of taxation to relief the bioplastic market. Yet, the regulation stated that bioplastics will be categorized as paper and should be certified according the EN13432 standard and mostly recognised through the Seed Plant logo. This statement brought confusion among supermarkets and the waste disposal industry. Because of the word "mostly" in the regulation statement, supermarkets thought it was not necessary to have a Seed Plant logo on the bioplastic package as long as they are EN13432 certified. Waste disposal facilities disagreed, because eliminating the logo could cause the disposal of bioplastics in the grey container by consumers and could also cause confusion among waste disposal collection workers.

Entrepreneurs in the food and packaging category also relate the slow diffusion of bioplastics to the behavior of local municipalities. In 2004 many municipalities refused the collection bioplastic waste because they felt they did not receive attention by firms. Municipalities needed to know that consumers are aware of what bioplastics are and that bioplastics are recognized by a clear logo. In some cases municipalities even refuse disposable bioplastics in festivals, which is an innovative and direct way to introduce bioplastics to the consumer.

Negotiation with the government is not always easy in the sense that there is lack of pace in finding agreements. One of the entrepreneurs states: "You can talk to municipalities. They will give you all the time in the world, but it is difficult to make fast deals with them." *Entrepreneur in the food and packaging category*⁴.

"Some municipalities refuse to accept our bioplastic cups in festivals. The reason is that these municipalities think that our materials that are used to make these cups, compete

with food production. This is of course not true, because our material comprises a relatively small amount. People often forget that our material is still in the development stage and cannot be compared to a product that has been 60 years in the market.”

*Entrepreneur in the material supply category*².

Respondent would also like the government to take more action to facilitate compostable bioplastics by informing the consumer it is possible to dispose bioplastics in the green waste bin.

Regulation was also measured on a Likert-scale (range: 1 = very weak regulations; 2 = weak regulations; 3 = neutral; 4 = strong regulations; 5 = very strong regulations; see Table 5). With regulation here is meant negative pressure from the government like high taxes or complex laws. Although some firms rate regulations to be strong, in general firms are not so concerned with regulations in terms of intensity. All firms must adhere to commonly accepted compostability and recycling regulations for bioplastics.

Table 5: Influence from the system on the entrepreneur

Company category		Regulations
1	● Supplier	1
2	● Supplier	2
3	● Food and Packaging	2
4	● Food and Packaging	2
5	● Food and Packaging	2
6	● Food and Packaging	2
7	● Food and Packaging	1
8	● Food and Packaging	1

1 = very weak; 2 = weak 3 = mediocre; 4 = strong; 5 = very strong

4.5.3 No consumer awareness

Several Dutch supermarkets have introduced biopackaging in response to consumer concerns about the depletion of fossil resources and environmental change. The use of biomaterials to produce renewable or compostable bioplastics has become a convincing

sales argument. Although this is an incredible step ahead, consumers are not aware of the environmental benefits of bioplastics and sometimes do not know of their existence:

“More supermarkets need to introduce bioplastics to make the consumer aware of their existence.” *Entrepreneur in the material supply category*¹.

The interviewed entrepreneurs actively negotiate with supermarkets about alternatives to common plastics in packaging. For these interviewed entrepreneurs, working in the supply and packaging category means that reaching the consumer would be to far a task. Most of the interviewed entrepreneurs state that consumers lack awareness of sustainability in general and bioplastics in specific. This is because consumers are loaded with terms like sustainable packaging, environmental friendly packaging or biopackaging. There is also no solid measure for sustainability. Although bioplastics are sustainable by nature, some entrepreneurs raise their concerns:

“Sustainability is not fully understood among the public.” *Entrepreneur in the food and packaging category*⁵.

“Nowadays we are loaded with terms like sustainability and environmentally friendly. These terms are not exactly defined or measured.” *Entrepreneur in the food and packaging category*⁵.

One entrepreneur explains it by giving an example that making a carton, used for transport, if fold in an efficient way can also save a lot of CO₂ in the transportation process. This can also be seen as sustainable without changing the carton material. Although the interviewed entrepreneurs are highly aware of sustainability, it remains a term that can divide this industry in applying bioplastics.

“Most of the firms are aware of sustainability but this awareness is correlated with compostability. Compostability has little to do with sustainability, even less with renewable materials. This is still a difficult concept for many people.” *Entrepreneur in the material supply category*².

