Chapter 7

Green Entrepreneurship in The Quintuple Helix Model

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Abstract: The issue of green entrepreneurship has been receiving a great deal of attention. The purpose of this chapter is to indicate the importance of green entrepreneurs in the quintuple helix model with a supportive role of sustainability-oriented innovation intermediaries. In order to create a detailed review of the critical points of current knowledge on relationship between green entrepreneurship and the quintuple helix model, we employ a systematic literature review methodology. Thereby, the arguments based upon broadly accepted facts are presented and systematized.

Keywords: green entrepreneurship, sustainable development, innovation of services, Quintuple-Helix Model, institutions of innovation system

Introduction

Historically, the economy and the environment have often been at odds. The industrial revolution shifted the economy towards a geo-based economy of coal, iron and steel and to large-scale factory production. Numerous inventors and entrepreneurial firms drove this transition and businesses were mainly the cause of, rather than the solution to, environmental degradation.

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Since that time, the attitude has changed. Being green is nowadays treated not as a cost of doing business, but a catalyst for innovation, new market opportunities and wealth creation (Gliedt, Parker, 2007; Hartman, Stafford, 1997) based on presumptions of sustainable development. The challenge of sustainable development, especially under the aspect of global warming, proves that there is rising demand for 'new green' knowledge solutions and know-how in order to utilize resources innovatively for society and the economy in an environmentally conscious manner (Carayannis, Barth, Campbell, 2012). This idea of achieving sustainable development by innovative attitude is described within the quintuple helix model. The purpose of the chapter, therefore, is to indicate the importance of green entrepreneurs in the quintuple helix model with a supportive role of sustainability-oriented innovation intermediaries.

This study aimed to create a detailed review of previous work assessing the relationship between green entrepreneurship and the quintuple helix model using systematic literature review as a research method. Literature review is a method that helps identify, synthesize, and evaluate the existing work published by scholars and researchers (Onwuegbuzie, Leech, Collins, 2012). The first step was to identify concepts that are relevant to the topic area. We searched the major research databases (Emerald Insight, Google Scholar, Science Direct, Springer) by using specific keywords. Next, a synthesis of the concepts and definitions from each associated literature was constructed to provide a clearer understanding of the relationships between mentioned concepts.

Green entrepreneurship as a factor of innovation

The purpose of this part of the paper is to give an up-to-date assessment of key topics and methods discussed in the current literature on green entrepreneurship. Green entrepreneurship is an important phenomenon from the economic development point of view. Since the 1970s, numerous environmental laws and regulations have been enacted, leading to an "ecorevolution" in economics (Lin, Chen, 2018). Green decision-making implies that decisions are made within environmental constraints, with an emphasis on conservation of natural resources and improvement in the quality of life of consumers (Sorensen et. al., 2014). The main idea is that a business can be profitable while having sustainable aims such as preserving the ecosystem, counteracting climate change, reducing environmental degradation and deforestation, improving farming practices and improving the environment, transporting drinking water, and/or maintaining biodiversity (Dean, McMullen, 2007). Therefore, environmental entrepreneurship could be an opportunity for reduction of environmental degradation "Greening the firm" is a pervasive topic as it touches on all aspects of a firm, including the firm's products and processes, business model, organizational design and management, and financial performance, making it a topic that is relevant across all sub-disciplines of business management (Sorensen et al., 2014).

There is no general definition of green entrepreneurship and there are many available terms describing it such as: ecopreneurship, eco-entrepreneurship, environmental entrepreneurship, entrepreneurship of the environment, sustainable entrepreneurship,

and ecological entrepreneurship. In this study, it is preferred to use “green entrepreneurship” as a more comprehensive concept. Anderson and Leal (1997) have presented a broad definition of green entrepreneurship with an emphasis on environmental outcomes: usage commercial tools for outdoor preservation by entrepreneurs, wildlife habitat development, rescue of endangered species and, in general, improving the environment. Dean and McMullen (2007) define green entrepreneurship as a process for defining and exploiting existing economic opportunities that are environmentally compatible with market failures. This definition suggests that market failures such as public goods, negative externalities, monopoly power, government intervention, and imperfect information result in environmental problems, but simultaneously lead to profitable opportunities for entrepreneurs willing and able to discover them (Thompson, Kiefer, York, 2011). Although there are some differences in these definitions, they are unified in a common theme: ecological and social environmental benefits.

