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CREATING TECHNOLOGY-DRIVEN ENTREPRENEURSHIP

Foundations, Processes and Environments

Creating Technology-Driven Entrepreneurship

Giuseppina Passiante • Aldo Romano
Editors

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To the lovely memory of Aldo Romano, our inspiring mentor and visionary leader

Foreword

In today's business age, organisational and local wealth creation is increasingly the result of an entrepreneurial spirit found within entrepreneurs, employees and change agents. This authoritative book makes a contribution towards disentangling the driving force of value creation represented by entrepreneurship. With a specific focus on the relevance of technology-driven entrepreneurship, some crucial questions are addressed that engage current debate. What is the role of technological entrepreneurship in transforming the current economic scenario? How can technology-driven entrepreneurship support innovation, job creation, productivity and economic growth? How are the processes of change fostered by technology-driven entrepreneurship? What are the main activities of a technology-driven entrepreneur? What is the learning process grounding the new forms of knowledge-intensive entrepreneurship? These are some of the relevant research and practical issues explored in this book. The editors, Giuseppina Passiante and Aldo Romano—interweaving a range of research contributions—provide answers and new insights about the nature, content and impact of technology-driven entrepreneurship, and outline how the entrepreneurs, exploiting advanced knowledge and technology, can enhance economic and social value-creation dynamics.

In *Creating Technology-Driven Entrepreneurship: Foundations, Processes and Environments*, the authors argue specifically regarding the importance of elaborating entrepreneurial learning processes and the need to create personalised entrepreneurial ecosystems made up of key stakeholders, resources, knowledge assets, services, competencies and relationships supporting the development of new business ideas, and enabling the capacity to overcome the geographical and industrial limitations of the traditionally based ecosystems. In particular, the framework for Entrepreneurial Learning is proposed and its three key principles are addressed and discussed, highlighting primarily the fundamental importance of developing entrepreneurial pedagogic approaches in teaching, learning and hands-on practices; second, the need for the creation of enabling environments to stimulate and increase entrepreneurial spirit and skills; and, finally, the relevance of nurturing the entrepreneurial ecosystem through a continuous engagement of its key stakeholders.

This book makes a significant contribution to strengthening the conceptual and empirical basis of a better understanding of the relevance of technology-driven entrepreneurship in the economic scenario, and how entrepreneurial learning processes can impact successfully on the capacity to translate new ideas, technologies and inventions into economic and social value, through innovative and knowledge-based business models.

The proposed models and frameworks aim to illuminate and elaborate on new entrepreneurial learning mechanisms that can equip organisations and individuals with the capacity to go beyond simple knowledge acquisition and transfer to encompass the context-specific values, attitudes and behaviours linked strictly to innovations.

At the present time, with so many challenges continuously emerging, and issues that are radically changing economic, social and employment-related scenarios, it is increasingly critical that individuals and organisations feel and develop new mixes of entrepreneurial attitudes, entrepreneurial skills and knowledge of entrepreneurship, as these are essential to achieve the goals they set for their entrepreneurial activities, and more generally for the purpose of value creation.

This book provides a new way of looking at entrepreneurship and entrepreneurial learning mechanisms, and introduces effective models, tools and techniques to transform economic and competitive scenarios, and more broadly to enhance intelligent, sustainable and inclusive growth and employment.

For this reason, *Creating Technology-Driven Entrepreneurship: Foundations, Processes and Environments* is a significant scientific contribution towards advancing the understanding of the role and relevance of entrepreneurship. It is an authoritative research work that will help entrepreneurs and organisations to understand how to create, use and integrate effectively knowledge and technologies to create value for them as well as for society in general.

The book not only presents the results of decades of research undertaken by the research team co-ordinated by Aldo Romano at the University of Salento, but most important integrates his spirit and vision. Aldo always embedded in his endeavours a mix of disruptive and forward-looking knowledge-based entrepreneurial competence and capability. He is an example of an academic entrepreneur who dedicated his life to inspiring a new generation of scholars and practitioners. Aldo developed initiatives, frameworks, events and institutions with the aim of fostering the development of an entrepreneurial mindset and the capacity to better and impact in a positive way on individual, organisational and local wealth creation. His passion and dreams for entrepreneurial learning and development have affected all those who were lucky to have the opportunity to be inspired by his energy. This book is the last research contribution by Aldo to the academic community, but all his accomplishments will continue to inspire and enrich our activities towards a better society.

University of Basilicata, Matera, Italy Giovanni Schiuma

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About the Editors

Giuseppina Passiante is Full Professor of Innovation Management and Technology Entrepreneurship at the University of Salento, Lecce, Italy. Currently her research fields concern Technology Entrepreneurship, and more specifically the experiential learning environment encouraging enterprise and entrepreneurship capabilities, skills and competencies. She is also an expert in knowledge-based organisations and local systems, information technologies (ITs) and clusters approaches, and complexity in economic systems. She has published several books and about 100 papers in these research fields. She is Associate Editor of the *International Journal of Innovation and Technology Management*, and co-ordinator of the International Ph.D. programmes on Technology Innovation and Entrepreneurship at University of Salento, Italy.

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Introduction

Giuseppina Passiante and Aldo Romano

The central role of technological entrepreneurship in transforming the current economic scenario has recently generated considerable interest. Its importance is related mainly to its capacity to support innovation, job creation, productivity and economic growth (Van Praag and Versloot 2007; EC 2013) and to promote sustainable smart development (SEECEL 2011).

Technology-driven entrepreneurship, defined for the first time by Schumpeter as the ability to respond to the creative processes of change (Schumpeter 1934), has been characterised in several successive scientific studies as a virtuous combination of intellectual and entrepreneurial capital. In this view, it has been conceived as the result of a virtuous mix of individual talents with creativity, instinct, courage, capabilities of vision, practical sense, passion for innovation and challenges, and passion for experimentation and leadership, together with a suitable environment equipped with technological, managerial and financial resources that allow talents to exploit market opportunities (Venkataraman 2004).

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In the current scenario of the knowledge economy, technology-driven entrepreneurship has assumed the characteristics of knowledge-intensive entrepreneurship. Specifically, the technology-driven entrepreneur has become a 'knowledge operator, able to utilize existing knowledge, integrate different knowledge assets and create new knowledge' (Malerba 2010). Knowledge-intensive entrepreneurship is consequently interpreted as the capacity to transform new ideas, technologies and inventions into economic and social value through innovative and knowledge-based business models. To this end, technology-driven entrepreneurship is characterised as a process that involves a plurality of actors operating within complex knowledge-based networks that develop among firms, universities and other organisations. The activity of a technology-driven entrepreneur is indeed related to a wide exploitation of knowledge-based technologies in different organisations; these organisations can be start-ups, corporate companies or academic companies; knowledge can be obtained by activating social, financial or expertise networks within and across this wide array of organisations.

However, the absence of accepted unifying theoretical assumptions of knowledge-intensive entrepreneurship, combined with a wide diversity of perspectives and a lack of congruence in the literature, continues to constrain its theoretical development (Shane and Venkataraman 2000). The most relevant shortcomings emerge in the comprehension of entrepreneurial learning processes (Minniti and Bygrave 2001; Politis 2005); nonetheless, 'entrepreneurship is a process of learning, and a theory of entrepreneurship requires a theory of learning' (Minniti and Bygrave 2001). Companies indeed have to be continuously entrepreneurial, regardless of their age and developmental stage. To this end, they have to develop continuous learning processes (Corbett 2005; Kenworthy and McMullan 2013). Indeed, entrepreneurs can be interpreted as being permanent learners (Franco and Haase 2009). Moreover, at the corporate level, managers also need to transform themselves into knowledge-intensive entrepreneurs, able to create and pursue new growth opportunities for their business. Efforts then have to be taken to develop entrepreneurial learning processes and to create knowledge-intensive entrepreneurs (Etzkowitz and Zhou 2008; Rae and Wang 2015). However, such initiatives remain isolated and fragmented, lacking holistic, integrative and systemic approaches that have the potential to cultivate entrepreneurial learning mechanisms that go beyond simple knowledge acquisition and transfer to encompass the context-specific values, attitudes and behaviours strictly linked to innovations.

More specifically, the practical and emergent values of entrepreneurial learning call for innovative educational methods and pedagogical techniques to facilitate experiential learning, as opposed to the teaching of general principles (Honig 2004). Such methods challenge current linear academic systems and demand new learning strategies, cultures, structures and processes that transcend planned knowledge transfer and acquisition (Rae 2006). Individuals have to develop mixes of entrepreneurial attitudes, entrepreneurial skills and a knowledge of entrepreneurship that are essential to achieving the goals they set for their entrepreneurial activities:

- An entrepreneurial attitude refers to the capacity of a person to make choices and stick to them, taking responsibility for their results. The attitude is based on the following individual characteristics: sense of initiative, risk propensity, self-efficacy, need for achievement, as well as the ability to work in an organised manner and the ability to persist when faced with obstacles and problems (Mohsin et al. 2015).
- Entrepreneurial skills concern the ability to turn ideas into action. Skills are based on creativity, as well as on the capacity to analyse, motivate, network and adapt (Hodges et al. 2015).
- Knowledge refers to a broad comprehension of entrepreneurship, including the role that entrepreneurs and entrepreneurship play in modern economies and societies (Hodges et al. 2015).

Figure 1.1 shows a framework for entrepreneurial learning, highlighting primarily the need for an enabling environment where key stakeholders allow young talents to achieve entrepreneurial outcomes through the adoption of a set of appropriate entrepreneurial practices. The framework is indeed focused on mixtures of enabling environments, engaging stakeholders and entrepreneurial practices.

The guiding principles of the framework may be synthesised in (NCGE 2008):

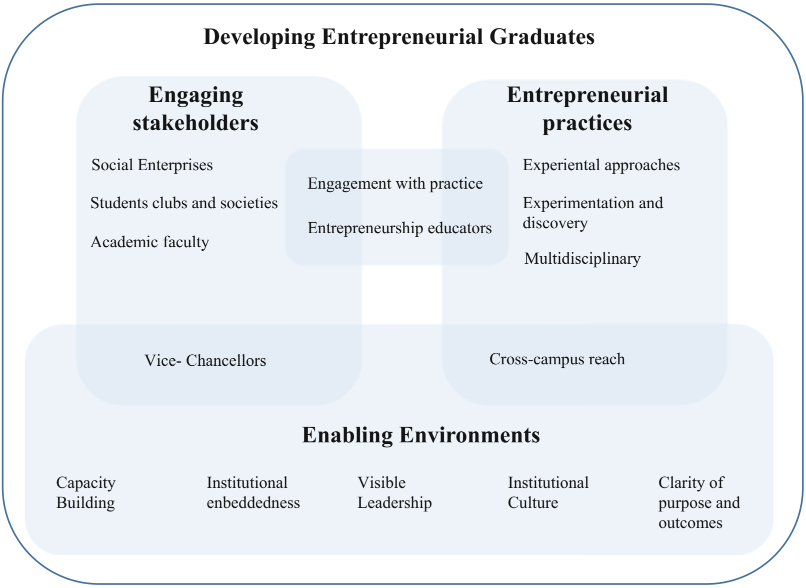

Fig. 1.1 Framework for entrepreneurial learning.
Source: Adapted from NCGE (2008)

1. *The development of entrepreneurial pedagogic approaches in teaching, learning and support practices*. As the skills suitable for developing entrepreneurship in the knowledge economy change, traditional education models are becoming irrelevant (Meira Soares and Amaral 1999; Scott et al. 2016). Universities and academics have been criticised for their inability to provide programmes and action-learning approaches suitable to develop entrepreneurial competences and mindsets, including the capacity to think creatively, strategically, analytically and reflectively, as well as to display mature confidence in one's own capacity and ability to collaborate, communicate and understand the current business scenario (Pollard and Wilson 2013). It is recommended that this human capital be developed beyond the 'business school', given that the most high-tech entrepreneurial ideas are likely to come from the creative and technical disciplines (EC 2008).
2. *The need for an enabling environment*, in both universities and other institutions, to develop enterprise and entrepreneurship behaviours in

students. Such environments should support activities such as practical problem solving, opportunity spotting, project management, budgeting, communicating, teamworking, coping with pressure and managing complexity to stimulate and encourage individuals to find opportunities, purchase resources and take action in all contexts that have relevance for their entrepreneurial objectives (Rubin et al. 2015).

3. *The involvement of the key stakeholders of the entrepreneurial ecosystem*. Entrepreneurship takes place in ecosystems in which multiple stakeholders develop continuous learning processes through relationships between them (WEF 2009). Indeed, successful entrepreneurship is expected to develop more where key stakeholders provide learning opportunities and facilitate the creation and exchange of tacit entrepreneurial knowledge (Ng 2015).

The following sections describe in detail each of the above guidelines.

1 Developing Entrepreneurial Pedagogic Approaches in Teaching, Learning, and Support Practices

In current educational systems, rigid curricular structures prevent students from engaging in a dynamic learning experience that addresses time- and context-specific questions and problems (Mumford 2006) and that promotes change-driven attitudes, instead opting for conformist and co-operative behaviours.

Higher education systems are expected to become more responsive to the skills needs and competences needs emerging from the metamorphosis of the current market and the business environment as well as the evolutionary patterns caused by technological, socio-economic and environmental changes.

The delivery of entrepreneurship education challenges universities and education institutions to review and reflect on some strategic issues:

- *Learning environments and pedagogies*

The development of learners' entrepreneurial capacities involves developing their mindsets, attitudes, belief systems, self-efficacy, emotions and personal values as much as their technical knowledge and skills. This is particularly important if the goal is to increase entrepreneurial propensity: realising this goal requires a learning model that emphasises experience, action and reflective practices, and that enables learners to experience entrepreneurial ways of thinking, behaving and acting, and to be responsible for their own actions and future through personal discovery, performance, experimentation and learning from failure.

- *Developing entrepreneurial teaching and learning*

It becomes necessary to evolve from the traditional transmission models of teaching (learning 'about') to new forms of experiential learning (learning 'for'), where students can learn entrepreneurial techniques that can be applied across a broad range of backgrounds. Experience is decisive for understanding and learning entrepreneurial concepts, and can be provided through innovative pedagogies that pose challenges to students, sustain them in drawing on resources from outside the university, and bring a 'real world' experience into the classroom or laboratory.

- *Developing engaging learning practices*

Pedagogic practices should include high levels of 'learning through doing', problem creation and problem solving, and project-centred learning that often simulates 'real-world' situations. Therefore, educators should:

  - Include activities to experiment, discover, practice, reflect on theory, and learn from each other. Students should also use multi-disciplinary approaches to integrate different forms of knowledge and views of the learning process.
  - Ensure flexibility to allow students to reorganise their knowledge, compare different approaches, be audacious, and adopt self-directed styles of learning.
- Developing practical mechanisms to embed a broad experience of entrepreneurship that includes innovation, creativity, collaboration

and problem solving, as well as to understand business, social enterprise and new venture creation processes. Moreover, students have to learn how to recognise opportunities, take risks, think strategically, work flexibly, develop resilience, manage complexity, cope with isolation, and acquire the more generic skills needed for the workplace (teamworking, communication skills, commercial awareness, and problem creation and problem solving).

- Enhancing self-development and self-directed learning as well as levels of self-efficacy to increase students' ambition and commitment to entrepreneurship. Since entrepreneurship is centred on the individual, students have to develop their entrepreneurial experience in line with their aspirations. To this end, the European Commission has suggested some guidelines:
  - Students have to approach entrepreneurship as a part of society rather than simply a part of business.
  - Learning from each other has to be a central part of an entrepreneurship education programme.
  - Students have to work with businesses in a real-life development project. 'This allows them to learn "in" entrepreneurship and to create knowledge "for" as well as "about" entrepreneurship'.

Moreover, the incredible development of information and communication technologies such as the internet is generating new scenarios in which people and machines can collaborate with each other in a way that was unimaginable in the recent past. As a consequence, a concept of collective intelligence is emerging, conceived as a process that orchestrates people, activities, knowledge resources and flows to achieve specific entrepreneurial goals. To face these new entrepreneurship-related dynamics, it becomes necessary to develop new learning fields, in which experiments are conducted with collective intelligence approaches and systems. In this view, it becomes necessary to define conceptual models and service architectures to leverage the 'wisdom of the crowd' as well as to set up an integrated virtual environment completely customised according to the real entrepreneurial opportunity and entrepreneur's needs.

2 Creating Suitable Environments for Technology-Driven Entrepreneurship

A suitable environment for supporting the development of technology-driven entrepreneurship, which is equipped with technological, managerial and financial resources, together with market opportunities, is usually identified in the concept of the business incubator. Business incubators are facilities that provide rental spaces, shared basic business services and equipment, and business assistance, coaching, and financial support to start-ups and young firms in order to accelerate their successful development (Allen and Rahman 1985; Campbell et al. 1985; Plosila and Allen 1985; Brooks 1986; Smilor and Gill 1986; Fry 1987; Kuratko et al. 1987; Merrifield 1987; Campbell 1989; Allen and McCluskey 1990; Lalkaka 2003; Zedtwitz and Grimaldi 2006; Aernoudt 2004; Hackett and Dilts 2004; Grimaldi and Grandi 2005; NBIA 2007).

Furthermore, pre-incubation services have recently become a key strategic asset for the development of the entrepreneurial learning processes that lead to success in the very early stages of the development of a business idea. While a business incubator provides its services to already founded start-up companies in their early stages of development, a business pre-incubator supports the entrepreneurial learning processes that develop during the planning stage (Wirsing et al. 2002; Kirby 2004; Hannon 2005), providing services on learning how to formulate business plans, develop a prototype, establish an entrepreneurial team, and lead the embryonic business to an investment and/or market-ready stage, up to the establishment of the new start-up.

Figure 1.2 shows a classification of business incubators and business pre-incubators.

As highlighted in Fig. 1.1, business pre-incubation aims to bridge the gap between the occurrence of a business idea and the establishment of a company. It sustains the learning processes of nascent entrepreneurs, while business incubators support the survival and growth of already existing entrepreneurial companies.

Moreover, they both provide services that can overlap between the pre-incubation and incubation stages, as shown in Fig. 1.3.

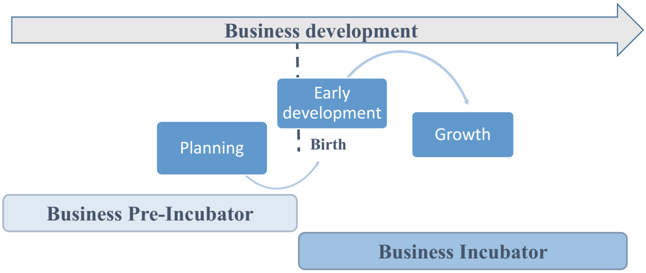

Fig. 1.2 Classification of business incubators and business pre-incubators. *Source*: Adapted from Deutschmann (2007)

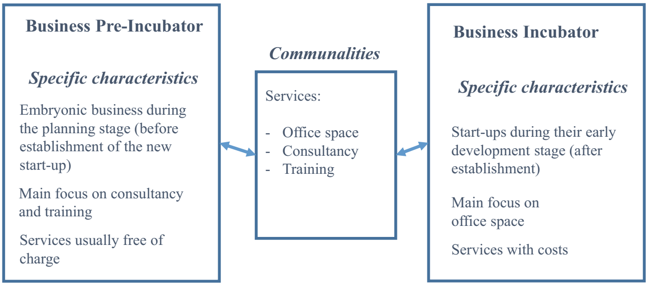

Fig. 1.3 Differences and communalities between business incubators and business pre-incubators.
Source: Adapted from Deutschmann (2007)

Pre-incubation is also widely defined as a 'risk-reduced environment where entrepreneurial ideas can be tested for market viability before progressing into the business incubator' (Dickson 2004). This definition, because of its all-encompassing character, can include all the services preparing the embryonic entrepreneur to develop learning processes appropriate to starting his or her business, such as, for example (Deutschmann 2007):

- Services offered during the period of pre-company formation: pre-incubators therefore only support entrepreneurial projects and companies that are not already registered (USINE 2005).
- A 'risk mitigation strategy' for both the incubation staff and the pre-incubated company (Dickson 2004: 14). According to this strategy,

embryonic entrepreneurs are allowed to test the markets with their products and services during the pre-incubation stage. This allows the nascent entrepreneurs to test the feasibility of their business ideas before taking the risk of establishing their own companies. On the other hand, a pre-incubator reduces the risk associated with selecting participants by only pre-incubating the business ideas with the greatest chance of success (Deutschmann 2007). Pre-incubation time may vary between a couple of months and several years depending on the pre-incubation concept (Dickson 2004).
- Courses on entrepreneurship (e.g. entrepreneurial paths), which offer credits for pre-incubation activities and integrate business plan development into degree programmes (Dickson 2004). The path from pre-incubation to business incubation is also promoted by offering tailored service packages for nascent entrepreneurs, and by organising pre-incubation as part of already existing business incubation.

Pre-incubators have become a facility that fills the gap between higher education and business incubators, not only in Western countries, but also within the BRICS (Brazil, Russia, India, China and South Africa) economies. For example, in China, pre-incubators have developed into a vehicle that connects technological results with the market, becoming one of the privileged means of fostering the growth model and the ambitions of the Asian giant.

The centrality of technology-driven entrepreneurship and pre-incubators requires a deep discussion on the implications for political agendas that seek to support the development of entrepreneurial attitudes and behaviours—in particular in small and medium-sized enterprises (SMEs), universities, and public institutions—with reference to the best practices at the European level.

3 Involving the Key Stakeholders of the Entrepreneurial Ecosystem

The expression ‘stakeholders’ is being used increasingly to denote actors that develop entrepreneurial learning processes. Stakeholders include people from neighbouring towns and villages, local and regional authorities, and the business sector (Pawłowski 2001). The relationship with key stakeholders is then considered to be the most suitable learning strategy, away from the 'instructional' context of higher education, to allow students to develop entrepreneurial learning processes (Gibb 2002). Students need to validate their ideas and modify them as necessary via direct contact with the key stakeholders outside the university, as well as leverage the potentiality of social networks and the internet (Vincett and Farlow 2008).

These entrepreneurial learning processes can be enhanced through creative environments where it is possible to integrate global and local processes of knowledge creation, knowledge diffusion and knowledge absorption (Schumpeter 1934; Venkataraman 2004). These creative environments, usually defined as 'entrepreneurial ecosystems', incorporate universities and research institutions, industry, states, governments, political systems, and culture-based public and natural social environments (Carayannis and Campbell 2009), as shown in Fig. 1.4.

Academic institutions assume a critical role as intellectual hubs by serving as pre-incubators for the exploitation of the results of innovation and research, as well as focal points for collaboration between researchers, students, professors, companies and entrepreneurs. Furthermore, universities are required to take specific actions to serve as catalysts for sustainable innovation systems involving various stakeholders, thus contributing to

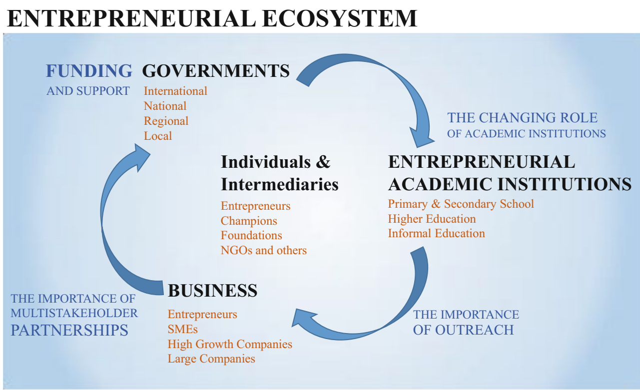

Fig. 1.4 Entrepreneurial ecosystem.
Source: Adapted from WEF (2009)

economic growth, firm and national competitiveness, and overall business performance. These elements characterise the envisioning of a new archetype of a university—the stakeholder university (Romano 2009)—which promotes learning and capability-building processes among globally distributed and integrated networks of heterogeneous stakeholders (employees, customers, suppliers, partners, academics, professionals and independent learners) (Elia et al. 2011) to nurture the next generation of entrepreneurs.

Additionally, entrepreneurship education requires close co-operation between academia and business. Companies and entrepreneurs play helpful roles in promoting entrepreneurial endeavours by providing knowledge, up-to-date expertise, mentoring, social capital and financial support. Entrepreneurs can also make a student's experience richer and more fulfilling by offering stimulating learning experiences that can give them the chance to experiment, discover new ways of thinking, link theory and practice, build commercial awareness, develop venture creation skills, and grasp the opportunities to network and build social capital. Strong links with entrepreneurs are also essential to adapt university curricula to the needs of employers. Entrepreneurs may take the roles of guest lecturers, entrepreneurs-in-residence, mentors, or professors of practice. On the other hand, they can call on the expertise of academics by hosting academic placements in their organisations, and can contribute to future employee development by providing student placements and offering company projects as case studies.

Finally, governments at the international, national, regional and local levels play important roles in deciding on suitable legal and fiscal frameworks for boosting entrepreneurship as well as in filling market gaps as necessary (WEF 2009). Governments can also support entrepreneurial education, by providing systemic strategic goals, including entrepreneurship education in primary, secondary and higher education, and by developing an integrated policy framework that covers the entire education spectrum from primary school to university.

To develop entrepreneurial learning processes for students, it becomes necessary to create personalised entrepreneurial ecosystems made up of key stakeholders, resources, knowledge assets, services, competences and relationships that support the development of new business ideas, and this often prompts the overcoming of the geographical and industrial limitations of traditional territorial-based ecosystems.

This book addresses and discusses all three guidelines of the framework for entrepreneurial learning. Specifically, in Chapter 2, Romano, Passiante and Del Vecchio aim to define an archetype of technology-driven entrepreneurship as it emerges in the current scientific and institutional debate. Starting from the assumption that technologies have a knowledge-intensive nature, the chapter discusses the following issues:

- The meaning of technology-driven entrepreneurship: a literature review, behaviours, attitudes, socio-economic processes, etc.
- The technology-driven entrepreneur as a knowledge-intensive entrepreneur.
- Technology-driven entrepreneurship as a learning process.

In Chapter 3, Elia, Margherita and Petti focus on corporate entrepreneurship, defined as an articulated process that originates from the creative ideas of managers and employees, and arrives at the generation of innovative results such as new products, processes, business units and ventures. In particular, the study presents 'individual' antecedents, with a particular focus on employee creativity, and 'organisational' antecedents, with specific attention to the human resource management practices that facilitate the emergence of entrepreneurial dynamics within organisations. An integrative model of antecedents and enabling conditions is then introduced and used to analyse some successful cases of creative organisations operating in technology-based industries.

In Chapter 4, Moustaghfir and Secundo shed more light on the entrepreneurial university model and analyse the main aspects of it. The purpose is to develop a framework for developing specific entrepreneurial competences and attitudes that are capable of fostering economic and business innovation, that are linked to academic and learning processes, and are facilitated through strategic, managerial and cultural mechanisms and practices. The intent is to offer a holistic scheme to support decision- and policy-making at both university and national levels to meet economic and technological challenges.

In Chapter 5, Secundo and Moustaghfir develop a new understanding of entrepreneurial learning, defining an integrated framework for the entrepreneurial learning process in the context of technology-driven entrepreneurship. Entrepreneurial learning has indeed emerged as an important yet insufficiently understood area of enquiry in the field of entrepreneurship, especially in knowledge-intensive entrepreneurship. However, very few studies are available that examine the specific processes which take place at the individual and collective levels in entrepreneurship and transform experience into entrepreneurial knowledge (Politis 2005; Rae 2006).

In Chapter 6, Ndou, Secundo and Mele present the results of an explorative analysis aimed at understanding how universities behave and which instruments, mechanisms and initiatives are being used to develop the set of skills, capabilities and capacities required for the creation of adequate entrepreneurial human capital. By presenting evidence of some of the most recognised cases of entrepreneurship centres in the most renowned European universities, the aim is to provide an insight into and to highlight the strategic pillars of a discontinuity in the process of human capital creation. Indeed, through a cross-case analysis Ndou, Secundo and Mele attempt to frame a 'process-based' model for entrepreneurial mindset creation in which entrepreneurial contents, learning strategies, collaborations and network relations between academia and industry are interlinked in a dynamic and interactive way.

Chapter 7 proposes a conceptual model and the service architecture of a collective intelligence system aimed at supporting technology-driven entrepreneurship. After an introduction on collective intelligence, Elia and Margherita propose a model of a collective intelligence system for setting up an integrated virtual environment for collective intelligence that is customised according to the real entrepreneurial opportunity and the entrepreneur's needs. The model and the system allow for the building of personalised virtual entrepreneurial ecosystems made up of the actors, resources, knowledge assets, services, competences and relationships required to better support the idea-to-venture process. In such a view, the model and platform proposed allow the geographical and industrial limitations of traditional territorial-based ecosystems to be overcome.

In Chapter 8, Ceci, Masciarelli and Prencipe present an overview of the different theoretical perspectives on the role of cultural values in the knowledge-sharing processes of a network of firms. They test the identified theoretical perspectives in an original empirical setting. According to their results, sharing similar cultural values contributes to creating a 'fit' between the entrepreneur and the network that is primarily responsible for the circulation of knowledge.

In Chapter 9, Petti employs official sources and literature, as well as cases and data collected through field research, to provide an overview of Chinese technology-driven entrepreneurship. To do so, the context, the actors, the practices and preliminary evaluations of the impact of some key factors will be illustrated and discussed, after which the peculiar features of Chinese technology-driven entrepreneurship and their persistence over time will be considered. The overall aim is to ascertain whether, and to what extent, the Chinese example offers different insights from what is usually believed, written and practised in Silicon Valley in the USA and the European Union (EU), as well as whether these are, or may represent, an extension of the current conventional models and knowledge.

Finally, in Chapter 10, Del Vecchio and De Maggio focus on the centrality of technology-driven entrepreneurship as a key process for the smart growth of regions, as well as for the competitiveness of individuals and organisations, and provide some implications for the political agendas of institutions and researchers. After the identification and analysis of some best practices at the European level, the chapter explores a set of actions that are useful for defining a political agenda able to support the development of entrepreneurial attitudes and behaviours, particularly in SMEs, universities and public institutions.

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2

The Technology-Driven Entrepreneurship in the Knowledge Economy

Aldo Romano, Giuseppina Passiante and Pasquale Del Vecchio

1 Introduction

Characterized by growing knowledge, turbulence and uncertainty, the current socio-economic scenario is largely recognized as an entrepreneurial economy. Technology-driven entrepreneurship arises as a strategic process and attitude for the competitiveness and survival of individuals, organizations and territories. Due to the nature of technologies as enablers for conception, execution and renewal of an entrepreneurial process, entrepreneurship of today is a knowledge-intensive and technology-driven process, different from the traditional entrepreneurship that is driven by the market. It is the knowledge-intensive nature of entrepreneurship to highlight learning as the key process accompanying the technology-driven entrepreneur. Embedded into a complex network of relationships, also identified as innovation ecosystems that are a favourable locus for disseminating and nurturing technology entrepreneurship, technology-driven entrepreneur is becoming a configurable

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learning actor, source and beneficiary of knowledge creation, diffusion and absorption, operated by a broad network of actors.

With the aim of providing systematization at several streams of research related to the technology-driven entrepreneurship, as emerging in the works of researchers and scholars in terms of behaviour, attitude, processes and environments, the chapter is organized around two main sections—first, one focused more on the analysis of technology-driven entrepreneurship at macro-level, starting from the entrepreneurial economy, the nature of the key enabling technologies as opportunities and tools for the creation of technology-driven ventures, as well as the centrality of the innovation ecosystems as suitable environments for conceiving and developing technology-driven entrepreneurship. In the second section, a deeper reading of the technology-driven entrepreneurship is provided, with the aim to define the archetype of technology-driven entrepreneurship as emerging in the current scientific debate. This is based on literature about the comprehension of its conceptual meaning, behaviours, attitudes, socio-economic process, knowledge-intensive configuration, as well as its comprehension as a learning process.

2 From the Entrepreneurial Economy to the Innovation Ecosystems: The Emergence of Technology-Driven Entrepreneurship

2.1 The Knowledge Economy as Entrepreneurial Economy

Characterized by turbulence, the continuous change in the offer and demand of goods and services and the emergence of new types of jobs and markets, the current socio-economic scenario is a context characterized by competitive dynamics, mainly based on the valorization of the vast knowledge that is created daily and shared worldwide. This new scenario results from the globalization, low-cost but highly skilled new players, the large diffusion and pervasiveness of technologies

(Audretsch and Thurik 2001; Romano 2013). Arthur (2012) defines this context as economy of the complexity, as a socio-economic scenario characterized by a perpetual motion and process of continuously computing and constructing itself.

Those new innovative dynamics and rules represent the strategic asset for the competitiveness of individuals, organizations and countries. Their competiveness and survival depends on their capacity of acquiring, developing and managing intangible assets for identifying new opportunities for growth and sustaining their processes of value creation for larger communities of stakeholders (Allee 2009). And this is the main assumption behind the characterization of the current socio-economic scenario as knowledge economy. Audretsch and Thurik (2001) and Thurik (2008) provide a synthetic overview of the current context that explains the shift from the economy of the twentieth century, also defined as managed economy, to the economy of today, also defined as entrepreneurial economy, through the analysis of 14 trade-offs related to underlying forces, external environment, firm behaviour and government policies. In synthesis, the model of the managed economy revolves around the links between stability, specialization, homogeneity, scale, certainty and predictability, on the one hand, and economic growth, on the other. By contrast, the model of entrepreneurial economy focuses on the links between flexibility, turbulence, diversity, novelty, innovation, linkages and clustering, on the one hand, and economic growth, on the other (Thurik 2008). Adapted from the works of Audretsch and Thurik (2001) and Thurik (2008), the following Fig. 2.1 offers a synthesis of the main trade-offs previously described.

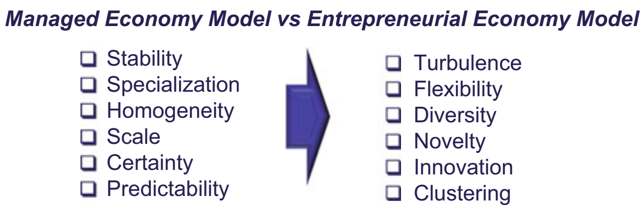

Fig. 2.1 The main trade-offs from the managed to the entrepreneurial economy.
Source: Adapted from Audretsch and Thurik (2001) and Thurik (2008)

Figure 2.1 suggests some useful considerations and comments:

- In the managed economy of the twentieth century, the dominant factors of production were labour and capital; in the entrepreneurial economy of the twenty-first century, the determining factor of production is knowledge, not only in terms of technical and scientific software but also as an input that includes aspects such as creativity, skills to communicate and emotional intelligence. Indeed, in the entrepreneurial economy, the competitive advantage is driven by innovative activity, and knowledge spillovers are an important source of this activity.
- The economy of the twentieth century is mainly focused on continuity, i.e., on incremental innovation compatible with existing core competencies and technological trajectories of the firm or the industry. The entrepreneurial economy of the twenty-first century is, instead, focused on radical innovation, standing beyond the boundaries of the core competence and the technological trajectory of the firm or the industry.
- In the managed economy, unemployment can be reduced only through lower salaries. In the entrepreneurial economy, high employment can be combined with high wages, while a low wage does not necessarily imply high employment. Small firms in general and new ventures in particular are the engine of not only employment but also productivity.
- In the managed economy, the external environment was characterized by stability, homogeneity and specialization. Turbulence, diversity and heterogeneity instead typify the external environment of the entrepreneurial economy.
- In the managed economy, firms are based on controls and transactions, competition is an alternative to cooperation, and economies of scale have a strategic role. In the entrepreneurial economy, firms are based on motivation, market exchanges and flexibility. Competition and cooperation are complementary.
- In the managed economy, public policy has an essentially constraining nature (antitrust policy, regulation, public ownership, concerns about excess profits and abuses in terms of market dominance). In the entrepreneurial economy, the government policy aims to create an environment suitable for supporting the success and sustainability of firms. The appropriate policy is to be the facilitator of international competitiveness,

growth and employment by creating links and networks, proposing incentives to firms and knowledge institutes, stimulating special and functional flexibility of labour, and creating forms of social innovation.

In such new economic and social context, entrepreneurship arises as the core process of individuals, organizations and territories. While, the growing complexity of the demand and the levels of increased competition requires a more diffused attitude to innovation.

In the same direction, Audretsch and Keilbach (2004) have focused their attention on entrepreneurial capital as diffused attitude of a society or region supporting the creation of new firms. Starting from the empirical analysis of the Silicon Valley, as well as from the awareness of the value of knowledge into the socio-economic dynamics of regions, the authors refer to entrepreneurial capital as the dimension of the social capital more relevant for creating the diffusion of an entrepreneurial culture.