From the entrepreneur's point of view, consumers should be knowledgeable about bioplastic packaging to support an increase in demand. But supermarkets are often silent about bioplastics, because they are not ready for the questioning consumer. Because supermarkets mostly introduced bioplastics only around organic food, some aware consumers could for example start questioning the retailer about the packaging material of other products. These products belong to other food sectors that have not yet started with biopackaging. But entrepreneurs hope that once supermarkets buy in large volumes of biopackaged food, other supermarkets will follow by seeing this as environmental activism. This is why entrepreneurs value the current development of logos that are accepted by most firms and are more clear to the consumer. One of these logos encourages the consumer to be aware of what kind of food he is purchasing. Through some logos consumers can trace the product to the original farmer and can interact with this farmer if they want to get more information. Another logo that appeals to the

interviewed entrepreneurs, especially those working with and promoting renewable materials, is the OK Biobased logo launched in September 2009 by Vincotte, a Belgian accredited inspection and certification organization. This logo, based on ranking with stars, shows the percentage of renewable materials used in the production of a certain bioplastic package. For example, one star means the product is 20-40% biobased, two stars mean the product is 40-60% biobased and so on. One of the interviewed entrepreneurs has claimed a 4-star ranking, meaning his products are 80-100% renewable. Entrepreneurs need the consumer to be aware of the presence of bioplastics. Once they are aware, producers will awaken and the quality of bioplastics must than justify the higher price. One interesting example targeting consumers is the production of bioplastics for short term use like disposable golf ball tees, fast food packages and lab accessoires. All the interviewed entrepreneurs are based on B2B work and have no B2C activities. This means they have no direct contact with the common buying consumer, but focus on working with other companies.

Trying to reach the consumer, a respondent working in the food and packaging category also explains that the company started two years ago with measuring CO₂ emission in the supply chain. The measurement starts by looking at the activities of the farmer till transport to the supermarket. Eventually the transported product gets the so called CO₂ points showing to the consumer the impact on nature to bring this product to the shelves. Yet, the respondent explains that the firms got complaints, for example because this is not applied to all products or that not all measurements are taken into consideration. The respondent explains that the firm cannot change the world by itself alone and that firms should do what they can.

4.5.4. Trend awareness

The Dutch bioplastic market consists of several actors like manufacturing companies, municipalities, national governments and waste agencies. Due to interactions between these actors in past years, interests took a more concrete shape. For example, recycling facilities stated their concern with the introduction of bioplastics, because they were afraid that consumers would dispose of bioplastics with PE plastic waste and this would eventually reduce the quality of the recycled PE plastic. Entrepreneurs introducing bioplastics recognize developing issues and trends around them for example the developments of new renewable materials and they have good expectations for the bioplastic market due rising oil prices. They also actively try to investigate possible networks.

“Recently I called a company trying to introduce bioplastics manufactured from algae. This is innovative, because algae are environmentally friendly. Although I understood this is still at lab level, we are open to such developments.” *Entrepreneur in the food and packaging category*⁵.

This same respondent explains that the message of the firm is slowly changing from compostable bioplastics to 100% biobased plastics.

To build shared knowledge, entrepreneurs talk especially to their near networks about bioplastics. Manufacturers of bioplastic packages, most of the time also acting as wholesalers of vegetables and fruits have close relations with their suppliers. “From time to time we visit our suppliers to track their production process and to talk about new materials.” *Entrepreneur in the food and packaging category*⁵.

“We are wary when our supplier uses genetically modified food to produce basic materials to manufacture packages as it can contaminate the packaged food.” *Entrepreneur in the food and packaging category*⁵.

Summarizing, the previous paragraphs discussed influences from the system context. The following paragraph will address how the interviewed entrepreneurs interact with the system context.

4.6 Entrepreneurial strategies to influence the system context

This section discusses the empirical results on the strategies that entrepreneurs have for influencing the system context to create the necessary changes in the system towards a successful introduction and diffusion of bioplastics.

Before going into details about strategies, it is important to state the following. When the entrepreneurs were presented with a number of possible strategies and were asked to chose the most common strategies they applied, the answer was that there was no specific strategy and that most of the presented strategies were more or less present. The intensity of these strategies depend on how the entrepreneur define the opportunities that may rise in their environment. For example, as mentioned earlier one of the entrepreneurs actively negotiates the use of renewable bioplastics instead of compostable bioplastics with his clients but then he is dependent on the choice of the client. The choice of the client thus determines the strategic choices of the entrepreneur.

After assessing the interview answers, four major strategies were detected. These strategies are discussed hereunder in order of importance (see Table 6).