Perspectives taken in the context of traditional entrepreneurship research are insufficient for explaining opportunity recognition in green entrepreneurship, since they consider only economic aspects. The social and ethical dimensions, relationships and cultural networks that bind groups of individuals, places and communities of interest are key drivers to engage in sustainability-oriented behavior (Schlange, 2006; Vickers, Lyon, 2012). For instance, the desire to help other people is often referred to as entrepreneurs’ prosocial motivation (Renko, 2013). In addition, the motivation for going green could be derived from the potential to gain reputational advantage related to “greening of the firm”, as it may eventually enhance marketing and financial performances of the firm (Miles, Covin, 2000).

The most important characteristics of green entrepreneurs as per Farinelli, Bottini, and Akkoyunlu (2011) and Schaper (2010) are:

- they take new business opportunities and engage in undertakings which usually involve very high risks; the outcome of these business ventures is often unpredictable;
- they have strong internal motivation;
- their activities have a generally positive impact on the environment and on economic stability;
- they consciously seek to secure a more sustainable future.

Moreover, green entrepreneurs are less motivated to achieve financial goals than their traditional counterparts as per Walton and Kirkwood (2010). Their study identifies five primary motivators for being a green entrepreneur: green values, passion, being your own boss, seeing a gap in the market, and earning a living.

Based on a combination of internal motivations and external (hard and soft) structural influences, there are four types of green entrepreneurs: innovative opportunists (driven by structure, e.g. regulation), visionary champions (early adopters), ethical mavericks (value driven) and *ad hoc* entrepreneurs (accidental, finance driven) (Taylor, Walley, 2004).

Green entrepreneurs are said to combine the environmental, economic and social components of sustainability in a holistic manner and to have a different organising logic than the more conventional entrepreneurs (Tilley, Parrish, 2006). Economic goals can be connected with environmental objectives by either removing environmental damaging processes or introducing innovative solutions to address environmentally degrading market imperfections or both (Cohen, Smith, Mitchell, 2008; Young, Tilley, 2006). Moreover, green entrepreneurs can be distinguished from business entrepreneurs using a few distinct features (Schaper, 2010; Patzelt, Shepherd, 2011; Chell, 2008):

- all their activities are green and entrepreneurial,
- they accept risks in a new development and an uncertain field,
- they combine prior knowledge of natural and communal environments with entrepreneurial knowledge,
- they show both motivation for personal gain (perception of threat) and motivation to develop gains for others (altruism),
- they have their own set of ideals and values. Green entrepreneurs share five motives: green value, market gaps, life-style, self-esteem, and passion for industry, products or services,
- show internal *locus* of control,
- the net effect of their business activities on the natural environment and changes in the direction of a sustainable future also separates green entrepreneurs from their business partners.

It is believed, that the activities of green entrepreneurs are different in industrialized and developing countries. Developed countries and international organizations have a lot of emphasis on green and market opportunities, while developing countries tend to focus more on the term entrepreneurship and market needs (Farinelli, Bottini, Akkoyunlu, 2011).

Barriers of Green Entrepreneurship

According to Hamdouch and DePert (2013), financial and economic barriers are the most important ones for green entrepreneurs. In another study, factors like government constraints, financial constraints, sector constraints, company constraints, and lack of demand were identified as green entrepreneurship barriers (Abuzeinab, Arif, Kulonda, Awuzie, 2016) a change in business models is required. The purpose of this paper is to investigate green business models (GBMs. According to Linnanen (2002, p. 74), there are three categories of barriers that green entrepreneurs need to overcome when offering green products. The first obstacle is the challenge of creating a market. It means that there is still a lack of awareness among the general public about the environment, and consumer behavior is slowly changing. The second is the finance barrier. Environmental entrepreneurs with drive and ideas often find it difficult to find investors who share their objectives and ideals. The third obstacle is the ethical justification for

existence of green entrepreneurs, which is a major issue to take into account when mainstreaming environmental businesses and innovations. A quest for ethical excellence sometimes complicates management (Linnanen, 2002).