A further emerging consideration of growth of organizations and institutions in knowledge economy is represented by its sustainable dimension, that is, assumed as the necessity of balancing and mutually complementing all forms of capitals, from the industrial to the human, from the natural to the societal (Hautamäki 2010).

2.2 The Knowledge-Intensive Technologies as Enablers of the Entrepreneurial Economy

To explore and to identify the strategic assets enabling the competiveness in the knowledge economy, we refer to the "structuralist-evolutionary model", based on the neo-schumpeterian research stream (Arthur 1999, 2009; Lipsey et al. 1998; Schumpeter 1934). According to this model, economy can be conceived as an expression of general purpose technologies or of enabling technologies. This means that economy changes constantly, as far as technologies evolve, and arises ultimately out of the phenomena that create technology. The evolutionary process of technology impacts and transforms "the economic structure from within, incessantly destroying the old one, incessantly creating a new one"

(Schumpeter 1942, p. 83). Novel combinations are created, in terms of new goods, new methods of production or transportation, new markets and new forms of industrial organization. In this way, the economy is "always in perpetual openness of change—in perpetual novelty" (Arthur 2009). Currently, the "smart technologies" grounded on intensive knowledge, such as ICTs, biotech, nanotech, advanced materials, etc., are driving the evolution of traditional economy, based on physical resources, towards configurations characterizing knowledge economy, based prevalently on immaterial resources. Identified as Micro-nano electronics, nanotechnology, advanced materials, photonics, industrial biotechnologies and advanced manufacturing technologies, Key Enabling Technologies (KETs) are by nature knowledge intensive, associated with rapid innovation cycles and highly skilled employment. They enable process, goods and service innovation throughout the economy and are of systemic relevance. They are multidisciplinary, with a trend towards convergence and integration. KETs feed into many different industrial value chains and sectors in heterogeneous ways. Due to their transversal nature, KETs will catalyze the strengthening and modernizing of the industrial base, and will also drive the development of entirely new industries in the entrepreneurial economy. The timely commercialization of KETs requires the development of high-risk products demonstration and proof-of-concept projects in order to generate technology-driven entrepreneurship. In the measure by which we assume those technologies are enablers of the entrepreneurial processes, the technology-driven entrepreneurship becomes the driver for the dynamic evolution of the market and the engine for the growth and the continuous change in the knowledge base related to the technologies (Malerba 2010).

This evolution determines structural changes in all the components of the economic system: physical capital, human capital, organization of production facilities, labour practices, managerial and financial organization of firms, geographical allocation of industries, industrial concentration, infrastructure, private-sector financial institutions and financial instruments (Lipsey et al. 1998). The level and the scale of these changes differ greatly from one smart technology to another.

The structural changes can, however, produce some evolutionary effects (Foray et al. 2011), such as:

- renewing traditional sectors through higher value-added activities and new market niches
- differentiating technologically from existing specialization into related fields
- starting new economic activities through radical technological changes and breakthrough innovations
- taking advantage of new forms of innovation, such as open and user-centric innovation, social innovation and service innovation

These structural changes, because of the nature of the aforementioned enabling technologies, allow characterization of the knowledge economy to be a smart economy, with all its components acquiring smart features. The radical change of the economy's nature is the effect of laws and rules determining that the dynamics behind the complex economics (Arthur 2012) can be synthesizable in the following items:

- Knowledge is an abundant and renewable resource. Different from low or decreasing returns associated with traditional factors of production, knowledge increases its value through use, and this implies its strategic role as a source of regeneration and as a binder and coordinator of other factors of production.
- In the knowledge economy, "increasing returns" and "diminishing returns" laws coexist (Arthur 1999). As well known, the "diminishing returns" law is based on the constraint of resource shortages: objects or physical inputs to production are finite resources; this law drives the traditional industrial age. The "increasing returns" law, instead, refers to the nature of knowledge, which is abundant and renewable. Indeed, "increasing returns" law is typical of the economics of "ideas", which follows very different assumptions from the economics of objects (Arthur 1999; Romer 1991), and is a symbol of high-technological, knowledge-intensive industries (Kelley 2005).
- Since knowledge develops according a "power law", and the traditional resource-intensive economy is evolving towards a knowledge-intensive economy, the current competitiveness is determined only by the capacity to create and exploit new knowledge.

- If equilibrium economics are based on stability, predictability and determinacy, the equilibrium of the new socio-economic context is the “nonequilibrium” (Arthur 2012) with indeterminacy, sense making, continuous change and openness. This is in the analysis of Arthur (2012), caused by uncertainty and technological innovation.

2.3 Innovation Ecosystems as Suitable Context for Creating a Knowledge Economy

The relevance in terms of technology-based entrepreneurship can be understood by focusing on the nature of the innovation, which is a non-linear process emerging from a wide, largely distributed process of collaboration within a community of actors (Leydesdorff et al. 2013). In this perspective, the relevance of the innovation ecosystems arises as enabling infrastructure in which a community of individuals with different backgrounds and experiences dynamically interacts by promoting processes of knowledge creation, diffusion and absorption. These processes allow linking research, higher education and innovation by providing solutions for problems, as well as creating socio-economic value by transferring ideas into the market. Malerba (2010) has described the innovation ecosystem perspective as the context impacting the creation of technology-driven entrepreneurship, as environment populated by various business actors, network of collaborations and institutional settings.

In this view, the innovation-ecosystem perspective highlights the opportunity of activating a non-linear process of co-creation as a strategic factor that catalyzes and integrates the vertices of the so-called “knowledge triangle” (EIT 2012; Maassen and Stensaker 2011): research, innovation and higher education. Identified as the strategic and organizational model for the governance of the European Institute of Technology, the triangle stresses the value of research as the process of knowledge creation, innovation as the process of economic and social valorization of knowledge, and education as the process enabling the training of suitable human capital, strategic asset for creating new knowledge and obtaining tangible returns from the created knowledge. These processes allow linking research, higher education and innovation by providing solutions for problems as well as creating socio-economic value by transferring ideas into the market.

A useful framework for capturing the complex composition of actors and processes taking place in an innovation ecosystem is identifiable in the Triple Helix model (Etzkowitz 2004; Ranga and Etzkowitz 2013). Starting from its first conceptualization, the Triple Helix identified in governments, academia and industries is the main macro-category of actors behind the processes of regional development and competitiveness, based on knowledge and innovation.

As Ranga and Etzkowitz (2013) demonstrated, the virtuous integration among the three categories of helix is the basis of the concrete valorization of knowledge distributed and created through the interactions of the governments, companies and universities. A further interesting representation of the forces operating in an innovation ecosystem is provided by the works of other researchers, which, starting from the Triple Helix, have firstly identified the media-based and culture-based public as the fourth Helix (Carayannis and Campbell 2009) and later in the natural environment the Quintuple dimension of the model (Carayannis and Campbell 2009, 2011).

The innovation ecosystem is locally structured, but it is also globally branched through the network of individuals, researchers and technicians involved in the basis of their own background to provide contributions to the solution of shared problems and emerging societal challenges (Romano 2013; Romano et al. 2014).

Shaping the boundaries of the previously mentioned Triple Helix model, the innovation ecosystem includes the entrepreneurs and their organizations (primary actors of the innovation and users of the knowledge), the research institutions, the universities (knowledge producers), the financial institutions that facilitate the innovation among the enterprises, as well as all those dynamic factors enabling the cooperation, the mobility, the exchange of knowledge and the social interactions (Romano 2013; Romano et al. 2014).

The innovation ecosystem is identifiable as a local system of actors where new ideas are generated, and the organizations are involved to transform them in reality.

Principally, three main attributes of an innovation ecosystems can be identified.

- a strong innovative entrepreneurial culture, able to stimulate creativity and capacity of assuming risks
- a continuous flow of ideas and persons: people moving easily from one organization to another, from research centres to enterprises and vice-versa
- informal network operating as transmitters of information and ideas

However, knowledge-intensive entrepreneurship has to operate within complex innovation networks, among firms, universities and other organizations.

Focusing on the dimension of dynamic and multi-actor environment in the innovation ecosystems, the activities of research, higher education and innovation co-exist and allow the activation of interactive- and collective-learning processes, generating intellectual and entrepreneurial capital (Romano 2013).

The innovation ecosystem has also been described as a community of individuals with different backgrounds and expertise, moving from the creation of new knowledge assets to their valorization in entrepreneurial processes.

The relevance of the issue, as well as the contribution that an innovation ecosystem can provide at growth and at social and economic wellness of a region, is supported by works of authoritative organizations, such as the World Economic Forum (WEF, 2009), which, in a report published in 2009, describe the innovation ecosystems as environments in which the innovative entrepreneurship arises. In confirming the importance of developing entrepreneurial attitudes in youths and adults, and in highlighting the non-ancillary assessment of the entrepreneurial education in respect to traditional education paths, the study suggests the opportunity of organic integration between the universities, the enterprises and the public institutions.

The innovation ecosystem can boost innovative entrepreneurship by creating new knowledge or by applying novel combinations of existing knowledge or by recombining existing knowledge in new ways.

Called to reserve attention to the sustainability in the innovation ecosystems, the following factors (Romano 2013) converge:

- scientific knowledge, often based on deductive processes and formal models (basic research)
- applied problem-based knowledge, often developed through inductive processes (applied research and experimental development)
- re-use or challenge of existing settlements

All those considerations highlight the relevant contribution that innovation ecosystems can provide in creating technology-driven entrepreneurship by leveraging on virtuous processes of knowledge creation, absorption and diffusion to support the rise of new entrepreneurial ventures as well as the capacity of the remaining entrepreneurial incumbents in terms of new products, processes, market and organizational settlement. As argued by Malerba (2010), this is a crucial step for the economic progress and competitiveness of countries.

Further, the meaning of innovation ecosystems can be derived from the concept of entrepreneurial or entrepreneurship capital (Audretsch and Keilbach 2004; Audretsch et al. 2008). Defined as "the milieu of agents, routines, traditions and institutions of an economy, a region or a society that is conducive to entrepreneurial behaviour and a culture of risk taking", the authors demonstrated the implications of such environments on the diffusion of an entrepreneurial culture coherent with the emerging challenges by the knowledge-intensive and technological paths of development.

3 Technology Driven Entrepreneurship: Foundations and Future Perspective

3.1 Literature Review

The scientific and institutional debate reserves growing attention to the issue of technology-driven entrepreneurship. Configurable as a knowledgeable actor embedded into a complex network of a plurality of actors with different profiles and backgrounds, the activity of a technology-driven entrepreneur cannot be reduced to an individualistic idea of traditional entrepreneurship, but it is related more to a wide exploitation of technologies through commercial applications in a variety of organizations. These organizations can be start-ups, corporate or academic entrepreneurship or can be obtained by activating social, financial or expertise networks within and across organizations (Romano 2013). Due to the knowledge-intensive nature of technologies addressing the creation and execution of an entrepreneurial process, the technology-driven entrepreneur has also been recently defined as a knowledge-intensive entrepreneur. Specifically, this means that he/she will be configured as "knowledge operator, dedicated to the utilization of existing knowledge, the integration and coordination of different knowledge assets, the creation of new knowledge, and engaged in the development of new products and technologies" (Malerba 2010, pp. 6–7). A knowledge-intensive entrepreneur is an individual with capacities, competencies and attitudes to transform new ideas, technologies and inventions in economic and social value, through innovative business models. Usually, the main risks of this process are represented by difficulties to evaluate market potential (business risks) and reliability of the technology-based offerings (technology risks) (Byers et al. 2011).

Starting with Stevenson and Jarillo (1990), three primary schools of thought regarding entrepreneurship have been identified:

- theories that identify the word with an economic function, which can be described as functional perspective
- theories mainly focused on the "personality" or "person-centric" perspective
- theories that conceptualize entrepreneurship from a behavioural perspective that focus primarily on the entrepreneurial process of new-venture creation

Within the "functional perspective", more contemporary economic theorists describe "entrepreneurial action", which is defined as the creation of an opportunity as well as a response to existing circumstances (Cope 2005; Formaini 2001; Hebert and Link 1988). The personality perspective or person-centric view of entrepreneurship (Malerba 2010) shows that certain individuals have a unique set of inherent, stable and enduring personality characteristics that predispose them to entrepreneurial activities (Greenberger and Sexton 1988). Several seminar articles had undermined the credibility of this personality perspective as a static approach that precludes the ability of an entrepreneur to learn, develop and change as they manage their businesses (Cope 2005; Gartner 1988). The behavioural perspective is a process-based view of new-venture creation, which, rather than trying to identify "who an entrepreneur is", considers the evolutionary nature of entrepreneurship and explores through learning who an entrepreneur may become (Rae 2006). It is useful to shift the focus from the "characteristics and functions of an entrepreneur" to the nature and characteristics of the entrepreneurial processes. The entrepreneurial process is our unit of analysis involving all the functions, activities, and actions associated with perceiving the opportunities and the creation of organizations to finalize them (Bygrave and Hofer 1991).

As it is well known, opportunities are identified through distinctive paths that result in being significantly affected by the context in which they are conceived and exploited. Concerning the context-dependent perspective (Malerba 2010), a systemic view of entrepreneurship arises in terms of environmental conditions and actors that influence the performances and opportunity of the growth of an entrepreneur. Whereas mainly non-technologically intensive business founders begin their entrepreneur processes with discovery of a market need then search for a means to exploit it, many technologists who form new high-tech companies typically consider the identification of a market need as secondary to technology development and only consider the commercialization of one as the new science has been developed (Newbert et al. 2007). The activity of a knowledge-intensive entrepreneur cannot be reduced to an individualistic idea of traditional entrepreneurship, but it is a wide exploitation of technologies through commercial applications in a variety of organizations; under different configuration, these organizations are obtained by activating social, financial or expertise networks within and across organizations.

Furthermore, technology entrepreneurship is considered the driver for economic growth, productivity and employment (Venkataraman 2004; Wennekers and Thurik 1999), and it is assumed in the institutional debate on the smart specialization of the regions to be the core process for the socio-economic development (Foray et al. 2011) and successful position in the emerging framework of the geography of the innovation (Asheim and Gertler 2005; Romano et al. 2014). This is in line with the fact that technologies reveal really important factors for stimulating and activating the innovation process (Schumpeter 1934).

Technological entrepreneurship has also been defined by Byers et al. (2011) as a business leadership style that makes possible the identification of high-potential, technology-intensive commercial opportunities, the gathering of resources, such as human capital and financial capital, the management of rapid growth, and the assumption of the necessary risk associated with the innovative actions in the market. Technology ventures exploit breakthrough advances in science and engineering to develop better products and services for customers. Technology entrepreneurship is assumed the result of merging entrepreneurial opportunity-seeking perspectives with technical and commercial concerns. This process combines two main elements: (1) technology, in terms of knowledge, skills and artefacts used to design and realize new products, services and delivery systems (Burgelman et al. 2001), and (2) entrepreneurship, as the mindset and behaviour required for identifying potential business opportunities, exploiting these opportunities through the recombination of existing resources, or creating new ones for developing and commercializing new products and services within existing or new markets (Hill and McGowan 1999; Hitt et al. 2001).

Technology entrepreneurship embraces all the activities and conditions at individual, organizational and system levels to make possible the shift "from idea to market", to convert a technology-based idea into a business opportunity, starting and accompanying the growth of successful ventures able to generate economic and social value. Those are some of the implications researchers and scholars proposed by focusing on its meaning as individual attribute (e.g., Byers et al. 2011), capability (e.g., Hindle and Yencken 2004), strategy (e.g., Gans and Stern 2003) and system (e.g., Abetti 1992).

Recent studies show knowledge-intensive entrepreneurship results from the combination of intellectual and entrepreneurial capital as the individual ability to manage and assume decisions under uncertainty, as well as to identify and exploit previously unexplored opportunities (Byers et al. 2011; Malerba 2010; Ndou et al. 2013). Considering the broad set of opportunities associated with the advancement of technical knowledge and research, technology-driven entrepreneurship is called to manage three different levels of knowledge, identified by Malerba (2010) in the knowledge of the domain, the organizational knowledge and that one related to the artefact. By focusing on the different stages behind the creation and development of technology entrepreneurship, from the stage of pre-entry, to start-up phase, to the expected sustainable growth, technology-driven entrepreneurship arises as an intrinsically dynamic process (Malerba 2010).

Knowledge-intensive entrepreneurs are, however, only a part of the wider set of knowledge-intensive human capital, which owns the strategic means of production (their knowledge) and can exploit them for its self-employment or for creating a new business. The "knowledge-intensive entrepreneur" subset, equipped also with creativity, innovation and risk-taking, as well as ability to turn ideas into action, is the main booster of the competitiveness in the knowledge economy, since it develops a wide array of innovation processes (Romano 2013):

- by generating new knowledge through research activities, aimed at developing radical innovation
- by adopting or adapting existing technologies and ideas and increasing the propensity for incremental innovation
- by strengthening social capital and innovation networks
- by spreading knowledge in the workplace and increasing the capacity to absorb new knowledge

3.2 From the Traditional Entrepreneurship to the Technology-Driven One

Focusing on the literature debate of the cause-relation behind the entrepreneurship and the market, it is possible to identify two main archetypes: market-driven entrepreneurship and technology-driven entrepreneurship (Newbert et al. 2007). The first identifies a market need and explores a technology with which to exploit it (market-driven entrepreneur), and the second identifies a technology and then explores a market need toward which it can be exploited (technology-driven entrepreneur). Whereas the former seeks to match unknown demand with new technologies, the latter seeks to match unknown demand with unknown technologies (Newbert et al. 2007).

Market-driven entrepreneurs begin their entrepreneurial processes with the discovery of a market's unsatisfied or unperceived need and work to find a way to satisfy it. Technology-based entrepreneurs, instead, consider the identification of a market necessity as a secondary element before the technology development and think about the commercialization only after the new science has been developed (Newbert et al. 2007).

Technology-driven entrepreneurs utilize complex and sophisticated social networks as sources of ideas, as well as to test, refine and validate trial ideas, exhibiting an extraordinary domain specificity that allows them to filter ideas outside specific markets and technologies (Gemmell et al. 2011).

A new type of entrepreneurship, in the scenario of knowledge-intensive economy, is confirmed by a recent study of Aulet and Murray (2013), published by the Kauffman Foundation. The study deepens the comparison between those two opposite approaches to entrepreneurship by focusing on the comparison of the features that characterize the traditional SMEs, assumed as market-driven entrepreneurial ventures, and the innovation-driven companies that operate according to the rules of the technology-driven entrepreneurship.

The innovation-driven entrepreneurship is addressed towards global markets, even if at the beginning it can be limited to regional or niche segments of demand. The focus on innovation, intended as technology, product, process or business model, guarantees the strategy of expansion at global levels and success of the entry strategy in a new market.

Focusing on the profiles of human capital enabling an innovation-driven entrepreneurial process, the study also argues that they have generally higher levels of education, and as usual, innovation-driven start-ups are conceived and led by PhDs in technological and scientific fields.

Furthermore, Aulet and Murray (2013) provide a deeper comparison between the two different typologies of entrepreneurship, as it is synthetized in the following Table 2.1.

Table 2.1 Traditional SMEs entrepreneurship vs Innovation-driven entrepreneurship

	Traditional SME entrepreneurship	Innovation-driven entrepreneurship
Market	Local or regional	Global
Innovation	Not necessary	Fundamental
Type of job	Non-tradable jobs	Tradable jobs
Ownership	Familiar and little external capital	Distributed ownership and large external capital
Rate of growth	Linear	Exponential

In providing a clear identikit of the innovation-driven entrepreneur, the study offers some implications for the governments to support the growth of such types of entrepreneurship that are first called to assume entrepreneurial behaviours. The focus of the governments, in promoting and accompanying the rise of innovation-driven entrepreneurship, is also suggested in the study for the fundamental contribution it can provide for creating new employment opportunities as well as for the socio-economic value it can create in the regions.

3.3 Technology Entrepreneurship as Learning Process

The knowledge-intensive nature of the entrepreneurship of the twenty-first century, based on exploitation of technologies, implies the importance of learning as an enabling process, as an ability to cope with the problems and to learn from those problems; as a consequence, the entrepreneurship arises as a learning process, and a theory of entrepreneurship requires a learning theory (Minniti and Bygrave 2001). As argued by Arthur (2012), the uncertainty characterizing the current socio-economic scenario makes necessary the attitude at the exploration of the external context for the scouting, the comparison and the capturing of opportunities. This is the synthesis of the continuous learning process characterizing the technology-driven entrepreneurship.

It is in such venue that, as argued by Cope (2005), learning becomes a required approach to afford the challenges associated with the conception and execution of an innovative entrepreneurial process. Anyway, the debate on the entrepreneurship does not currently possess sufficient conceptual frameworks to explain how an entrepreneur learns (Cope and Watts 2000). For this reason, entrepreneurial learning has emerged as an important area of inquiry in relation to both the academic studies of entrepreneurship and the practical development of new entrepreneurs. The literature of the entrepreneurial education includes a variety of theoretical approaches focused on diverse aspects of the phenomenon; overall, these approaches are divided into two main fields, depending on their unit of analysis: those focusing on the figure of the entrepreneur and those focusing on the organizational context (Erdélyi 2010). The first approaches are concerned with the personal learning experience and the cognitive capabilities of the "entrepreneurial individuals", the latter on how entrepreneurship takes place as a collective activity and at various scales, from the single firm and its immediate network towards the national system of innovation. In brief, entrepreneurial learning is either considered an individual activity or a collective activity (Erdélyi 2010).

Kolb and Kolb (2005), who define learning as the process of knowledge creation through the transformation of experience, give a systematic approach of experiential learning. In the entrepreneurial practice, this is a continuous and a recursive cycle, resulting from a dialectic tension or opposing means of experience acquisition and transformation.

According to Minniti and Bygrave (2001), technology-driven entrepreneurship is a process of learning, and this is the cause why, for the authors, a theory of entrepreneurship requires a theory of learning. In the same direction, Rae (2006) argued that learning is of increasing importance in technology-driven enterprise, given the growth significance of science and technology innovation in new venture creation. As it is well known, entrepreneurship has traditionally been dominated by economic-based thinking (Rae 2006). Schumpeter (1934) observed the importance of learning in the entrepreneurial process. But the contribution of economics to understanding the human and social processes of entrepreneurship and learning is limited, while human, sociological and psychological sciences are starting to be relevant for understanding entrepreneurial behaviour (Rae 2006). Experiential and social theories of learning have been developed, which combine actions, conceptualization and social practices.

According to Rae (2006), the art of entrepreneurial practices is learned mainly in the entrepreneurial learning environment, through inductive, practical experience rather than in the educational environment.

Experiential Learning Theory (ELT) is built on six propositions shared by twentieth century scholars (Kolb and Kolb 2005):

- Learning is best conceived as a process, not in terms of outcomes.
- All learning is relearning.
- Learning requires the resolution of conflicts between dialectically opposed modes of adaption to the world.
- Learning involves the integrated functions of the total person—thinking, feeling, perceiving and behaving.
- Learning results from synergetic transaction between the people and their environment.
- Learning is the process of creating knowledge.

Experiential learning is portrayed as a spiral, where the learner "touches all the bases"—experiencing, reflecting, thinking and acting in a recursive process.

The experiential learning space assumes relevance in the experiential leaning theory. Experiential learning spaces are defined by the attracting and repelling forces (positive and negative valences) of the two poles of the dual dialectics of action/reflection and experiencing/conceptualizing, creating a two-dimensional map of the regions of the learning space (Kolb and Kolb 2005). The learning space theory reminds us that learning spaces extend beyond the teacher and the classroom: they include socialization in a wider community of practice. For this purpose, it could be useful to recall the theory of knowledge creation of Nonaka and Konno (1998) that introduces the Japanese concept of "Ba", which is a shared space that is the foundation for knowledge creation; "knowledge is embedded in Ba, where it is then acquired through one's own experience or reflections on the experiences of others" (Nonaka and Konno 1998, p. 40). Knowledge embedded in "Ba" is tacit and can only be made explicit through sharing of feelings, thoughts and experiences of persons in the space.

In the triadic model of the entrepreneurial learning, proposed by Rae (2006), the learning space is represented as "contextual learning", resulting from three subsidiary themes: learning through immersion within the industries, opportunity recognition through social participation and practical theories of entrepreneurial actions. Contextual learning includes social participation in communities, industries and other networks through which individual experiences are related and compared, and shared meaning is constructed. Through related experience and social relationships, people learn intuitively and may develop the ability to recognize opportunities. Contextual learning includes the development of skills, expert knowledge and social contacts from employment, experiences and know-how in industry. Much of the learning is functional, technical and problem solving, finding up by discovering and experiential learning of how things are done, with established routines and practices that work in given situations. The influence of the contextual carrier experience on the entrepreneurial formation is often profound (Rae 2006).

Contextual learning has important implications for technology-based entrepreneurship, because innovation, opportunities and entrepreneurial skills are developed through this typology of learning, and this cannot occur without participation.

According to Kolb and Kolb (2005), the implementation of these learning spaces in higher education requires a holistic programme of institutional development, including interventions of development at the level of curriculum, faculty, students, staff and resource. The following five design principles help educational institutions focused on the promotion of learning:

1. Evaluation of educational structures and processes against promotion of learning criteria
2. Longitudinal outcome studies to determine learning value added
3. Becoming a learning-centered institution
4. Continuous research and inquiry about the learning process
5. Becoming a learning organization through continuous stakeholder conversation

In recent empirical research (2011), Gemmel et al. highlight strong evidence of the three key ideational processes common to all technology entrepreneurs. "First, they all utilize complex and sophisticated social networks as sources of ideas and to test, refine and validate trial ideas; second, technology entrepreneurs exhibit extraordinary domain specificity by filtering ideas outside technologies and market; finally, they actively experiment and iterate ideas rather than engage in protracted conceptual analysis" (Gemmell et al. 2011, p. 8).

The authors' research strongly disagrees with the established theories of opportunity recognition and serial/linear entrepreneurial processes. Technology-driven entrepreneurs recognize problems and work as part of teams to solve these problems through complex but well-defined social interaction as part of a cycle of learning and experimentation.

In the classical theory of entrepreneurship, entrepreneurial process is commonly portrayed as an orderly and linear process (Shane 2003) (see Fig. 2.2.).

The entrepreneurial opportunity recognition is described as a creative decision-making process to assemble "new ideas and means". This linear process is coherent with the "position strategy", which articulates a competitive position within a market product or technology space.

The entrepreneurial processes related to technology-driven entrepreneurship are always nonlinear. Embedded into a complex network of relationships, these ideas can be tested and iterated to derive useful implications and feedback. Figure 2.3, below, offers a synthetic representation of the iterated flows of activities composing the nonlinear entrepreneurial ideation process described.

Fig. 2.2 The traditional linear entrepreneurial process

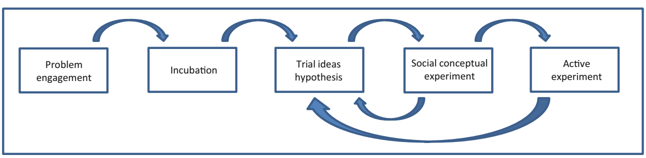

Fig. 2.3 A nonlinear entrepreneurial process.
Source: Adapted from Gemmell et al. (2011)

This nonlinear process is coherent with "perspective strategy", which is a visionary, adaptable and entrepreneurial form of sense making to interpret events against the backdrop of what is unknown and assumed without the environment (Gemmell et al. 2011).

As previously described, experiential theory of learning combines actions, conceptualization and social practices. Mapping the stages of Fig. 2.2 into the experiential learning theory, Gemmell et al. (2011) proposed a useful and highlighting theoretical framework that extends experiential learning theory beyond creativity and learning into broader, multilevel social constructs for innovation:

- Problem engagement = concrete experience: engaging in problem formulation is a predominantly concrete experiential process.
- Incubation = reflective observation: incubation/reflective observation can occur on either an individual level or jointly between trusted partners or the inner group.
- Trial idea/hypothesis formulation = abstract conceptualization: following an incubation period, individual or inner groups conceptualize and analyze specific ideas and hypotheses.
- Social conceptual experimentation = active experimentation: socializing an idea involves the acting experimentation processes followed by a complete learning cycle for sense and process of social feedback.

The relevance of human capital in the knowledge society has encouraged numerous scientific contributions and policy guidelines, especially in Europe, to rethink the education and training systems.

As a consequence, this strategic role of knowledge-intensive human capital with entrepreneurial attitudes and competencies requires radical rethinking of the education systems at all levels. Indeed, the quality of primary, secondary and tertiary education becomes strategic, in order to generate a workforce that is consistent with the structures and dynamics of the knowledge economy.

Investing in creating knowledge-intensive entrepreneurship must be considered one of the highest return investments. Young people who benefit from entrepreneurial learning develop business knowledge and essential skills and attitudes, including creativity, initiative, tenacity, teamwork, comprehension of risk, and a sense of responsibility. Therefore, it is relevant and strategic to deepen the features of technology-driven entrepreneurship and the nature of the entrepreneurial process, particularly entrepreneurial experiential learning process, in order to conceptualize the nature of the boosters generating technology-driven entrepreneurship. To this end, after having recalled the main scientific research streams on entrepreneurship, we will assume as a unit of analysis the entrepreneurial process and its specificities identified in the entrepreneurial experiential learning process. The issue is actually confirmed by the recent initiatives launched at the European Level, through the "2020 Action Plan", aimed at reigniting the entrepreneurial spirit in Europe (EC 2013). The Action Plan moves from the analysis of the need of promoting a more technology-based entrepreneurship to bring back growth and higher levels of employment. It is particularly important to speed up the development of KETs industrial applications. Technology-based entrepreneurship makes knowledge economies more competitive and innovative.

4 Conclusions

Aimed at contributing to the systematization of the scientific debate on the technology-driven entrepreneurship, the chapter has deepened the meaning of knowledge economy as a socio-economic context characterized by turbulence and uncertainty, as well as by the large and diffused accessibility to the knowledge. This has allowed comprehension of the reasons behind the identification of entrepreneurship as key processes and strategic attitudes and behaviours supporting the competitiveness of individuals, organizations and regions. The radical changes that occurred in the shift from the managed economy of the last century to the entrepreneurial economy of today have offered a large representation of the new rules and dynamics affecting the survival and competitiveness of the actors of a global and interconnected society. The recalled neo-structuralist model of reading the society as an expression of its technologies applied to the current scenario has clarified the reasons of the knowledge-intensive and technology-driven nature of the entrepreneurship process as well as the different profile of the traditional one. Due to the knowledge-intensive nature of technologies, opportunities and means for the conception, execution and renewal of an entrepreneurial process, the entrepreneurship of today is configurable as a knowledge-intensive and technology-driven process, different from the traditional entrepreneurship that is also driven by the market. The focus on knowledge as the primary cause and condition behind entrepreneurship has allowed us to derive the centrality of learning as the key process accompanying the technology-driven entrepreneur in all phases of the venture. Embedded into a complex network of relationships, also identified in the so-called innovation ecosystems, technology-driven entrepreneurs are involved in a continuous process of learning. In such innovation ecosystems, as favourable locus for disseminating and nurturing technology entrepreneurship, distributed processes of knowledge creation, diffusion and absorption take place by activating a virtuous process of collaborative learning. In terms of systematization of the literature in technology-driven entrepreneurship, the chapter highlighted the dimensions of process, behaviour and the attitude emerged in the previous works of researchers and scholars by demonstrating the growing relevance of the issue in the agenda of scientists and institutions.

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3

Corporate Entrepreneurship: The Antecedents at Individual and Organisational Levels in Technology-Based Firms

Gianluca Elia, Alessandro Margherita and Claudio Petti

1 Entrepreneurship from a Corporate Perspective

1.1 Introduction

The concept of entrepreneurship is traditionally associated with the initiative of individuals who transform promising business ideas into successful new ventures. In the Schumpeterian view, the most innovative individuals are able to drive sustainable change and creative destruction in specific markets and industries, acting alone or within large companies (Schumpeter 1934, 1949). However, the entrepreneurial process is also engaged in by established organisations, which are able to address the asymmetries between market demand and the potential of socio-technical innovation. On such an extended scale (from individuals to corporations), *corporate entrepreneurship* is activated as a means of achieving organisational

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innovation and increasing financial and market performance, with exemplary cases such as Apple, 3M, Procter & Gamble and Google.

More specifically, corporate entrepreneurship represents the process of new business creation within established firms to improve organisational profitability and competitive position, or the strategic renewal of existing businesses (Zahra 1991). It thus includes the creation and development of new business ventures, new products or services, or new strategies and competitive stances. Therefore it becomes a key driver of organisational innovation, business performance and market leadership for organizations operating in technology-intensive industries.

The focus on technology-based firms is timely, and particularly relevant for corporate entrepreneurship. Indeed, the presence of innovative technologies and their market-relevant applications is a trigger for the creation of new products and services, as well as of the new business ventures that produce and commercialise them. The multidimensional nature of corporate entrepreneurship and its complexity in terms of enabling factors has generated the motivation for research to investigate and systematise such elements within an integrative perspective and model.

In just such an endeavour, this chapter aims to identify the antecedents of corporate entrepreneurship at both individual and organisational levels. In particular, the focus is on technology-based firms. For this purpose, the chapter is structured as follows: the next section reports some evolutionary patterns in the corporate entrepreneurship concept and its enablers. The concept of creativity is then analysed, together with its relationship with organisational innovativeness, the role of human resource management as a driver of creativity, and organisational innovativeness. The model and related assessment tool to be used in the corporate context are then introduced. Concluding remarks summarise the contributions of this work to theory and practice, and reflect on planned and likely developments for further research.

1.2 Evolution of the Corporate Entrepreneurship Concept

The concept of corporate entrepreneurship is not new, but dates back almost 40 years to the mid-1970s, with seminal papers that have introduced its main definitions, characteristics and enabling factors (Guth and Ginsberg 1990; Hanan 1976; Hill and Hlavacek 1972; Hornsby et al. 2002; Miller 1983; Peterson and Berger 1972; Quinn 1979; Vesper 1984). As a multidimensional construct, corporate entrepreneurship consists of five main dimensions (Block and MacMillan 1993; Chesbrough 2002; Edralin 2000; Ellis and Taylor 1987; Guth and Ginsberg 1990; Hornsby et al. 2002; Kuratko et al. 1990; Miller 1983; Nielsen et al. 1985; Pinchot 1985; Srivastava and Agrawal 2010; Thornberry 2001; Zahra and Covin 1995).

The first dimension is *innovation*, which is the transformation of new ideas into value-added products and services, as well as the optimisation of production processes and the development of organisational systems and forms. The second is *new business venturing* (or *corporate venturing*), which is the creation of a new business unit within an existing organisation, or the acquisition of a new business to embed within an existing firm with the final aim of creating or searching for new businesses in the external market. The third is *intrapreneurship*, which is the development of internal markets and independent units within large companies to test new offerings or improve existing services, technologies or methods. The fourth dimension includes *strategic renewal* activities (or *self-renewal* or *organisational transformation*), which refers to the undertaking of major organisational changes through the renewal of ideas and new combinations of existing resources, as well as the transformation and revitalisation of a company's operations by changing the scope of both its business and its competitive approach. Finally, the *industry rule-breaking* dimension refers to changes in the rules of competition in the industry made by the enterprise.

Every definition of corporate entrepreneurship has a multi-faceted nature and meaning, even if the predominant characteristics can be attributed to the five dimensions mentioned above. Table 3.1 provides a list of corporate entrepreneurship definitions (in chronological order) indicating the principal dimension.