Table 6: Entrepreneurial strategies to influence the system context

		<i>Actor</i>		
		Government (national, local)	Industry (large firms, SMEs, competitors, suppliers)	Consumers (households, companies)
<i>Category of system interactions</i>				
Network interactions		Lobbying through branch associations	Strategic partnership	
			Supplier entry strategy (patenting, competitive pricing, product differentiation)	
Institutional interactions	Regulative			
	Normative			Private persuasion
	Cognitive			

4.6.1. Strategic partnership

The current strategy of pushing bioplastics through retail markets is still a very slow process. However, joint activities by manufacturers and suppliers will help promote awareness among consumers. Thus, to most interviewed entrepreneurs, strategic partnership is essential to grow in this market. Such partnerships enable firms to make continuous improvements by accessing resources. Such resources include markets, capital, technologies and people. Especially fast growing firms rely more on strategic partnerships to extend their technical and operational resources. This way they save time and boost productivity by not having to develop their own resources from scratch. This gives them the freedom to concentrate on innovation and their core business. Especially the food and packaging industry benefit from the established suppliers in terms of cost reduction and manufacturing. One of the entrepreneurs in the food and packaging sector explains the importance of strategic partnership:

“Strategic partnership even with our competitors is important to boost the diffusion of bioplastics packages. And because it is still a niche market, we need each other very much.” *Entrepreneur in the food and packaging category*⁴.

Suppliers of materials also benefit from strategic partnering, but they are not as expansive as the food and packaging firms. This is because there is a certain capacity in the production of materials. Suppliers of materials focus on patenting their technologies and competitive pricing so that entrants are kept out. Also, suppliers of materials focus on product differentiation by offering a diversified line of biomaterials. This increases customer lock-in by making customers loyal to their suppliers which is in the end important for profits and a deterrent for entrants.

4.6.2. Supplier entry strategy

The entrepreneurs were asked about how they face the competition between each other and the use of protective strategies like patenting. Entrepreneurs explain that they in general need each other to boost the bioplastic industry. However, there is a clear distinction in how suppliers of materials and the food and packaging category face the competition. Although like the food and packaging category the suppliers use strategic partnering, suppliers also focus on entry strategies to keep newcomers out. One of the suppliers of materials has 3 patents and the other has hundreds. This way a costly production process is protected. Suppliers also focus on brand quality to ensure that client stay loyal to their products. By investing in brand quality, suppliers can set a competitive premium prices to their products. This premium price will not easily be achieved by entrants because entrants need to invest relatively as much on brand quality as incumbents but the reality is that entrants lack the financial resources that incumbents enjoy.

Suppliers of materials also use product differentiation to distinguish their products from competitors. An example is the traditional plastic water bottle. From the outside there is not so much difference between a bottle of water and another bottle. In this case biodegradability becomes a differentiation point to target a demographic segment that is proactive in healthy lifestyle. Biomaterial used in the production of such bottles offers a tangible environmentally friendly argument for its use. The production process uses 60% less fossil fuel resources than traditional PET plastics.

4.6.3. Niche strategy

All the respondents recognize that the bioplastic market is still a niche market. Most respondents in the food and packaging category focus on bioplastic packaging for retailers. Although the retail market is a mass market with huge potential to introduce bioplastics, introduction is still slow. This is where suppliers of biomaterials differ in their strategy of introduction. Suppliers are trying to find interesting niche markets for their products as one of the two participating suppliers explains:

“I am more interested in the application of biodegradable products where the end-of-life of the product is relatively short. An example is nursery pots. Gardeners and farmers can insert potted plants directly into the ground and leave them to break down into carbon dioxide and water, eliminating double handling and recycling of traditional plastic containers. Other applications are in the fast food serviceware, like sandwich packages, plastic disposables in hospital labs, tree nets for protection from parasites and golf tees”

4.6.4. Private persuasion

The interviewed entrepreneurs mention that the lack of awareness leads to misunderstanding by common consumers and retailers. In order to remove the barriers in the category of cognitive institutions entrepreneurs in the food and packaging category use a strategy of private persuasion. They do not openly advocate the use of bioplastics, but instead they privately persuade decision makers, for example marketing managers, of retail companies.

Firms in the food and packaging category sometime also need to persuade common consumers about the used packages. Some aware consumers may contact such firms asking about the origins of the materials used for packaging. Some of these consumers argue about the use of genetically modified feedstock. In this case entrepreneurs try to lift cognitive barriers by explaining that some choices have to be made at this moment and that not all possibilities are at hand.

Although the interviewed entrepreneurs state their concern about the lack of awareness among regular consumers, these entrepreneurs core activities are essentially B2B. The focus of these entrepreneurs, mainly in the food and packaging sector, is especially on the demand side, because at this moment there are enough suppliers. The demand side, comprised by retailers, is important for the growth of these entrepreneurs and the diffusion of bioplastics. An entrepreneur explains:

“Supermarkets can make you or break you.” *Entrepreneur in the food and packaging category*⁴.

Thus, supermarkets not aware of the eventual environmental impact of bioplastics or aware but too price focused, can delay the diffusion of bioplastics. This is why especially wholesalers divert from focusing on sustainability and focus more on price and demand:

“Discussing price with retailers is vital to keep business running.” *Entrepreneur in the food and packaging category*⁴.

“I don’t get stubborn with the retailer. For example if I’m introducing renewable bioplastics to the retailer while he explicitly wants compostable bioplastics, I’ll give him what he wants.” *Entrepreneur in the food and packaging category*⁴.