However, barriers to green entrepreneurship could be overcome with the use of philosophy related to helix models. Green entrepreneurship focuses on implementing green technologies and preventing environment degradation. What is more, the process of creating green innovations could and should be supported by many institutions, which can help to reduce the risk of launching green innovations and are described within Quintuple Helix Model (Carayannis, Barth Farinelli, Campbell, 2012).

The features of Quintuple Helix Model

The Quintuple Helix Model is derived from the triple helix model, developed in 1995 by Henry Etzkowitz and Leydesdorff (1995) and based on the work of Watson and Crick (1953) in the field of biology, who proposed a double helix model, quickly accepted as the discovery of the specific structure of DNA and awarded the Nobel prize in 1962. The triple helix model, based on the aforementioned concept, describes the dynamics of the relationships between universities (science), industry and public administrations in the context of the creation and development of innovation in national, regional and, increasingly, local innovation systems that underpin a knowledge-based economy (KBE).

The triple helix model can be treated as an empirical heuristic that uses economic and not only economic factors as explicators (Schumpeter, 1964; Nelson, Winter, 1982) and the policy of regional and national authorities (Freeman, 1987; Freeman, Perez, 1988). Moreover, the model theoretically defines internal dynamics of change caused by inventions and innovations based on science (Noble, 1977; Whitley, 1984).

The dependencies within this triangle are not defined in advance and are subject to dynamic change. The most important features of the model include the following:

- The emergence of links between the three types of entities (science – business – administration) responsible for the development of a knowledge-based economy and for constantly increasing the level of innovation in a given space. The most important player in this triad are enterprises, with science and administration taking a supporting role in the innovation processes developed in enterprises;
- playing a role originally assigned to another type of entity, universities begin to be entrepreneurial and become a space for the emergence of enterprises. They become key stimulators of the local community, often influencing the decisions of local and regional administrations. Companies, meanwhile, are involved in sharing knowledge, training employees or participating in research projects and developing academic functions. Administrative authorities, acting according to principles of new public management, also become similar to companies, and by educating their employees, to universities,

- the formation of intermediate organizations located in the functional space between the types of actors: spin-offs, spin-outs, incubators and technology parks, research commercialization and patent rights protection offices, scientific networks, as well as local production agreements.

The triple helix model became the basis for considering the directions of development for a knowledge-based economy. Attempts to describe the impact of national and regional innovation systems are made by various contributing authors along with the creator of the model's concept, Leydesdorff. Research on the relationships in national innovation systems using the triple helix model for Germany (Leydesdorff, Fritsch, 2006), Japan (Leydesdorff, Sun, 2009), Hungary (Lengyel, Leydesdorff, 2011), Norway (Leydesdorff, Strand, 2013), and Russia (Leydesdorff, et al., 2015) are based on the assumption that a knowledge-based economy should lead to the creation of patents (see Figure 1.).

The basic innovation 'core model' of the Triple Helix focuses on the knowledge economy. Quadruple Helix already brings in the perspective of the knowledge society (and of knowledge democracy). From the point-of-view of the Quadruple Helix innovation model, it is evident that there should be a coevolution of the knowledge economy and of knowledge society (see also Dubina et al. 2012). The Quintuple Helix finally stresses the socioecological perspective of the natural environments of society. In such a perspective, social ecology focuses on the interaction, co-development and co-evolution of society and nature (Carayannis, Campbell, 2010, p. 59). In the transformation to a knowledge-based society, knowledge-based economy and knowledge-based democracy (Carayannis, Campbell 2009) and simultaneously under the aspect of climate change, it is possible to generate new and usable knowledge in conjunction with sustainable development.