Other authors go beyond these five dimensions, highlighting other facets of corporate entrepreneurship. For example, Floyd and Wooldridge (1999) and Kanter (1985) consider corporate entrepreneurship to be a learning process that feeds the organisation's intellectual capital and knowledge assets to pursue business goals. This is in line with Rutherford and Holt (2007), who link corporate entrepreneurship to the exploration and exploitation of employees' competences and skills. Burgelman (1983),

Table 3.1 Definitions of corporate entrepreneurship

Author	Definition of corporate entrepreneurship	Predominant dimension
Burgelman (1983)	A process whereby firms engage in diversification through internal development	Intrapreneurship
Miller (1983)	Activities that an organisation adopts to enhance innovation in products, risk-taking and reactive responses to environmental forces	Industry rule breaking
Kanter (1985)	A firm's ability to learn and unlearn continuously by creating and exploiting new combinations of knowledge and by leveraging the organisation's intellectual capital and in particular human and social capital	Strategic renewal
Stevenson et al. (1989)	The process of value creation through providing a set of resources for the effective and efficient exploitation of an opportunity	Innovation
Stevenson and Jarillo (1990)	The ability of individuals within the firm to pursue opportunities, which defines the ability of the whole organisation to be entrepreneurial	Strategic renewal
Zahra (1991)	The process of creating new business within established firms to improve organisational profitability and enhance a company's competitive position or the strategic renewal of existing business	Intrapreneurship
Covin and Slevin (1991)	The basic strategic stance of a firm (measured through its innovation, proactivity and risk-taking behaviour) in relation to engaging in entrepreneurial behaviour	Strategic renewal
Kao (1993)	The attempt to create value through the recognition of business opportunities and the management of risk-taking appropriate to those opportunities	Industry rule breaking
Scott et al. (1998)	The process of stimulating innovative ideas and processes, often with a focus on wealth creation	Intrapreneurship
Sharma and Chrisman (2007)	A process whereby an individual or a group of individuals, in association with an existing organisation, creates a new organisation or instigates renewal innovation within that organisation	Strategic renewal

(continued)

Table 3.1 (continued)

Author	Definition of corporate entrepreneurship	Predominant dimension
Floyd and Wooldridge (1999)	An organisational learning process involving both the exploration of new knowledge and the exploitation of existing knowledge	Industry rule breaking
Antoncic and Hisrich (2001)	The process of the creation of new business ventures and other innovative activities, such as the development of new products, services, technologies, administrative techniques, strategies and competitive stances	New business venturing
Shaw et al. (2005)	Efforts aimed at promoting innovation from an internal organisational perspective through the assessment of potential new opportunities, the alignment of resources and the exploitation and commercialisation of new products	Innovation
Hayton and Kelley (2006)	A process which renews companies, enhances their competitive advantage, spurs growth, creates new employment opportunities and generates wealth	Strategic renewal
Rutherford and Holt (2007)	A process enhancing the ability of the firm to acquire and utilise the innovative skills and abilities of the firm's members	Strategic renewal
Rutherford and Holt (2007)	A process enhancing the ability of the firm to acquire and use the innovative skills and abilities of the firm's members	Strategic renewal
Lau et al. (2010)	A strategic option to refine an organisation's business model to meet changing customer needs and to enhance its competitive position in the market	Strategic renewal
Montoro-Sánchez and Ribeiro Soriano (2011)	The process of creation and development of an entrepreneurial culture within businesses in order to increase the firms' innovative capacity	Strategic renewal
Duobiene (2013)	A dynamic process evolving coherently with the organisational lifecycle	Intrapreneurship

Zahra (1991) and Covin and Slevin (1991) put forward an alternative perspective of corporate entrepreneurship, viewing it as a strategic stance for diversification through internal development, thus relating it to the enhancement of the company's competitive position. Miller (1983) and Kao (1993) connect corporate entrepreneurship to risk-taking behaviours, with the ultimate aim of seizing new opportunities and developing appropriate businesses. In contrast, Hayton and Kelley (2006) link corporate entrepreneurship to specific indicators to measure the impact created at the corporate and external levels.

1.3 Corporate Entrepreneurship Enablers

The enablers of corporate entrepreneurship (Lumpkin and Dess 1996; Schmelter et al. 2010) can be found at the process, contextual and individual levels (Rutherford and Holt 2007). However, aspects related to the organisation (e.g. structure, culture, management practices and innovation strategy) and the individual (e.g. leadership style, personal skills and attitudes) vary at the country level (e.g. the 'geography' of technological innovation), the industry level (e.g. low-tech versus hi-tech sectors), the company level (e.g. absorptive capacity) and the individual level (e.g. competence profiles).

Regarding the individual level, Hayton and Kelley (2006) have described the knowledge, skills and personality of four specific company roles (innovator, broker, champion and sponsor) capable of integrating existing and new knowledge with the aim of fostering entrepreneurship within companies by recognising, evaluating and capturing new entrepreneurial opportunities. Other studies have focused on the identification of the main attributes characterising entrepreneurial behaviour, such as questioning, observing, experimenting and idea networking, with the final aim of generating innovative ideas (Dyer et al. 2008).

At the organisational level, culture and values play a fundamental role in improving informal and voluntary behaviours that are at the heart of corporate entrepreneurship (Burgelman 1983; MacMillan 1993). Hayton et al. (2002) have extended the scope of some studies, hypothesising that entrepreneurship is facilitated by cultures that are high in masculinity and individualism and low in uncertainty avoidance and power—distance relationships (Hofstede 1984). Such studies identified four groups of factors that create an association between culture and entrepreneurship—i.e. needs and motives, beliefs and behaviours, cognition and cultural values. Organisational culture and values encourage people to generate ideas, solutions and new knowledge (Wong 2005). In particular, team spirit and collaboration, the empowerment of employees and leader/senior management support are crucial elements in sustaining corporate entrepreneurship, to a greater extent than rewards and freedom for employees (Srivastava and Agrawal 2010).

A matter of relevance is the identification of an integrative perspective in the determination, classification and analysis of the multifaceted conditions that can support the emergence and overall performance of the internal entrepreneurial process in specific contexts. Hornsby et al. (2002) and Kuratko et al. (2014) introduced the *Corporate Entrepreneurship Assessment Instrument* (CEAI) for measuring five specific dimensions associated with an environment conducive to entrepreneurial behaviour—i.e. top management support, work discretion, rewards, time availability and organisational boundaries.

The existence of corporate entrepreneurship within a company can be recognised by looking at different 'genes' (Lumpkin and Dess 1996; Miller 1983; Schmelter et al. 2010), found at process, contextual and individual levels (Rutherford and Holt 2007). First, *autonomy* is the independent action of an individual or a team in producing an idea or vision. Second, *innovativeness* is the firm's ability to create an innovative offering. Third, *proactiveness* is the firm's capacity to anticipate competitors when introducing new products, services or technologies. Fourth, *risk propensity* is the firm's willingness to engage in ventures with a highly uncertain outcome. Finally, *competitive aggressiveness* is the firm's propensity to challenge its competitors directly and intensely.

A large body of literature shows the existence of a link between corporate entrepreneurship and company financial performance measured in terms of profitability, market share and growth (Behram and Özdemirci 2014; Lumpkin and Dess 1996; Zahra 1993; Zahra and Covin 1995). Many companies have thus begun to define their own corporate entrepreneurship strategies as a vision-directed and organisation-wide reliance on entrepreneurial behaviour that purposefully and continuously rejuvenates the organisation and shapes the scope of its operations through the recognition and exploitation of entrepreneurial opportunity (Ireland et al. 2009).

Soleimani and Shahnazari (2013) have validated a research model based on four specific groups of factors that support corporate entrepreneurship, such as the personal characteristics of entrepreneurs, human resource practices, organisational culture and employee satisfaction. In further detail, the personal characteristics of entrepreneurs—which have a direct and considerable impact on performance of the company (Adams 2005; Switzer and Huang 2007)—concern the internal control centre, the need for achievement, risk-taking, orientation towards results, tolerance of ambiguity, responsibility, and flexibility in the face of change. Human resource practices refer to compensation strategies, performance appraisals, working teams, delegation, management support for innovation, aspects of employment, job design and education. Organisational culture concerns a strategic asset employed to improve informal and voluntary behaviours that are at the heart of corporate entrepreneurship (Burgelman 1983; MacMillan 1993). Elements such as the organisational system, team spirit, leadership, senior management support and empowerment are important drivers of employees' innovation and entrepreneurship at the company level (Lee and Tsang 2001; Srivastava and Agrawal 2010). Finally, employee satisfaction refers mainly to the gratification derived from work and from relationships with colleagues (Mayer and Schoorman 1998; Miskell and Miskell 1994) and employee loyalty (Allen and Grisaffe 2001; Tsui et al. 1997; Varona 2002).

Chen et al. (2005) highlight four factors with regard to entrepreneurship. First, there is the system of the board of directors and management which supports top management and shareholders in promoting long-term and potentially risky projects. Second, they note the entrepreneurial ability of managers and executives to seize opportunities and learn from failures. Third, there is the entrepreneurial personality of managers and executives, their self-efficacy and independence, and the choice to involve staff in the formulation of strategy. Fourth is corporate strategic entrepreneurial management and the existence of an innovation-oriented culture that is beneficial for the training and development of entrepreneurs and staff.

Finally, some studies provide country-related or comparison studies of corporate entrepreneurship, with particular reference to China, Italy, Japan, the UK and the USA (Karsteter and Carraher 2006), as well as South Africa (de Villiers-Scheepers 2012).

1.4 Creativity and Corporate Entrepreneurship

Corporate entrepreneurship constitutes company renewal or a new venture creation process which is initiated and led by the internal human resources of an organisation. Corporate entrepreneurship originates from the creative ideas and initiatives of managers and employees, and it is thus a matter of major concern for organisations to stimulate and leverage the creativity of individuals and teams (the internal 'crowd'). What are the characteristics of employees and managers, as well as the aspects of the internal environment, that can stimulate creativity and innovation?

1.4.1 The Concept of Corporate Creativity

Since the mid-1980s, the concept of creativity has gained importance in human resource and management studies aimed at identifying the ultimate foundation of organisational success. Creativity is typically defined as the generation or production of ideas that are both novel and useful (Amabile 1988) and it has been recognised as a critical means by which organisations and their members can create meaningful and sustainable value for stakeholders (Amabile 1988; Amabile et al. 1996).

A relevant body of knowledge has investigated the meaning and the sources of creativity within organisations (Adams 2005; George 2007; Zhou and Shalley 2003) and specific attention has been paid to intrinsic motivation (Amabile 1988; Amabile et al. 1996; Shalley et al. 2004). Creativity has been also correlated with factors such as autonomy, encouragement, resources, pressures and organisational impediments (Amabile et al. 1996). Some authors have suggested that collaborative effort among peers is crucial for idea generation (Amabile and Gryskiewicz 1989). Leadership, support for innovation, managerial role expectations, career stage and systematic problem-solving styles are also related significantly to individual innovative behaviour in the workplace

(Scott and Bruce 1994). Creativity has been related to organisational cultures (McLean 2005), human resource development (Joo et al. 2013) and the role of team composition and organisational climate (Somech and Drach-Zahavy 2013).

People generate creative ideas, and thus attention has been paid to the internal processes that might lead to creative insights. Among such processes, there has been a specific focus on *intrinsic motivation* as a facilitator of creativity (Amabile 1988; Amabile et al. 1996; Shalley et al. 2004), as opposed to *extrinsic motivation*, which dampens creativity. Intrinsic motivation stems from a positive engagement in work and related tasks, whereas extrinsic motivation stems from sources external to the performance of work, such as external pressures, job requirements and influences from others (Amabile et al. 1996).

Authors have investigated a range of contextual factors that act as facilitators of or detractors from organisational creativity, grouped in four main categories: signals of safety, creativity prompts, supervisors and leaders, and social networks (George 2007). In analyses of the work environment, creativity has been also correlated with factors such as autonomy, encouragement, resources, pressures and organisational impediments (Amabile et al. 1996). Some authors have suggested that collaborative effort among peers is crucial for the generation of ideas (Amabile and Gryskiewicz 1989). Models of creativity and innovation in organisations have been proposed, together with lists of specific activities that leaders should undertake to promote creativity (Amabile 1988).

The structural determinants of team performance have been studied in terms of culture, creativity and knowledge (Yoon et al. 2010), whereas other reviews have examined quantitative empirical research concerning factors influencing individual creativity in the workplace (Egan 2005). The effects of self-concept traits and entrepreneurial orientation have been studied in relation to firm performance (Poon et al. 2006). For example, innovative work behaviour has been found to be related positively to participative leadership, external work contacts and innovative output (De Jong and Den Hartog 2008).

Different Eastern and Western perspectives have been presented in relation to creativity, with a focus on how people perform creatively and how they assess creativity (Morris and Leung 2010), showing some cultural universalities as well as some systemic differences. Many differences are explained in terms of the view of creativity as a solution that is both novel/original and useful/appropriate, with Western social norms prioritising novelty whereas Eastern norms prioritise usefulness. Organisational culture is a factor moderating employee creativity and motivation. Managers thus need to be aware of corporate culture and match employees' motivations accordingly.

1.4.2 Creativity and Organisational Innovation

In the context of innovative behaviour in the workplace, it has been found that leadership, support for innovation, managerial role expectations, career stage and systematic problem solving are significantly related to individual innovative behaviour (Scott and Bruce 1994). Four human resource management practices—hiring and selection, reward, job design and teamwork—have also been found to be positively related to employee creativity. Other studies have focused on corporate creativity and the real determinants of innovation and organisational improvement (Robinson and Stern 1997).

The roles of creativity, innovation and entrepreneurship have also been investigated in the field of research and development (R&D) management (Shih and Chang 2008), and a creativity theory of knowledge spillover entrepreneurship was introduced by Audretsch and Belitski (2013). The relationships between cognition, creativity and entrepreneurship have been analysed, with a specific focus on the paradoxical role of knowledge, which can either enhance or inhibit creativity, as well as on the processes that influence the originality of newly generated ideas (Ward 2004).

The dimensions of organisational creativity and firm performance have been studied, with a focus on the mediating role of corporate entrepreneurship and the moderating role of the environment. In particular, firm performance is associated with entrepreneurial behaviour, which is in turn associated with organisational creativity (Bratnicka and Bratnicki 2013); in particular in dynamic and complex environments, organisations are likely to employ a creative strategy.

Other studies have investigated the mediating role of psychological availability in the relationship between human resource management (HRM) processes and employee creativity, best explained in terms of the intervening variables of perceived uncertainty, stress and psychological availability. In particular, it has been found that the structuring of HRM is associated negatively with perceived uncertainty and stress, and such perceptions produce a sense of psychological availability, which in turn enhances employee creativity (Binyamin and Carmeli 2010).

Questioning, observing, experimenting and idea networking are information-seeking behaviours aimed at changing the status of an organisation. Indeed, they trigger cognitive processes and increase the probability of generating innovative ideas (Dyer et al. 2008).

The focus on creativity has increased since the 1990s because of turbulent changes in the business environment, fierce competition in global markets and the knowledge-based economy, which has made jobs more complex and mobile. In particular, the transition in creativity research has been based on three perspectives of creativity: personal characteristics, contextual perspectives and integrative perspectives. This is shown in the work of Joo et al. (2013), who undertook an integrative literature review and presented a conceptual framework addressing the relationship between creativity and human resource development.

The influence of organisational culture on creativity and innovation has also been investigated (McLean 2005). Personal and contextual factors affecting employee creativity have been studied (Oldham and Cummings 1996), as have the roles of team composition and climate in creativity and the implementation of innovation (Somech and Drach-Zahavy 2013). Other connections between human resource development and creativity have been explored, pointing to the importance of looking at knowledge workplaces, workforce projections, work values, occupation projections, on-the-job training and entrepreneurship (Waight 2005).

1.5 Managing Entrepreneurial Human Resources

If creativity is a skill that may characterise (or not) the individuals of a corporation, organisations can put in place proper strategies and actions aimed at acquiring or building entrepreneurial employees and managers. Practices such as hiring and selection, reward, job design and teamwork have been found to be related positively to employee creativity (Jiang et al. 2012). The role of HRM can thus be crucial in stimulating an entrepreneurial attitude among employees, boosting corporate entrepreneurship (Montoro-Sánchez and Ribeiro Soriano 2011; Rutherford and Holt 2007), as does the use of innovative tools and approaches (Elia and Margherita 2015).

The use of proper HRM practices encourages entrepreneurial behaviours and corporate entrepreneurship (Hayton 2005). Generally, HRM activities are understood to include work design, resource planning, recruitment, selection, training and development, rewards and compensation, assessment and the creation of a positive work environment and employee relations. Effective HRM practices have been shown to enhance company performance by contributing to employee and customer satisfaction, innovation, productivity and the development of a favourable reputation in the firm's community. From this perspective, HRM can influence employees' behaviour, attitudes and performance (Noe et al. 2003), thus boosting corporate entrepreneurship (Barringer and Milkovich 1998; Block and Ornati 1987; Fong et al. 2013; Montoro-Sánchez and Ribeiro Soriano 2011; Rutherford and Holt 2007; Sykes 1992).

Morris and Jones (1993) highlighted five main HRM practices with a high impact on the level of entrepreneurship within an organisation, i.e. performance appraisal, compensation, orientation and training, recruitment and career development and job design. HRM practices can stimulate entrepreneurial dynamics and influence employees' behaviour, attitudes and performance (Noe et al. 2003). Similarly, Hornsby et al. (1993) identified five successful practices conducive to corporate entrepreneurship, i.e. the appropriate use of rewards, management support for innovation, the availability of resources for innovation, encouragement and support for learning and co-operation, and a diffused culture of individual risk-taking.

HRM practices can mediate the relationship between corporate entrepreneurship and firm performance, which means that corporate entrepreneurship affects firm performance both directly and through its effects on HRM practices (Kaya 2006). This is also confirmed by the fact that the failure of many new ventures is caused by the inability of the founders to manage HRM issues successfully (Baron 2003).

Numerous case studies have also been conducted to investigate the relationship between HRM practices and corporate entrepreneurship (Lee et al. 2011); as have empirical studies in both small and medium-sized enterprises (Castrogiovanni et al. 2011) and large companies, in both Germany (Schmelter et al. 2010) and the USA (Morris and Jones 1993). All these studies have highlighted that the implementation of proper HRM practices encourage entrepreneurial behaviours and corporate entrepreneurship (Hayton 2005; Twomey and Harris 2000).

For large companies, the case of Montalt-Valencia Lee et al. (2011) shows the adoption of five main HRM practices to foster corporate entrepreneurship: co-operation among executives; the discovery of opportunities by leveraging experience and social capital; a virtuous connection between internal selection, training and career development; exporting improvements to new divisions; hybrid individual/monetary rewards and collective/non-monetary rewards.

For small and medium-sized enterprises, a case study in Spain (Castrogiovanni et al. 2011) shows that trust-based relationships, open communication (between owner-managers and employees), training practices and a reward system based on the promotion of employees can help to develop entrepreneurial behaviours. Similar studies highlight the most significant drivers of corporate entrepreneurship in the firm. Edralin (2000) considers employee relations, training and development, recruitment and selection influential; Ribeiro-Soriano and Urbano (2009) affirm that openness in communication supports the creation of a sense of trust among employees, which in turn facilitates entrepreneurial behaviour; whereas, Schmelter et al. (2010) focus on staff selection, development, training and rewards.

1.6 A Model of Antecedents for Corporate Entrepreneurship

As previous pages have demonstrated, the success of the corporate entrepreneurship process within technology-based companies is influenced by many factors at the individual and organisational levels. We have performed an extensive literature review in areas such as entrepreneurship, HRM and organisational psychology, with the aim of isolating factors of influence and creating a taxonomy or classification model. The research process included two core steps. First, we undertook a multi-disciplinary search of relevant articles using combined keywords in Google Scholar as well as in electronic databases such as ABI-Inform and ISI Web of Knowledge (in targeted journals—for example, *Entrepreneurship Theory and Practice*, *Human Resource Management Review*, *Journal of Applied Psychology* and *Journal of Business Venturing*). The search terms used were 'corporate entrepreneurship', 'entrepreneurship', 'intrapreneurship', 'innovation' and 'venturing'. These were cross-referenced with the terms 'human capital', 'HRM' and 'creativity'. Articles were searched for claims, conclusions and findings concerning the constructs investigated by the studies, the definitions of terms, gaps and calls for follow-up studies relevant to the research. The coding schema was based on the classification of articles in three groups according to the predominant focus; i.e. corporate entrepreneurship foundations, the creative behaviour of individuals and HRM practices. The second step aimed to isolate the key constructs analysed in the papers as potential antecedents, mediators or moderators of corporate entrepreneurship. Based on the meaning of each construct, an initial list of 178 constructs was refined and synthesised (e.g. the constructs 'trusted environment' and 'trusted relationships' were collapsed into a unique construct named 'trust and loyalty'), thus providing a final taxonomy of elements related to the emergence and performance of the internal entrepreneurship process (third step).

The result is a taxonomic classification comprising 52 elements, including two large groups and four sub-groups of antecedents. The two large groups distinguish the antecedents in terms of whether they are primarily of organisational or individual relevance. Antecedents related to the individuals or actors in the entrepreneurial process (*actor-related antecedents*) are then classified into *professional characteristics*, i.e. factors related to the background and work experience of the individual, and *psychological characteristics*, i.e. elements related to the personal attitudes and traits of the individual.

Antecedents related to the group or community to which the actor belongs (*organisation-related antecedents*) are separated into the *system of values* of the organisation, i.e. aspects pointing to the organisational mindset and climate, and *management practices*, i.e. 'hard' dimensions related to the processes and practical approaches undertaken within the organisation. The overall classification model is presented in Fig. 3.1.

The four groups or antecedents have a varying impact on the 'maturity' of the internal entrepreneurial process of the organisation. Maturity is the combined and integrated degree of development of antecedents that generate the right conditions for the corporate entrepreneurship process to happen and be successful. Maturity is thus related to whether the corporate entrepreneurship process is properly defined, structured, executed and measured within the organisation, and if so, to what extent.

This maturity concept is relevant in assessing the extent to which the individual and contextual conditions of the organisation are likely to support an internal entrepreneurship process that is performing well. The

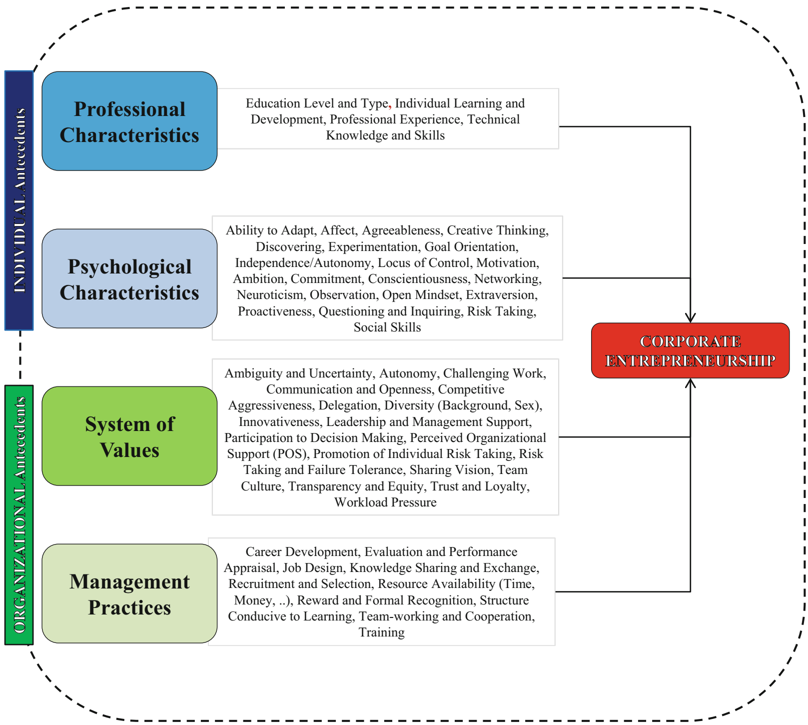

Fig. 3.1 Antecedents of corporate entrepreneurship

model of antecedents distinguishes determinants related to the *physiology* of the organisation (i.e. *management practices*) and 'softer' aspects related to the *psychology* of the company (i.e. *system of values*). This approach is also used to classify individual aspects into the 'soft' characteristics of the employee/manager (e.g. personal attitude) and 'hard' aspects (e.g. professional background). Adopting this twofold perspective is a relevant strategy to examine the systemic view of conditions that can affect the overall performance of corporate entrepreneurship. Moreover, the model opens up a way to investigate the indirect reciprocal mediation and/or moderation effects that one group of variables (enablers) can have on other groups. Indeed, it may be deceptive to evaluate the maturity of corporate entrepreneurship within an organisation as simply high or low, and it is thus salient to isolate the impact that single determinants can have, enabling the measurement of different levels of maturity as well as their combined impact.

2 Measuring Corporate-wide Entrepreneurship: An Assessment Tool

2.1 Introducing the Concept of Crowd-venturing

Organisations are communities in which the creativity of individuals can be valorised through participative forms of innovation generation and implementation. Innovative companies pursue a collective and distributed rather than an individualised and centralised approach to organisational renewal and entrepreneurship. In other words, innovative companies leverage the collective intelligence embedded within their organisations.

The concept of collective intelligence emerged at the end of the 1970s, but it was formalised to a greater extent in the 1990s (Lévy 1994; Pór 1995) and has been applied as an approach to solving complex problems by connecting people and computers so that together they can act more intelligently (Malone et al. 2010). In the corporate world, the concepts of collective intelligence and the 'wisdom of crowds' (Surowiecki 2004) have been adopted in initiatives seeking to build virtual environments for collaboration and innovation, as well as crowd-sourcing (Laubacher 2012). Some examples include the screening and selection of ideas, such as in Quirky, VenCorps and Springwise, and crowd-funding, such as in Kiva, Kickstarter, Eppela, GrowVC, Indiegogo, Springboard Ventures, Profounder, SoMoLend, CapAngel and ProFounder.

Building on such emerging trends, we introduce the concept of *crowd-venturing* to indicate a structured and systematic process of leveraging the distributed 'intelligence' and creativity internal to the organisation (crowd), to initiate and develop effective entrepreneurial activities giving rise to new products, services, processes or business ventures (venturing).

Crowd-venturing is a form of collective intelligence (Elia et al. 2015). Based on the classification of Boder (2006), the four distinguishing elements or components of collective intelligence can be identified as follows in the case of crowd-venturing: (1) competent actors are represented by smart and creative people within the organisation; (2) physical and knowledge resources are represented by the know-how of people, ideas, experience, prototypes and projects; (3) the objectives to be achieved are new products, services, processes or business ventures; (4) the assessment strategy and tools are represented by problem solving, mind mapping, brainstorming sessions and IT-based collaborative systems.

The 'measure' of the performance of the crowd-venturing process draws on aspects such as company reorganisation and the creation of renewed ideas, proactiveness in market introduction and new product development, the proclivity for high-risk projects, the pursuit of new businesses and new industries, the expansion of market share and the creation of new businesses distinct from the parent company.

2.2 The Assessment Tool

The model of antecedents presented in the previous section was used to design a tool to measure the extent to which an organisation's population is employed to drive the performance of the corporate entrepreneurship process—i.e. the maturity of the crowd-venturing process. More specifically, we moved on from the CEAI, developed by Kuratko et al. (2014), a diagnostic canvas used to assess a manager's perception of the internal company environment for corporate entrepreneurship. We extended this to account for the importance of technological development as a driver of corporate entrepreneurship and the elements related to individual and group creativity that drive the internal entrepreneurial process.

The tool can be used to measure a company's capacity for supporting crowd-venturing successfully, and to evaluate strengths and weaknesses related to the individual and team composition of the organisation (the crowd) and the institutional/company environment in which the entrepreneurial process is conducted. The crowd-venturing assessment tool includes four key sections and 47 Likert-style questions with a 1–5 evaluation scale (1 = *completely false*, 2 = *false*, 3 = *neither false nor true*, 4 = *true* and 5 = *completely true*). Section A includes 10 questions related to the personal and psychological characteristics of employees, such as '*Are employees flexible in the face of changes and comfortable with complexity?*' and '*Are employees independent and able to operate autonomously?*'. Section B includes five sections related to professional employee characteristics, such as '*Have employees had previous entrepreneurial experience?*' and '*Do employees possess multidisciplinary knowledge (legal, business, social, etc.)?*'. Section C includes 12 questions related to the value system of the organisation, such as '*Does your company stimulate knowledge sharing and learning processes?*' and '*Are training activities focused on developing creativity and problem solving skills?*'. Section D includes 20 questions related to management practices adopted by the company, such as '*Does your company provide spaces and tools for developing new ideas, prototypes and projects?*' and '*Does your company encourage employees to suggest improvements in processes or practices?*'.

We have also defined a classification of company 'archetypes' based on the combined maturity of individual and organisational conditions. It is possible to identify four different organisational models, as represented in Fig. 3.2.

If the maturity level of both individual and organisational factors is low, the company is characterised by a status quo in terms of entrepreneurial development as there is a lack of entrepreneurial attitude and competences, and the organisation does not provide support for corporate renewal activities (*entrepreneurship desert*).

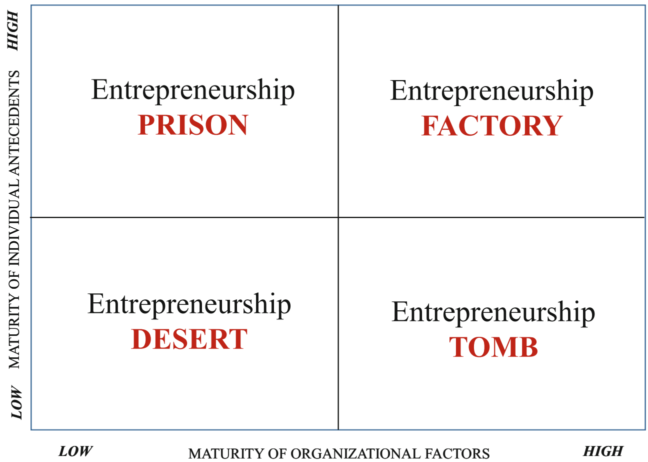

Fig. 3.2 Crowd-venturing archetypes

If the maturity level of both individual and organisational factors is high, the company is characterised by a relentless approach to entrepreneurial development in which individuals are creative and propose innovation projects that are fully supported by the organisation. The organisation thus exemplifies a mature management approach and a corporate renewal attitude (*entrepreneurship factory*).

If the maturity level of individual factors is low, but the maturity of organisational factors is high, the company is characterised by the presence of human resources with no entrepreneurial attitude, despite the fact that the organisation supports potential corporate renewal activities (*entrepreneurship tomb*).

Finally, if the maturity level of individual factors is high, but the maturity of organisational factors is low, the company is characterised by the presence of employees with an entrepreneurial spirit that is not properly supported by the management context (*entrepreneurship prison*).

3 Concluding Remarks

Corporate entrepreneurship is a process at the core of the strategic renewal and growth of successful companies. It is thus highly salient to understand how such a process is undertaken, and under which enabling conditions.

This chapter has illustrated a model of the individual and organisational antecedents of the corporate entrepreneurship process, together with an assessment tool to evaluate the maturity level of companies with respect to this process. In particular, the goal is to support the diagnosis and analysis of the company climate via the evaluation of the endowment of individual and organisational factors that are conducive to a successful corporate entrepreneurship process.

From a theoretical viewpoint, the work presents a comprehensive list of factors, grouped into four main categories, which can affect the existence and performance of corporate entrepreneurship. This could generate a series of field studies aimed at identifying possible relationships between the four categories, or the elements included within them.

From a practitioner perspective, the chapter provides company managers and executives with an assessment tool useful for the design of better conditions to stimulate entrepreneurial dynamics within their organisations. Indeed, the identification of all the elements that affect the performance of corporate entrepreneurship provides a sort of checklist for managerial action aimed at developing and stimulating creativity and the human resource potential for innovation.

The assessment tool illustrated has preliminarily been tested in three companies operating in the ICT and microelectronics industries. A follow-up study is under way and others are planned for the future. These studies have the potential to open up new avenues for developing methodologies aimed at activating entrepreneurial dynamics within organisations. In relation to this, the model of antecedents can be operationalised through the identification of appropriate key performance indicators and target actions (thus developing a sort of balanced scorecard of the corporate entrepreneurship process and performance). The *professional characteristics* and *psychological characteristics* of individuals can be used, from a managerial perspective, as design requirements for human resource planning, recruitment and selection activities. Concerning organisational factors, the *system of values* and *management practices* can be adopted as managerial targets to be achieved through the implementation of a successful management system aimed at creating the right conditions for the corporate entrepreneurship process.

Corporate entrepreneurship has been studied in the literature since the 1970s. By integrating the contextual conditions that streamline the internal entrepreneurship process, this chapter adds to the existing studies in the field. The systemic model is original in terms of its components, and provides a research platform from which to define a multitude of research hypotheses aimed at demonstrating the impact of individual-related and organisation-related conditions for the corporate entrepreneurship process and its effectiveness.

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4

Entrepreneurial Learning Processes for Technology-Driven Entrepreneurship: Assumptions and Behavioural Dynamics for an Integrative Framework

Karim Moustaghfir and Giustina Secundo

1 Introduction

In today’s business landscape it is widely acknowledged that the long-term viability of any firm operating in dynamic and complex environments will ultimately be determined by its ability to le’n and innovate successfully (D’Aveni 1994; Hoopes et al. 2003). A virtuous cycle of creativity, research and development (R&D), knowledge generation, application and innovation has accentuated the rate of competition and change. Knowledge, competences and learning have emerged as the key drivers of competitive advantage, making organisations rethink the way they generate value and remain competitive.

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This process is known as 'corporate entrepreneurship' and assumes a challengeable dimension that impacts the survival and competitiveness of companies that are called on to remain entrepreneurial (Shane 2000). Specifically, corporate entrepreneurship means developing a new product, service or process within an organised business context (Dess et al. 2003); this requires the capacity to discover, evaluate and exploit new opportunities. A study conducted by Carlsson et al. (2009) reveals the positive relationship between knowledge creation through R&D activities, entrepreneurship and economic growth in the USA during and after the Second World War.

Such a process of (1) bringing together varied and complementary knowledge resources and competences; (2) cultivating the spirit of initiative taking, problem-solving and the entrepreneurial mindset; (3) providing the necessary technological and economic context to spur scientific experimentation, creativity and idea generation; and (4) translating innovative ideas into valuable intrapreneurship or entrepreneurship opportunities and actions underpins technology entrepreneurship, which represents a key catalyst for today's technology-driven economic development and growth.

Continuous learning processes allow entrepreneurs to develop and grow as well as enabling organisations to engage in strategic renewal processes (Cope 2005; Corbett 2005; Kenworthy and McMullan 2013). Entrepreneurial learning emerged as an important yet insufficiently understood area of enquiry in the field of entrepreneurship, and in particular in technology-intensive entrepreneurship. However, very few studies are available that examine specific processes taking place at individual and collective levels in entrepreneurship to transform experience into entrepreneurial knowledge (Cope 2005; Politis 2005; Rae 2006). From a dynamic learning perspective, there remains a pressing need to understand what and how individuals learn to become effective entrepreneurs or, to use Rae's (2000) words, how individuals learn to work in entrepreneurial ways.

In terms of the process of 'how' entrepreneurs learn, there is a common recognition that entrepreneurs are action-oriented and that much of their learning is experience-based (Rae 2000; Rae and Carswell 2001). Technology-intensive entrepreneurial organisations are likely to use creativity-based learning as well as unlearning and experiential learning, since they operate in dynamic and complex environment. Giving the importance of adopting a learning perspective of entrepreneurship, the prime objective of this chapter is to develop a deeper grasp of the key elements underpinning the entrepreneurial learning process.

In our attempt to address such little guidance, this chapter intends to elaborate an integrative framework exploring the entrepreneurial learning process in technology-driven entrepreneurship while trying to provide an answer to the following research question: What are the most relevant learning processes, practices and determinants to enhance the entrepreneurial mindset in the domain of technology-driven entrepreneurship?

The objective of this chapter is indeed to shed more light on the crucial role of learning to sustain technology entrepreneurship and to propose a holistic entrepreneurial learning model that brings together learners, the learning process, learning environment and learning outcomes, while leveraging context-specific determinants and incentives and key critical individual, organisational and environmental factors facilitating and contributing to entrepreneurialism/entrepreneurial development in incumbent corporations. For the purpose of this chapter, a systematic literature review is used as research methodology to develop an integrated framework of entrepreneurial learning for technology-driven entrepreneurship. The proposed framework is composed of different building blocks: (1) the entrepreneurial learning process, (2) the enabling factors, (3) behavioural determinants, (4) design elements, and (5) assessment criteria including learning outcomes. The framework integrates the area of entrepreneurship with the area of entrepreneurial learning and organisational factors, and contributes to ongoing research on how a 'learning lens' can be applied to create avenues for further research in entrepreneurship (Wang and Chugh 2014).

The remainder of this chapter is organised as follows: first we shall explain the interplay between learning and entrepreneurial learning as taking place in technology entrepreneurship contexts. Next, we shall draw on the principles underpinning learners' behaviours to explain how a behavioural change perspective should be adopted to stimulate entrepreneurial development in incumbent corporations. We shall then identify critical instructional design elements necessary to support entrepreneurial learning and facilitate the attainment of technology entrepreneurship objectives. Finally, we shall propose an integrative framework encompassing requirements, actors, processes, key determinants and factors for a value-generating entrepreneurial learning experience.

2 Learning, Entrepreneurial Learning and Technology Entrepreneurship

Technology-driven entrepreneurship, investigated as a nonlinear process aiming at identifying unexplored opportunities to transform new ideas, technologies and inventions into commercially viable products and services as well as through innovative business models, is recognised as the engine of economic and regional growth (Malerba 2010). By highlighting the importance of coping with problems and uncertainty and learning from them, technology-driven entrepreneurship arises as a learning process that needs to be sustained continuously at both individual and collective levels (Erdélyi 2010; Gemmell et al. 2012).