This shows that entrepreneurs have their own visions but need to be flexible in their negotiations. Most of the firms have grown enough in size to have their own marketing department or marketing expert to do the negotiation with other companies.

Another respondent in the food and packaging category also explains that although the firm is paving a path towards renewable bioplastics, compostable bioplastics will not be neglected.

4.6.5. Lobbying through branch organizations

All participating firms, except a young firm, are members of a Dutch bioplastics association. This association supports firms with basic information and sometime provides support when firms request governmental subsidies.

“It is pleasant to have a Dutch branch association with which we can exchange information. This branch association also have networks with foreign branch associations that can provide more information on foreign trends. The association also supports our contact with the government. We think it is better to negotiate together with the government instead of going alone.” *Entrepreneur in the food and packaging category*⁸.

Respondents acknowledge the importance of this association because it served as a channel between them and the government. For instance, the branch association lobbied for firms to reduce governmental taxation of bioplastics. This association also persuaded municipalities to collect bioplastic waste.

Although the entrepreneurs did not pursue tax reduction by themselves, this strategy can be seen as advocacy coalition. By employing the power of persuasion, the branch association changed a formal institution. Thus, one cannot speak of entrepreneurs running in packs because there was no active collective operation between the entrepreneurs in order to reach an institutional change.

Entrepreneurs do not wage into system changing activities by themselves, because they are busy with their day-to-day activities.

“I do not try to change the system. This would be too far for me. This is something for the branch association.” *Entrepreneur in the material supply category*¹.

“We leave lobbying activities to the branch association. We do not make fundamental changes in the system. This honor is beyond my reach.” *Entrepreneur in the food and packaging category*⁵.

“Lobbying is not our quality. This is more appropriate for the branch association.” *Entrepreneur in the food and packaging category*³.

Summarizing, the previous paragraphs discussed entrepreneurial strategies to influence the system context. In the next chapter the results will be analyzed according the conceptual framework.

5. Analysis

In this chapter the interview results are analyzed to understand how entrepreneurial strategies and influences from the system context are interrelated to each other.

By carefully assessing and analyzing all the influences and strategies mentioned by the interviewed entrepreneurs, they can be traced back to be coming from a distinct category of system interactions and to a distinct actor or actor group. For instance, for the introduction of bioplastics, entrepreneurs needed the acceptance of municipalities to collect bioplastic waste. This can be assigned to the category of regulative institutions and to the actor government, while a strategy of partnering was assigned to network interactions with industry actors. By putting the categories of system interactions on the vertical axis and the groups of actors on the horizontal axis, a two-dimensional framework is created where the influences from the system context and the strategies from entrepreneurs can be clearly mapped.

5.1 *Network interactions*

As explained in section 2.3, the conceptual model can be used to map network interactions and institutional interactions. This section is about network interactions and according the results nor strong or weak network failures. Entrepreneurs mention strategic partnering as an important strategy because cannot afford to lose their established network in this still niche market and at the same time they are expanding their network to eventually expand their market share. However, there is a potential risk of growing inertia due an internal orientation. Until now, a cooperative and trustful relationship between entrepreneurs has been established because entrepreneurs are familiar with the they can offer to each other. Trust between them increases when for example a firm offers certified products and showing professionalism in negotiations. Due this internal orientation entrepreneurs will be reluctant of letting new entrants in. As a result, there is potential risk that firms may get locked into existing technological trajectories. This is especially the case for the suppliers of materials, because they tend to patent their products in combination with product differentiation to keep thus increasing lock-in of customers and at the same time deterring entrants. It is also difficult for new suppliers to compete with prices of existing suppliers. Product differentiation partly removes the pricing arsenal of entrants because customers become less price sensitive (Schmalensee, 1982). As customers become loyal to the incumbent suppliers, the incumbent suppliers can raise their prices to a certain extent without losing customers (Shepherd, 1997). At the same time, the incumbent supplier is able to increase the entrant's costs of entry. By making selling expenses, for example costs of advertising to support product differentiation, incumbent suppliers are actually forcing entrants to do

the same. If entrants wish to compete with the incumbent's differentiated products, they will also have to differentiate. The costs incurred by the entrant will likely always be higher relative to the incumbent's costs because, as a result of decreased price sensitivity among customers, the incumbent supplier will be able to maintain higher prices than the entrant.

5.2 *Regulative interactions*

The second category of interactions in the conceptual model is the category of institutional interactions comprising regulative, normative and cognitive interactions. The interviewed entrepreneurs can be characterized as entrepreneurs in the Schumpeterian sense, with a strong motivation to make change happen, particularly with regard to sustainability in the sector. Bioplastic firms were able to start easily in the bioplastic market because of several reasons. First, they were able to persuade investors of the sustainable advantages of biomaterials. Thus, sustainability was used as an entry strategy. But, although sustainability is still used to further diffuse bioplastic innovations, once the market became aware of the presence of bioplastics the negotiations became less about sustainability and more about price and profitability. Second, the biomaterials market has no strict regulations that could hamper the growth of the market. This environment gave opportunity for the acceptance of bioplastic. However, like the fast adoption of biodegradable biofuels, cost issues are still present and no large volumes are being produced.