The goal and interest of the *Quintuple Helix* is to include *the natural environment* as a new subsystem for knowledge and innovation models, so that 'nature' becomes established as a central and equivalent component of and for knowledge production and innovation (Carayannis, Barth, Campbell, 2012). The *natural environment* is for the process of knowledge production, and the creation of a new innovation is particularly important because it serves for the preservation, survival, and vitalization of humanity, and the possible making of new green technologies. With the *Helix of Natural Environment*, 'sustainable development' and 'social ecology' become constituents for social innovation and knowledge production (Carayannis, Campbell, 2010):

"The Quintuple Helix furthermore outlines what sustainable development might mean and imply for 'eco-innovation' and 'eco-entrepreneurship' in the current situation and for our future" (Carayannis, Campbell, 2010, pp. 62–63)."

The most important constituent element of the *Quintuple Helix* – apart from the active 'human agents' – is the resource of 'knowledge', which, through a circulation (*circulation of knowledge*) between social subsystems, changes to innovation and know-how in a society and for the economy (Barth, 2011). The *Quintuple Helix*, thereby, visualizes

the collective interaction and exchange of knowledge in a state (nation-state) by means of the following five subsystems: (1) *education system*, (2) *economic system*, (3) *natural environment*, (4) *media-based and culture-based public (also civil society)*, (5) and the po-

Figure 1. Patents resulting from a knowledge-based economy created on the basis of the triple helix model

Source: Adapted from "The Triple Helix of University – Industry – Government Relations" by L. Leydesdorff, (2013) E. Carayannis and D. Campbell (Eds.), *Encyclopedia of Creativity, Innovation, and Entrepreneurship*, New York: Springer.

litical system (Carayannis, Campbell, 2010). To analyze sustainability in a *Quintuple Helix* and to make sustainable development determination for progress therefore means that each of the five described subsystems (*helices*) has a special and necessary asset at its disposal, with a social (societal) and academic (scientific) relevance for use (Barth, 2011; Meyer, 2008, Carayannis, 2004).

In summary, the *Quintuple Helix Model* can be described (see Figure 2) as a theoretical and practical model for the exchange of the resource of knowledge, based on five social subsystems with 'capital' at its disposal, in order to generate and promote a sustainable development of society (Carayannis, Campbell, 2010). In this *Cumulative Model of Quintuple Helix*, the resource of knowledge moves through a *circulation of knowledge* from *subsystem-to-subsystem* (Barth, 2011, p. 6).

Figure 2. The Quintuple Helix model and its function (functions)

Source: Carayannis, Barth, Campbell, 2012, based on Etzkowitz, Leydesdorff (2000), Carayannis, Campbell (2006; 2009; 2010), and Barth (2011).

This *circulation of knowledge* from subsystem-to-subsystem implies that knowledge has qualities of an *input* and *output* of and for subsystems within a state (nation-state) or between states. If an *input* of knowledge is contributed into one of the five subsystems, then *knowledge creation* takes place (Carayannis, Barth, Campbell, 2012).

This *knowledge creation* aligns with an exchange of basic knowledge and produces new inventions or knowledge as *output*. The *output* of *knowledge creation* of subsystems has two routes: (1) the first route leads to an *output* for the production of innovations for more sustainability in a state (nation-state); (2) the second route leads to an *output* on new know-how back into the *circulation of knowledge*. Through the *circulation of knowledge*, the new *output* of newly created know-how of a subsystem changes into *input* of knowledge for a different subsystem of the *Quintuple Helix*. (Carayannis, Campbell, 2010; Barth, 2011).

Carayannis, Barth and Campbell (2012) emphasise the dominant role of educational system in the quintuple helix model. However, as all helix models presume, effective innovation is based on cooperation among all the entities engaged in innovation process, with dominant role of enterprises, responsible for launching new solutions onto the market. We agree, that a *circulation of knowledge* is kind of regulator in the system, but it is not only the function of universities, because every party in the model is playing a role originally assigned to another type of entity. Moreover, formation of intermediate organizations located in the functional space between the types of actors has high priority in research commercialization, patent rights protection, scientific collaboration, as well as local production agreements, especially in sustainability transitions related to green entrepreneurship and innovations.