As Minniti and Bygrave (2001) state, 'entrepreneurship is a process of learning, and a theory of entrepreneurship requires a theory of learning'. Some scholars focus their attention on the experiential nature of entrepreneurial learning considered to be fundamental for the continuous development of entrepreneurial knowledge (e.g. Minniti and Bygrave 2001; Politis 2005). Independently of the conceptualisation, entrepreneurial learning has a broad relevance with a wide range of implications both for start-up companies and for established businesses (Reuber and Fischer 1993). Companies have to be entrepreneurial the whole time, regardless of their length of experience or developmental stage. The continuous learning process allows entrepreneurs to develop and grow (Corbett 2005; Kenworthy and McMullan 2013). Moreover, at the corporate level, operating managers alsoneed to transform themselves into innovative entrepreneurs engaging in entrepreneurial processes to create and pursue new growth opportunities for their businesses (Ghoshal and Bartlett 1999). More generally, developing '*entrepreneurial human capital*' interpreted as a catalyst of creativity, innovation and entrepreneurship is a key aspect for post-modern entrepreneurial management.

In terms of the process of 'how' entrepreneurs learn, there is a common recognition that entrepreneurs are action-oriented and much of their learning is experience-based (Rae and Carswell 2001). Entrepreneurial technology-intensive organisations are likely to use creativity-based learning as well as unlearning and experiential learning, since they operate in dynamic and complex environments.

In the following section we shall briefly address the state of the art in entrepreneurial education, after which we shall define learning strategies and processes, and focus on the characteristics of entrepreneurial learning as practised in a technology-driven context.

2.1 Learning and Entrepreneurial Learning

Cope (2005) observed that 'a better theoretical grasp of entrepreneurial learning is imperative, as it is through learning that entrepreneurs develop and grow'. Building on an educational case study, Rae (2009) defines entrepreneurial learning as learning to recognise and act on opportunities, and interacting socially to initiate, organise and manage ventures. This process has the double connotation of both learning to behave in, as well as learning through, entrepreneurial ways. Learning should be relational, authentic, relevant, useful and shared productively.

The concept of entrepreneurial learning has been defined mainly from a perspective of entrepreneurship theory. For example, Minniti and Bygrave (2001) define entrepreneurship as a process of learning, where entrepreneurial learning is described as being generated, at least in part, by the reinforcement of the belief in certain actions because of their positive outcomes. Similarly, Politis (2005) describes entrepreneurial learning as a process that facilitates the development of the knowledge necessary to be effective in starting up and managing new ventures. His study highlights entrepreneurial learning as an experiential process where enterprising individuals develop their entrepreneurial knowledge continuously throughout their professional lives (Politis 2005). Entrepreneurial learning can also be conceived as a lifelong learning process, where knowledge is shaped and revised continuously as new experiences occur (Sullivan 2000). Based on Kolb's (1984) theory, entrepreneurial learning can be regarded as an experiential process in which entrepreneurs develop knowledge through four distinctive learning abilities: experiencing, reflecting, thinking and acting (Bailey 1986; Johannisson et al. 1998). Following this order of ideas, many other scholars have assumed that entrepreneurial action is the result of learning that is a process by which people acquire, assimilate and organise newly formed knowledge with pre-existing structures (e.g. Cope 2005; Corbett 2005; Rae and Carswell 2001).

Accordingly, entrepreneurial learning is the outcome of dynamic social processes of sense-making, which are not only cognitive or behavioural but also affective and holistic (Cope 2005; Gibb 2001). It is a dynamic process of awareness, reflection, association and application that involves transforming experience and knowledge into functional learning outcomes (Rae 2006), where 'process' refers to the logic of explaining the causal relationship between entrepreneurs' previous experiences and the performance of the subsequent venture (Politis 2005). Hence, entrepreneurial learning is complex and interconnected, with a somewhat ad hoc approach to formal learning and a heavy reliance on experiential learning (Warren 2004).

Very little effort was made to distinguish between 'entrepreneurial experience' and 'entrepreneurial knowledge', or what Reuber et al. (1990) refer to as 'experientially acquired knowledge'. Literature and research suggest that much of the learning that takes place within an entrepreneurial context is experiential in nature (e.g. Collins and Moore 1970; Deakins and Freel 1998; Reuber and Fischer 1993). Experiential learning can be described as the process whereby knowledge is created through the transformation of experience (Kolb 1984). Such learning can produce new behavioural patterns, judgemental structures and generative mechanisms for action (Holcomb et al. 2009). This learning cannot and should not be divorced from the specific context, including organisational context, within which it takes place. Such learning occurs in a context of application that corresponds to Mode 2 knowledge production (Gibbons et al. 1994). According to Kolb (1984), we can distinguish between two basic and interrelated dimensions of experiential learning: (1) acquisition (grasping), which corresponds to entrepreneurial experience; and (2) transformation, which is considered to be equivalent to entrepreneurial knowledge.

Minniti and Bygrave (2001) ascertain that knowledge acquired through learning-by-doing takes place when agents choose among alternative actions whose payoffs are uncertain and, as a result, risky. Kirzner (1979) defines entrepreneurial knowledge as a 'rarefied abstract type of knowledge—the knowledge of where to obtain information (or other resources) and how to deploy it'. Acquired knowledge generates routines and decisional procedures. Routines are patterns derived from successful solutions to some particular problem (Nelson and Winter 1982). This shows how enterprising individuals develop their entrepreneurial knowledge continuously throughout their professional lives. According to Harrison and Leitch (2005), experiential learning is a process that alters the character of behaviour relatively permanently, and is organised by existing operating procedures, practices and other organisational rules and routines (Holmqvist 2003).

Holcomb et al. (2009) distinguish between experiential and vicarious learning, which can be defined as observational learning involving the modelling of the behaviours and actions of others (Bandura 1977). This suggests that people differ in the manner in which they accumulate knowledge. Learning processes adapt incrementally (Levinthal 1996) as people learn from the consequences of actions taken, and from the behaviour and choices they observe in others. Eliasson (1998) discovered how experimenting managers have to bundle together a number of interrelated competences into a competence bloc through a process of creating (innovation), recognising (risk capital provision), diffusing (spillovers), and exploiting successfully (receiver competence) new ideas in clusters of firms. For Piaget (1950), intelligence and learning take place in evolutionary stages, where equilibration or attempts to create a balance between ourselves and the environment leads to our intellect development by changing mental structures to reflect unique situations or new experiences (Honig 2004).

2.2 Entrepreneurial Learning and Entrepreneurial Competences

The entrepreneur's predominant reasoning also affects the accumulation of his/her knowledge (Politis 2005). Sarasvathy (2001) refers to two kinds of predominant logic or reasoning: (1) *causal reasoning*, which uses techniques of analysis and estimation to explore and exploit existing and latent markets; and (2) *effectual reasoning*, which calls for synthesis and imagination to create new markets that do not already exist. Rae (2006) found that entrepreneurial learning occurs and can be interpreted by reference to three factors: (1) the personal and social emergence of the entrepreneur; (2) contextual learning, which leads to the recognition and enacting of opportunities in specialised situations; and (3) the negotiated enterprise, which includes processes of participation and joint enterprise, changing roles over time, and engagement in networks of external relationships. Building on the first factor, Liang and Dunn (2008) pinpoint the importance of optimism versus realism, among other entrepreneurial characteristics, in shaping entrepreneurs' experiences and consequently also their knowledge.

Entrepreneurship competences are similarly ambiguous, comprising a range of personal characteristics, attitudes and skills such as problem solving, leadership, communication, self-awareness and assessment skills, as well as business and managerial competences (Frank 2007). Gibb (1987) defines an entrepreneur as an individual demonstrating a marked use of enterprising attributes such as initiative, persuasive power, moderate risk-taking, creativity, independence, problem solving, a need for achievement, imagination, leadership, hard work and internal locus of control. According to MacPherson (2009), entrepreneurs exemplify nine common areas of learning content: acquiring business-specific knowledge; learning business mechanics; learning about context, customers and the competition; studying people; studying leadership principles; reflecting on company values; and discovering how to create learning organisations.

Much of the necessary knowledge about exploiting opportunities can only be learned through managerial and business experience (Cope and Watts 2000). Having prior management experience provides entrepreneurs with training in many of the skills such as selling, negotiating, leading, planning, decision-making, problem-solving, organising and communicating (Lorrain and Dussault 1988). Accordingly, while certain functional skill sets can be 'taught', experiential learning is essential to entrepreneurial learning (Gibb 1987; Warren 2004).

In the following section, a behavioural perspective will be adopted to disentangle the complexities underpinning learning, which represents the platform for effective technology entrepreneurship processes.

3 Entrepreneurial Learning as a Process of Shaping Behaviour for Technology-Driven Entrepreneurship

Individuals create knowledge and learn in contexts thanks to their cognitive capabilities and models, which they use and renew through reciprocal interaction (Turvani 2001). Entrepreneurial learning in technology-driven contexts should not only be about acquiring and assimilating entrepreneurial knowledge, but also about changing the culture to one that values entrepreneurial attitudes and mindsets, and consequently facilitates entrepreneurialism.

Building on the assumptions underpinning behaviourism, this section will explain to what extent entrepreneurial learning represents a critical determinant in shaping entrepreneurial behaviour. The aim is to demonstrate that entrepreneurial ideas and actions are the results of a complex process of perception, judgement and intention that is mainly context- and personality-driven.

Since entrepreneurialism is strictly linked to a behaviour-shaping process, this section will also focus on the importance of adopting a change theory to foster entrepreneurial learning and entrepreneurial mindsets in a technology-driven corporate context. Critical success factors, along with behavioural change practices, will also be discussed regarding their effect on creating the necessary conditions for entrepreneurialism.

3.1 Entrepreneurial Attitudes and Behaviours

A central concept for understanding human behaviour is the notion of attitude. An attitude is a learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object (Fishbein and Ajzen 1975). Attitudes can be examined through the use of a model that treats the concept from the arousal process (Guerin 1970): (1) a cognitive factor acts as a stimulus; (2) it is interpreted through the needs and value system of the individual; and (3) the attitude is aroused. Following this process, attitudes act as behavioural triggers based on a stimulus—response consistency (Katz 1964). In the case of entrepreneurial learning, stimuli could find their origins in customer or market needs, new scientific results, process needs, changes in perception, or social demographics.

The stimulus—response consistency also refers to individuals' perception or to the process whereby they organise and interpret their sensory impressions in order to give meaning to their environment and to construct what they call 'reality' (Robbins and DeCenzo 2008). Different factors shape and sometimes distort perception, and consequently people's intention to engage (or not) in a certain behaviour. These factors can reside in the perceiver (i.e. personality, motives, interests, past experiences and so on); in the object being perceived; or in the context in which perception is made. Further, perceiving is not a passive act; it entails a gesture of interpretation (Rizzello 1999). Such an interpretation refers to individuals' genetic background and individual experience, but also to primary dispositions that developed over time in society. An example of such dispositions are habits whereby individuals engage in previously adopted or acquired behaviour or thoughts that are triggered by an appropriate stimulus or context (Hodgson 2006).

Attribution theory has been the predominant psychological explanation of people's behaviour, focusing on the various causes that people assign to behaviour (e.g. Heider 1958; Weiner 1986). Through processes of perception and attribution, individuals form beliefs regarding their organisational environment (Robertson et al. 1993). These beliefs energise, direct and regulate behaviour (Bernstein and Burke 1989). Actors tend to attribute their own behaviour to situational causes, whereas observers tend to attribute the same behaviours to stable dispositions (Jones and Nisbett 1972).

It is generally recognised that people's perception, attitudes, intentions and behaviours are driven by their personality. An individual's personality is a combination of the psychological traits that characterise that person (Robbins and DeCenzo 2008). Nearly all personality traits—whether cognitive or motivational—that can be diagnosed in adults are to a certain extent genetically based and therefore largely stable (Rosenstiel 2011). A widely used model to view personality is the 'big five' model (Digman 1990), which delineates five factors of personality including extroversion, agreeableness, conscientiousness, emotional stability and openness to experience. Research has shown that important relationships exist between these personality dimensions and effective action (e.g. Caprara et al. 2001; Hurtz and Donovan 2000).

There is also a growing recognition that individual values play an important part in shaping behaviours (Higgs and Lichtenstein 2010). Hayek (1952) views individuals as being driven by moral sentiments that can never be explained using a fully rational concept (Gick 2003). Allport (1955) also emphasised that individuals' value priorities influence their perception of reality, and in turn their behaviour. Caprara et al. (2006) found that values were more powerful in explaining behavioural variation than personality traits. Personality traits are largely endogenous characteristics, while personal values are learned adaptations strongly influenced by an individual's environment (Olver and Mooradian 2003).

As people respond to the way they perceive their environment, this process facilitates their learning. Learning theorists typically segment learning into three distinct stages that represent the different learning processes occurring over time (Mone and Shalley 1995): the declarative stage, the knowledge compilation stage, and the procedural stage of learning. Social learning theory (Bandura 1977) recognises that individuals learn through both observation and direct experience. In fact, learning is defined as any relatively permanent change in behaviour that occurs as a result of experience (Robbins and DeCenzo 2008).

Operant conditioning (Skinner 1969) argues that behaviour is a function of its consequences. Operant behaviour is voluntary or learned behaviour rather than reflexive or unlearned. When the consequences are pleasant, people tend to repeat and reinforce their behaviours. Manz and Sims (1980) define reinforcement contingencies as environmental cues that precede employee behaviour (i.e. discriminative stimuli), including the rewards that subsequently reinforce behaviour.

When learning occurs, new knowledge is acquired. Knowledge is memorised in rules of both perception and conduct (Hayek 1978). Rules include norms of behaviour and social conventions as well as legal rules

(Hodgson 2006). Knowledge can also be regarded as a mental model or belief (Denzau and North 1994). Accumulation of knowledge is the storage of stable connections (Zhao and Zhu 2008). Such stable connections are mainly synaptic connections in the human brain, transmitting, receiving and processing electrochemical signals from neurotransmitters within a synapse.

When receiving a signal or a feedback signal from outside, an individual processes it, compares it with stable and unstable preferences and knowledge, and then maintains the original preferences, knowledge and behavioural pattern, or adjusts them and forms new ones (Zhao and Zhu 2008). When a new signal causes unstable knowledge to change, an individual behaviour pattern may be changed. Such complex dynamics make both rationality and bounded rationality very limited for explaining human behaviour in its entirety (Cosmides and Tooby 1994).

3.2 Factors Shaping Entrepreneurial Behaviour

While the social psychology literature suggests that social norms and personal attitudes predict human behaviour (Fishbein and Ajzen 1975), social cognitive theory explains human functioning in terms of a triadic model of dynamic interplay between the environment, individual cognitive states, and attitudes (Bandura 1977). Behaviour is also affected by patterns of organisational structure, technology, styles of leadership and systems of management (Chaneta 2010). An organisational work setting comprises four major interrelated subsystems: organising arrangements, social factors, technology and physical setting (Porras and Robertson 1992). Rosenstiel (2011) states that 'the behaviour of people in organisations is not only dependent on the characteristics of the person, but also on the general conditions, the rules, regulations, job descriptions, and other explicit guidelines, on informal norms inside the group and the corporate culture, and on hard conducive or obstructive conditions (i.e. resources and barriers)'.

The variables affecting entrepreneurial behaviour fall into three major classes: (1) ability to learn; (2) motivation to engage in an entrepreneurial experience; and (3) external factors that facilitate or constrain entrepreneurial learning (Evans 1986). Contemporary scholars of intelligence (e.g. Ashkanasy and Daus 2005; Gardner 1993; Sternberg et al. 2000) recognise that a model of intelligence based only on intellectual capacity and abilities is insufficient tor explain human capabilities and behaviour in real life: emotions should also be considered as a part of human intelligence. Some scholars have characterised this type of intelligence as 'emotional intelligence', defined as an individual's ability to perceive emotion in him/herself and in others, to understand emotion, and then to manage it in both self and others (Barsade et al. 2003).

The job characteristics model, for example (Hackman and Oldham 1980), posits that job characteristics (comprising skill variety, task identity, task significance, autonomy and feedback) should enhance work performance through three psychological states (experienced meaningfulness, experienced responsibility and knowledge of results). Job characteristics affect entrepreneurial performance through motivation (Evans 1986). Individual behaviour is influenced by the goals a person chooses or accepts. While people have been shown to use search-reduction heuristics in past research (e.g. Payne 1976), Mone and Shalley (1995) found that individuals with specific difficult goals in complex tasks actually engaged in greater changes in strategy. Role conflict, role ambiguity and experienced stress also affect the extent to which goals and intentions can be translated into accomplishments.

Goal setting and acceptance as well as feedback-seeking behaviour in the context of entrepreneurial learning and action are influenced by individual and organisational cultural orientation (Sully de Luque and Sommer 2000). An organisation also has a personality, which we call its culture (Chaneta 2010). Organisational culture is a system of shared meaning within an organisation that determines, to a large degree, how employees act (Robbins and Coulter 1996). In every organisation there are systems or patterns of values, symbols, rituals, myths and practices that have evolved over time (Chaneta 2010). Such dimensions direct individual entrepreneurial behaviour.

Individual work behaviour is driven by personal goals and organisational factors as well as social networks (Robertson et al. 1993). For example, group pressures and dynamics, including 'groupthink' and 'social loafing' can have a major influence on the behaviour and performance of individual members (Albanese and Van Fleet 1985; Chaneta

2010). In a social system, the behaviour among its members is ensured by altruism, solidarity, sympathy and group decisions, and is considered the morality of the small group (Hayek 1979). Multi-level analysis has shown that collective efficacy, or the shared perception of team capability, influences the extent to which an individual engages in a certain behaviour (Tasa et al. 2011).

Other organisational factors, including leadership and empowerment, can also influence individual entrepreneurial behaviour. Leadership can be described as a process through which the supervisor structures reinforcement contingencies that modify the behaviour of subordinates (Sims 1977). Leadership has implications for developing commitment and increasing compliance in task behaviour, influencing group maintenance and identification, and influencing the culture and climate of an organisation (Guzzo and Salas 1995). Similarly, empowerment climate and psychological empowerment play complementary roles in engendering individual and team entrepreneurial behaviours (Tuuli and Rowlinson 2009).

3.3 The Consequences of Entrepreneurial Behaviour

Performance behaviours are defined as the measurable behaviours that are relevant to the achievement of individual and organisational goals (Campbell et al. 1993). In the context of entrepreneurial learning, performance behaviours may refer to entrepreneurial competences, attitudes and mindsets, but in particular to the results of entrepreneurial activities in terms of the generation of new ideas, and technology-driven business opportunities. A study conducted by Choi (2004) determined that both organisational context and individual characteristics influence employees' innovation-use behaviour. In a similar vein, Dorenbosch et al. (2005) found a strong positive relationship, indicating that a proactive attitude as ownership promotes the generation and implementation of ideas within the work context. Motowildo et al. (1997) also specify a stronger link between personality characteristics and contextual performance. Similarly, individual psychological characteristics, including perceived self-efficacy, personality and commitment, were identified as determinants for knowledge-sharing as an individual behaviour (Bock and Kim 2002; Cabrera et al. 2006).

Contextual performance research has focused primarily on conformistic or co-operative behaviours and not on change-oriented behaviours such as voice (Speier and Frese 1997). Scholars have begun to recognise the importance of behaviours that emphasise employee initiative, such as making constructive suggestions for change (e.g. LePine and Van Dyne 1998; Scott and Bruce 1994).

Organisational qualities such as decentralisation, job enlargement and participative management can also promote behaviours that result in beneficial experiences for organisation members (e.g. Likert 1967; McGregor 1960). In contrast, organisational characteristics designed to control members' behaviour can generate behavioural reactions such as aggression, withdrawal, apathy and minimisation of the amount of work performed and initiative taking (Strauss 1963). An increased body of evidence also suggests that strong cultures are associated with high organisational performance through their effect on individual behaviour (Chaneta 2010).

Early empirical research in psychology indicated that motivation and performance are influenced significantly by feedback (Ammons 1956). Those in the field of entrepreneurial behaviour continue to promote feedback as a cue for motivation, performance and learning (Koestner et al. 1987; Vroom 1964). The motivation of employees to engage in proactive or extra-role behaviour is the focus of research on concepts such as 'organisational citizenship behaviour' (Organ 1988), 'personal initiative' (Frese et al. 1996), 'employee creativity' (Oldham and Cummings 1996), and 'critical reflective behaviour' (Van Woerkom 2003).

Research team effectiveness has also been shown to depend on two mechanisms: behaviours related to the task itself (technical) and behaviours that promote the socio-emotional context of the group (social) (Stewart and Barrick 2000). Teamwork behaviour is described as activities that are devoted to enhancing the quality of the interactions, interdependencies, co-operation and co-ordination of teams (Morgan et al. 1993). Collective efficacy influences the relations between individual traits and behaviours in teams (Tasa et al. 2011). Collective efficacy has been shown to relate to group cohesion (Lent et al. 2006) and group co-operation and communication (Lester et al. 2002). In contrast, negative group behaviours such as ego-defensiveness resulting from the dissonance created by the pressure of threats or inducement may lead to hostility, rationalisation and withdrawal (Guerin 1970).

4 A Framework for Entrepreneurial Learning: Process, Contextual and Behavioural Factors, Design Elements and Assessment Criteria

In light of what has been discussed in the preceding sections, this section will introduce an integrative framework of entrepreneurial learning within a technology-driven corporate context. The model includes a process of entrepreneurial learning alongside the required supporting contextual and behavioural factors, design elements and assessment criteria. Figure 4.1 illustrates the details of the integrative framework.

The following sections provide a detailed explanation of each block of the framework.

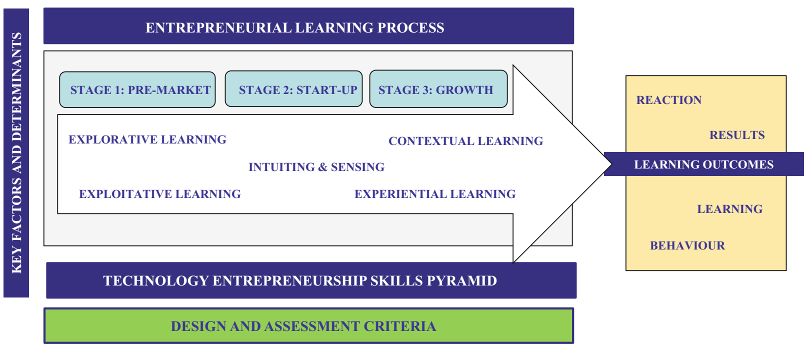

Fig. 4.1 Entrepreneurial learning for technology-driven entrepreneurship—an integrative framework

4.1 The Process of Entrepreneurial Learning

The process of entrepreneurial learning adopts a stage-based approach for technology entrepreneurship learning that is both dynamic and non-linear to facilitate the development of entrepreneurial competences, behaviours and mindsets. The discussion on the importance of learning within technology-driven entrepreneurship provides interesting insights regarding the nature of the entrepreneurial learning process. Specifically, the main assumption behind this model is that learning occurs in all the phases of the entrepreneurial process following the knowledge-intensive nature of the technology-driven venture. The processes are not limited to start-ups; they are also of interest to existing companies and well-consolidated ventures seeking to sustain the growth phase.

The entrepreneurship development process includes three stages: pre-market to foster enterprise awareness; start-up to cultivate an entrepreneurial mindset; and growth to develop entrepreneurial capabilities. Based on this assumption, the model identifies a set of primary processes by which entrepreneurs enhance their own knowledge base as well as their entrepreneurial attitudes:

- *Explorative learning process*: in all the phases of their experience, entrepreneurs live an exploration of the environment around the organisation. Specifically, in exploring entrepreneurial opportunities, a technology-driven entrepreneur learns to discover by enacting and interpreting alternatives to the present business in order to prove 'ex post to yield desirable results' (Wang and Chugh 2014). Exploration with entrepreneurial learning and practice is coherent with the dimension that facilitates the foresight of evolutionary paths associated with specific technology domains in order to define the characteristics of goods and services (product technology); the processes to create them (process technology); the forms in which the processes can be organised (organisational technologies); and the concurrent processes of exploring market opportunities (marketing technologies).
- *Exploitative learning process*: this process focuses on 'directed search that is amenable to ex ante planning and control to limit variety

achieved by honing in on and deepening initial insights as experience increases' (Wang and Chugh 2014). In an exploitative learning process, entrepreneurs often start with acquiring knowledge existing outside their ventures while experimenting with trial and error learning (Bingham and Davis 2012).

- *Experiential and contextual learning process*: as argued by Rae (2006), the 'art of entrepreneurial practice' is learned better in experience-based rather than educational environments. Contextual learning arises in Rae's triadic model in relation to experience and social relationships through which entrepreneurs learn intuitively. By searching for solutions to address technical problems, and by observing and participating in entrepreneurial routines and practical activities, the achievement of learning objectives through contextual learning can be assumed to be a suitable process.
- *Intuitive and sensing learning process*: this can be assumed as another process of acquiring entrepreneurial skills and attitudes in knowledge-intensive and technology-based industries. Originally defined in the psychological field, sensing learning is associated with learning by knowing circumstances and experiences through contact with external stakeholders. The concrete and practical nature of this kind of learning process is coherent with the profile of a technology-driven entrepreneur (Gemmell et al. 2012).

These learning types are not exhaustive, but they represent a sample of learning modes that address the current entrepreneurial learning research gaps.

4.2 Technology Entrepreneurship Skills Pyramid

Building on a static view of the technology entrepreneur profiles provided by the *technology competence pyramid* (see Fig. 4.2 below), the proposed model adopts a dynamic perspective of technology entrepreneurship learning in which each stage describes a set of competences, attitudes and skills. A successful technology-intensive entrepreneur must be able to use knowledge, attitudes and skills in such a way as to be able to

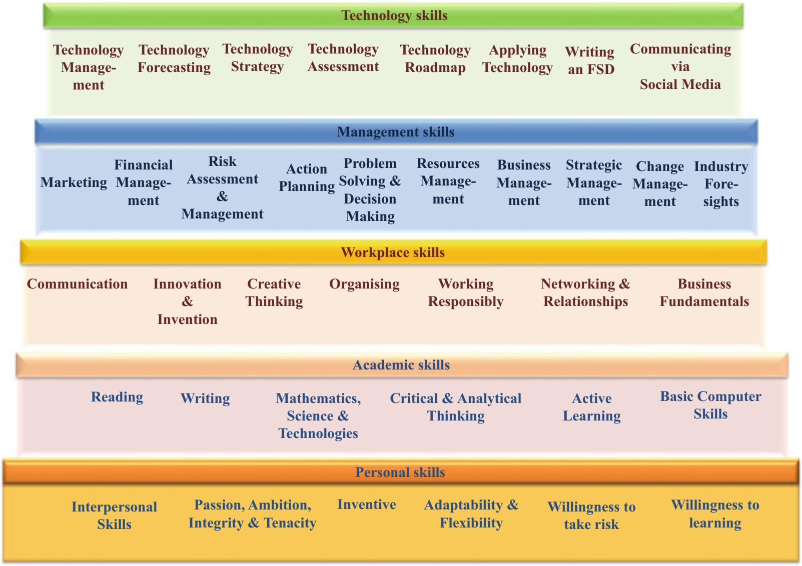

Fig. 4.2 Entrepreneurial skill pyramid

deal effectively with tasks, problems, dilemmas and contradictions. The entrepreneurial role requires entrepreneurs to scan their environments, choose potential opportunities, and take advantage of those opportunities by devising the necessary strategies. To achieve these objectives, the entrepreneur must be equipped with specific skills, including creativity, tolerance of ambiguity, identification of opportunities, and venture evaluation, career assessment, deal making, networking and ethical assessment, and consequently the abilities to identify new market opportunities, to maintain and use networks, plan and organise, and implement strategies to face any difficulties involved in sustaining the business.

Competences consist of more than just a single characteristic. They comprise a group of attributes, some of which are applicable to all entrepreneurs, while others are occupation/industry specific. Because some competences are less universal than others, we have represented the competence model as a pyramid (Fig. 4.2) in which universal competences occupy the lower part and specific competences are located near to the top. This is not to give priority to one competence over another, but is simply to represent the layers of competences that are beneficial for entrepreneurs when facing different business situations. As shown in Fig. 4.2, we distinguish between two competence sets: universal competences, which include personal, academic and workplace skills, and specific competences, which include those of management, and specific technological abilities. Each set is derived from the personal characteristics of an entrepreneur and some of them cannot be learned through studies or experiences because they are innate characteristics of the person.

4.3 Key Factors and Behavioural Determinants

Three factors determine entrepreneurial behaviour, action and performance, namely: competence, effort and support.

Competence is defined as knowledge that can be translated into behaviour or action in a specific context. Entrepreneurial competence in technology-intensive contexts is valuable when it drives appropriate and relevant technology entrepreneurship actions. The relationship between knowledge and psychomotor processes is generally emphasised (DuBrin 2004). When perceiving a signal or an event (e.g. demand, need, research results, etc.), a person organises and interprets sensory impressions to attribute a favourable or unfavourable judgement. First, the person tries to understand the signal, and through a cognition process he/she interprets it based on stable/unstable personality traits and his/her personal value system. This will lead to the development of the affective part of an individual attitude towards the signal, whereby the person generates emotions and feelings about the perceived object. These emotional states will consequently drive individual behaviour and the way the person decides to act with regard to the perceived signal. In this perspective, attitudes are composed of cognitive, affective and behavioural parts. Individual action is then a consequence of stimulus—response processes that occur dynamically, systematically and regularly. In some cases, actors may witness potential cognitive dissonance or a discrepancy between their thinking and behaviour (Fishbein and Ajzen 1975). This means that individual feelings and emotional states are not consistent with their actions. This situation causes individual entrepreneurs possible discomfort that will hinder their performance, particularly if they do not have control over the elements or reasons behind such cognitive dissonance. The context also remains crucial when developing an entrepreneurial competence or stimulating entrepreneurial behaviours, including, for example, leadership, management style, cultural values and so on.

Effort is the second factor. In line with perceptual causes and attitudinal consequences, individual entrepreneurs having the required competences may not show the necessary interest in using such valuable assets to add value. Effort is therefore a function of motivation that can be defined as the internal desire and energy spurring someone to act in a certain way to achieve both individual and organisation objectives. Motivation is different from satisfaction. While satisfaction is an emotional state resulting from the positive evaluation of an individual's experience and can consequently be assessed through organisational climate indicators, motivation, on the other hand, is reflected in an individual's dedication and productivity (Johnston 1976). People can be happy because of satisfactory working conditions, high fixed salaries, lifestyle and so on, but they are probably not willing to put in additional effort or exhibit consistent entrepreneurial behaviours that contribute to performance. Motivation hence becomes a determinant of individual commitment that represents the process whereby actors believe in the organisation's strategy, culture and structure, and demonstrate a willingness to contribute to its success. In addition to meeting individual needs that might lead to potential workforce satisfaction but not necessarily motivation, technology entrepreneurship learning requires a set of managerial practices to promote a sense of equity, training and development support, assignment and objective clarity, rewards, and compensation. For example, actors link the performance of a specific entrepreneurial behaviour and the attainment of an innovation objective to subsequent individual outcomes; in the absence of rewards for task accomplishment, actors will show no commitment in the future. Organisations must therefore deliver the right entrepreneurship training to enhance self-efficacy, foster a management-by-objectives style, and support it through performance-oriented and variable compensation plans. Moreover, they should design efficient performance appraisal instruments to assess individual performance levels adequately, and consider rewards that are valued by actors based on their personal interests, needs and expectations.

To nurture the adequate stimuli that will help actors exhibit expected entrepreneurial behaviours and actions, organisations should also focus on the third performance determinant, namely *support*. Support can involve different organisational facets and dimensions, including, for example, training and development, job design, internal relationships and working conditions. From a holistic perspective, different retention determinants might be considered. These range from organisational characteristics (e.g. vision, strategy, culture, leadership and management styles, policies and procedures, etc.), to job characteristics (e.g. job description and specification, task identify and significance, skill variety, autonomy and responsibility, feedback, etc.), to rewards (e.g. performance-based rewards, variable pay, fair compensation, attractive benefits, etc.), to career planning and development (e.g. talent management, succession planning, coaching and mentoring, etc.), to relationships with supervisors, co-workers, teammates, and subordinates. All these factors can enhance job meaningfulness, sense of ownership, learning, self-fulfilment, and consequently motivation, entrepreneurial behaviour and performance (Goldman 1970).

4.4 Design Elements

Entrepreneurial learning in technology-intensive contexts, encompassing both academic and corporate environments, must follow strict instructional design principles and procedures. First, a needs assessment must be conducted based on the gaps detected between current skills and competences and intended technology entrepreneurship requirements. Learning can focus on knowledge acquisition, competence development, or attitude and behaviour change. For each skill, ability or attitude, organisations should identify the target competence levels and regroup similar gaps into potential learning programmes. This will also help to determine the intended objectives for each learning programme. In this perspective, organisations will devise homogenous entrepreneurial learning programmes focused on specific and quantifiable competence gaps and levels. Based on the importance of the skills and competences related to the task and the significance and frequency of responsibility, organisations can also determine priorities, decide on the learning sequence, and hence optimise the allocation of financial and human resources to meet learning needs.

Second, organisations must design the content of different learning programmes and decide on the methods to be used for delivering the learning material efficiently. The design phase must take into consideration three major factors encompassing a learner's readiness, learning style and learning transfer. A learner's readiness depends on the initial knowledge and competence level considered as prerequisites to attain the target learning outcomes, but also on the learner's motivation to attend and benefit from the entrepreneurial learning experience. Learning styles can also enhance attention span and thus maximise the benefits of the learning experience (Bandura 1977). For adult learning, for example, the principles underpinning andragogy must be considered. In fact, adults are motivated to learn, to acquire new competences, and to reshape their behaviours, but they need both intrinsic and extrinsic motivational factors. Adults like self-paced learning experiences and active practice methods. Learning transfer should also be given enough attention when designing learning content and material. When attaining the intended learning outcomes and developing the necessary competences, learners should also receive the necessary support to transfer such learning in a clearly defined technological application context. Support is emphasised through different practices including task clarity, learning conditions, equipment and technologies, and rewards and compensation. If transfer does not occur, learning remains ineffective and performance unchanged, with no innovation or entrepreneurship results. Following the purpose of learning or entrepreneurial development, different methods can be selected. These can range from classroom discussions to on-the-job learning practices, to coaching and mentoring, and outdoor learning. Organisations can also adopt information and communication technologies to deliver learning content. The proliferation of electronic experience learning systems has made it possible for learning specialists to deliver interactive and customised learning experiences while achieving substantial cost savings and economies of scale. To make e-learning effective, effort must be made to design content that responds to specific entrepreneurship needs and motivates learners to benefit from such self-paced learning programmes.

Third, organisations must make specific delivery decisions to enhance buy-in and facilitate learners' engagement and commitment. In general, three major delivery determinants should be selected: time, location and the use of mentors. For the time and location, efforts must be made to prevent potential distractions, and motivate learners to pay attention and acquire the target competences. The selection of mentors must also take into account the intended learning objectives, the nature of the content, and the methods used. Delivery is a critical phase whereby organisations ensure learners' motivation and commitment, and consequently the effectiveness of learning. Finally, an entrepreneurial learning programme that does not create any value for the organisation is not strategic and is judged not to be valuable. Ultimately, organisations must demonstrate the benefits to be gained from such learning initiatives. The next section describes the assessment criteria and provides examples of some entrepreneurial outcomes resulting from various entrepreneurial experiences.

4.5 Assessment Criteria and Learning Outcomes

Four criteria can be considered for the assessment following Kirkpatrick's (1987) model, as applied in both academic and corporate contexts: reaction, learning, behaviour and results. *Reaction* focuses on learners' satisfaction with regard to the learning experience. Despite the importance of such feedback from learners, however, evaluation on this basis might suffer from subjectivity and personal bias. The second criterion, *learning*, intends to assess the acquisition of the learning material and whether the target competences have been developed or not. *Behavioural evaluation* aims to appraise any change in learners' perspectives with regard to entrepreneurial attitudes. Examples here could focus on the kind of entrepreneurial mindset that is to take shape following specific contextual and profile requirements: emerging young entrepreneur, academic entrepreneur, intrapreneur or corporate entrepreneur and so on.