In terms of regulative interactions, the respondents were able to negotiate tax reduction for the production of bioplastics. This created the critical mass to reduce the tax on bioplastics. Although this negotiation was indirect through a bioplastic association, this shows the collective stance of firms to support the bioplastic market. To agree about this issue collectively can be seen as a strategic move, because some of the firms could have chosen not to negotiate a tax reduction to hamper other firms that lack financial resources. Companies agreed on this issue because they need each other to increase the volumes of bioplastics in the market. This also shows how important it is for firms to be a member of a branch organization. In this case the branch organization represents the companies of the bioplastics sector and thus has more power to lobby for regulatory changes and to create legitimacy for the new industry in the system. Such branch organizations take the lobbying activities out of the hand of the individual companies and entrepreneurs, since these are probably too small, have too little time or too few resources to lobby themselves. Another example is establishing a common standard for the industry's products, like the Seed Plant logo, to guarantee quality for consumers.

However, none of the firms actually pursues a strategy of running in packs as described by Van de Ven (2005) – there is no entrepreneur that runs together with competitors. Lobbying to change regulations is difficult for every entrepreneur because it is a time consuming task on local level, on national level and especially on European level. Entrepreneurs may collaborate with other sectors in order to finalize their products. For example, some entrepreneurs work with firms specializing in biodegradable ink needed

for information to be printed on bioplastics packages. This means that other potential sectors could benefit from a growing bioplastic market.

5.3 Normative and cognitive interactions

In terms of normative and cognitive interactions, firms have evolved shared values of how do business with each other and what to expect from the competition. There is a shared value of sustainability among the firms. The normative pressure from the system context comes from not understanding what really sustainability is. Respondents say the government is not fully communicating the advantages and the handling of bioplastics to common consumers. Local municipalities sometimes ignore bioplastics for minor reasons for example because bioplastics are made from organic feedstock. But this is not a fair reason because the current bioplastic volume in the market is still very small. The government is seen as a barrier to the introduction of bioplastics because there is no national plan to facilitate this introduction, but it is left to local municipalities. To overcome this barrier the government should develop a law that forces, to a certain extent, the use of bioplastics. An example of a successful policy in such a situation can be identified in Britain. Some years ago, the British government issued a plastic recycling directive. Companies were complying fast to this law. A respondent even received the urgent request of a British food wholesaler to further use recycled materials in plastics from a certain date.

There is a normative orientation, not only by large firms but also small firms participating in this research, towards renewable bioplastics. For suppliers and retailers, renewable biomaterials provide a way to reduce industrial waste and avoid regulatory issues especially because the productions process involves no biological hazards. Although the price of renewable materials is still higher than traditional plastic materials, the costs will be reduced because large quantities of bioplastics are expected to return to extract the original materials for reuse. It is also expected that biomaterials in general will benefit from the rising oil price.

Summarizing, in this chapter the results were analyzed to explain how entrepreneurs interact with the system context. According the used framework, entrepreneurs interact with the government, the bioplastic industry and retailers. Both suppliers of materials and manufacturers of bioplastic product interact indirectly with the government through a bioplastic association. All entrepreneurs are aware of the necessity to increase the volumes of bioplastics in the market thus there is positive interaction between them. In the following chapter the conclusion and further recommendation will be presented.

6. Conclusion and further recommendations

The motivation behind this study was to investigate the interactions between the entrepreneur and the system to gain more insight in the entrepreneurial strategies to influence the system context. In this case the scope was on the Dutch bioplastic market.

This was an interesting choice, because it is a relatively new market which is not explored extensively yet. This led to the following research question:

“Which strategies do entrepreneurs carry out in order to accelerate the development of the emerging field of sustainable biomaterials?”

The research question was studied from the perspective of innovation systems. This is because innovation systems literature recognize the great importance of the system context for introducing sustainable innovations. But there is more research needed to explain the strategies of entrepreneurs to change the system and to gain more insight into the dynamic interactions between the macro-level of innovation systems and the micro-level of entrepreneurial strategies (Hekkert et al., 2007; Markard & Truffer, 2008).

The empirical findings of this research confirm the suggestion of the literature on sustainable entrepreneurship that entrepreneurs are able to correlate economic growth with advancements in sustainability (Lepoutre, 2008; Dijkema 2006; Gerlach, 2003; Cohen & Winn, 2007). For this theoretical strand, insights from this research can be useful in explaining the specific barriers, drivers and characteristics of a supportive system context for sustainable entrepreneurship and to explain how entrepreneurs developing innovations that integrate the three aspects of sustainability could more effectively contribute to the transition towards sustainability.