Innovation intermediaries support for green innovation and sustainable development

The sustainability-oriented innovation intermediaries that focus on green innovation can be defined as “organizations that assist firms in the eco-innovation process by providing external impulse, motivation, advice and other specific support often by acting as an agent or broker between two or more parties” (Kanda et al., 2015, p. 3). The systematic literature review revealed several pathways by which innovation intermediaries can encourage sustainability. Above all, Kilelu et al. (2011) and Hannon et al. (2014) identified a set of key functions of energy innovation intermediaries in the United Kingdom. The functions included demand articulation (scanning for information/opportunities, foresight through strategic planning, diagnosis through needs/knowledge gap assessment), network building (gate keeping through filtering/selecting collaborators, match making through forming partnerships/market connections), capacity building (organizational development through incubation/support services, training and competence building through management/technical skills/certifications), innovation process management (mediating and arbitrating), knowledge brokering (matching knowledge demand and supply), and institutional support (boundary work between science and practice, institutional change through advocacy, regulation change, and attitudes/practices change). In the context of sustainability-oriented innovation intermediaries, one or more actors within the intermediary would focus on incorporating sustainability principles into these functions in order to encourage and support the creation of businesses and technologies that can act as niche experiments and/or change the regime subsystems.

There are other pathways by which intermediaries can encourage sustainability. For example, some incubators influenced sustainability via the landlord-tenant relationship by requiring tenants to demonstrate specific climate adaptation or mitigation performance, as well as broader environmental, social, economic and governance criteria (Abbate, Coppolino, 2012). In other cases, incubators required prospective tenants to fulfill sustainability focus areas (e.g., sustainable IT, green building, solar and wind energy, energy storage, energy efficiency, smart grid) (Bank, Kanda, 2016). Bank and Kanda's (2016) case studies conducted in Germany, Finland and Sweden outlined the process by which incubators can influence sustainability entrepreneurship through the mechanism of tenant selection by requiring prospective tenants to incorporate sustainability metrics into business plans and goals. They found that some incubators did not fill enough spots and needed to weaken the sustainability criteria to attract more tenants, while other incubators had more applicants than spots and therefore could be more selective regarding the merits of the sustainability ideas. The challenge for incubators attempting to contribute to sustainability is how to gradually influence the incorporation of sustainability principles into the non-sustainability tenant's business plans as they move from incubator to accelerator and eventually graduate to their own office space and growth model.

Kivimaa et al. (2017) found that a university innovation intermediary incubator in Finland did not ‘operationally integrate sustainability’ into the intermediation process.

Rather, entrepreneurs creating and scaling businesses within that incubator incorporated sustainability on an individual basis. Recommendations for co-creating sustainability with the help of university intermediaries included having a sustainability expert, coordinator, or team to work with the intermediary and its entrepreneurs to ingrain sustainability principles into projects and business plans, using sustainability objectives for the intermediary like requiring a portion of the projects deliver sustainability benefits, requiring environmental management and reporting to the university from the incubator and its occupants, and using lifecycle analysis or other sustainability metrics to evaluate projects and proposals.

Strategies and techniques of innovation intermediaries for sustainability transition

An important finding from the systematic literature review about how sustainability-oriented innovation intermediaries facilitate cross-level interactions is that two processes contribute to the creation and survival of innovations: (1) niche to regime interactions, and (2) regime to niche interactions (Gliedt et al., 2018). Moreover, Kivimaa (2014) identified three techniques employed by innovation intermediaries to contribute to niche development. First, they help articulate expectations and visions, including the application and commercialization of technologies and the advancement of sustainability objectives. Second, they help build social networks by carrying out roles such as gatekeeping and brokering, configuring and aligning interests, managing and finding financial resources, and identifying and managing human capital skills. Third, they instigate learning processes, including knowledge gathering, processing, generation, and combination. Learning processes are also related to the assessment, evaluation, piloting, and prototyping of technology, and investment decisions in emerging businesses.

Additional processes focus on communication, education, training, advice, support, and learning-by-doing. Bush et al. (2017) expanded upon Kivimaa's (2014) framework by adding intermediary activities that facilitate empowering processes to encourage broader diffusion of the technology innovation and the corresponding transformation of the regime. These activities include embedding a new regime with new standards/rules, consulting on policy development as a means of influencing opinion and policy direction, and working to encourage policy change through communication and implementation strategies.