The most significant evaluation deals with the *results* generated through learning actions. Results can be assessed at the individual, process or organisational level. For individual actors and processes, evaluation can focus, for example, on productivity and other efficiency indicators. For the results, organisations must compute cost—benefit analyses, calculate the return on learning investments in terms of idea generation, for example, and demonstrate the added value of entrepreneurial programmes in terms of new business creation, profitability, customer satisfaction and other market-oriented indicators. The intent is to show to what extent an entrepreneurial learning initiative is a revenue enhancer rather than being a cost consumer, and hence the strategic contribution of such programmes to organisational success. Other examples could be provided based on the various experiences that are designed to promote different forms of entrepreneurship: (1) new products, services, or processes in the case of corporate entrepreneurship; (2) the creation of a new company when it comes to independent entrepreneurship; (3) start-ups and spin-offs leveraging R&D, technology and scientific results for academic entrepreneurship; (4) global strategies and operations for international entrepreneurship; and (5) the creation of social value and community-service products when developing social entrepreneurship.

5 Conclusion

Technology entrepreneurship has become a fundamental value generation asset for business development and sustainable economic growth in an ever-changing environment where the rate and magnitude of technological change have increased dramatically. To cope with such complex evolutionary patterns, businesses and higher education organisations alike are rethinking their value creation models to attain competitive advantage by grasping potential business opportunities, or in some scenarios to survive in the face of economic threats and constraints.

To foster technology entrepreneurship, organisations need to develop the individual and team capabilities necessary to cultivate entrepreneurial mindsets, cultures, values and skills, including, for example, creativity, innovativeness, critical and analytical thinking, initiative taking and leadership, and emotional intelligence. Entrepreneurship learning has also emerged as a fundamental practice within business and academic organisations to achieve such objectives.

In this chapter we approached entrepreneurial learning as a process, as well as considering behavioural factors, instructional design and assessment determinants. We do believe any entrepreneurial learning action is primarily a change initiative aiming at reviewing, adapting and aligning attitudes and cultures with organisational strategies and structures. Understanding the factors that affect individual entrepreneurial behaviours and managing motivational systems that spur individuals and teams to act in an entrepreneurial way stands at the basis of any activity, initiative or action focusing on new-technology-driven idea generation and the translation of such ideas into business opportunities.

Building on such learning, process, behavioural and design perspectives, we proposed an integrative framework that has the potential to trigger academic reflection and research to adopt a more holistic view and a system-thinking approach for technology-intensive entrepreneurial learning that goes beyond the process perspective to capture the drivers of entrepreneurialism as an attitude, behaviour and a cultural belief that also requires scientific design and assessment determinants.

We believe that the proposed integrative framework also represents value-adding implications for businesses and academic organisations alike, to support their decision-making and design procedures in relation to their learning and development strategies.

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5

Rethinking the University System: A Strategic Roadmap Towards the Entrepreneurial University Model

Giustina Secundo and Karim Moustaghfir

1 Introduction

Rethinking universities and higher education learning systems to promote the mindset and capabilities needed to trigger entrepreneurial initiatives has become paramount. Entrepreneurial learning requires unplanned, emergent, short-term and non-sequential development processes (Atherton 2007; Gibb 2002). In addition, the practical and emergent values of entrepreneurial learning emphasise innovative educational methods and pedagogical techniques for facilitating experiential learning, as opposed to the teaching of general principles (Honig 2004). Such values challenge the current linear academic systems and

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call for learning strategies, cultures, structures and processes that transcend planned knowledge transfer and acquisition (Rae 2009).

As the skill base of the economy changes, the disciplinary basis of universities becomes irrelevant (Meira Soares and Amaral 1999). Universities and academia have been criticised for their inability to provide programmes and action learning approaches that promote entrepreneurial competences and mindsets, including the capacity to think creatively, strategically, analytically and reflectively, confidence in one's abilities, the ability to collaborate, well-developed communication skills, and an understanding of the current business context (Pollard and Wilson 2013). Human capital with a creative and entrepreneurial mindset and spirit is able to transform organisations into smart systems and 'living organism' (Schiuma 2011); higher-order thinking, creativity and entrepreneurial skills have become more important in the workplace than 'subject-specific skills' (Dutta et al. 2014). In current educational systems, rigid curricular structures prevent students from engaging in a dynamic learning experience that addresses time- and context-specific questions and problems (Mumford 2006) while promoting change-driven attitudes, as opposed to conformist and co-operative behaviours.

Higher education systems are expected to become more responsive to the emerging skill and competence needs stemming from the *metamorphosis* of the current market and business environment as well as the evolutionary patterns caused by technological, socioeconomic and environmental changes. Universities are required to take specific actions to adapt to the new economic landscape, but also to become a *catalyst* for innovation systems involving various stakeholders, all while contributing to economic growth, firm and national competitiveness, and overall business performance. The expression 'stakeholders' is being used increasingly to denote the environment of a university. Stakeholders include students, but also graduates, local communities, local and regional authorities, and the business sector (Freeman 1984; Pawlowski 2001; Redford and Fayolle 2014). However, the development of entrepreneurial mindsets that support technology-driven entrepreneurship calls on universities to promote a deep reconfiguration of their organisational processes and programmes (Secundo et al. forthcoming). Universities need to become agents of regional innovation in the Schumpeterian sense, moving towards an ‘entrepreneurial university’ setting (Clark 1998; Etzkowitz 2004; Guerrero and Urbano 2012; Röpke 1998), where the relationships with key stakeholders are vital aspects for setting up an innovative learning strategy for students (Vincett and Farlow 2008).

This chapter will shed more light on the entrepreneurial university model while analysing the characteristics of each system element. Our purpose is to develop a framework whereby the development of a specific entrepreneurial mindset in students will be facilitated through strategic, managerial and cultural mechanisms and practices. The intent is to offer a holistic scheme to support decision- and policy-making at both the university and national levels to face economic and technological challenges.

The remainder of this chapter will be organised as follows: Section 2 debates the entrepreneurial mindset for technology-intensive entrepreneurship and why it should be developed. Section 3 discusses the characteristics of human capital with a mindset for technology-driven entrepreneurship. Section 4 analyses the features of the emerging model of higher education systems where to develop such innovative profile. Later, in Section 5, a strategic roadmap for activating the evolution of the higher education system towards the entrepreneurial university model is suggested and discussed. Finally, conclusions link the proposed roadmap to decision- and policy-making in the university to reinforce its role from the provision of basic science to innovation and regional development.

2 Why an Entrepreneurial Mindset for Technology-Intensive Entrepreneurship Should Be Developed

In today’s world, innovation is the engine of the knowledge-intensive and sustainable growth of regions in a highly competitive market. The countries that are leaders in innovation capability are those with an availability of highly skilled human capital (Dutta et al. 2015). Hence, nurturing the next generation of human capital with creativity and an entrepreneurial mindset is a key priority for the research agenda of policy-makers to sustain innovation at a regional level.

For this purpose, across the globe, governments have acknowledged the importance of motivating individuals (human capital), businesses and related stakeholders to perceive and develop new technology-intensive opportunities that can promote positive changes and economic growth (Blenker et al. 2008). Entrepreneurial development is also a means of responding to new economic challenges, creating jobs, and fighting social and financial exclusion (OECD/EC 2013). Defined for the first time by Schumpeter (1947) as the ability to respond to the creative processes of change, knowledge-intensive entrepreneurship or technological entrepreneurship (Giacon 2008; Malerba 2010; Prodan 2007; Romano et al. 2014) is interpreted as the capacity, competence and attitude to transform new ideas, technologies and inventions into commercially viable products and services to create economic and social value through innovative business models (Allen 2010; Lumpkin and Dess 1996; Połczyński and Jaskólski 2005). However, this capacity demands more highly skilled human capital with an entrepreneurial mindset (Dutta et al. 2014) able to explore new areas of opportunity, especially in technology-intensive industries where the ability to set up new business configurations is linked to the capacity to transform ideas, opportunities and inventions into economic and social value (Allen 2010; Elia et al. 2011).

Nations with a high availability of qualified human capital take the lead in innovation capability over others. Other factors, such as technology and capital, also influence the innovation process; these correlate directly with the human factor. Among the innovation leaders in the Global Innovation Index (Dutta et al. 2015), we find the top ten countries that have succeeded in creating well-linked innovation ecosystems, where investments in human capital thrive in fertile and stable innovation infrastructures to create impressive levels of innovation outputs: Switzerland, the UK, Sweden, the Netherlands, the USA, Finland, Singapore, Ireland, Luxembourg and Denmark (Dutta et al. 2015).

This is confirmed in a study by Martínez et al. (2010), who assert that entrepreneurship education is effective when there is a receptive and fertile socioeconomic context with adequate infrastructure, economic stability and technological progress. The authors analyse several aspects of entrepreneurship education and training in 38 countries, which they divide, according to GEM classification, into factor-driven, efficiency-driven and innovation-driven countries. They show that, in general, entrepreneurship education and training improve the awareness of entrepreneurship, increase self-efficacy and intentions, and have a positive influence on opportunity identification and reducing fear of failure. However, while entrepreneurship education increases entrepreneurial activity in developed economies and countries, investment in education and training does not have the same effect in factor- and efficiency-driven economies.

Indeed, and according to modern growth theory, human capital creation and development is a central element and driver of the technical and innovative progress necessary for growth. Becker (1994) was one of the first economic and social theorists to recognise human capital as a set of skills that increase the productivity of the worker within firms and, ultimately, the overall production process of nations. Even though it is difficult to quantify, human capital is treated as the stock of knowledge or skills that has a positive impact on economic output.

For these reasons, students at all levels of education need to be equipped with an entrepreneurial mindset. In particular, graduates of science and engineering disciplines are expected to found new ventures in dynamic, innovative areas that will generate significant economic growth and boost employment (Lüthje and Franke 2003). Targeting engineering and science students with an entrepreneurial mindset is an emerging priority for our universities and higher education systems (Venkataraman 2004) and is increasingly in demand from policy-makers and practitioners (OECD 2011; WEF 2011). An entrepreneurially-minded, technology-intensive actor is able to design value-added products and processes that create demand through innovation, resulting in positive cash flow, revenue and regenerative profits for the enterprise creating the product (Creed et al. 2002; Kriewall and Mekemson 2010).

The role of universities and in general of higher education systems to train engineers and scientists who are highly skilled in technical competences is not enough; their educational programmes must aim at enhancing students' creativity, original thinking, leadership qualities and initiative (Cobb et al. 2008; Dutta et al. 2014) for all the other non-business students, from biology to the humanities. Adequate regional planning for enhancing human capital development through

Table 5.1 Impact of entrepreneurship education

	Individual level	Organisational level	Societal level
Job creation	Individuals with entrepreneurial skills are able to sustain economic growth	'Entrepreneurial firms' create new jobs	Innovation and entrepreneurship are source of growth
Economic development	Entrepreneurship allows individuals to find economic success	Organisational renewal is the engine for a firm's success	Renewal and innovation processes are fundamental for society
Globalisation and innovation	People need entrepreneurial skills to afford the challenges of a changing world	'Entrepreneurial firms' play a key role in the market	A flexible market requires human capital with higher-order thinking skills

Source: Adapted from Lackéus (2015)

entrepreneurial education is a fundamental strategy for creating suitable conditions for knowledge-based innovation that will lead to regional economic development. The reasons for developing an entrepreneurial education can be found at individual, organisational and societal levels, while the positive impact of entrepreneurial education can be analysed in terms of job creation, economic success, globalisation and innovation. Moreover, job engagement and creativity, and the impact on societal challenges, are less common but promising (see Table 5.1).

3 Human Capital with a Mindset for Technology-Driven Entrepreneurship

A mindset is a personal way of thinking (Ekman and Ekman 2009). In his book, *Five Minds for the Future*, the American psychologist Howard Gardner defines an integrated future mindset in terms of the synthesizing mind (the ability to integrate the idea from different disciplines), the disciplinary mind (the mastery of some academic disciplines), the creating mind (the capacity to clarify a new problem), the respectful mind and the ethical mind (it is able to merge roles at work and as a citizen and act consistently with those conceptualisations) (Gardner 2006). An *entrepreneurial mindset* is conceived as the best of the five minds (Ekman and Ekman 2009): it requires both thinking and action to be combined in a professional way. Building on this distinction, other authors have defined an *entrepreneurial mindset* through five constituent elements: (1) the capacity to think creatively, strategically, analytically and reflectively; (2) confidence in one's abilities; (3) the ability to collaborate; (4) well-developed communication skills; and (5) an understanding of the current business context (Pollard and Wilson 2013). Moreover, this 'entrepreneurial mindset' is thought to be not only distinct, but also learnable and able to be developed through deliberate practice.

The emergence of the entrepreneurial mindset in science and engineering through technological development since the 1990s has been described as a revolution, whether in microelectronics, bio- and nanotechnology, materials science, computer science, medicine, or other high technology disciplines. At the same time, the boundaries between the engineering disciplines are disappearing as engineering itself becomes more interdisciplinary in order to solve increasingly complex problems and societal challenges (NAE 2005). The rapid resolution of the urgent challenges affecting societies (e.g. security, sustainable mobility, energy, health care, education, etc.) is more than before a core prerequisite for engineering and science graduates. It is becoming more commonly understood and accepted that engineers need business, social and interpersonal skills to operate effectively in the organisational environments in which they work. A fundamental role in society is covered by '*technology-intensive entrepreneurs*'. They have science-based or engineering-based backgrounds, and have entrepreneurial attitudes and self-adapting behaviour that enables them to operate successfully in the 'smart' economy (e.g. intelligent materials and processes communicating with computers), 'green' economy (e.g. environmentally sustainable economic activities), and 'bio' economy (i.e. an understanding of mechanisms at the genetic level for health and living systems) (Elia et al. forthcoming). Renewed effort is required from academic communities and practitioners alike to describe, highlight and encourage a new generation of small entrepreneurs who are the real engine of the most successful and innovative businesses in Europe.

Technology-intensive entrepreneurs represent an answer to this need (Allen 2010; Elia et al. forthcoming; Giacon 2008). They are part of a new generation of young entrepreneurs who 'think differently' and use new and unexpected perspectives to imagine their business, products and services. Thus they must be knowledge creators able to invent, imagine, explore, inspire, create new business technology opportunities and work in such a way as to generate social and economic value through the use of new technologies. In addition to the technical skills required to design and build bridges, cars and cities, technology-intensive entrepreneurs need to work with people who have different perspectives and responsibilities to get those products accepted, implemented and used. This emerging professional profile therefore defines an entrepreneur who can identify potential market- and technology-driven opportunities, gather necessary resources, and manage rapid growth and risks using decision-making skills. In other words, they play many roles and functions as a single agent, and need support to give their novel ideas a concrete form. We can distinguish four main typologies of technology-intensive entrepreneurs (Giacon 2008) (Fig. 5.1):

- *The emergent young innovative entrepreneur*: he/she is a young person with smart ideas, sometimes highly qualified, able to build rapidly growing businesses within a few years, particularly in the field of ICT (information and communications technology).
- *The academic entrepreneur*: a university scientist (most often a professor, sometimes a Ph.D. student or a post-doc researcher) who sets up a business company in order to commercialise the results of research initiated through academic projects.
- *The family entrepreneur*: this typology includes individuals who inherit or buy a business. They are often sons or daughters of self-employed artisans or small entrepreneurs that are active in a traditional industry. This new generation of entrepreneurs is able to lead the evolution of the previous firm from traditional products to innovations that are rich in terms of technology upgrading and improvements.
- *The sci-tech or entrepreneurial engineer*: these people lead the whole process, ranging from ideation and design to implementation and management of complex systems that satisfy societal and environmental challenges (sustainability), leverage technological potential (feasibility), and create business opportunities (economic profitability).

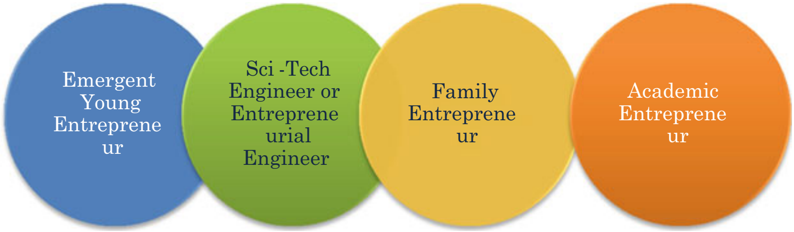

Fig. 5.1 Typologies of technology-intensive entrepreneurs

The four categories of technology-intensive entrepreneurs are composed of agents of change who are able to exploit new technologies, to think differently, and to use other perspectives to imagine their business and product. Particular attention is devoted in this chapter to the professional profile of the fourth category above, the sci-tech or entrepreneurial engineer.

3.1 The Evolution Towards the Sci-tech Engineer or Entrepreneurial Engineer

By the end of the twentieth century, after two centuries of parallel development with different goals and low reciprocal interactions, science and technology converged into a single entity, initiating a new science—technology revolution (sci-tech). The 'sci-tech revolution' has blurred the distinction between basic and applied research, overcoming the classical linear innovation model and shortening the cycle time from invention to application. Thus, *the sci-tech engineer* could be defined as 'a person who uses scientific knowledge and microscopic building blocks to create products, materials, and processes that are useful to man' (Tadmor 2006). The sci-tech engineer brings together scientific knowledge, technical expertise, creativity and design capabilities to produce an output that is valuable for people.

Indeed, according to Allen (2010), 'as an applied science, engineering seems to have a natural symbiosis with entrepreneurship in that the term entrepreneur comes from French word *entreprendre*, which means to undertake an action … entrepreneurs recognise opportunity and gather the resources needed to launch a venture, they take action … similarly, engineers apply mathematics, science and system integration to conceive, design, build and operate useful objects or processes'. This allows for the introduction of the entrepreneurial engineer profile—a person who is able to design value-adding products and processes that create demand through innovation, resulting in positive cash flow, revenue and regenerative profits for the enterprise releasing the product (Creed et al. 2002; Kriewall and Mekemson 2010). Figure 5.2 illustrates the evolution of the engineer's role.

Aligned with this vision, several scholars have focused their attention in different ways on this newly emerging engineering profile. At the beginning of the twenty-first century, the concept of 'entrepreneurial engineer' was introduced to characterise a multi-dimensional set of attributes: some are related to the basic sciences, design, and manufacturing processes and industry-specific knowledge; while others are more related to soft skills (communication, team working, critical thinking, flexibility), business and project management, and career-long learning. The entrepreneurial engineer is thus a 'T-shaped' professional, in the sense that the 'vertical' domain specialisation (the 'I-shape') is completed by a set of horizontal competences and attitudes. A further evolution, the 'Π-shape' was introduced by IBM research (Hayashi and Kurokawa 2009) to refer to a professional able to combine different industry-specific competences

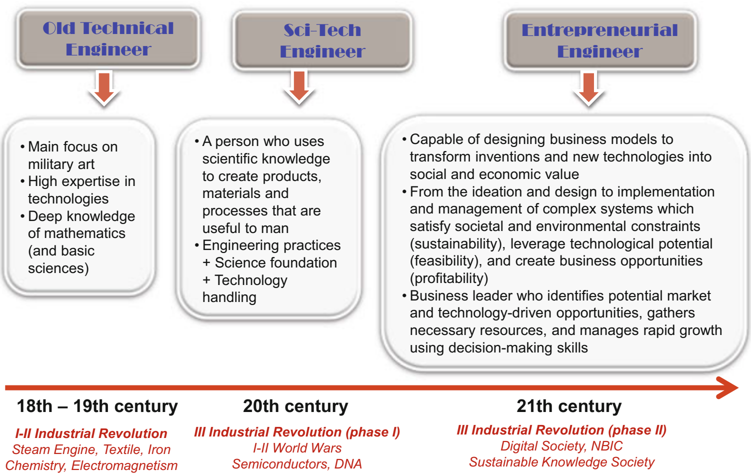

Fig. 5.2 The evolution towards the entrepreneurial engineer

Table 5.2 A competence framework of the entrepreneurial engineer

Integrator-related competence	
Holistic vision	See connections among components and integrate them
Interdisciplinary mindset	Integrate several knowledge domains to solve complex problems
Problem-solving	Identify the real causes of a problem and formulate alternative solutions
Project orientation	Conceive and develop initiatives as a project
Scientific background	Master analytical and logical skills applied in problems and solutions
Leader-related competence	
Communication	Promote and encourage mechanisms to stimulate dialogue
Creativity	Invent, innovate, and think 'outside the box'
Ethical standards	Evaluate solutions that are coherent with ethical responsibilities
Leadership	Guide the shaping process for the ultimate use and governance of technology
Lifelong learning	Develop a desire to acquire and update knowledge and skills continuously
Team working	Work with people with heterogeneous skills, culture, habits and behaviours
Entrepreneur-related competence	
Entrepreneurship	Recognise market needs to launch new ventures
Risk	Assess and evaluate risk
Flexibility	Embrace necessary changes that allow for constant success
Proactivity	Act in advance of a future situation rather than just reacting
Socioeconomic background	Understand the rapidly changing scenario
Strategic approach	Build and analyse future scenarios to define development strategies

Source: Elia et al. (2011)

and knowledge integrated by a balanced mix of social skills, problem-solving attitudes, a project-oriented mindset, and management style. The entrepreneurial orientation represents the basis for the development of further specialisations following emerging needs and opportunities (Elia and Poce 2010).

In the engineering field, such a profile combines a fourfold set of competences, acting as (Elia et al. 2011): (1) a 'specialist', providing technical expertise of world-class standing and applying concepts related to well-defined knowledge domains; (2) an 'integrator', managing across boundaries and combining technical and organisational capabilities by the synthesis of business, social, ethical, and technological issues; (3) a 'leader', providing creativity, vision and innovative strategies to reshape dynamic industries through proactive behaviour; and (4) an 'entrepreneur', identifying the potential value of an idea or technology and transforming it into business and social value (Spinks et al. 2006) (Table 5.2).

4 The Entrepreneurial University as a Booster for the Creation of Technology-Intensive Entrepreneurs

The achievement of the ambitious goals related to the creation of a new profile of knowledge-intensive entrepreneurs as well as the promotion of a large and diffused entrepreneurial culture within society calls on universities to promote a reconfiguration of their traditional processes and programmes. This is to assure better openness to market stakeholders and the adoption of interdisciplinary approaches for education, research and innovation, the creation of public—private partnerships, and the wider involvement of a larger community of stakeholders at both national and international levels.

Universities are institutions with a long history and have gone through several stages in their development (Clark 1998, 2004). While initially conceived as institutions with a teaching mission, in recent years universities have begun to assume a 'third mission': contributing to society and economic development more directly (Table 5.3). In particular, thy are undergoing a 'third revolution' (Etzkowitz and Viale 2010), overcoming the 'first and second revolutions' (Etzkowitz 2004; Etzkowitz and Leydesdorff 2000). Now universities are being required to operate in a more entrepreneurial way (Gibb et al. 2009), commercialising the results of their research, spinning out knowledge-based enterprises (Kirby 2006), and enhancing the diffusion of innovation in increasingly knowledge-based societies (Etzkowitz 2004). Creating the appropriate

Table 5.3 The evolution of the university's mission

	First industrial revolution	Second industrial revolution	Third industrial revolution	
			Phase I	Phase II
Mission of the university	Mainly teaching	Teaching + Research	Teaching + Research + Innovation (*Third Mission*)	Teaching + Research + Innovation + Development (*Multiversity*)
Configuration	Single helix	Double helix	Triple helix	Triple helix and beyond
Role of scientists	Isolated and truth-seeking	Truth-seeking with little focus on applications	Networked	Networked and entrepreneurial, able to match knowledge with innovation
Nature of invention	Generated by engineers through experiments and trial and error (*steam engines*, *textiles*, *wrought iron*)	Pivotal breakthroughs in the laws of nature (*Organic chemistry*). A macro-invention (*electro-magnetism*) requires many other micro-inventions (*technology for the transmission of electrical impulses*) to become an innovation (*telegraph*)	Important scientific discoveries (*recombinant DNA*, *nuclear power*, *semiconductors*)	Integration between different emerging generic technologies (*NBIC*)
Academic–industry collaboration	Very low	Existing, though with different methodological approaches, rules, perspectives, aims	Existing, with a leading role of the university	Strong. All the actors participate in the birth of new hybrid institutions
Academic–government collaboration	Absent	Absent (except for military issues)	Existing (government encourages and funds discoveries)	

Source: Adapted from Elia et al. (forthcoming) environment for entrepreneurial behaviour requires a complex mix from the perspective of the 'triple-helix model', where new patterns of collaboration among industry consortia, university linkages and government agencies emerge (Campbell 2005; Campbell et al. 2004).

However, the role of universities and higher education centres goes far beyond the delivery of knowledge, to include participation in ecosystems, partnerships and industrial alliances that contribute to economic and social development. The value of the new approach relies on integrating knowledge, experience and action within entrepreneurship programmes (Heinonen and Poikkijoki 2006).

One significant European response to these unprecedented challenges is seen in the development, in concept and in practice, of the 'entrepreneurial university' (Clark 1998; Etzkowitz 2004; Gibb et al. 2009; Guerrero-Cano 2008; Kirby 2006; Röpke 1998): an organisational and strategic model of universities aligned with the above-mentioned dynamics allowing them to include the so-called third mission in the traditional teaching and research missions, which contributes to improving regional and economic growth (Clark 2004; Etzkowitz 2004; Guerrero and Urbano 2012).

There is no clear definition of an entrepreneurial university, but rather there is an invaluable plurality of approaches—inventive, creative and yet practical—which emphasise innovative entrepreneurial styles. The most relevant attempts to define the entrepreneurial university include:

- The entrepreneurial university (Clark 1998; Currie 2002; Etzkowitz 2004; Gibb and Hannon 2006; Guerrero and Urbano 2012) is a crucial model for innovating knowledge-based societies, for spinning out knowledge-based enterprises, for creating employment, and for generating socio-economic value in synergy with institutions and industries (Etzkowitz 2004).
- An entrepreneurial university can mean three contemporary things (Röpke 1998): (1) the university itself, as an organisation, becomes entrepreneurial; (2) the members of the university (faculty, students, employees) somehow turn themselves into entrepreneurs; (3) the interaction of the university with the environment, or the 'structural coupling' between university and the region, follows entrepreneurial patterns.

- The entrepreneurial and innovative higher education institution is designed to empower students and staff to demonstrate enterprise, innovation and creativity in teaching, research and the third mission. Its activities are directed towards enhancing learning, knowledge production, and exchange in a highly complex and changing societal environment as an organisation; it is dedicated to creating public value via processes of open engagement (Gibb et al. 2013).
- An entrepreneurial university allows the model of the 'triple helix' metaphor/configuration—used to describe the interconnections and operations of three forces or actors in society: universities, the business sector, and government (Blenker et al. 2006; Etzkowitz and Leydesdorff 2000)—to be developed (Etzkowitz 2011; Etzkowitz and Viale 2010) to generate new institutional and social formats for the production, transfer and application of knowledge.

The model of the entrepreneurial university is grounded in the *Schumpeterian scientific research stream*; according to the Schumpeterian perspective, every university, regardless of it scientific and professional specialisation, can grasp many opportunities by recombining its input and assets in an innovative way: in doing so it can obtain better results with the same inputs. If a university does not have an entrepreneurial attitude, it constantly needs to provide new resources for its growth. If a university is inspired by the Schumpeterian perspective, its changes become mainly endogenous: they are produced by its own internal initiatives (Röpke 1998; Schumpeter 1934). Consistently, the reinvention of the twenty-first century university has to emerge endogenously, through systematic and controlled trials, which is consistent with the new paradigms of the knowledge economy (Romano 2009).

4.1 Applying a System Thinking Approach to the Entrepreneurial University

A system thinking approach is required to disentangle the complexities revolving around the evolution of the university model towards a more entrepreneurial configuration. For the purpose of this chapter, *system* *thinking is defined as an approach for developing models to promote our understanding of events, patterns of behaviour resulting from the events, and, even more importantly, the underlying structure responsible for the patterns of behaviour.*

Coherently, the European round table of the World Economic Forum (WEF 2011) suggested some insights for 'reinventing' European educational systems at all levels (from primary school to universities) through an entrepreneurial manifesto built around seven pillars. The seven interconnected pillars represent the strategic actions required to launch radical innovation in lifelong learning processes for the development of transversal skills to prepare individuals for today's varied and unpredictable career paths (Volkmann et al. 2009). Following the same direction, the European Commission (EC) and the Organisation for Economic Co-operation and Development (OECD) have published a 'Guiding framework for entrepreneurial universities' (EC/OECD 2012) in which the entrepreneurial university model is described according to the following seven areas:

1. *Strong leadership and good governance* are considered to be crucial factors for strengthening the university's entrepreneurial agenda, as well as its entrepreneurial culture;
2. *University—business external relationships for knowledge exchange* in terms of relationships with key partners and collaborators with the final aim of reaching the third mission. Relationships also have to be developed with the public sector, regions, businesses, alumni, professional bodies and so on;
3. *Organisational capacity, people and incentives* to fulfil the university's entrepreneurial agenda, including financial strategy, attracting and retaining the right people, and incentivising entrepreneurial behaviour in individuals;
4. *Entrepreneurship development in teaching and learning*, reflecting the need for the organisational structure to support entrepreneurial development as well as to provide the right tools to deliver education and training opportunities;
5. *Pathways for entrepreneurs to support 'intrapreneurs'* in their career development or would-be entrepreneurs (staff and students) on their

way to becoming entrepreneurs, from ideas to market growth or into employment; this needs a pluralistic approach to provide access to internal and external opportunities and expertise;

6. *The entrepreneurial university as an internationalised institution*, since a university cannot be entrepreneurial without being international, even if it is possible for it to be international without being entrepreneurial; and
7. *Measuring the impact of the entrepreneurial university*, ranging from the local to the global. Such impacts indeed affect both internal (students/graduates, staff) and external (local businesses, organisations, whole communities) stakeholders. This measure could then overcome the limits of the current measurements that are mainly related to spin-offs, intellectual property and research outcomes that do not consider the strategic impact of an entrepreneurial university in terms of graduate entrepreneurship, retaining talent, local economic development and broader entrepreneurial strategy.

The critical factor for a university to be entrepreneurial is its *organisational culture*, which must be characterised by a collective mindset whereby entrepreneurship is facilitated in a combined top-down, bottom-up fashion, including a high tolerance for risk-taking (Clark 1998). An important part of the organisational culture is how flexibly rules are interpreted, and more specifically how rules support entrepreneurship, but also when not to apply rules and to rely on broad activity-directing instead (Gjerding et al. 2006).

Another cultural aspect deals with steering capability, which should neither be centralised nor decentralised. It could be characterised as 'centralised decentralisation' (Clark 1998). The role of top leadership in defining strategic issues for the institutional agenda is crucial (Kristensen 1999). The university management should strongly encourage entrepreneurial activities among faculty through several actions: developing income-generating products and marketable services, consulting, business linkages, interdisciplinary partnerships, and knowledge production in ongoing enterprises, and producing income from technology transfer activities which provide intellectual property (Slaughter and Leslie 1997; Subotzky 1999). Faculty should also be encouraged to play the role of *entrepreneurial scientists* and network builders (Etzkowitz et al. 2008), pursuing a tripartite academic career: as a scientist, innovation researcher, and entrepreneur (Etzkowitz and Viale 2010). Support must also be provided to staff and faculty members to develop the necessary competences in strategic management, project management, knowledge management, and a clear understanding of modern pedagogy, which will make them *academic managers* (Zaharia and Gibert 2005).

According to Hay et al. (2003), barriers to the development of an entrepreneurial culture in universities include the collegial, professional and bureaucratic nature of the institutions. A university cannot become entrepreneurial simply by creating innovative structures; it must change its conceptions regarding the mission of the university within society (Zaharia and Gibert 2005). The process of entrepreneurial transformation is lengthy and varies between universities, influenced as they are by traditions, economic development, cultural factors and legislative frameworks (Zaharia and Gibert 2005). Through entrepreneurial transformation, universities should not become enterprises, nor strive to be more like enterprises (Meira Soares and Amaral 1999).

Based on the models of entrepreneurial university as described in the scientific literature, a general question emerges: *how is it possible to facilitate, catalyse, speed up and support the evolution of traditional managerial universities towards an entrepreneurial configuration?* The specific catalysts of the entrepreneurial university can be designed internally for each specific university/college, or can be an expression of universities located in a particular region and connected with other similar academic institutions. All over the world, universities and higher education institutions have started to move towards the radical configurations and transformations needed to build entrepreneurial university settings. Following similar paths, European universities and research institutions have committed themselves to strengthening entrepreneurship as part of their strategies, and have made a number of initiatives to promote an entrepreneurship agenda. Table 5.4 provides examples illustrating some best practices that have been implemented successfully by universities around the world, with reference to each building block of the entrepreneurial university framework.

Table 5.4 Entrepreneurial universities: best practices

Entrepreneurial university building blocks	Entrepreneurial university	Key parameter	Description
Leadership and governance	KU Leuven (Katholieke Universiteit Leuven), Belgium	*Governance of the technology transfer process*	In 1972, KU Leuven established the Technology Transfer Office. Over the years, it has moved progressively towards a decentralised and diffused approach to university—business co-operation, which is embedded in all the university's units and structures. It relies on interdisciplinary research divisions and on the progressive inclusion of technology transfer goals in the researchers' culture
Organisational capacity, people and incentives	Arizona State University, USA	*Reorganisation in interdisciplinary schools based on grand challenges*	Arizona State University has demonstrated a great commitment to creating economic and social value and impact. For this purpose, the university recently reorganised the institution to address grand societal challenges
Entrepreneurship development in teaching and learning	Coventry University, UK	*Human resource development for entrepreneurship education is in place*	The Institute of Applied Entrepreneurship offers Coventry University Schools and Colleges assistance with developing an enterprise curriculum and sustainable enterprise and entrepreneurship activities. The main focus is to contribute towards generating more awareness and accessibility to enterprise education. The range of activities includes workshops, coaching and continuing professional development programmes for the faculty

(continued)

Table 5.4 (continued)

Entrepreneurial university building blocks	Entrepreneurial university	Key parameter	Description
Entrepreneurship development in teaching and learning	EM Lyon Business School, France	*The university is structured to stimulate and support entrepreneurial learning*	EM Lyon Business School's mission since 2003 has been formulated as *Educating Entrepreneurs for the World*. This indicates the commitment of the school to lifelong learning and to training entrepreneurs who are capable of creating wealth and social development, and operating in different systems around the world. Activities carried out are connected with education and teaching, entrepreneurship research and entrepreneurship educational research, and start-up support through the provision of infrastructure (business incubator) and access to networks
Pathways for entrepreneurs	Aalto University, Finland	*The institution supports innovative approaches to learning*	The Aalto Factories were conceived as creative spaces that foster informal meeting and collaboration at all levels. They were launched in 2008, and were organised into the Design Factory, the Media Factory and the Service Factory. The Factories lead research and innovation projects involving students, companies and researchers, and they benefit from dedicated technologies and facilities

(continued)

Table 5.4 (continued)

Entrepreneurial university building blocks	Entrepreneurial university	Key parameter	Description
University—business external relationships for knowledge exchange	University of Limerick, Ireland	*The university specifically supports staff and student mobility between academia and the external environment*	The Cooperative Programme (CoOp) at the University of Limerick is a compulsory part of every undergraduate degree. The university has an established network of over 1,700 co-operative education employers who provide a range of relevant career experiences in industry, commerce, public services and other professions—about 30 % of which are international participants. Typically, placements last for eight months, prior to which every student is trained by the university
The entrepreneurial university as an internationalised institution	University of Turku, Finland	*The institution demonstrates internationalisation in its approach to teaching*	The strategy of the Finnish Ministry of Education and Culture emphasises the level of internationalisation, which is also reflected in the University of Turku's strategic agenda. For this purpose, the university is very active in international relations through collaborative research projects and programmes, participation in international networks, participation in international conferences and receiving visiting professors, student and staff exchanges, as well as joint curriculum development and degrees. The International Office of the university facilitates the international mobility of students, researchers and teachers

Source: EU/OECD (2012)

4.2 The Entrepreneurial University as a Stakeholder University

Over the next three decades —into the 2040s— the university is expected to take a proactive role in innovation and regional development through a clear engagement in entrepreneurial activities (Urbano and Guerrero 2013). while the situation is emergent in nature, the decentralisation and reduction of university funding and recent policy changes indicate that universities might need to pay more attention to developing a wider range of entrepreneurial relationships with external stakeholders to enhance national and regional innovation systems. From this perspective, the interplay between academia and external stakeholders such as industry, non-governmental organisations (NGOs), government institutions, investment funds, and technology transfer offices (TTOs) is of paramount importance to generate value jointly.