Already from the first interview it became clear that the participating firms were run by active and enthusiastic individuals. Some of these individuals run their own companies and some are part of a large company. This research shows that entrepreneurs entered the market by approaching the system with sustainable advantages of their products thus winning the trust of professionals in the plastic industry to work with them and the trust of investors for financial support. In doing so, they have created added value by developing innovations that integrate the three aspects of sustainability: social responsibility, limiting environmental impact and creating economic growth. The empirical findings of this research confirm the proposition of the literature on sustainable entrepreneurship that entrepreneurs are able to reconcile economic growth with advancements in sustainability (Lepoutre, 2008; Dijkema 2006; Gerlach, 2003; Cohen & Winn, 2007). But fulfilling these sustainability aspects does not immediately mean the sector has reached maturity. The fulfillment of these aspects has to be recognized and acknowledged by actors in the system. But, although the bioplastic market is small relative to the traditional plastic market, bioplastic entrepreneurs secured their place in the market through their networks of local and even international producers and manufacturers.

The empirical results show that none of the entrepreneurs in practice uses the exact strategy of running in packs (Van de Ven, 2005). There are no active collective strategies to change the system. This is a recommendation point that will be elaborated in the next paragraph. A strategy of advocacy coalition can be identified in the lobbying of a branch association on behalf of the entrepreneurs. By reaching an agreement with the government to lower the bioplastics tax, these entrepreneurs, although indirectly, have

changed a formal institution. The entrepreneurs think it is not their task to change the system, but the task of the branch association.

Suppliers of biomaterials use patenting strategies because they are at the head of the bioplastic supply chain incurring huge R&D costs thus they need to secure revenues. This patenting along with competitive pricing makes it difficult for entrants to start a supply firm. Thus, it is easier for entrants to start in the food and packaging category.

Firms in the food and packaging category focus of marketing strategies towards the retailers. This is because they need to deal with price issues. Retailers are confronted with the high price of bioplastic packages. Marketing managers in the food and packaging category try to negotiate the advantages of bioplastics to the managers of retail companies. Some retailers have adopted bioplastics, but this is not on a national scale. Enthusiastic managers in retailing companies that have not adopted bioplastics yet eventually face high corporate management that are not convinced of the profitability of bioplastics.

All responding firms say it is important to work according to a standardized system that supports the recognition of their products as being compostable. Thus, it was obvious for all interviewed entrepreneurs to apply the European EN 13432 certification. Entrepreneurs take this as a self commitment to ensure the identification of their products and their proper handling in end-of-life recovery options. Getting a product certification is important to show other firms they are dealing with quality products thus increasing the chance of collaboration.

All participants acknowledge the importance of bioplastics association in supporting their contact with the government. By lobbying through branch associations, firms were able to reduce taxation on bioplastics. Participants also find it a too far to take the responsibility to change the system and see this activity fitting for the branch association.

There is a clear distinction between a young firm and an incumbent firm in terms of resources and activities. One of the participating young firms was mainly run by one person and focused on selling bioplastic consumer products like biodegradable cups, cutlery and bags. Such firms have an important role in raising the awareness about bioplastics. The website of this firm makes bioplastic products easily accessible. Eventually, as the number of bioplastic products rises, more people will be aware of bioplastics which has a generally positive effect on the diffusion of bioplastics. Larger firms have more resources and facilities to that enable them easy access to economies of scale. There is also the distinction between suppliers of materials and the food and packaging firms. Suppliers of materials have the advantage of supplying foreign markets to evade Dutch regulations when these regulations could get tighter. Suppliers of materials have production facilities in foreign countries to serve local markets.

Taking the results into consideration, it becomes clear that suppliers of materials and food and packaging firms use different strategies (see Table 7).

Table 7: Entrepreneurial strategies to influence the system context

Suppliers of materials	Food and packaging firms
Patenting	Strategic partnering
Competitive pricing	Private persuasion
Product differentiation	Focus on the user
Niche strategy	Lobbying through branch associations
Lobbying through branch associations	

Whereas suppliers use patenting strategies to benefit from technological developments and competitive pricing to fence entrants, food and packaging firms focus on partnering strategies with wholesalers of fruit and vegetables and retailers to enforce the bioplastic market. Suppliers will not likely search extensively for buyers, because they are limited by a certain production capacity. Suppliers of biomaterials also focus on niche markets trying to find innovative diffusion points. For example, instead of concentrating on mass markets like food packaging for retailers, suppliers are researching the application of biomaterials in festivals, plant pots and hospital disposables. The possibilities are huge and such applications should eventually trigger consumer awareness.