Although these activities fall within the skillset of policy entrepreneurs as regime actors¹, policy entrepreneurs were not discussed in the Bush et al. (2017) study,

¹ Regime actors are "supporters of transition by forming powerful coalitions to push through a reform agenda that fits incumbent regimes interest, or opponents of transition by downplaying the need for transformation" (Fischer, Newig, 2016, p. 13). Intermediaries are defined by the roles that they play, including "providing and distributing necessary information, services, mediation, connecting niche-level activities with regime-level institutions, and diffusing new technologies and practices through the regional level" (Fischer, Newig, 2016, p. 14).

suggesting a need for synthesizing these two areas of literature. Based on findings from case studies, Mattes et al. (2015) built upon the MLP by adding a new intermediary subsystem specifically aimed at encouraging innovation and socio-technical transitions. Mattes et al. (2015) argue that local energy development can be driven by the interactions between the scientific subsystem (e.g., science and education), the political subsystem (e.g., political parties and actors), the public administration subsystem (e.g., municipal and regional administration), the industrial subsystem (e.g., companies compete or cooperate), the financial subsystem (e.g., funding, venture capital, banks), and the civil society subsystem (e.g., NGOs, mobilized citizens). The intermediary subsystem (e.g., labor unions, chambers of commerce, network connectors, new enabling organizations) acts as a key connector between the other subsystems to encourage and accelerate the creation of niche experiments as well as changes to the regime. The co-evolving nature of these regime subsystems and actors that connect the niche to regime are critical for sustainability transitions. Mattes et al. (2015, p. 257) suggests that "change may be triggered, pushed or hindered by either subsystem, and the interaction between them increases the necessity to coordinate".

Therefore, depending on the country, state, or city, sustainability professionals could instigate a transition by mobilizing change from within any of these subsystems; however, it is more likely that a transition will successfully break through and change the regime if coordination occurs between more than one subsystem. For example, competition within the industry and scientific subsystems can drive research and development and innovation, but policy innovation within the political subsystem can help to coordinate and accelerate those innovation processes. Mattes et al. (2015) found that new intermediary organizations were created to encourage and coordinate transitions of the energy system toward sustainability in some cases, while existing organizations such as the chamber of commerce and business networks acted as intermediaries in other cases.

The intermediaries helped to bridge gaps between different cultural norms and industrial, scientific, administration and social subsystem actors in the quintuple helix model. The intermediaries were also able to help overcome bottlenecks like legal challenges and administrative red tape. Klewitz et al. (2012) suggest that innovation intermediaries may be able to strengthen a small and medium sized business' ability to absorb and use new information to create sustainability innovations. The intermediary can provide support to businesses via knowledge gathering, processing, testing, validation and training capacity. The intermediary can also help evaluate the effectiveness of sustainability innovations over time. Klewitz et al. (2012) also suggests that a complex intermediary combining public (local government agency) and private (environmental consultancy) organizations within the regime can act as an external stimulus to get businesses to start thinking about sustainability experiments. This represents a regime to niche function where the intermediary influences and supports sustainability innovation.

On the other hand, Gliedt et al., (2018) examined how sustainability-oriented innovation intermediaries can help to create the conditions to accelerate the timeframe of a sustainability transition by fostering more openings for innovations to break through

from the niche to the regime level. Innovation intermediaries connect the niche to the regime via organizational and institutional networks within and between clusters. As part of making socio-technical system change, the framework identifies how intermediaries work to overcome bottlenecks and gain support for integrated solutions that have economic and sustainability benefits, including improved environmental performance due to technology upgrades (see Table 1.).