The literature includes many attempts to classify stakeholders using various criteria. According to Freeman (1984), two main groups can be identified for a university: internal stakeholders (alumni, faculty, administration and university staff) and external stakeholders (industry, government and the regional/local community, and citizens). The stakeholders' engagement is essential for the entrepreneurial university to create value by improving the socio-economic environment (Fayolle and Redford 2014). Value emerges through joint collaborative endeavours, where different stakeholders bring together their assets, competences and know-how.

The stakeholder view in education is not completely new. In fact, since the 1960s the rise of the stakeholder society and the shift from elite to mass education has had major consequences in terms of redefining the purpose of higher education and the legitimacy of various actors. The stakeholder perspective has thus been adopted to look at the internationalisation of higher education and to identify major stakeholders that have a role in such endeavours; i.e. government, academia and the private sector (Knight 1997). The stakeholder approach has also been used to demonstrate the need for changes in the universities' structure and the strategy needed to cope with the transforming environment and educational needs (Jongbloed and Goedegebuure 2001). Universities need to assume their role in society and engage various stakeholders and their communities in the process (Fayolle and Redford 2014).

These aspects recall the envisioning of a new type of university—the stakeholder university (Jongbloed et al. 2008; Romano 2009)—which promotes learning and capability-building processes among globally distributed and integrated networks of heterogeneous stakeholders (Margherita and Secundo 2011). The stakeholder university can be a trigger for inter-organisational innovation and value creation, a hub of learning networks that brings with it major benefits such as the strong integration of education with research and project activities and virtuous private—public partnerships with different actors (Margherita and Secundo 2011). By using a stakeholder perspective, the entrepreneurial university creates a powerful process by intentionally developing a network of social contacts from which resources can be obtained and with whom the university will work to convert these resources into added value (Fayolle and Redford 2014).

5 Building a Strategic Roadmap for Activating the Evolution Towards the Entrepreneurial University Model

From an entrepreneurial perspective, the multi-faceted performance that a university is required to achieve embraces a larger meaning of social value creation through the management of stakeholder relationships (Post et al. 2002). Stakeholders' engagement with universities needs to be planned to sustain the entrepreneurial activities within their local and regional community. Stakeholders engaged with entrepreneurial universities start acting in accordance with entrepreneurial values, translating concept into action (Fayolle and Redford 2014).

To make a university more entrepreneurial, it is necessary to consider an 'evolutionary' model to accomplish a number of changes in some of the main components that characterise the entrepreneurial orientation of a university. This process cannot be implemented without a clear vision of the university, strong leadership support, and the planned involvement of the internal and external stakeholders of the university.

A complete roadmap for imagining and sustaining the evolution of a university towards the model of an entrepreneurial university interpreted as a stakeholder university requires the planning of four phases covering different actions to be implemented (Table 5.5): (1) inspira-

Table 5.5 A roadmap of strategic planning to support the evolution towards the entrepreneurial/stakeholder university

	Strategy	Mainstream actions
Phase 1: Inspiration	Key actors define the key role of universities in the wider regional development	• Convey a clear understanding of entrepreneurship as a strategic objective of the university • Assure top-down support for it • Identify the internal stakeholders to diffuse a clear mission • Establish entrepreneurship education objectives and support for start-up activities • Set-up a local project organisation
Phase 2: Implementation and Networking	Develop experimental initiatives that foster the development of an entrepreneurial culture among students, university staff and former entrepreneurs	• Develop a mission for entrepreneurship education to be communicated to the regional community • Identify a champion for programmes and projects • Establish contact with businesses and institutions • Develop education, research and innovation programmes for a wide target (former entrepreneurs, students, executives, citizens, etc.) • Facilitate faculty orientation for entrepreneurship support • Adopt holistic and interdisciplinary design programmes with innovative action-learning strategies

(*continued*)

Table 5.5 (continued)

	Strategy	Mainstream actions
Phase 3: Consolidation	The developed experience needs to be revisited to consolidate the model of entrepreneurial support	• Create a fully available centre for innovation and entrepreneurship focused on the pre-incubation and incubation phases of entrepreneurial development • Create reward systems for faculty and staff • Foster the development of high-tech and low-tech growth-oriented entrepreneurship • Follow up and evaluate the initiatives
Phase 4: Self-sustainment and growth	Engage relevant stakeholders continuously in the wider ecosystems	• Develop a network with other universities. • Involve businesses and institutions in the delivery of entrepreneurial education initiatives for a wider audience. • Diffuse an entrepreneurial culture in society.

tion; (2) implementation and networking; (3) consolidation; and (4) self-sustainment and growth.

During *Phase 1: Inspiration*, the key actors and stakeholders define the revised role of the university within the local community in order to assess the impact of the university in terms of regional development. A strategic vision is necessary, co-ordination between key actions, top-down support, planning, and the launch of specific pilot projects to foster change are required. During *Phase 2: Implementation and networking*, experimental initiatives are designed and launched to foster the development of an entrepreneurial culture among students, university staff and former entrepreneurs. In this phase, the establishment of indicators to assess the outcome and impact of pilot projects is fundamental to identifying key strategic recommendations for future action. The collaboration, co-ordination and engagement of both external and internal university stakeholders support the enhancement of the designed initiatives. In *Phase 3: Consolidation*, the university is more mature in terms of actions adopted to diffuse and implement an entrepreneurial culture and orientation. All efforts and actions should be devoted to the launch of a fully available centre for innovation and entrepreneurship focused on the pre-incubation and incubation phases of entrepreneurial development. Business incubation, either in campus or through partnerships with external partners, should be offered. Knowledge transfer is facilitated by external stakeholders such as institutions, entrepreneurs and start-ups. Finally, during *Phase 4: Self-sustainment and growth*, the university board engages with relevant stakeholders continuously in a wide entrepreneurial ecosystem through a set of actions, including the diffusion of an entrepreneurial culture in society, while planning dedicated events as well as specific monitoring sessions for start-ups, to accelerate the process.

6 Conclusions

The creation and development of an entrepreneurial mindset for technology-driven entrepreneurship requires a reconfiguration of universities' organisational structures and processes by promoting large and tight partnerships and collaborations between different stakeholders. This allows for the emergence of an innovative governance and organisational model of the university called *the stakeholder university*, where the entrepreneurial mindset related to the activation of innovative processes and approaches supports the development of the profile of technology-intensive entrepreneurs and individuals in society who are able to learn through practice, and to acquire the essential competences and skills necessary for the launch of 'technology-intensive' entrepreneurship initiatives.

In such a perspective, the contribution of universities to the creation of highly qualified entrepreneurial human capital goes far beyond the delivery of knowledge for entrepreneurship, to encompass active participation in the regional ecosystems through a structured roadmap strategy that will activate the transformation of the traditional university to become an entrepreneurial university, interpreted here as a stakeholder university. The four phases of such a strategy are (1) inspiration; (2) implementation and networking; (3) consolidation; and (4) self-sustainment and growth. For each phase, the strategy and key actions have been identified to facilitate the creation of a new profile of knowledge-intensive entrepreneurs as well as the promotion of a large and diffuse entrepreneurial culture within society.

These priorities call for a better reconfiguration of traditional university processes and programmes, to assure more openness to market stakeholders; the adoption of interdisciplinary approaches for education, research and innovation; the creation of public—private partnerships; and the wider involvement of a larger community of stakeholders at the national and international levels. The modernisation of universities and higher education institutions is identified as an enabling factor for achieving the ambitious objectives of intelligent, sustainable and inclusive growth.

The following principles characterise the entrepreneurial attitudes and mindset of universities operating as stakeholder universities and talent incubators (Gibb 2010): (1) determination and courage in creating their own autonomy, moving from the idea that, gradually, the funding sources will not depend exclusively on the state; (2) practice of the idea that an excellent culture emerges from the sharing and integration of knowledge within a community that is local, national and international; (3) consciousness that the commercialisation of ideas to create value in a society does not represent a threat to academic values; (4) providing entrepreneurial education not only to students but also to a wider community composed of entrepreneurs, managers, citizens and scientists; (5) promoting the creation of entrepreneurship centres as a 'hub' to embed entrepreneurship institutionally throughout the university, to maximise the impact on regional development; (6) encouraging the diffusion of an entrepreneurial culture by providing lifelong learning initiatives not only for nascent entrepreneurs; (7) designing learning experiences built around the entrepreneurial process to develop the entrepreneurial mindset in action; (8) ensuring that the concept of entrepreneurial education is present in all faculties and integrated into the curricula through the adoption of interdisciplinary approaches; (9) support the creation of a broad spectrum of interdisciplinary activities, as well as forming interdisciplinary departments and research centres; (10) introducing action-based and entrepreneurial learning through experimentation in the laboratory and in collaboration with the external community; and (11) fostering collaboration and exchange within public—private networks to maximise the benefits of an entrepreneurial culture within the regional innovation ecosystem. By embedding a culture of entrepreneurship that engages key stakeholders, universities can sustain the diffusion of entrepreneurial activities within their local community and regions.

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6

A Process-Based Model for Inspiring Technology-Driven Entrepreneurship: An Education Perspective

Valentina Ndou, Giustina Secundo and Gioconda Mele

1 Introduction

Creating an entrepreneurial mindset among the members of a society (public sector, private sectors, academia, etc.) is seen as a critical process in coping with uncertainty and complexity, but also as a mechanism for creating and thriving on these (Gibb 2005). This scenario translates into a need to equip individuals not only with an entrepreneurial mindset but also with the capability to design organisations of all kinds—public, private and NGO—to support effective entrepreneurial behaviour (Gibb 2005). Students at all levels of education, young entrepreneurs and those starting up businesses need to be equipped with an entrepreneurial mindset, defined by five constituent elements: (1) the capacity to think creatively, strategically, analytically and reflectively; (2) confidence in one's

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abilities; (3) the ability to collaborate; (4) well-developed communication skills; and (5) an understanding of the current business context (Pollard and Wilson 2014).

The extant literature concludes that entrepreneurs can be made (Henry et al. 2005a, 2005b) and an 'entrepreneurial perspective and spirit' can be developed (Kuratko 2005). This means that entrepreneurial learning and entrepreneurial outcomes should meet the social and economic needs of all the stakeholders involved (students, families, organisations and countries) (Fayolle et al. 2011; Fayolle 2013). As such, the important role of entrepreneurship education (EE) in promoting more entrepreneurial mindsets generated by advanced technologies is now widely recognised.

In this scenario, universities are called on to play an instrumental role in promoting technological change and innovation (Bramwell and Wolfe 2008; Elia et al. Forthcoming 2015) as well as in creating favourable environments for entrepreneurship at all levels (Kirby 2004). Entrepreneurial development in teaching and learning is one of the seven building blocks of a university moving towards the entrepreneurial model (EC/OECD 2012). The extant literature demonstrates that the higher education sector has a crucial role to play as an incubator of knowledgeable individuals who are able to produce novel ideas for development (Venkataraman 2004) as well as developing an innovative entrepreneurial mindset (Secundo et al. 2015a, 2015b).

In recent years, a growing number of universities and colleges throughout the world have begun to provide entrepreneurship education (Katz 2003; Kuratko 2005). Their roles and contribution are demonstrated by the high level of innovation and entrepreneurship that flourished around Silicon Valley and some other regions in the USA and other parts of the world, with extraordinary universities at their core (Venkataraman 2004). However, while entrepreneurship education was a priority for business schools originally, in recent years, the entrepreneurial mindset and competences have emerged as a relevant aspect to be created at all levels of education and for all students. However, the expansion of entrepreneurship education beyond business schools to 'science and technology' departments may pose additional challenges to the strategy of entrepreneurship education and processes (Duval-Couetil 2013; Secundo et al. Forthcoming 2015a). In relation to this, universities have recently instituted special centres for entrepreneurship. The aim of these is to support a broad spectrum of learning initiatives, provide funding for various educational programmes and support social community development. These centres contributed to increasing the visibility of entrepreneurship as a profession and as a field of study (Fisher et al. 2011). However, little empirical work has been aimed at understanding how the entrepreneurship centres develop highly qualified human capital with an entrepreneurial mindset in terms of their learning goals, strategies, and learning processes and content (Warhuus and Vaid Basaiawmoit 2014). This evidence strongly suggests a need to encourage further analysis of entrepreneurship education programme development.

Consequently, building on previous studies aimed at exploring the emerging trends revealed in some postgraduate programmes offered by universities located in the 10 most innovative countries in Europe to create qualified human capital with an entrepreneurial mindset (Ndou et al. 2013), the aim of this chapter is twofold. First, it provides insights into the strategic pillars related to the process of human capital creation with an entrepreneurial mindset for technology-intensive entrepreneurship. Second, through an explorative cross-case analysis of some European entrepreneurship centres, it aims to define the 'invariance traits' of the emerging entrepreneurship education initiatives from which to construct a 'process-based' model for entrepreneurial mindset creation, in which the entrepreneurial contents, learning strategies, collaborations and network relations between academia and industry are interlinked in a dynamic and interactive way.

The chapter is organised as follows. Section 2 will discuss and introduce the importance of entrepreneurship education for technology-driven entrepreneurship. Section 3 will highlight the paradigm shifts in entrepreneurship education grouped as follows: the goal (why); the target and stakeholders (who); the initiative and learning strategy (how); and, finally, the contents (what). Section 4 will describe the research method. Section 5 will present the main findings and propose a 'process-based' model for entrepreneurial mindset creation, in which the entrepreneurial contents, learning strategies, collaborations and stakeholder involvement are interlinked in a dynamic and interactive way. Finally, a discussion will conclude the chapter by highlighting the challenges involved in inspiring technology-driven entrepreneurship from a lifelong perspective.

2 The Role of Entrepreneurship Education in Technology-Driven Entrepreneurship

The development of technology-driven entrepreneurship is more than ever a core prerequisite for non-business students. Moving entrepreneurship education outside the business school is therefore argued to be more effective in influencing the entire university (QAA 2014), since engineering, computer science and life sciences students are more used to producing innovations: 'Forward looking universities … put the entrepreneurship centre on the other side of the campus from the business school' (QAA 2014: 22).

It is becoming understood and accepted more commonly that engineers need business, social and interpersonal skills to operate effectively in the organisational environments in which they work. Technological developments since the 1990s have been described as a revolution, whether in microelectronics, bio- and nanotechnology, materials science, computer science, medicine or other high-technology disciplines. At the same time, the boundaries between the engineering disciplines are disappearing, as engineering itself is becoming more interdisciplinary to solve increasingly complex problems. Today, the fields of engineering and science more generally are at the forefront of the development and marketing of advanced technologies. For these reasons, governments across the globe have acknowledged the importance of motivating individuals (human capital), businesses and related stakeholders to sustain the development of the new generation of small entrepreneurs who provide the real engine driving the most successful and innovative businesses in Europe.

2.1 Entrepreneurship Education's Impact on Society

Encouraging an entrepreneurial mindset in students and developing a more entrepreneurial attitude and culture within the established incumbent corporation, or diffusing greater entrepreneurial awareness at the society level, are the different goals of entrepreneurship education. Accordingly, investing in entrepreneurship education is one of the highest-return activities Europe can support. Surveys suggest that between 15 % and 20 % of students who participate in a mini company programme at secondary school will later start their own company, a percentage that is about three to five times that for the general population. Whether or not they move on to found businesses or social enterprises, young people who benefit from entrepreneurial learning develop business knowledge and essential skills and attitudes, including creativity, initiative, tenacity, teamwork, an understanding of risk and a sense of responsibility.

Consequently, ‘enhancing innovation and creativity, including entrepreneurship, at all levels of education and training’ is one of the four strategic objectives of the DG Education and Culture—Education and Training 2020 (European Commission/EACEA/Eurydice 2013). Higher-order thinking and entrepreneurial skills have become more important in the workplace than ‘subject-specific skills’ (GII 2014). Moreover, entrepreneurship education plays a key role in education, enterprise and society (see Fig. 6.1) at the level of the individual, the institution, the economy and the whole society (Lackéus 2015).

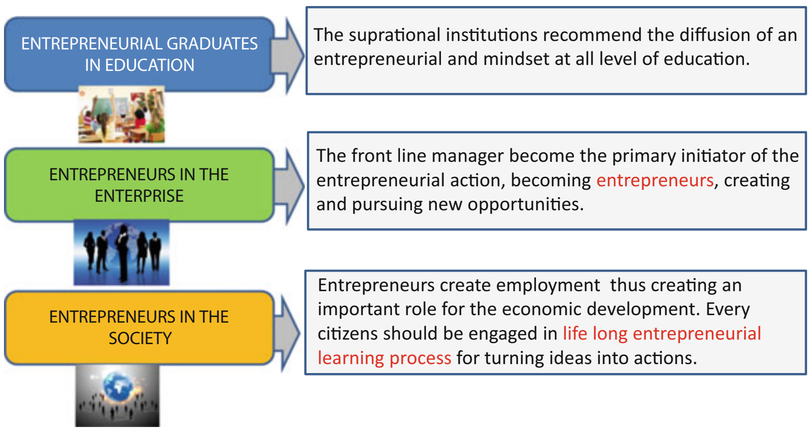

Fig. 6.1 The wide scope of entrepreneurship education in the economy

2.2 Entrepreneurship Education's Approaches

The two most frequently used terms in this field are enterprise education and entrepreneurship education (Lackéus 2015). The term enterprise education is used primarily in the UK and is defined as focusing more broadly on personal development, mindset, skills and abilities, whereas the term entrepreneurship education is defined as focusing more on the specific context of setting up a venture and becoming self-employed (Mahieu 2006; QAA 2012). In the USA, the only term used is entrepreneurship education (Erkkilä 2000). In Northern and Eastern Europe, some additional terms are used. In Sweden and the Balkans, the term entrepreneurial learning is often used as an equivalent to enterprise education (see, for example, Heder et al. 2011; Leffler and Falk-Lundqvist 2013). Other terms used in Finland are internal entrepreneurship education and external entrepreneurship education (see, for example, Seikkula-Leino et al. 2010). Internal entrepreneurship education is a synonym for enterprise education, and external entrepreneurship education is a synonym for entrepreneurship education. Adding to the confusion here is the fact that internal entrepreneurship is sometimes used as a synonym for intrapreneurship—that is, acting entrepreneurially in an established organisation (see, for example, Burgelman 1983). Independent of the definition, recent studies show that entrepreneurship education plays a significant role in promoting the spirit of entrepreneurship among students. Those who have attended entrepreneurship courses are more likely to start their own businesses than are other students (Packham et al. 2010). Other studies point out that entrepreneurship education, especially in scientific and technological universities, is crucial to enhancing entrepreneurs' innovation skills in a context that changes rapidly (Menzies and Paradi 2003). A recent study conducted by Martin et al. (2012) demonstrates that entrepreneurship education is in fact positively associated with higher levels of human capital assets, higher levels of knowledge and skills, positive perceptions of entrepreneurship, and intentions to become an entrepreneur.

Nevertheless, a common denominator between these differing approaches is that all students can, and should, encourage their ability and willingness to create value for other people, thus developing an

Entrepreneurial mindset

LEARNING OUTCOMES OF ENTREPRENEURIAL STUDENTS

Entrepreneurial BEHAVIOR	• Opportunity recognition • Creativity and Innovation • Problem solving • Taking action • Responsibility for managing projects • Ability to reflect in challenging environment • Personal awareness • Networking and communication.
Entrepreneurial ATTITUDES	• Achieve goals and ambitions • Enhance self-confidence and belief • Perseverance, resilience and determination to achieve goals • Internal locus of control • Active experimentation and orientation • Creative solutions to challenging and complex problems • Holistic approach to management
Entrepreneurial SKILLS	• Persuasion and negotiation • Leadership capacity • Idea negotiation with stakeholders • *Lifelong learning* • Reflection and action • Entrepreneurial spirit • Interpersonal skills • Communication and Strategy skills

Fig. 6.2 The entrepreneurial mindset learning outcome framework

entrepreneurial mindset. This is at the core of entrepreneurship education and is a competence that, increasingly, all citizens need to have in today's society, regardless of their career choice. Creating new organisations is thus viewed as one of many different means of creating value. A common goal of these programmes and initiatives is to develop an entrepreneurial mindset in everyone: a way of thinking, the capacity to develop creativity, a sense of initiative, problem solving, goal attainment, motivation and risk taking for opportunity development (Pollard and Wilson 2014). Figure 6.2 illustrates the main components of an entrepreneurial mindset in terms of entrepreneurial behaviour, entrepreneurial attitudes and entrepreneurial skills (QAA 2012).

The development of an entrepreneurial mindset represents a common element of entrepreneurship education across six key areas in universities and higher education institutions (Gibb 2012):

1. *Creating wide awareness* among the student population and staff about the need to develop a range of personal enterprising competencies to prepare them for their professional career and an employment world of greater uncertainty and complexity.
2. *Developing capacities* to embed the delivery of these competencies contextually within the curriculum and pedagogy of different departments throughout the university.

3. *Developing self-efficacy* (awareness, know-how, confidence and intention) to start a business or pursue self-employment in the future.
4. *Supporting current start-ups* to develop the capacity of those who currently wish to find/exploit an idea immediately and start a venture. There will always be a small group of staff and students who wish to pursue this in the form of a spin-off or technology-intensive start-up.
5. *Creating an understanding of the life-world* of work in micro, small- and medium-sized organisations.
6. *Supporting directly the transition to employment in SMEs* and small organisations in general, including social enterprises.

The common elements of the evolving notion of entrepreneurship education can be identified (QAA 2014):

- Entrepreneurship education aims to produce graduates who are capable of identifying opportunities for setting up a new venture, developing and growing an existing business, or designing an entrepreneurial organisation.
- Entrepreneurship education focuses on the development and application of an *enterprising mindset and skills* in different contexts, including new or existing businesses, non-governmental organisations (NGOs), the public sector and social enterprises.
- Entrepreneurship education has the ultimate goal of developing *entrepreneurial effectiveness*; that is, a combination of enterprise awareness, an entrepreneurial mindset and entrepreneurial capability. It is the ability to behave in enterprising and entrepreneurial ways. Multidisciplinary approaches and mixed pedagogies are likely to be appropriate. Entrepreneurial effectiveness can be defined as the ability to behave in enterprising and entrepreneurial ways.

Entrepreneurship programmes in higher education seem to be most likely to have an immediate effect. Students are mature enough to realise entrepreneurial ambitions and to put ideas into practice. Indeed, the evidence shows that students are affected positively by programmes/activities running under strategies.

Despite a converging trend towards a common understanding of entrepreneurship education (Katz 2008), difficulties in standardising it remain (Jones and Matlay 2011).

3 Rethinking Entrepreneurship Education to Develop an Entrepreneurial Mindset and Capacity: Pillars and Trends

Based on these insights and the recommendations of supranational institutions (EC 2006, 2008a, 2008b, 2013; OECD 2008; WEF 2009, 2010; Cotoi et al. 2011), the most relevant changes and challenges of entrepreneurship education can be grouped into the following categories: the goal of entrepreneurship education (why); the target and stakeholders (who); the initiative and learning strategy (how); and finally the content of entrepreneurship education (what). Figure 6.3 illustrates the main issues analysed in entrepreneurship education.

A detailed description and definition of each item considered is given in the following paragraphs.

3.1 Entrepreneurship Education's Goal: Why

Defining the purpose of entrepreneurship education means starting from the definitions of entrepreneurship—one termed 'wide' and one termed 'narrow' (Lackéus 2015)—to highlight it in terms of a wider impact on society in general. According to the *narrow* definition of entrepreneur-

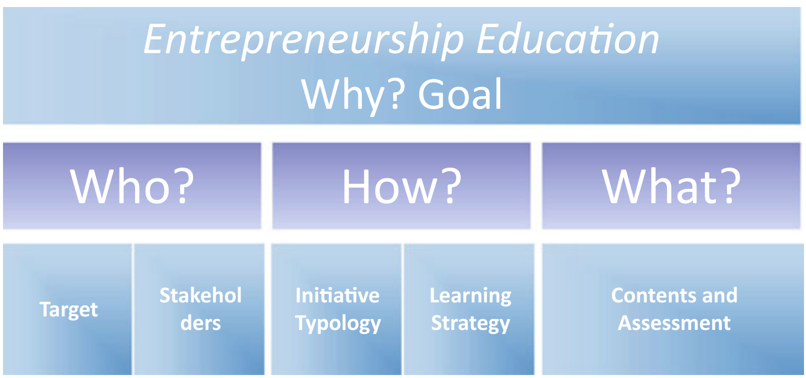

Fig. 6.3 The main components of entrepreneurship education

ship, it is about opportunity identification, business development, self-employment, venture creation and growth; i.e. becoming an entrepreneur (Mahieu 2006; Fayolle and Gailly 2008; QAA 2012). According to the *wide* definition of entrepreneurship, it concerns personal development, creativity, self-reliance, initiative taking and action orientation; i.e. becoming entrepreneurial. The definition and approach used have a profound effect on the educational objectives, target audiences, course content, teaching methods and student assessment procedures, leading to a wide diversity of approaches (Mwasalwiba 2010). According to the 'narrow definition', entrepreneurship education should pursue the goal of developing an individual's intention to act entrepreneurially (Liñán 2007) and to facilitate their entrepreneurial identity work (Hytti and Heinonen 2013). This type of programme can be defined as 'awareness education', or educating about entrepreneurship (Kirby 2004; Liñán 2007). In contrast to awareness courses, these practical contents are more action-oriented. Liñán (2007) refers to them as 'start-up education' or educating for entrepreneurship (Kirby 2004). Finally, programmes that focus on small business survival and growth are emerging to provide the necessary skills through entrepreneurial methodologies. They can be called educating through entrepreneurship or 'growth education' (Kirby 2004; EC 2008).

3.2 Entrepreneurship Education's Target: Who

Since the mid-2000s, entrepreneurship education target students have changed radically. Originally begun in business schools to create knowledge about entrepreneurship theory, different entrepreneurship education initiatives among US, Canadian and European universities have emerged in recent years, with the aim of creating entrepreneurial mindsets among non-business students and in other vocational disciplines such as engineering, science and biology (Hynes 1996; Katz 2003; Keogh and Galloway 2004). This vision has been enlarged by the STEM (science, technology, engineering and mathematics) education and institutions that were among the early adopters of entrepreneurship education (Vesper and Gartner 1997). STEM majors have the potential to develop high-growth ventures because these are concentrated in high-technology industries (Autio 2007; Schøtt 2007). Finally, with the emergence of entrepreneurship centres as supporting institutions, managers, former entrepreneurs, young entrepreneurs and citizens in general are also introduced as natural target groups for entrepreneurship education from the lifelong learning perspective.

3.3 Entrepreneurship Education's Contents: What

Edelman et al. (2008) highlight the existence of a gap between what is taught in entrepreneurship and what entrepreneurs do. Research shows a wide variation in programme contents, especially when considering programmes devoted to non-business students (Fayolle 2013) or STEM students (Gibb et al. 2009). The contents related to entrepreneurship, especially for non-business students, should include: (1) encouraging an understanding of the processes of organisation development (from start-up through survival to growth and internationalisation); (2) focusing on a holistic approach to business management based around problems and experience; (3) creating the capacity to design entrepreneurial organisations in different contexts, and understanding how to operate them successfully; (4) focusing on the processes of opportunity seeking, evaluation and opportunity grasping in different contexts, including business contexts; and (5) understanding entrepreneurial management in different contexts. However, students need to learn how to manage a business, how to grow a business and how to venture a business (Kirby 2004; Wilson 2008), not just how to start one. The contents could follow a phased approach to entrepreneurial development to satisfy the needs of different targets (students, academic entrepreneurs, young 'start-uppers', managers, etc.).

3.4 Entrepreneurship Education's Learning Strategy: How

The literature focusing on the 'learning perspective of entrepreneurship' (Young and Sexton 1997; Minniti and Bygrave 2001; Cope 2005) affirms that an entrepreneurial mindset and capabilities 'can only be acquired through learning-by-doing or direct observation' (Cope 2005: 381). Since research on how real-life entrepreneurs engage in entrepreneurial learning processes is largely disconnected from the educational domain (Lackéus 2015), however, there is a need for evidence showing how students develop their entrepreneurial mindsets and competencies. Educating people about the kinds of problems faced by entrepreneurs can be undertaken by shifting from traditional lectures and business case strategies towards problem-based learning pedagogies (Fayolle 2013).

The pedagogical approaches and learning strategies with similarities to entrepreneurial education are experiential learning (Kolb 1984), situated learning (Lave and Wenger 1991), iterative experimentation in collaboration with external stakeholders (Sarasvathy and Venkataraman 2011), interaction with the outside world (Fayolle and Gailly 2008), problem/project-based learning (Helle et al. 2006), cognitive apprenticeship (Collins and Sawyer 2006), social constructivist learning (Steffe and Gale 1995), problem-based learning (San Tan and Ng 2006) and project-based learning (Jones and English 2004). Therefore, the shift in entrepreneurial learning strategies is towards *action-oriented learning*, in which the teacher is a moderator more than a lecturer, and creativity and reflections evolve from practising enterprises through real processes (Seikkula-Leino et al. 2010). With this aim, the 'venture creation approach' (Ollila and Williams-Middleton 2011), in which students create real-life ventures with the intention of incorporating them after graduation, has been growing in recent years. This approach has been capable of both increasing the entrepreneurial capacity available in a region, creating jobs and alleviating the challenges involved in early-stage university commercialisation, often termed a 'valley of death' (Barr et al. 2009; Lackéus and Middleton 2015). These rare or unique features explain to a large extent why entrepreneurial education can trigger much higher levels of motivation, and experienced relevancy, engagement and deep learning than other pedagogical approaches can (Lackéus 2013).

3.5 Entrepreneurship Education's Stakeholders: Who

Interaction with the university's outside world is a key aspect of entrepreneurial education (Gibb 2008; Lackéus 2013). The most developed systems for facilitating educational institutions' interaction with the outside world can be found in the interaction with the main stakeholders of the 'triple-helix model' (Etzkowitz and Leydesdorff 2000): increased collaboration between universities, government entities and industry can be facilitated. Universities need to activate partnerships with a variety of stakeholders, including not only industry and other educational institutions but also broader learning communities within civil society as well as other regional entrepreneurs and the business industry (EC 2009; Matlay 2011; Redford and Fayolle 2014). Stakeholders' engagement in entrepreneurship education is a phased development process that can be planned, highlighting clear differences in the strategies and outcomes of the involvement. The stakeholders engaged in the entrepreneurial development process need to act in accordance with entrepreneurship education's goals and values, translating the concepts into practice (Redford and Fayolle 2014). The stakeholders' engagement could include work placements, contributions to curriculum delivery and assessment, and industry-based assignments (Secundo et al. Forthcoming 2015a, Forthcoming 2015b). Moreover, keeping close to the real-life world of entrepreneurs by observing them, meeting them regularly and discussing their concerns (Fayolle 2013) ensures that the curriculum is linked with industry; in this case, regional entrepreneurs play an essential role in developing the entrepreneurial mindset of students and young entrepreneurs.

3.6 Entrepreneurship Education Initiatives' Typologies: How

Curriculum activities devoted to students and traditionally confined to the classroom or laboratory need to move towards the external campus community to gain from the benefits of participation and engagement by all the stakeholders belonging to the ecosystem in which the university is located. This will allow students to benefit from a wide variety of learning opportunities. The activities outside the classroom or extracurricular activities could include the following (Wilson 2008):

- *Initiatives for business design and launch*: incubation initiatives, technology transfer, incubator/science parks, technology transfers.
- *Business and entrepreneurship development*: business consultancies' start-up and spin-off counselling, entrepreneurs-in-residence, venture capital funds, coaching start-ups.
- *Knowledge exchange*: forums, workshops, summer schools, student conferences, student clubs.
- *Business simulation and competition*: venture camps, boot camps, business plan competitions and so on.

These activities allow the university to activate non-formal learning programmes aimed to provide lifelong learning to a wider target audience, including former entrepreneurs, young entrepreneurs, family entrepreneurs, academic entrepreneurs, young talents with innovative ideas, and citizens in general.

4 Research Method

To investigate the role of entrepreneurial centres in inspiring entrepreneurial mindsets, competencies and capabilities for technology-driven entrepreneurship, and to support universities in fulfilling their core role in entrepreneurship education, a multiple-case study analysis was employed in this study. The cases selected consisted of entrepreneurial centres initiated and firmly rooted in entrepreneurial universities (Rasmussen and Sørheim 2006; Eisenhardt and Graebner 2007). The multiple-case study method allows researchers to address generalisation bias and to effectuate a cross-case comparison that teases out propositions deeply grounded in varied empirical evidence (Eisenhardt and Graebner 2007), thus revealing more common patterns regarding the phenomenon.

4.1 Case Selection

For this purpose, we undertook an in-depth cross-case analysis of eight entrepreneurial centres located in European universities devoted to diffusing an entrepreneurial mindset and technology-driven entrepreneurship. The centres were chosen in accordance with the following criteria:

- They are considered to be pioneers and leading centres based in well-known European universities, with a focus on technology-driven entrepreneurship;
- They are located within countries ranked in the first places in terms of the Global Innovation Index (GII 2014), respectively (the Netherlands, ranked 4; the UK, ranked 2; France, ranked 21; Denmark, ranked 10; and Germany, ranked 12); the centre in France was chosen because it was among the first centres to be created in Europe;
- They offer learning initiatives devoted to a wide target audience (not only students but also former or potential entrepreneurs), moving from the development of entrepreneurial awareness to the support of incubation activities;
- They are focused on high-tech or technology-intensive entrepreneurship; and finally,
- They have received awards or recognition for their achievements in terms of entrepreneurial development in the ecosystem in which they are located.

4.2 Case Exploration and Analysis

The research methodology adopted consists of a web-based content analysis. Each case in the study was analysed following the steps of a traditional approach to web-based content analysis. According to Herring (2010), content analysis is an established social science methodology, which broadly includes, as Baran (2002) suggests, 'the objective, systematic, and quantitative description of the content of communication'. As McMillan (2000) proposes, after formulating the research question and selecting the sample, the analysis should continue with three other phases, consisting of:

- *Phase 1: Definition of categories for coding.* In response to the need to provide comparable cases for the eight entrepreneurship centres, we proceeded with the coding of the variables and items to analyse. The categories studied were the six main items identified in the literature as being crucial to entrepreneurship education, specifically: (1) typology of learning initiatives, divided into two main groups: curricular and extracurricular learning activities; (2) goals of each initiative; (3) target groups; (4) content; (5) learning strategy; and finally (6) stakeholders' involvement.

- *Phase 2: Collection of the contents for coding and checking the coding reliability.* The data collection consisted of running a deep content analysis of the web pages of the eight entrepreneurial centres by examining all the contents of each category in detail. For each of these programmes, we coded the learning goal and the entrepreneurship contents. Moreover, qualitative data were extracted from the syllabus or the web page of the programmes to identify the involvement of the stakeholders in the programmes, and the main learning methodologies used. The data extracted for each case were then recorded in Excel files and analysed to derive the trends of entrepreneurship education. The data collection resulted in the identification of more than 150 entrepreneurship education programmes, clustered into the following categories for a more in-depth review: curricular learning activities, business launch and development, knowledge exchange, business simulation, and competition.
- *Phase 3: Analysis and interpretation of the data collected.* In this phase, the data analysis provided a description of the eight entrepreneurship education centres; moreover, the clustering of qualitative data relating to the cross-case comparisons supported the identification of similarities and 'invariance traits' of the entrepreneurship education programmes expressed in terms of the educational aim, the programme's objectives, the programme's contents, the stakeholders' involvement and the learning strategy. According to the relevant trends in the phenomenon, we proposed a process-based framework to develop entrepreneurial competence for technology-driven entrepreneurship.

5 Research Findings and Results

The findings are divided into three main sections. In the first, a description of the main features and characteristics of the analysed entrepreneurship centres located in European universities provides a detailed scenario about the evolution of their mission and the educational activities offered to develop an entrepreneurial mindset in students and young entrepreneurs. In the second section, the invariance traits of entrepreneurship education initiatives and programmes, as derived from the analysis of the education initiative of the centre, are provided; and, finally, a process-based model for entrepreneurial mindset creation is presented.

5.1 Overview of the European Entrepreneurship Centres

The analysis of the data on entrepreneurship education confirms that its role is to co-ordinate and guide different entrepreneurial activities through the development of entrepreneurial awareness in a more practical way by promoting the activities of co-working; creating incubator facilities either directly on campus or in collaboration with other providers; and embedding entrepreneurial educational activities into the curricula throughout the university. The research results obtained from the data analysis of each centre are provided in Table 6.1. The centres also play an important role in creating a multi-disciplinary environment, as for them it is easier to engage different faculty members as well as to organise interdisciplinary courses and various extra-curricular activities. Furthermore, the activities related to commercialising research and to creating public and private networks at both local and international levels are considered crucial.