The interviewed entrepreneurs can also be prudently classified according the framework of Klein Woolthuis of system building and system following entrepreneurs (Klein Woolthuis, 2010). The interviewed entrepreneurs started by convincing the environment of the sustainable advantages of bioplastics and went further by convincing the government to reduce the tax on the production of bioplastics thus they can be called system building entrepreneurs. The entrepreneurs have also set standards for bioplastics to ensure the production of qualitative bioplastic products. Through these activities they have paved the way for new firms in the bioplastic business. On the other hand it seems that the interviewed entrepreneurs have reached a point where they take their position for granted. Entrepreneurs are at this moment not busy changing their environment fundamentally. They are more busy with improving their products and technologies to reach more consumers. For example, entrepreneurs are trying to reach the functional quality of traditional plastics to meet the expectation of the market. Thus, there is an orientation towards following the system. This does not mean that the entrepreneurs are not capable of again being system building entrepreneurs. The choice of being system building or system following depends on the available resources of the entrepreneur and his priorities. For example, an entrepreneur with less resources will likely have to deal a lot with the competition compared with an entrepreneur with more resources.

The transition from fossil based plastics to bioplastics, especially renewable bioplastics, involves a radical technological change implying institutional changes. Existing interests will try to keep bioplastics off the political agenda as existing institutional environments may favor established technologies (Hvelplund, 2005).

6.1 Recommendations

This section provides recommendations based on the findings of this research. These recommendations should not be considered as final advice, but as points of thought and discussion. There is time and opportunity to develop solutions because the bioplastics market is still in its infancy with low market volumes compared to traditional plastics. Yet, because the bioplastic market is still a niche market it is still not completely certain how it will develop in the future. Thus, it is advisable to take incremental actions to see how the system reacts. It remains the task of all parties involved in plastics waste management and of governmental organizations to construct best practice recovery solutions for both bioplastics and conventional plastics.

Collective strategy. Sustainable innovations need a collective strategy where the industry and the government recognize a collective gain for society and the environment. In this research it was identified that firms collectively wanted tax reduction for bioplastics.

A good debating point between actors is the definition of sustainability. As shown in the results, there is no clear definition of what sustainable packaging is. This is why the packaging industry is fragmented when it comes to debating about this issue. This raises the risk of bioplastics receiving disproportionate attention for their environmental advantages.

Motivating others to take part in collective action demands a high level of skill at institution building and framing "stories that help induce cooperation from people in their group that appeal to their identity and interests, while at the same time using those same stories to frame actions against various opponents." (Fligstein 2001: 113).

Although Dutch firms took a collective stance to reduce the bioplastic tax and succeeded, it was a reactive action. The recommendation is to take more proactive actions to increase their institutional legitimacy. For example, some countries have taken a collective decision to ban plastic bags in supermarkets. Before introducing a plastic bag ban it is important to propose effective and practical alternatives for consumers to carry their shopping. It is also important to take into consideration the various environmental consequences of the ban. In the end firms by themselves cannot lead consumers from intentions to actions. The government must participate actively to achieve long-lasting changes in consumer behavior.

Economic perspective. The price of bioplastic materials or biopolymers is generally still higher than traditional materials for several reasons. Most biopolymers have been commercially accessible for a couple of years and production volumes are low compared to the traditional plastic industry. Early development costs are also very high. Finding cheap sources of raw materials is supportive to gradually introduce bioplastics. Feedstock costs are an important driver of the economic processes of all plastics and long-term trends present an opportunity for renewable materials (Bohlmann, 2007).

Suppliers of materials are working hard to keep their fossil fuel use in manufacturing as low as possible. Suppliers can reach up to 60% less CO₂ emissions compared to the manufacturing of polyethylene and they are also developing better material properties that can lead to thinner films. Yet, scale-up and commercialization costs are major barriers to mobilize lab discoveries into the market. Thus, to counter the price issue, substantial capital investment from private investors and governmental agencies will be required. Investments can be helpful to take over costs but also to drive improvements to performance and barrier properties of bioplastics thus enabling the bioplastic industry to compete more effectively with traditional plastics.

It is important not to exclusively consider the price of biomaterials, but also all associated costs that include the costs of handling and disposal, which are much lower for bioplastics than traditional petroplastics. Thus, marketing of bioplastic products is most successful when their cost savings and functional advantages are fully exploited.