Table 1. Strategies of innovation intermediaries for sustainability transition in the quintuple helix model

Strategies	Description	Parties involved*
Proposition 1.	Technology entrepreneurs and champions (niche actors) instigate cross-level revolts by linking environmental behaviour and sustainability goals to organizational change.	Economic and natural subsystems
Proposition 2.	Innovation intermediaries facilitate cross-level revolts by connecting organizations as agents of sustainability to green innovation systems.	Economic, education and natural subsystems
Proposition 3.	Policy entrepreneurs (regime actors) drive cross-level revolts by integrating entrepreneurial actions within innovation intermediaries to broader socio-technical system change.	Political, economic and natural subsystems
Proposition 4.	Policy entrepreneurs (regime actors) provide system memory and stability (remember) to the multi-level system during periods of rapid change and uncertainty.	Political, economic, social (society) and natural subsystems
Proposition 5.	Innovation intermediaries coordinate and integrate their actions with technology entrepreneurs and champions, and policy entrepreneurs, to foster niche creation and regime change activities.	Education (scientific), economic and natural subsystems
Proposition 6.	Policy entrepreneurs (regime actors) work to overcome bottlenecks by aligning ideas and policy mixes with political trends to create integrated solutions during a window of opportunity.	Political, scientific, economic and natural subsystems
Proposition 7.	The extent that organizations as agents of sustainability, green innovation processes, and green economic development strategies, successfully transition the institutions and infrastructure of society to a more sustainable state is associated with the rate of change in propositions one through six.	All party involved, impulse to change can come from any party (quinta-lateral relationships)

* First party mentioned is the leader of change.

Source: own source, modified from Gliedt, Hoicka, Jackson, 2018.

The propositions offer pathways for future research on the relationships between innovation intermediaries, champions and policy entrepreneurs. Given their importance to institutional changes at the regime level that can support niche innovation and diffusion, future research should examine how policy entrepreneurs can contribute to regime change functions (Kivimaa, Kern, 2016) in coordination with niche actors and intermediaries.

Conclusion

The role played by entrepreneurs (business) in helix models is complex. In traditional approach, entrepreneurs created new solutions on their own to profit from innovation

without sharing with others. However, the risk of innovation was lowering profitability and it was the reason to develop the idea of triple helix model with derivate, to support launching innovation by universities and administrations.

Switching to Green Entrepreneurship passes from either being aware of the shift in environmental thinking or being innovative (Brannback, Carsrud, 2015). Modern innovative enterprises treat green entrepreneurship as a key to market success and many researchers associate green entrepreneurship with innovations. If innovation is the essence of entrepreneurship, then green entrepreneurs 'destroy existing conventional production methods, products, market structures and consumption patterns and replace them with superior environmental goods and services. They create the market dynamics of environmental progress' (Schaltegger, 2002)

Moreover, the combination of innovation and green entrepreneurship is vital for creating a new businesses (new wealth, new goods and services), making contribution to job creation or reviving an existing business by exploiting new opportunities (Farinelli et al., 2011). On the other hand, it is a kind of technological innovation that reduces the negative impact of human activities on the environment and can contribute to solving environmental problems such as global warming or loss of biodiversity.

Green entrepreneurship can manifest itself in softer and more radical ways (GREENT, 2016). Softer forms of ecological modernization keep the current economic structures and mechanisms, but at the same time, a higher level of ecological effectiveness is achieved through better technologies. On the other hand, more radical forms of re-thinking of the economic paradigm and achieving disruptive innovations exist. Examples of these are the LETS (local exchange trading systems), where goods and services are exchanged using local currencies or without currencies; or community supported agriculture, which enables farmers to receive solidarity funding from the community at the beginning of the growing season in order to guarantee access to fresh and clean food for the members of the community.

Within the quintuple helix model, sustainable development became a core idea, pushing innovators to launch new solutions with support given by universities, administration and society to reduce natural environment degradation. Among seven strategies undertaken by intermediary institutions dedicated to foster innovation processes, the highest synergy is achieved in seventh proposition, based on quinta-lateral relationships.

An important question for researchers and practitioners is to understand how policy entrepreneurs can influence the development of policy mixes that support innovation and green job creation, while guiding the direction of intermediaries, entrepreneurs, administration and universities towards sustainability principles. Innovation intermediaries seem to be necessary to integrate all sides of the quintuple helix model.

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