The target audience of each centre is wide and multi-disciplinary. As depicted in Table 6.1, it spans students (both graduate and undergraduate) to executives, managers and a range of potential and practising entrepreneurs. This is a demonstration of the way in which entrepreneurial learning is conceptualised today. It does not simply entail learning how to create a start-up and how to make a business plan, but it is a 'mindset',

Table 6.1 The entrepreneurship centres—sample description

Entrepreneurship center	Mission/goal of the center	Achievements	Entrepreneurship initiatives developed	Targets
Delft Center of Entrepreneurship, Delft University of Technology, Netherlands	Encourage students and researchers to become entrepreneurs and to engage in entrepreneurial activities, through four pillars: inspiration, activation, education, realisation	151 start-ups	Education and Research Incubation Programme and Support Workshop, Symposium, Forum Competition	Students Executives Scientists Entrepreneurs Companies
Netherlands Institute for Knowledge Intensive Entrepreneurship (NIKOS), University of Twente, Netherland	Provide education and research about entrepreneurship as well as consultancy, training and business development support	450 entrepreneurship, 300 firms supported.	Education and Research Consultancy & training and business development support VentureLab & Symposium Incubation	Students Entrepreneurs Businesses
ITU Business Development A/S, IT University of Copenhagen, Denmark	Start-up accelerator for entrepreneurs affiliated with the university	More than 100 companies	Business Lunch Initiatives Technology transfer activities VentureCup Competition	Student Start-up Researchers Business

(*continued*)

Table 6.1 (continued)

Entrepreneurship center	Mission/goal of the center	Achievements	Entrepreneurship initiatives developed	Targets
Aarhus University Center forEntrepreneurship and Innovation, Aarhus University, Denmark	Build bridges between the theoretical research and its application in society	More than 50 students start-up	Education and Research Business Support Take off and Take off Growth Programme Workshop	Businesses Students Lecturers
INSEAD- International Centre for Entrepreneurship (ICE), France	Accelerate the entrepreneurial ambitions of students and turn INSEAD into a catalyst for entrepreneurship initiatives, providing inspiration, driving team formation, and facilitating venture development	Ranked at no. 4 among all MBA schools for unicorns: start-ups whose valuation exceed US$1 billion	Education and Research Entrepreneurship Education Fund Boot Camps, Venture Competition Forum, Entrepreneurs in Residence	Students Alumni (start-uppers, entrepreneurs, etc.)
EMLYON Incubator, EMLYON Business School, France	Provide assistance from the outset of the entrepreneurship process, giving a robust support structure	1,350 entrepreneurs supported, 950 companies set up or taken over, 10 of which are stock-market listed 90 % five-year survival rate, 11,000 direct jobs created	Academic Entrepreneurship Course and Programme Pre-incubation Programme: Entrepreneurs in the City, start-up programme Incubation Initiatives: Boost programme, Mentorship Executive education for growth	Executives Researchers Students Entrepreneurs

(*continued*)

Table 6.1 (continued)

Entrepreneurship center	Mission/goal of the center	Achievements	Entrepreneurship initiatives developed	Targets
Centre for Entrepreneurial Learning (CfEL), Cambridge University, UK	Spread the spirit of enterprise by providing educational activities to inspire and build skills in the practice of entrepreneurship	More than 200 business ventures created	Entrepreneurship Course and Lectures Training Programme Business Simulation and Competition	Aspiring entrepreneurs (students, Ph.D.s, etc.) Entrepreneurs Innovators
Center for Entrepreneurship/ Center for Innovation and Business Creation, Technical University of Munich (TUM), Germany	Inspire the next generation of entrepreneurs through unique, integrated instruction to identify challenges and develop solutions. Six pillars: Sense, Touch, Assess, Recognise, Take-off, Understand More	More than 700 companies Center for Innovation and Business Creation (per year): 50 Start-ups 1,000 Participants, 10 Industry Partners	Education and Research Service for Entrepreneurs: Start-up programme and executive training Start-up Fund Summer/Spring School Business Simulation and Game	Enterprise Students Researchers

a way of thinking about society and the economy, to create new wealth for it continuously.

Most of the centres were created during the time frame extending from the late 1990s to 2014; only the EMYLON Incubator in France, previously called an *entrepreneurship centre*, dates from an earlier period. It was initiated in 1984, when the EMYLON Business School began its activities to develop entrepreneurial attitudes and mindsets among students and faculty members.

However, the centres have continued to evolve and to create new institutional branches to respond better to the need to encourage an entrepreneurial spirit among their participants. Thus, for example, in the case of Delft University, the Delft Center of Entrepreneurship was created to stimulate students, faculty members and others to engage in technology-driven entrepreneurial behaviour, often drawing heavily on academic knowledge. In 2005, the Yes!Delft Incubator was created, to foster the development of technological start-ups into leading businesses in their industries, and, finally, in 2010, Yes!Delft Students was launched, with the aim of stimulating the conversion of students' and researchers' ideas into businesses; it is at present the largest high-tech incubator in Europe. This is an indication of the recognised relevance of these centres over time, and the need to develop and provide further support to the different phases of the entrepreneurial process.

The mission of the centres emerged as being related mainly to boosting the entrepreneurial initiative among the target groups through a set of different programmes and initiatives. The learning initiatives to develop entrepreneurial capability range from education and research to incubation programmes, workshops and competitions. The curricular learning activities offered refer to the entrepreneurship courses that aim to diffuse an entrepreneurial culture and mindset as well as to integrate the promotion of awareness, research activities and the development of enterprise capabilities (creativity, innovational thinking, entrepreneurial mindset, etc.). These courses are designed mainly for undergraduate, graduate and postgraduate students, but in some cases the participation of young entrepreneurs or those who already have a business idea is allowed.

Furthermore, in addition to the curricular learning activities, a range of extracurricular learning activities can be identified in workshops, business competitions, venture capital, summer schools and so on, which complement the learning and provide practical experience. This variety of extracurricular activities reflects the wide target audience and diverse set of needs and competencies they wish to satisfy with an entrepreneurial education. While on the one hand students need to build capabilities, skills and mindsets 'about' or 'for' entrepreneurship, potential and practising entrepreneurs on the other hand need to build the necessary knowledge and skills for starting or operating a business as well as for becoming higher-performing entrepreneurs.

For example, in the course named 'Ready to Start Up' offered by Yes!Delft Student, the participants are students, entrepreneurs and others who have already passed through the evaluation of the commercial feasibility of their business idea, while the programme Enterprise Tuesday of the Centre for Entrepreneurial Learning (CfEL) is open not only to students but also to academic and university staff, members of other universities and the local business community.

Moreover, all the centres analysed organise workshops, forums, summers schools and symposia that bring together speakers, live cases and panels to share the latest knowledge about entrepreneurship. In this cluster of initiatives, it is important to cite the Symposium Social Entrepreneurship, organised by the Netherlands Institute for Knowledge Intensive Entrepreneurship (NIKOS), which aims to engage in discussion about the current state of social entrepreneurship research, and how to use research outcomes as an instrument to address social challenges. The INSEAD Center for Entrepreneurship, founded in 2003, organises a Global Entrepreneurship Forum every year for current and aspiring entrepreneurs.

Finally, the business simulation and competition initiatives include programmes in which the participants play a game or enter a competition to experience what it takes to become an entrepreneur. An example of these activities is the Do-it! game offered by Yes!Delft Student. The game consists of a fictional business idea and includes the entire process of starting a business. In a few hours, the participants gain the basic knowledge of how to start a company and then transform it into a successful business.

Referring to the performance of the centres over time, we found remarkable contributions (Table 6.1). The centres are recognised for the value they have created in terms of the number of start-ups created, the number of target groups they have dealt with, the number of people who have created their own ventures, the extent of the network created around the centre, as well as the various forms of recognition they have received in the European and global arenas.

It is worth noting the achievement realised by the Technical University of Munich (TUM) as an active contributor to the solving of societal challenges by facilitating the creation of 50 new start-ups per year, supporting the growth of new companies and contributing to the support of more than 700 companies through its entrepreneurship education programmes. The EMLYON Incubation, in 30 years, has been involved in 1,350 projects with industry and incubated 950 companies with an 85 % survival probability after 5 years, in total creating 11,000 jobs (Zagelmeyer 2015).

The data analysis related to learning strategies, entrepreneurship education and stakeholders' involvement turned out to be more complex, because, depending on the target group's profile and goals to be achieved, these issues have changed substantially over time.

In fact, during our data collection phase, we identified more than 150 entrepreneurship education programmes composed of a diversified set of contents, typologies of learning strategies and modalities for engaging with the outside ecosystem, and in particular with the stakeholders. Each centre has been analysed according to the coding's categories described in the research method—Phase 1, and specifically: (1) typology of learning initiatives; (2) goals of each initiative; (3) target groups; (4) content; (5) learning strategy; (6) stakeholders' involvement. An extract describing the methodology used for analysing each entrepreneurship centre is presented in Table 6. (the case of the Delft Center of Entrepreneurship has been used as example).

To grasp significant insights from the case analysis, we proceed by undertaking a clustering analysis of the qualitative data of cross-case education programmes that allows us to identify the main invariance traits.

Table 6.2 An example of data analysis for entrepreneurship centre

The case of the Delft Center of Entrepreneurship, TU Delft, Netherlands	1. Learning initiatives			
		Extracurricular learning activities		
	Curricular learning activities	Business launch & development	Knowledge exchange	Business simulation & competition
	Turning technology into business	Student start-up programme	Entrepreneurship forum	Do-it! game
2. Goal of the example of course/initiative	Give all knowledge and the tools needed to build a business successfully	Accelerate the development of a student company	Inspire and excite students towards entrepreneurship	Give the basic knowledge to start a company and to transform it into a successful business
3. Target group	Multi-disciplinary groups of Master's students, Ph.D. students, staff, researchers from all faculties within TU Delft	Delft students entrepreneurs	Delft students and entrepreneurs	Delft students
4. Content/ description of the example of course/initiative	Business concept and business model Marketing Basics of companies' finance IP, legal and tax issues Build a strong team Present a patent project	The programme offers: a flexible work space at the YES!Delft Incubator, coaching by professional entrepreneurs and coaches, network of student entrepreneurs, Incubation Services	Multiple well-known and successful entrepreneurs and CEOs share their personal stories	A game to experience what it takes to become an entrepreneur. It start from scratch with the goal to eventually start the most successful business

(*continued*)

The case of the Delft Center of Entrepreneurship, TU Delft, Netherlands	1. Learning initiatives			
		Extracurricular learning activities		
	Curricular learning activities	Business launch & development	Knowledge exchange	Business simulation & competition
	Turning technology into business	Student start-up programme	Entrepreneurship forum	Do-it! game
5. Learning strategy	Interactive lectures, participant-centred case studies, homework assignments, classroom assignments, individual group coaching	Professional coaching and advice	Symposium, Lectures, Workshop, Drinks	Business game
6. Stakeholders' involvement	Co-operation with the business community and the Ministry of Economic Affairs for curriculum delivery	Students entrepreneurs and coaches share ideas and experiences to support the creation of new ventures	Meetings, lectures and discussions with founders of companies to create awareness	Co-ordination by an activation committee (multi-disciplinary team)

Table 6.3 The 'invariance traits' of the entrepreneurship education programmes

	Category I—Inspiration (Inspire, Awareness)	*Category II—Exploration* Idea generation and design	*Category III—Exploitation* Turn idea into business	*Category IV—Acceleration and Growth*
	'About'—Awareness Education → Entrepreneurial awareness in students Entrepreneurial culture in incumbent corporation	'For'—Start-up Education → Entrepreneurial mindset for the design and launch of new venture		'Through'—Growth Education → Entrepreneurial capabilities for survival and renewal/growth of venture
Objectives	Understand sense, inspire, analyse, become aware, discuss/reflect, acquire knowledge on entrepreneurship and the context of management and economics	Recognise, explore, analyse and develop knowledge, mindset, skills, competencies, and capabilities for the entrepreneurial process	Design, apply, build, launch, develop, implement business ideas, new ventures, new business models, new products/services	Accelerate, support, lead, coach, counsel, take off, innovate, grow, sustain the venture

	Category I—Inspiration (Inspire, Awareness)	*Category II—Exploration* Idea generation and design	*Category III—Exploitation* Turn idea into business	*Category IV—Acceleration and Growth*
	'About'—Awareness Education → Entrepreneurial awareness in students Entrepreneurial culture in incumbent corporation	'For'—Start-up Education → Entrepreneurial mindset for the design and launch of new venture		'Through'—Growth Education → Entrepreneurial capabilities for survival and renewal/growth of venture
Content	Inspirational lectures Introduction to entrepreneurship Entrepreneurship Forums Monthly Incubator Tour Entrepreneurship course Introduction to Intrapreneurship Foundations of Entrepreneurial Thinking Entrepreneurs and Democracy Social Entrepreneurs Introduction in Strategy and Organisation	Innovative Entrepreneurship Entrepreneurship and Business Creation Idea generation Business validation Trendspotting and Future Thinking Entrepreneurial Marketing Entrepreneurship in the Life Sciences Business Plan seminar basic Project and research methods for entrepreneurship Marketing Entrepreneurship Lab Technology Entrepreneurship Lab Entrepreneurial Finance Entrepreneurship and Law	Design of technological innovations Entrepreneurship and Business Design Design and leadership Ideation—Creating a Business Idea Strategy and creativity Innovation Through Creativity and Design Creativity and Enterprising Behaviour New Venture Creation Competencies/ Entrepreneurship in the Life Sciences	Managing New Venture Growth Entrepreneurial Strategy Crowdfunding Take off—Growth Innovation Service Growth Programme Development companies Specialised seminar on legal, finance, advanced marketing, strategic innovation, PR, business sustainability issues.

(*continued*)

Table 6.3 (continued)

	Category I—Inspiration (Inspire, Awareness)	*Category II—Exploration* Idea generation and design	*Category III—Exploitation* Turn idea into business	*Category IV—Acceleration and Growth*
	'About'—Awareness Education → Entrepreneurial awareness in students Entrepreneurial culture in incumbent corporation	'For'—Start-up Education → Entrepreneurial mindset for the design and launch of new venture		'Through'—Growth Education → Entrepreneurial capabilities for survival and renewal/growth of venture
Target profile	Low profile of knowledge on entrepreneurship (bachelor's, master's, Ph.D. students)	Inspired and awarded students regarding the opportunities of entrepreneurship (Students, businesses, researchers)	Increased level of knowledge, competencies, awareness and recognition of the opportunities for entrepreneurship. (students, businesses, entrepreneurs, researchers.)	High level of knowledge, competencies and capabilities for venture creation (entrepreneurs, innovators, businesses)
Stakeholders involvement	Beginning to enter the entrepreneurship ecosystem … by inviting entrepreneurs to take seminars in class to create awareness	Events for networking creation Visits to businesses Visits to technological parks and incubators	Co-working in a project-based and action-based modality with different with businesses, banks, public administration and technology research institutions for creating new ventures	Entrepreneurship ecosystem

(*continued*)

	Category I—Inspiration (Inspire, Awareness)	*Category II—Exploration* Idea generation and design	*Category III—Exploitation* Turn idea into business	*Category IV—Acceleration and Growth*
	'About'—Awareness Education → Entrepreneurial awareness in students Entrepreneurial culture in incumbent corporation	'For'—Start-up Education → Entrepreneurial mindset for the design and launch of new venture		'Through'—Growth Education → Entrepreneurial capabilities for survival and renewal/growth of venture
Learning methodology/ initiatives	Lectures/seminars/ teamwork in-class exercises, reflections and discussions/ debates, and inspirational seminars Entrepreneurs talk Entrepreneur-in-Residence	Lectures, seminars, case studies, problem-based learning, learning by doing/ exercises, discussions, and case studies, business plan competition, business trips, start-up events	Action based learning/ Entrepreneurial Project, Industrial visits/Incubation/ Mentorship, Pitching and Venture Competition, hands-on project work, practical mentored sessions	Experiential learning, Conferences Workshops, Incubation Services consulting, professional coaching , specialised seminars and counselling

5.2 The 'Invariance Traits' of Entrepreneurship Education

The clustering analysis of the qualitative data of cross-case education programmes (Phase 3) revealed a remarkable pattern regarding the main trends followed by the centres for creating entrepreneurial awareness, competencies and capabilities. In many of the cases considered, we found that the entrepreneurial education and initiatives are structured according to phases or steps that seek to guide and sustain different target profiles to move through a process of awareness and opportunity recognition to the creation of practical capabilities for creating workable concepts and allowing the growth of new ventures.

Indeed, in some centres, we found the establishment of structured processes according to which the initiatives and activities are organised. It is worth mentioning here the case of the Netherlands Institute for Knowledge Intensive Entrepreneurship with its three-step process (recognising or creating an opportunity for value creation; converting this opportunity into a workable concept; and capitalising on the concept in a (growing) organisation); the case of the Technical University of Munich (TUM) with its seven-step approach (sense, touch, assess, recognise, take off, understand and more (StarTUM)); and the case of the Delft Center on Entrepreneurship with its four-step approach (inspiration, education and research, incubation and growth). While in some other cases the specific references to these steps is not explicit, the data analysis allows us to observe that almost all centres organise their activities and initiatives on entrepreneurship according to an evolutionary path aimed at providing participants with the basics of entrepreneurial decision-making and opportunity recognition as well as hands-on experience and practical abilities for the development of real entrepreneurial business ideas.

Therefore it emerges that the main objectives, typology of content, initiatives, level of engagement with stakeholders, learning methodologies and approaches used can be structured according to a 'process-based model' aimed at creating in an evolutionary manner an entrepreneurial mindset, an entrepreneurial culture and leadership, and capabilities for applying creativity in developing innovative ventures (see Table 6.).

The analysis revealed four main categories/phases into which it is possible to categorise the different patterns related to the entrepreneurial centres' learning initiatives (as seen in Table 6.).

Category I—Inspiration includes the education programmes and learning initiatives the centres undertake that allow the target participants to sense, understand, inspire, analyse, become aware, discuss/reflect and acquire knowledge on entrepreneurship and the context of management and economics. The contents provide the participants with awareness, inspiration and a general understanding about enterprising, entrepreneurship and entrepreneurial activities. The learning methodologies used are mainly in a traditional form, consisting of lectures, case studies, seminars and so on. Regarding the stakeholders' involvement, at this stage some initiatives that aim to create the first tie with the entrepreneurial ecosystem begin to be structured through the organisation of inspirational seminars, entrepreneurs' talks and entrepreneurs-in-residence, for example, to connect participants with experienced entrepreneurs and enable them to discuss entrepreneurial topics.

However, as Moberg and Stenberg (2012) argue, 'Entrepreneurship is when you act upon opportunities and ideas and transform them into value for others.' Therefore, the development of an entrepreneurial mindset and capabilities requires the creation of other entrepreneurial qualities to recognise, explore, design, act on and launch new ventures. These activities aim to make students more creative, opportunity-oriented, proactive and innovative. To accomplish this objective, two other categories are identified in our cross-case analysis: *Category II—Exploration* and *Category III—Exploitation* of entrepreneurial opportunities. In these stages, the education activities and initiatives revolve around the identification of new 'technology-intensive' opportunities, opportunity recognition, opportunity assessment, creative problem solving, design and ideation of the new ventures, value creation, teamworking and network building. The participants follow a process that takes them from business planning to the organisational aspects of the new entrepreneurial venture up to its launch. The aim here is threefold: to provide participants with more specialised knowledge 'about' the entrepreneurship topic, to create capabilities and competencies for the entrepreneurial process and to empower them to recognise real opportunities, identify and solve problems creatively, manage complex businesses, projects and situations, turn ideas into new ventures, think strategically and create innovative networks.

In these phases, the learning strategy adopted is a combination of traditional methods, such as lectures, seminars, case studies and so on, and more 'action-based learning' methods consisting of project-based learning, entrepreneurial projects, incubation and competition, for example, aimed at encouraging creativity and innovative thinking. The participants develop entrepreneurial attitudes and capabilities through co-operative learning, interdisciplinary teams, experimentation in laboratories, simulations and other exploratory and exploitation activities. Moreover, the first example of enterprise-oriented activity aims to give the students a flavour of entrepreneurial processes, challenges and activities. Through the organisation of entrepreneurship-oriented activities (competitions, projects, etc.), the participants develop skills such as teamworking and communication, and improve their entrepreneurial skills by learning from existing businesses/entrepreneurs, who share their knowledge and histories with the participants.

The level of engagement and collaboration with stakeholders is higher and consists of the direct involvement of the participants with businesses through sponsored factory tours and in-kind equipment, work placements, incubation, entrepreneurial networks and so on, in which different actors in the entrepreneurial ecosystem, such as technology-based firms and venture capital providers, participate to discuss, present and collaborate in creating new entrepreneurial success initiatives.

Another relevant pattern that emerges is the provision of support, mentorship and guidance after the creation and incubation phase of the new venture (*Category IV—Acceleration and Growth*). In fact, we found that in almost all the cases (see Table 6.), the offering of guidance and support in building and growing new ventures is an integrated activity of the centre. The supporting and coaching activities are organised in numerous ways: advanced, specialised and high-quality training programmes regarding strategic growth; specialised programmes in legal, financial, public relations (PR), intellectual property (IP) issues and so on for the sustainability of the venture; and spaces, technologies, expertise, facilities, coaching and mentoring, and access to international networks to help the business to grow and be sustainable over time. The activities include summer schools, executive programmes, consultation, mentoring, co-working, innovation factories and network events aiming to sustain and accelerate the successful development of start-up companies by providing entrepreneurs with targeted resources and services. These activities are finalised to produce successful enterprises that are financially viable and freestanding as well as to enlarge the 'space of opportunity' involving all the stakeholders of the local territorial community in the learning and research activities.

5.3 Toward a Process-based Entrepreneurial Learning Model for Developing Entrepreneurial Competence

The cross-case data analysis reveals that the outcomes centres seek to achieve with different entrepreneurship initiatives and activities tend to focus on four entrepreneurial stages, with different aims in terms of learning goals, entrepreneurship content and stakeholders' involvement:

1. *Inspiration*—this stage focuses on creating the overall awareness and mindset of entrepreneurship as well as the general understanding and knowledge needed to start and manage an entrepreneurial activity.
2. *Exploration*—this stage tends to focus on the participants, creating specific entrepreneurship capabilities, competencies and skills aimed to scan, sense and act upon new opportunities and to capitalise on them in an entrepreneurial initiative in a creative and innovative way.
3. *Exploitation*—the third stage consists of developing practical entrepreneurial abilities to take advantage of opportunities by putting the participants in real-world situations to solve specific problems through the ideation, design and management of new ventures.
4. *Acceleration and Growth*—,the fourth stage consists of providing the participants with the tools, resources, knowledge and capabilities to sustain growth and to be able to create value continuously with the new venture.

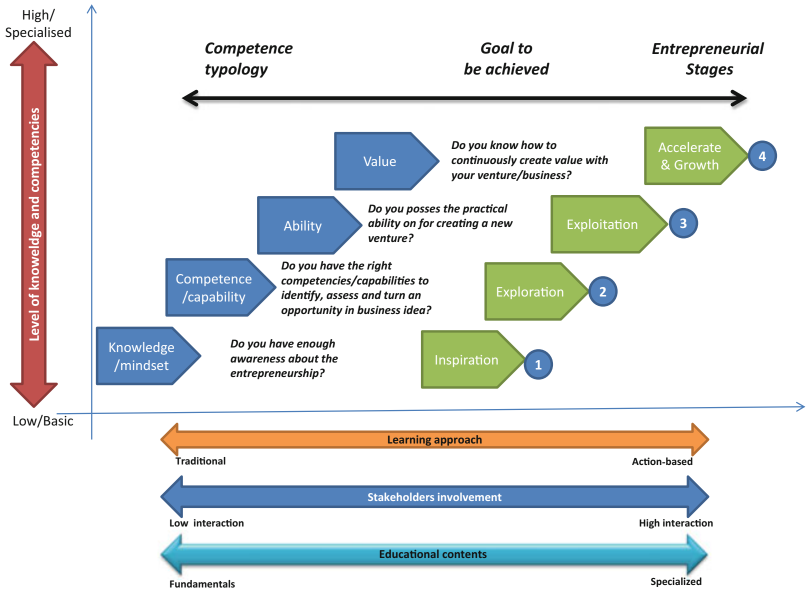

Fig. 6.4 A process-based entrepreneurial learning model for developing entrepreneurial competence

Starting from these considerations and from the invariance traits discussed in the previous section, it is possible to design an integrated process-based framework for developing entrepreneurial competence. The framework relates the entrepreneurial competence to be developed in people (the profile of the target groups) and the entrepreneurial stage/process that the centres activate to respond to diversified needs and competence levels of the target groups (see Fig. 6.4).

In greater detail, the process-based framework is composed of the following building blocks: the competence typology to be created in people (from knowledge and awareness development to value creation), the goal to be achieved for the target (from the creation of entrepreneurial awareness to the capacity to create value with the new venture), the corresponding four entrepreneurial stages (from inspiration to acceleration and growth), the learning approach, the stakeholder involvement, and finally, the learning content that characterises the typology of the learning initiatives involving the target profile.

The four entrepreneurial stages target different groups, including students, managers, entrepreneurs and academics, with specific requisites and objectives to achieve. However, these domains are interlinked and are structured in an evolutionary mode that seeks to guide the target groups along the path that best fits their prior knowledge/skills and objectives to attain, starting from a previous self-assessment. Thus, for example, students (both undergraduate and graduate) start their progress along the path towards entrepreneurial learning from the first stage, which tends to focus on creating awareness and inspiration, and then proceed to the other stages to develop more action-based capabilities for the entrepreneurial process. Meanwhile, young entrepreneurs' or managers' involvement is based mainly on the exploitation and acceleration stages, as they are more interested in learning how to deal with changes, how to respond innovatively to new challenges, and how to accelerate and sustain the growth of their venture over time.

In the same manner, the learning methodologies are also structured according to the level of knowledge, skills and competencies of the target groups following a process-based model. The learning strategies range from traditional bounded practices to active forms of learning and practical learning opportunities. The final aim is to engage participants actively in experiential learning that constitutes appropriate modes for building the necessary practical skills and for instilling entrepreneurial ability.

Furthermore, the stakeholders' involvement becomes stronger when the participants move from one stage to another. During the first stages, the level of engagement with the stakeholders is lower, consisting of short meetings with entrepreneurs and inspirational people. However, as the participants progress further along this pathway, their relationship with the ecosystem becomes tighter and stronger. The participants in the late stages of the process are totally involved in team working with the outside stakeholders to solve real problems and to propose innovative solutions together.

This is a dynamic, interactive and evolutionary process-based model that emerges as a common approach to process-based entrepreneurial learning for developing entrepreneurial competence in almost all the centres considered in this study. According to this model, learning methodologies, entrepreneurial contents and stakeholders' engagement are structured in a way that permits diversified and heterogeneous target groups to follow dynamically the process that better suits their specific profiles, moving from the provision of basic knowledge and understanding to the creation of the conditions for them to co-create and acquire entrepreneurial ability in practice.

6 Conclusions

This study has revealed intriguing patterns related to the role that centres play in instilling and creating an entrepreneurial mindset and capabilities. The centres reported in this study tend to focus on creating different competencies in the participants, including knowledge, skills, attitudes and behaviours for entrepreneurial development. Creating these diversified competencies requires a broad range of interventions regarding content, learning methodologies and the level of engagement with stakeholders.

The cases mapped in this study target a diversified set of participants, ranging from graduate and undergraduate students through researchers, academics and managers to potential and practising entrepreneurs, with the ambition not just to create new ventures but also to instil in participants the capability to think innovatively by continuously co-creating value in relation to the opportunities given in the context.

In response to the diversified set of target groups, the entrepreneurship centres seek to create suitable learning environments by providing varied learning content, initiatives and activities. As described in the findings, the learning path towards the creation of entrepreneurial competency is a 'process-based one' that depends on the level of knowledge, skills and abilities the target groups possess as well as on the goals they seek to achieve. Therefore, for an efficient and qualitative conduit towards an entrepreneurial mindset, the centres provide the participants with different typologies of content that range from basic contents regarding entrepreneurship and the main theoretical frameworks to specialised programmes for venture growth and sustainability as well as networking events, competitions, incubations, consulting and other active and experiential forms of learning that enable the participants to be actively involved in solving real tasks and challenges encountered by entrepreneurs. Moreover, the centres undertake a series of extracurricular entrepreneurial initiatives aimed at addressing the whole entrepreneurial process, ranging from awareness raising and the development of an entrepreneurial attitude to the development of entrepreneurial skills and capabilities, and supporting venture creation.

In summary, the universities with their entrepreneurship centres create and enable the 'entrepreneurial journey' (Edwards and Muir 2014), facilitating the entrepreneurs' transformation from the role of students to that of entrepreneurs on their journey from university to business through the implementation of enterprise education initiatives to valorise the knowledge acquired to start a business and the entrepreneurial skills for employability. On the entrepreneurial journey, strong collaboration with the outside stakeholders was revealed, which is a very important contribution for many reasons, as they:

- Offer a higher quality and quantity of education as they constitute role models for the participants by contributing relevant and up-to-date real-life experiences.
- Provide target groups with larger possibilities to create effective networks for collaborating and solving real-life problems.
- Provide greater opportunities to learn from real-life contexts through action-oriented initiatives with the direct involvement of entrepreneurs and influencers.

All these patterns are integrated into the process-based model proposed in this chapter, according to which, depending on the goals of the centres and the target profiles, the path towards the creation of an entrepreneurial mindset and capabilities changes. This process-based model to develop entrepreneurial competencies and value has several implications (Secundo et al. Forthcoming 2015b):

- It provides an interactive pathway that combines dynamically the phases towards entrepreneurial venture creation, entrepreneurial learning strategies and collaboration with the stakeholders' network;
- It encourages the diffusion of an entrepreneurial culture through the provision of lifelong learning initiatives;
- The different activities and initiatives used to educate and stimulate the entrepreneurial mindset could be structured according to the out-

comes expected and the typology of competences that the participants would like to achieve;
- It permits the design and development of the entrepreneurial mindset in action; and
- It fosters collaboration and exchange within outside networks to maximise the benefits of the entrepreneurial culture.

Despite the insights and implications that this cross-case analysis provides, the study suffers from a limitation in that the research approach involves a web-based analysis; major implications and insights would emerge from field research and additional interviews with the centre directors. A further limitation is related to the lack of evaluation of the effectiveness of the process proposed. In fact, future research needs to be realised to test the goodness of the model proposed through focus groups and expert panels. Furthermore, future research could focus on measuring the long-term effect of the different phases of the process proposed and the effect of entrepreneurship education.

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7

A Collective Intelligence Platform for Developing Technology Entrepreneurship Ecosystems

Gianluca Elia and Alessandro Margherita

1 Technology Entrepreneurship: Building Successful Ecosystems on a Global Collaborative Scale

Entrepreneurship and innovation are engines of economic growth and societal progress (Allen 2009; Wennekers and Thurik 1999). In particular, technology-based entrepreneurship has gained relevance as a driver of economic development and the renewal of regions and territories (Phan and Der Foo 2004; Venkataraman 2004). Its potential lies in the transformation of technology-grounded ideas into artefacts and technology applications with market value (Kirzner 1997; Venkataraman and Sarasvathy 2001).

However, many good ideas based on technological and scientific research do not survive the 'valley of death', i.e. they are not able

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to generate successful products/services with appropriate levels of profitability (Auerswald and Branscomb 2003). These failures, caused by factors such as incorrect market and customer analysis, inappropriate business and organisational models, or competence gaps in the entrepreneurial team, have an impact both for the entrepreneur and for society in terms of resource waste and missed opportunities for creating new jobs and economic prosperity.

Besides the innovative dimensions of the entrepreneurial initiative, success depends on the environmental system and the conditions in which the initiative itself is conducted, i.e. on the *ecosystem*. Many successful cases show the positive impact of the *entrepreneurship ecosystem* in supporting the conceptualisation, development and growth of entrepreneurial projects.

First, successful ecosystems have been created by leading companies, such as Hewlett Packard, Google and Apple (in Silicon Valley, California, USA), as well as Infosys and Wipro (in Bangalore, India). Second, leading universities are able to create infrastructures for collaboration among students, researchers, companies and investors. Successful cases include the Massachusetts Institute of Technology (MIT), Stanford University, UC Berkeley, Carnegie Mellon and the Georgia Institute of Technology. Third, visionary and successful entrepreneurs also play a significant role in the creation of new initiatives to promote innovation ecosystems; for example Mike Lazaridis, the founder of BlackBerry, who founded the Mike and Ophelia Lazaridis Quantum-Nano Centre for quantum computing at the University of Waterloo, Ontario, Canada, and Tony Hsieh, the founder of Zappos, who created an urban incubator to promote disruptive innovations in Las Vegas. Finally, public institutions and governments invest funds to create technology-intensive centres and incubators, such as Tech City in London, Start-up Chile, the Zhongguancun Science Park in Beijing, Paris-Saclay in France, the city of Berlin, the Skolkovo technology park in Russia, and Israel's technology security park.

In all these cases, a common factor in their success is the complex set of relationships and learning interactions among actors, such as enterprises, institutions, financial investors, experts and professionals, universities, research centres and creative talents (Edquist 2005; Isenberg 2010). However, the development of such ecosystems is often based on the ability to 'pull' resources and networks of relationships characterised by physical co-location and industry proximity. Two possible limitations are that: (1) not all the resources required to develop an entrepreneurial initiative may be located in the same region; (2) different entrepreneurial initiatives may require different types of support depending on their stage of development.

Such factors prevent the total replication of successful models in other regions and contexts. It is indeed practically impossible to replicate the social and structural forms of capital that characterise a specific territory in other scenarios. This is where the challenge emerges: if 'local' ecosystems become global, potential entrepreneurs worldwide can connect to a global system of expertise, assets and relationships to convert promising ideas into successful business ventures.

The incredible development of information and communication technologies (ICT) and the internet are making the achievement of this challenge more feasible. In particular, a new scenario of pervasive collaboration and interaction among people and computers is enabling models of *collective intelligence* whereby the 'wisdom of the crowd' can help to solve complex problems in a more effective way. The undertaking of an entrepreneurship journey can be considered a possible problem to be solved, and thus the new archetype of the entrepreneurship ecosystem is based on the creation of a system of actors, resources, knowledge assets, services, competencies and relationships around the potential entrepreneur that is needed to provide better support for the idea-to-venture process. A 'personalised' ecosystem can thus be tailored around the real needs of the entrepreneur, through a dynamic process that lasts the entire lifecycle of the entrepreneurial initiative.

This chapter aims to illustrate the theoretical and architectural constituents of this 'personalised' ecosystem, and the way in which the enabling platform leverages collective intelligence to cater for the needs of an aspirational entrepreneur. More specifically, the next section introduces collective intelligence. We then address the actors, activities, resource flows and environmental context of the model ecosystem on which the enabling platform is based. Finally, the enabling technology platform is presented and a new model for a personalised entrepreneurial ecosystem is discussed.

2 What is Collective Intelligence? Definition and Applications in the Entrepreneurship Domain

Knowledge is the most valuable resource that organisations and territories develop, protect and exploit to remain competitive and ensure socio-economic growth (Grant 2002; Maskell 2001; Zack 1999). Consequently, knowledge management has evolved as an important field for research and practice, influencing several business theories and frameworks (Baskerville and Dulipovici 2006). For example, in *information economics*, knowledge management has contributed to the diffusion of terms such as 'knowledge economy' and 'knowledge clusters' (Florida 2002; Powell and Snellman 2004). In the *strategic management* field, concepts such as knowledge strategy, core competences, dynamic capabilities and absorptive capacity have arising, generating a significant impact on the strategic and operational choices of organisations (Cohen and Levinthal 1990; Hamel and Prahalad 2005; Zack 1999). In *technology*, knowledge management tools and architecture have emerged, and existing applications such as intelligent agents and decision support systems have been revitalised (Maier 2007). In the *organisational culture* and *behaviour* domains, concepts such as values, trust, creativity, innovation and organisational learning have also become familiar to corporations (Brown and Duguid 1991; March 1991), whereas the *organisational performance* field has seen the introduction of new terms— for example, intellectual capital and intangible assets (Bontis 2001; Mouritsen et al. 2005).

An emerging concept in the knowledge management domain is *collective intelligence* (Boder 2006). Collective intelligence synthesises the collaboration among people and machines, and studies how they can be connected to each other so that they act more intelligently than do single individuals, groups or computers have done before. Research in the collective intelligence field aims to design and build solutions that address societal problems and emerging challenges, with existing applications in areas such as climate change and global warming (Atlee 2008; Lévy 2008; Malone and Klein 2007; Malone 2008; Malone et al., 2010).