Pursuing higher standards. All the respondents in this research have high quality product certifications. All the respondents mentioned the upcoming trend of renewable or biobased bioplastics that use for example starch or cellulose as materials. This is because entrepreneurs are keen on seeking sustainable solutions that offer various possibilities to the end-of-life of bioplastics. Renewable bioplastics offer versatility because they can be composted through industrial processes, incinerated through waste to energy systems but also recycled back to the original compound. Suppliers also try to use biobased materials as much as they can to comply to new star-based certifications. Algae is one of the most promising research areas right now. Algae is already widely used as a raw material for biofuels, but this is also advancing to bioplastics. Given the high content of renewable resources in biobased plastics, they have the advantage that they are less effected by price movements in fossil resources. Yet, there are still some technical issues in the manufacturing of biobased plastics. Biobased plastics require non renewable or non compostable additives to reach the qualitative properties of traditional plastics but such additives reduce the biobased content.

This trend of biobased plastics need thorough communication with the government, because at this moment the government is promoting a biobased economy, thus such developments can trigger the attention of the government if communicated correctly.

Retailers. Although retailers are not included in this research, their role is important for the diffusion of bioplastics as mentioned by the respondents. Retailers do not want a supply chain that damages the environment, but when it comes down to it, it is all about price. Retailers are under a slow but growing pressure to reduce packaging. The food and packaging industry should take advantage of this pressure and try to persuade the retailers to take larger volumes of bioplastic packages and together reach a price consensus. Such activities should make the retailers more proactive and less reactive. Retailers will need to find which customers are willing to pay a premium price for more sustainable packaging

6.2 Research limitations and further research

An important element that can be incorporated into further research would be a longitudinal investigation the dynamic relation between entrepreneurs and the system context to distinguish between different interaction patterns in different stages of the industry life cycle. Although the results cannot be generalized, the results provide a rich picture of the experiences and perceptions of individuals within the bioplastic industry.

This theoretical framework of Klein Woolthuis et al. (2005) and Edquist & Johnson (1997), distinguishing between actors and categories of system interactions, proved to be a suitable perspective to analyze the interview data. Starting from the empirical findings from the interview answers, each mentioned influence or strategy could be assigned to one or more of the defined categories of system interactions and to one or more of the specified actors. This same theoretical framework also proved to be applicable for structuring the interview results of a comparable research in the healthcare sector (Janssen, 2009). This shows that this theoretical framework is a fitting way to systematically analyze and map the interactions between entrepreneurs and the system context. With this theoretical conceptualization of the interactions between entrepreneurs and the system context in mind, the next step is to empirically investigate the interactions in practice.

7. References

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Appendices

I. List of strategies provided to the entrepreneurs

1. Marketing and media
2. Demonstration projects
3. Cross-functional teams
4. Open advocacy
5. Private persuasion
6. Making exceptions
7. Ex ante investment with ex post justification
8. Partnering
9. Focus on the user
10. Pro-active investment
11. Building trust
12. Making exceptions
13. Direct lobbying
14. Strategic partnerships

II. Influence from the system on the entrepreneur

<i>Firm</i>	Firm 1	Firm 2	Firm 3	Firm 4	Firm 5	Firm 6	Firm 7	Firm 8
<i>Factor</i>								
Regulation	+	+	+ / -	+ / -	-	+	-	-
Public awareness of sustainability	+ / -	+	+	+	+	-	+ / -	-
Subsidies	+	+	-	+	+	+	+	+
Big firms forming a block	+ / -	-	-	-	+	+	+	-
Investors	-	-	+ / -	+ / -	+	+ / -	+	-
Interest from media	+	+ / -	+	+ / -	+ / -	+	+	-
Suppliers	+	+ / -	+	+ / -	+	+	+	+
Supermarkets	+	-	+	+	-	+	+	+
Number of stakeholders	+	-	+ / -	+	+	-	+	+
The aware consumer	+	-	+	+ / -	+	-	+	-
Entrepreneurial climate	+	-	+ / -	+ / -	-	+	-	+
Price focused market	+	-	-	-	-	-	-	-
Guidance from the government	+	+/-	+ / -	-	-	+	-	-

III. Interviews

1. Founder and CEO, 10-20 employees, Production of renewable raw materials for bioplastics, interviewed on 07-07-2010.
2. Business Development Manager, 50-100 employees, Production of renewable raw materials for bioplastics, interviewed on 12-08-2010.
3. Founder and CEO, <10 employees, Wholesale of bioplastic bags and disposables, interviewed on 15-07-2010.
4. Founder and CEO, <10 employees, Production of bioplastic packages based on renewable materials, interviewed on 28-06-2010.
5. Manager New Packaging Development, 50-70 employees, Wholesaler specialized in import and export of fruit and vegetables, interviewed on 30-06-2010.
6. Productmanager Industrial Packaging, >100 employees, Production of packaging materials and flexible foils, interviewed on 27-07-2010.
7. Senior Marketeer Corporate Marketing & Communication, >300 employees, Wholesaler specialized in the production of packages, disposables and hygenic products, interviewed on 07-07-2010.
8. Manager Procurement & Distribution of Food Packages, >1000 employees, Wholesaler specialized in import and export of fruit and vegetables, interviewed on 12-07-2010.