The concept of collective intelligence emerged at the end of the 1970s, but since the 1990s the spectacular emergence of ICT and internet-based services has provided unprecedented opportunities for huge numbers of people dispersed all over the planet to work together and interact via e-mail, instant messaging, forums, blogs, wikis and podcasts. Using these technologies, it is now feasible to produce collaborative scenarios that would have been impossible to imagine just a few years ago.

In the broadest sense, collective intelligence is defined as 'the capacity of a human community to evolve toward higher order complexity thought, problem-solving and integration through collaboration and innovation' (Pòr 2008). From this perspective, the concept is applied as an approach to solving complex problems, such as global warming, seismic events, traffic management and waste management.

The main challenge of collective intelligence systems is how to improve such collective efforts so that they are an improvement over individual efforts, effectively linking intelligence and knowledge to achieve a common objective (Lévy 2010). Collective intelligence systems can be active or passive, collaborative or competitive. Wikipedia is an example of an active collaborative-based system; while Innocentive, in contrast, is an active and competitive-based system in which people compete with each other to offer possible alternatives to specific problems highlighted by organisations, and there is only one winner. Google is an example of a passive collaborative-based system, as users are not aware of their important role within the page-ranking algorithm.

Six basic elements are required to allow the fostering of collective intelligence (Boder 2006). First, collective intelligence is built on actors endowed with a set of competences that are complementary among the group, and valuable for the purpose of the collaboration (e.g. solving a problem, conceptualising a new idea, designing a new product or service, etc.). Second, knowledge and intangible *resources* represent the main fuel for the collective intelligence engine. Indeed, the access to explicit and implicit sources of knowledge, which are sometimes codified but are most of the time linked to unstructured and informal relationships, constitute the initial basis of intelligence. Making explicit the individuals' expertise ensures the continued updating of the knowledge bases and the activation of interactive learning processes. Third, *interaction mechanisms* include the generic tools that individuals can use to perform an action. These include problem-solving techniques, visual discussion systems, communities of practice, mind-mapping tools, interviews and questionnaires, storytelling and ICT-based services, such as database navigator, expertise finder, web collaboration suite and social networking tools. Fourth, a collective intelligence system should have clear and well-defined *objectives*. In the case that there are many subgoals, it is fundamental to ensure that there is coherence between them. Fifth, *culture and norms* explicitly address possible contradictory constraints and conflicts that can arise during the execution of activities. These constitute the 'mechanics' of the interaction and are usually created through an inclusive and participative process. In particular, respect and trust are cultivated and practised, especially when individual competences are enhanced and valorised within the corporation. Finally, *evaluation criteria* are required to assess the progress of the collective intelligence process in terms of efficiency, effectiveness and the overall value generated. The definition of criteria should be done by a significant group of stakeholders, to ensure representativeness.

Collective intelligence prospers under conditions of *diversity* (i.e. people with different backgrounds), *independence* (i.e. individuals contributing without any influence from others) and *aggregation* (i.e. the use of mechanisms for combining and processing individual estimations to obtain a collective estimation), thus giving rise to the phenomenon known as the 'wisdom of crowds' (Surowiecki 2004).

Corporations have recently started to introduce collective-intelligence-based approaches to foster participative forms of collaboration and leverage their in-house innovation capabilities (Malone et al. 2009). Some of these approaches include prediction markets, crowd-sourcing and corporate wikis (Doan et al. 2011), which seem to be very effective in their own contexts (Zhang et al. 2009).

Collective intelligence thus becomes a core competence of organisations; it captures the distributed expertise of people, exploits internal and external knowledge assets, orients creativity and adopts virtual tools to generate new ideas, solve complex problems and foster collaborative innovation processes.

The current global economic crisis is driving interest in experimenting with participative approaches and systems aimed at improving the welfare of territories through promoting entrepreneurial activities in society at large.

Indeed, there is mounting interest in the use of collective intelligence in different domains (Pérez-Gallardo et al. 2013). The number of applications focusing on pursuing entrepreneurial goals both at the individual and organisational level is growing, with the final aim of improving creativity and the innovative capabilities of individuals and organisations (Leimeister 2010).

A first attempt in this direction is crowd-sourcing, which supports the development of a start-up by leveraging outsourcing strategies (Laubacher 2012). Some examples include TopCoder and Innocentive for complex tasks and challenges; NineSigma, Hypios and YourEncore for collaborative problem solving; Amazon's Mechanical Turk and CrowdFlower for very simple tasks; and Elance and BootB for matching demand and the offer of knowledge and expertise. These examples provide start-ups with access to valuable crowd-based creations at an accessible cost.

Other examples of collective intelligence applications that support the entrepreneurial process relate to idea screening and selection processes, such as Quirky, VenCorps and Springwise. A widely diffused phenomenon that has been growing rapidly in recent years is crowd-funding, which supports the diffusion of an entrepreneurial culture worldwide by sustaining innovative ideas and projects, mainly in the early stage (Lambert and Schwienbacher 2010; Schwienbacher and Larralde 2012). Kiva, Kickstarter, Eppela, GrowVC, Indiegogo, Springboard Ventures, Profounder, SoMoLend, CapAngel and ProFounder are examples of crowd-funding platforms.

By considering the entrepreneurial process overall and not in a specific phase (i.e. idea evaluation and funding), IStart and IBridgeNetwork, powered by the Kauffman Foundation, represent two interesting platforms that support networking and stimulate collaboration among aspiring entrepreneurs, mentors and advisers, researchers and potential investors, with the aim of conceiving, refining and developing innovative ideas and transforming them into successful ventures.

3 Entrepreneurship Ecosystems: A Collective Intelligence Model

The design and creation of an entire entrepreneurial ecosystem tailored around the specific needs of the entrepreneur, which leverages the distributed intelligence of other entrepreneurs and individuals, represent at the same time a challenge and an opportunity. A tentative approach based on collective intelligence, which could provide an effective solution to this complex problem, is presented here. Specifically, the proposed model is composed of four main components representing the actors in the ecosystem (who), the activities performed (what), the knowledge assets and flows (how) and the overall environment containing the services available (where). These components and the overall model are described below (Elia et al. 2014a, 2014b).

3.1 Who—Actors in the Ecosystem

The *who* dimension includes the individuals and groups directly or potentially involved in the execution of entrepreneurial activities. Each actor brings knowledge and competences to the system and, taking different roles, participates in the virtual community. The key actor is the *entrepreneurial actor* motivated to launch an entrepreneurial project, which can be one of four types, as illustrated in Table 7.1. The entrepreneurial actor is a person (or a team) willing to create socio-economic value by capitalising on a good idea and transforming it into a valuable business. Entrepreneurial actors are characterised by common traits such as passion, resilience, self-confidence, flexibility and risk acceptance (Fisher 2011), as well as behavioural characteristics such as questioning, observing, experimenting and idea networking (Dyer et al. 2008).

Around the core entrepreneurial actor, several categories of stakeholders participate in the entrepreneurial ecosystem. Based on modern network theories (Allee 2000), an extended understanding of the term stakeholder can be defined to include the following actors and parties:

- Banks
- Business and management consultants
- Business partners
- Large companies
- Individual investors
- Incubators and accelerators

Table 7.1 Types of entrepreneurial project

Project type	Description
Academic entrepreneurship	Creation of a new company (start-up or spin-off) which originates from a knowledge-intensive domain, such as a university or research centre. The company usually valorises the results of a given piece of research on the market, capitalises on distinctive know-how and competences, and realises technology transfer and university—company matching activities
Independent entrepreneurship	Creation of a new company that industrialises and commercialises a new product, process or service, by valorising a promising idea that fills a market gap or meets a customer need
Corporate entrepreneurship	Development of a new product, service or unit within an organised business context from the strategic perspective to conceive, foster, launch and manage a new business that is distinct from the parent company, but leverages the parent's assets, market position, capabilities or other resources
International entrepreneurship	Internationalisation of the market scope of a company to scale market perspectives and make the company international

- Intellectual property (IP) offices
- Labour representatives and trade unions
- Local, national and international government bodies
- Other organisations and associations
- Physical infrastructure
- Professional and support services
- Researchers and professors
- Scientists and technologists
- Social leaders
- Standardisation bodies
- Spin-offs, start-ups, and innovative small and medium-sized enterprises (SMEs)
- Successful entrepreneurs
- A talent pool
- Technology parks
- Universities and education/training institutions
- Venture capitalists and business angels

Table 7.2 Types of stakeholder role

Role	Description
Service and/or content provider	Companies, individuals, agencies and other organisations that can provide services (e.g. business, payment, education, market analysis, knowledge provisioning, etc.) and/or content (e.g. videos, tutorials, other materials) available to the whole community
Champions and sponsors	Testimonials, politicians, famous entrepreneurs, academics and other public or private personalities with experience, resources, strengths and the reputation to support the growth and development of the entrepreneurial initiatives
Community animators	People and organisations crucial to enhancing and stimulating the degree of participation and contribution of other actors in the activities and initiatives of the entrepreneurial community

These stakeholders can play different roles in the entrepreneurial system, according to the relationship they establish with the main actor, as illustrated in Table 7.2.

The *entrepreneurial actors and stakeholders* can belong to 'explicit groups', i.e. defined subcommunities based on specific goals or activities to be executed, or can be organised dynamically into 'implicit groups' by specifying specific rules and criteria (e.g. people who talk about a specific topic, the top commenter individuals, or the top influencers).

3.2 What—Activities of the Ecosystem

The *what* dimension refers to the *entrepreneurial roadmap* to be executed for a given entrepreneurial project, i.e. the complex set of 'desk', 'pre-market' and 'market' activities required to accomplish the idea-to-venture process successfully (Byers et al. 2010). *Desk stage* activities are the preliminary explorative and design tasks, which aim to prepare for the creation of the venture; *pre-market stage* activities prepare the company and the entrepreneur for access to the market; and, finally, *market stage* activities are realised when the venture is fully operational and active on the market. Table 7.3 provides further details.

3.3 How—Knowledge Assets and Flows in the Ecosystem

The *how* dimension refers to the knowledge resources, procedures, documents, discussions, experiences, news, etc., and all those elements that can help a potential entrepreneur to develop his/her own project. Knowledge resources are created by individuals or the community at large, and they can be exchanged and uniquely identified (e.g. using a uniform resource identifier [URI], tweet, a concept on dbpedia.org). Each resource can be connected to other resources through immediate relationships, such as those existing between a blog and the comments related to it, or between an e-mail and a document attached to it. Other relationships can be simple metadata (extracted, for example, from the Dublin Core ontology) or content-based annotations specified directly by the users or by the system through automatic extraction from text, video, images and audio sources. Resources can be stored as Linked Open Data and thus can be derived from external sources, suggested and related to what people do on the platform.

Stakeholders in the ecosystem are intertwined by knowledge flows, i.e. work and information exchange flows realised between two actors ('1 to 1' flows), or between one actor and the community ('1 to N' flows). The following types of flows can be realised:

- *Conceiving*: flows involving the production of a primitive and original idea about a new product, service or solution.
- *Creating*: flows involving the production of an artefact or resource that has to be used or transformed.
- *Deciding*: flows involving the process of selecting one alternative from among different possible solutions.
- *Inspiring*: flows involving one actor stimulating—perhaps indirectly—another actor in the process of creation or conception.
- *Networking*: flows involving the expansion of contacts owned by an actor.
- *Recommending*: flows involving one actor who endorses a specific solution, alternative, resource, or another actor.

Table 7.3 Entrepreneurship roadmap and activities

Stage	Related activities
Desk activities	*Scenario scanning*—Scanning industries and regions to find opportunities and elaborate new visions.
	Opportunity recognition—Examining political, social, technological and economic trends can lead to the identification of emerging needs that can be transformed into attractive opportunities by combining good timing with realistic solutions.
	Concept definition and value proposition—The customer value proposition consists of the sum of total benefits that a vendor promises to customers after receiving the associated value transfer.
	Revenue model and definition of value capture—The revenue model describes how (strategy, methods and sources) a business will earn income and produce profits.
	Detailed business planning—Entrepreneurs respond to attractive opportunities by presenting a story with a convincing business plan through which the money and resources required can be obtained from potentially interested investors.
Pre-market activities	*Funding and capital raising*—Entrepreneurs estimate the capital required for their new business by reviewing the financial projections and the cash flow statement included in the business plan. With these data, they proceed with bootstrapping or contacting 'business angels' and venture capitalists to collect the money required and motivate the investment.
	Acquisition of resources and team organisation—Beyond financial resources, entrepreneurs also require physical resources, mainly talented people. To identify the resources required, entrepreneurs focus on core processes, outsourcing the other non-core functions to partner companies that can do them better and cheaper.
	IP analysis and legal formation—When entrepreneurs establish a new business, they must make some important choices related to IP issues (trade secrets, patents, trademarks, copyrights, etc.), because these can affect competitive advantage significantly.
	Product and service development—The design and development of products and services, including detailed engineering activities, with the final aim of commercialising the new offering and increasing market share.

Table 7.3 (continued)

Stage	Related activities
Market activities	*Operations management*—Launching the new venture requires a chain of value-adding activities and a set of physical, financial and informational flows, which also need to be properly orchestrated. *Profit and harvesting*—Analysing how the company generates revenues and manages revenue growth is fundamental in defining the financial constraints and the raising of new funds from investors. At the same time, the company should adopt a plan to harvest the benefits. *Venture expansion and development*—Managing a new business from start-up to maturity requires different strategies. To grow, a firm needs to create new businesses by making successful acquisitions and by launching an internationalisation plan.

- *Requesting*: flows involving an actor addressing a demand to another actor or group.
- *Sharing*: flows involving the collective availability of something created by a single person or a smaller group.
- *Suggesting*: flows involving advice related to open issues.
- *Transferring*: flows involving the movement of an informational or monetary resource between actors.

These flows represent the core of the collective intelligence process. Actors in the ecosystem employ flows to collaborate and to increase the chances of success for a new venture. From this perspective, the community acts as 'co-designer', 'co-developer' and 'co-validator' of an entrepreneurial project, thus contributing to conceiving an idea, defining the specifications, evaluating prototypes and testing the solutions in real-life settings. The ultimate goal is to reduce the risk of proposing business solutions that will not be adopted by the market (low acceptance), are not innovative from a socio-technical perspective (old-fashioned) or are economically unproductive (un-economical).

3.4 Where—Environment of the Ecosystem

The *where* dimension includes the 'environment', with its related services and applications, required to activate the entrepreneurial process. The collective intelligence process happens in real-life settings, as well as in virtual contexts, in which actors meet each other, exchange knowledge and engage in decision flows.

The entrepreneurship ecosystem requires a '*collaboratorium*' able to capitalise on the potential of discussion tools, such as e-mail, chat, wikis and web forums, to enable global knowledge sharing and effective global-scale deliberation and decision-making concerning complex problems and controversial issues. This collaboratorium is conceived as a work space that provides users with tools for structuring dialogue and discussions, together with a semantic organisation for analysing the structure of contributions and relationships among the contributors, and finally offering infographic and interactive instruments for mining knowledge within communities and exploring possible collaborative patterns. Thus, within the collaboratorium, people and systems can collect, share, analyse and make sense of data and information to derive knowledge useful for taking collective and effective actions. Moreover, thanks to the tools and services available, participants are able to co-design and co-create valuable content, ideas, projects and solutions for solving complex problems, facing challenges and co-experimenting with innovative services or prototypes.

By aggregating the different and isolated contributions of motivated individuals with heterogeneous expertise, the collaboratorium can support the identification of promising ideas and proposals that it would otherwise be too difficult or expensive for a single person, group or organisation to obtain.

Through cumulating individuals' comments, votes, rates, tasks and rankings, the collaboratorium can filter and select the winning ideas and proposals, as well as predicting trends and future events with limited economic effort. The gathering of individual and unconscious contributions is essential to obtain widely shared proposals. In addition, by promoting dialogue and mutual understanding among committed and aware users, who provide reflections and contributions to address complex problems and controversial themes, the collaboratorium supports the ideation, co-design and co-creation of pioneering solutions with high potential for innovation.

Typical tools included in a collaboratorium aim to realise the following processes:

- The involvement of individuals and groups, promoting their engagement to participate in the community.
- Discussion of issues and problems that open up the ground to creativity for inventing and proposing new ideas.
- Observing users' behaviour and contributions.
- Collecting individual feedback and opinions.
- Categorising each contribution according to its semantic structure.
- Summarising the key concepts to give an immediate sense and direction of the discussion.
- Monitoring the activities and relationships of the communities to identify future patterns for implementation.
- Moderating discussions and revitalising interactions and contributions.
- Visualising patterns through actionable dashboards and calculating metrics and indicators to maintain the pulse of the entire living organism.
- Supporting decision-making processes and the co-ordination of actions to implement the selected initiative.

Virtual environments endowed with collective intelligence tools have to promote interdisciplinarity, interactivity and internetworking, with individualised access, immediate feedback and interoperable architecture (Elia 2010). They leverage the potential of the internal and external crowd's intelligence to identify the most valuable ideas or projects, and forecast business and social impact. Thus today they represent a key asset for organisations and territories wishing to activate development processes for smart and sustainable growth.

4 Entrepreneurship Ecosystems: The Enabling Technology Platform

Based on the model described in the previous section, the core services of a supporting technology platform have been developed. The platform has to provide the set of environmental conditions and applications (the 'where') required to support different actors (the 'who') to perform different activities (the 'what'), using an array of resources and engaging in a set of flows (the 'how'). Based on open innovation principles (Chesbrough 2006), the goal is to create an entrepreneurial information system (EIS) that can valorise the collaboration, communication and sharing of knowledge among all the stakeholders involved in the entrepreneurship ecosystem.

An example can help to clarify the scenario of use. A professor in a Faculty of Economics wishes to launch a start-up in the software industry as his project of academic entrepreneurship. He is in the phase of IP analysis and the legal formation of his venture. He thus decides to log in to the 'collaboratorium' and use the services, knowledge and network of relationships that the platform provides. In particular, this allows him to get in touch with legal advisers, consultancy companies and peers to discuss his needs. He also uses the forum and opinion provision services to request suggestions from the wider community. Once he identifies the right provider, he can request quotes for the consultancy services that he needs to undertake IP analysis and legal formation activities. Moreover, the professor can employ the platform knowledge base in search of articles, readings and case studies concerning the IP protection topic. Finally, to develop his own knowledge and skills regarding IP protection, the platform suggests that he attends two on-line courses and one face-to-face seminar with field experts. Figure 7.1 provides a schematic representation of this scenario.

The choices made directly by the actor are complemented by the suggestions provided by the platform. On the basis of the intelligence of the system built upon the choices of other actors who have experienced in similar situations and the semantic links to knowledge repositories, the system proposes further services and specific knowledge items that can

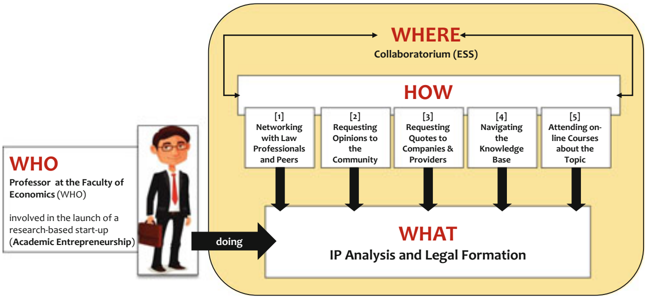

Fig. 7.1 An illustrative scenario

support the actor on his/her entrepreneurial journey, including learning resources (Assaf et al. 2009).

The EIS adopts the principles of enterprise social software (ESS), as used in corporate settings, to encourage, support, capture and analyse streams of discussions between groups of people, aiding in the identification and selection of potential valuable ideas. Figure 7.2 illustrates the logic architecture of the collective intelligence platform that supports virtuous connections between working, learning, innovation and entrepreneurship. The platform supports competence management, content management and community management processes by integrating structured and unstructured learning tools with distributed knowledge repositories, collaborative working systems, real/virtual laboratories and a network of relationships with individuals and stakeholders (Elia 2010).

The platform includes six categories of services (where) aimed at supporting interaction and the accomplishment of the several phases of the entrepreneurial roadmap related to a specific entrepreneurial project. All the categories are integrated to guarantee complete support (educational, business, collaborative and individual) to potential entrepreneurs. Specifically, these comprise:

1. *Work list*: a personal agenda containing all the engagements derived from participation in the development of entrepreneurial projects (participation in virtual meetings, the submission of documents, a review of the financial plan, collection of market data, etc.). The work list can be shared easily with other collaborators and new potential

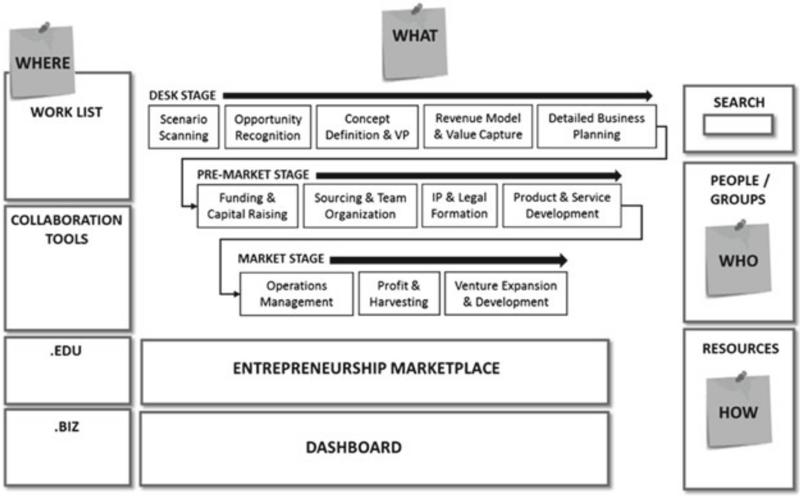

Fig. 7.2 The enabling platform

contributors to schedule appointments directly and arrange meetings instantly.

2. *Collaboration tools*: a suite of services for virtual participation and co-operation (e.g. wikis, blogs, chat rooms, document management systems, forums, virtual meetings, project management suites, etc.). The traditional time-based logic of this category of services, particularly for social tools such as blogs and forums, is completely overturned. The flows of messages and contributions should not be organised according to time as this often generates scattered content and noise, and highlights only the most recent posted contributions; rather, they have to be structured according to a recursive three-level organisational format made up of topics, problems and questions (first level), arguments, solutions and answers (second level), and positions, views and opinions (third level). In this way, the first two levels contribute to developing the debate on a structured semantic basis, through possibly iterative and well-contextualised contributions and goal-oriented discussions, while the third level provides support for decision-making by considering clearly expressed 'yes' or 'no' positions, and by evaluating positive and negative feedback.

3. *.EDU suite*: a set of services (e.g. skills-gap analysis, course enrolment and delivery, monitoring and reporting, virtual classrooms, etc.) to sensitise individuals to entrepreneurial culture and develop the entrepreneurial skills and competences of individuals and groups according to the specific entrepreneurial activity or task to be completed. Services can be oriented to enable structured and unstructured learning, creating flexible and modular learning environments characterised by easy access to applications, resources and users (Elia et al. 2009). The tracking of the learning experiences is based on both the Shareable Content Object Reference Model (SCORM) standard and the emerging Tin Can API standard (also known as Experience API or xAPI), which consider that people learn not only from the widely diffused SCORM-compliant courses, but also from interactions with other people, platforms and contents, including massive open online courses—MOOCs (Cirulli et al. 2015).
4. *.BIZ suite*: a set of services available to the entrepreneurial team to support the creation, planning, analysis and growth of the new venture project (e.g. partner discovery, sentiment analysis, SWOT analysis, risk analysis, market prediction, business intelligence, virtual exhibitions, collaborative laboratories, business plan competitions, virtual pitches, etc.).
5. *Entrepreneurial marketplace*: a contest management system enabling people to publish innovative ideas, collect feedback and comments from the crowd concerning the level of innovativeness, receive suggestions to increase the level of feasibility, identify and invite new members to complete the entrepreneurial team, and contact potential investors interested in financing the idea development.
6. *Dashboard*: an interactive console to measure the level of social networking for the entire system and evaluate the nature of the relationships (e.g. the most active people and groups, the most discussed ideas, projects with the greatest participation, most-debated issues, most-requested stakeholders, the rise of new trends, the organisation of groups); thus valuable new relationships can be supported and activated and so on. The dashboard also allows the visualisation of data related to the tracking of activities performed by the users (as individuals or groups) to be shared with other users (e.g. exchange of

information, interactions, virtual meetings, etc.) and to obtain resources (addition of comments in a document, a new contribution within a wiki, a reply to a post in a blog, semantic annotations or metadata associated with any other resources, etc.), or services (creation of new blogs or wikis, posting of a new idea, submission of new reports, activation of a new project, etc.).

For each user, the platform (learns and) creates a twofold profile (Damljanovic et al. 2012; Flores et al. 2015): the *conceptual profile* and the *social profile*. The conceptual profile is based on the integration of two typologies of information: (1) the explicit information that users provide, both in the personal account and when he/she declares something (e.g. the association of metadata with a document); and (2) the implicit information that the system collects by tracking the user's activities (e.g. the projects created by the user, the typology of content uploaded and downloaded, participation in other projects, identity on external social networking platforms, etc.). The social profile is built automatically by the system by analysing the interactions the user establishes with other users through collaboration and by using techniques to index unstructured content and make intelligent searches (e.g. by leveraging the Linked Open Data cloud, or the API to access other social networking systems). Clearly, both explicit intelligence and derived intelligence (Alag et al. 2012) contribute to representing the overall profile of the users, thus creating new opportunities for the proposal of ideas, team composition and project development.

5 Discussion and Conclusion

Successful entrepreneurial initiatives are driven—at least to some extent—by the presence of virtuous ecosystems of actors, resources and services, which make it possible to streamline the idea-to-venture process. The breakthrough development of ICT and collective intelligence theories and tools has created the enabling conditions to design 'personalised' entrepreneurship ecosystems, which are *glocal*, *project-specific* and *dynamic*.

Such systems can be glocal because, regardless of the geographical position of the entrepreneur, it is possible to engage in an entrepreneurial initiative by leveraging a pool of complementary resources distributed worldwide. The systems are project-specific, i.e. they are tailored to the specific requirements of the initiative in terms of market and product/service peculiarities. Finally, the systems are dynamic in that the combination of resources and enabling factors can change according to the specific phase and time of the project.

This chapter has introduced the foundational elements of an 'eGosystem' aimed at building around the entrepreneur the appropriate conditions and resources necessary to start a technology entrepreneurship project. Such an intelligent system possesses four dimensions: (1) the *actor*, i.e. the entrepreneurial individual and *all the stakeholders* involved in the specific *entrepreneurial project*; (2) the *entrepreneurial roadmap*, i.e. all the phases and activities required to bring an idea to the market; (3) the *knowledge flows*, i.e. the resources and personal interactions; (4) the environment in which the ecosystem is developed.

Actors in the ecosystem operate by relying on their competences and experiences. Interaction and co-ordination mechanisms (e.g. trust, culture, routines, formal and informal norms), together with a pool of accessible knowledge resources (e.g. multimedia documents, blog entries, wikis, chat sessions, learning resources, reports, web pages and links) constitute the formal and informal repositories of implicit and explicit experiences and practices that can support the overall entrepreneurial process.

To create a sustainable entrepreneurial ecosystem, it is pertinent to develop key elements, such as informal networks, links with universities, professional and support services, capital services and a talent pool (Cohen 2006). Granovetter (2005) has shown that entrepreneurs' interpersonal relationships and social ties with a diversity of stakeholders that characterise the market affect the performance of enterprises, enabling access to resources and intangible assets that come from different relational and institutional spheres. A new development in the collective intelligence concept can thus be proposed as a field of experimentation for knowledge management and collaboration/socialisation platforms.

This chapter has presented a collective intelligence system based on a new collaboration and socialisation paradigm to enhance the potential of business and social communities in realising technology-based innovation and entrepreneurship processes. The model needs further improvements in terms of its components and their reciprocal relations. In addition, it has not been field tested and this may be considered a limitation of the study.

The application of the model can be imagined in different scenarios or contexts. A first site of application is related to supporting initiatives aimed at creating positive conditions for promoting regional development. In this case, the model is a tool that could be applied to support business development and new venture generation. A second potential scenario for application would be to support the launch of actions aimed at building competences and skills in the area of technology entrepreneurship at different levels (i.e. undergraduate, graduate, executive). Finally, the model could drive the design of a new generation of entrepreneurship information systems, i.e. core and dynamic knowledge platforms aimed at gathering, processing and using knowledge to enhance the possibility of the success of companies and regions through knowledge-based entrepreneurship.

Our next research will be dedicated to fine-tuning the approach and identifying different cases or pilot initiatives through which it will be possible to implement the approach and various alternatives. In doing so, we shall aim to verify the empirical validity of the approach and fine-tune the model and its components from both an organisational and a technological point of view.

The model can support two main applicative scenarios: (1) the design and implementation of ecosystems tailored to the real specificities of the entrepreneur that can be integrated, developed and monitored dynamically throughout the whole life-cycle of the entrepreneurial initiative; (2) fostering more effective technology entrepreneurship processes and innovation-oriented initiatives within corporations and organisations.

Under conditions of diversity, independence and aggregation, communities can achieve better results than any single individual by exploiting the 'wisdom of crowds' (Surowiecki 2004) and experimenting with cognition, co-ordination and co-operation (Ellis et al. 1991; Engelbart and Ruilifson 1999; Malone and Crowston 1994). Today, this can be realised thanks to the spectacular development of ICT and the internet since the 1990s, which has provided unprecedented opportunities for huge numbers of people to work together and interact within collaborative scenarios (Bonabeau 2009).

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8

Entrepreneurial Learning in a Network: The Role of Cultural Values

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In this chapter we look at entrepreneurs as permanent learners (Franco and Haase 2009). We posit that the networks to which the entrepreneurs belong play a crucial role in their learning process. It is widely accepted that being immersed in a network is strongly related to the sharing of similar cultural values. However, we know precious little about what the main elements of cultural values are that affect entrepreneurial behaviour and learning. Here we aim to provide an overview of the different theoretical perspectives on the role of cultural values so as to shed light on how those values might influence knowledge sharing in a network of companies. We empirically test the identified theoretical perspectives

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empirically in an original setting. We find that sharing similar cultural values contributes to creating a 'fit' between the entrepreneur and the network, which is mainly responsible for the circulation of knowledge.

Recent studies have proved that belonging to a network with shared cultural values has an impact on individual behaviour and learning. Membership of organisations with shared cultural values is related to 'life satisfaction' and happiness (Ferriss 2002; Inglehart 2010). Social networks that are formed in these groups are characterised by a strong sense of identity among members, by relevant social support, and by the presence of shared frameworks for interpreting reality (Lim and Putnam 2010). The benefits of shared cultural values can also impact on the innovation process. A context characterised by shared values may, by creating a common language and communication codes, foster the exchange of ideas, the identification of new opportunities, and a combination of the resources and knowledge of a large and heterogeneous pool of actors (Martins and Terblanche 2003; Giuliani and Bell 2007). In line with this reasoning, this chapter investigates how entrepreneurs participating in a network share not only business interests but also cultural values. This empirical context has been selected because it presents a high level of cohesion, while data from previous studies report an equally high level of innovativeness among members (Ceci et al. 2014, 2015).

1 Entrepreneurship Learning and Network

Scholars agree that firms belonging to networks are likely to be more competitive and innovative than are isolated firms (Ahuja 2000; Baptista 2000; Baptista and Swann 1998; Brass et al. 2004; Podolny and Stuart 1995; Powell et al. 1996). There are several issues that can explain this probability. Within networks, sharing of information, resources and knowledge among firms is facilitated, and hence the likelihood of producing new ideas increases (Dahl and Pedersen 2004; Sorenson et al. 2006; Storper and Walker 1989). This is because of the presence of a set of relationships established by professionals that enables localised learning and knowledge sharing among firms (Giuliani and Bell 2005; Keeble and Wilkinson 1999; Ceci and Iubatti 2012). The learning processes of firms are expedited if firms are exposed to external sources of knowledge that improve knowledge exchange (Burt 1992; Inkpen and Tsang 2005; Knoke 1990; Masciarelli 2011; Laursen et al. 2012).

Networks are composed of multi-dimensional links (Brass et al. 2004; Faems et al. 2008; Padgett and Powell 2011). Padgett and Powell (2011) emphasise that these links contribute not only to the social and economic development of networks, but also to knowledge sharing, to developing new relationships among actors and to generating new subnetworks. In particular, social and personal relationships increase information flow within networks: when personal relationships exist, actors tend to improve knowledge sharing because of the existence of trust, which depends mainly on personal relationships (Granovetter 1985; Lorenzen 2001). Personal relationships, enabling partners to trust each other's behaviour, foster knowledge exchanges that are essential to the developing of networks (Gulati 1998; Mellewigt et al. 2007). Economic actions and outcomes are affected by a set of social relationships and the overall structure of networks in which they are embedded (Granovetter 1985; Granovetter and Swedberg 1992). Contributions on this topic explain how it is that, in networks characterised by embedded relationships, firms are motivated to pursue goals that could possibly result in no immediate economic revenue or growth yet serve to strengthen the network (Powell 1990; Provan 1993; Smitka 1991; Uzzi 1997).

We posit that one of the key factors that facilitate knowledge exchanges and entrepreneurial learning in a network is the fit, or congruence, of the individual with the values of the network. The fit of one person with the network is conceived as the extent to which personal values, beliefs and needs are compatible with the culture of the network (Chatman 1989). The concept of fit has a long tradition in organisational behaviour studies (Nadler and Tushman 1998). Scholars have adopted different facets to explain the concept of fit. The dimensions most used are supplementary and complementary (Piasentin and Chapman 2006). Supplementary fit refers to the congruence between individual and network values, whereas complementary fit pertains to the compatibility between individual and network aims. This literature emphasises that both supplementary and complementary fit produce a positive outcome for the individual and the network (Ostroff et al. 2002).

O'Reilly et al. (1991) explain that organisational behaviour researchers have usually followed one of two approaches: the first analyses the interaction of individual characteristics and occupational attributes (Drazin and Van De Ven 1985; Venkatraman 1989), while the second focuses on the fit between the specific characteristics of an organisation and the characteristics of the people working in it (Chatman 1989; Joyce et al. 1982). In this chapter we follow the second approach, looking at the fit between the entrepreneur and his/her network. It is therefore a person—situation fit: if there is a fit between the entrepreneur and the network, it means that the entrepreneur shares with the other members of the network an understanding, evaluation and interpretation of the world. Therefore this fit is likely to diminish conflict and misunderstandings in the communication process, generating positive effects on the entrepreneur's propensity to exchange knowledge with others while improving innovation and organisational performance.

2 The Role of Cultural Values in Entrepreneurship Learning

The relevance of culture in management studies has emerged since the seminal, if controversial, contribution by Hofstede published in *Organizational Dynamics* (Hofstede 1980). His point was that no such thing as 'general management theories' exist, and no theories are applicable to the world as a whole because diversity in culture makes for inapplicable theories that emerge from the observation of local practice. As a consequence of Hofstede's contribution, management scholars started paying attention to the role of culture in management.

To explore the importance of shared culture and value, it is crucial to define in this chapter what we mean when we refer to culture and value. Following the definition of Parsons and Shils (1951), culture is 'composed by a set of values, norms and symbols that guide individual behaviour'. Therefore values appear to be a component of culture. To define 'values' we adopt the view of Rokeach (1973): 'values are enduring beliefs that a specific mode of conduct or end state of existence is personally or socially preferable to an opposite or converse mode of conduct or end state of existence'.

The first contributions paid attention to the diversity among nations, with particular emphasis on the collectivism/individualism dichotomy (Hofstede 1980, 1993; Kedia and Bhagat 1988; House et al. 2004). In a collectivist society, network or group individuals view themselves primarily as parts of the whole. By contrast, when individualism prevails, personal interests and goals motivate individuals (Triandis 1995). More specifically, Hofstede identified the following dimensions of culture that play a role in influencing culture and economic behaviour:

1. *Collectivism/individualism*: individualism is defined as 'a loosely knit social framework in which people are supposed to take care of themselves and of their immediate families only', while collectivism 'is characterised by a tight social framework in which people distinguish between in-groups and out-groups, they expect their in-group to look after them, and in exchange for that they feel they owe absolute loyalty to it' (Hofstede 1980).
2. *Power distance*, 'the extent to which a society accepts the fact that power in institutions and organizations is distributed unequally' (Hofstede 1980).
3. *Uncertainty avoidance*, defined as 'the extent to which a society feels threatened by uncertain and ambiguous situations and tries to avoid these situations by providing greater career stability, establishing more formal rules, not tolerating deviant ideas and behaviours, and believing in absolute truths and the attainment of expertise' (Hofstede 1980).
4. *Masculinity/femininity*, where masculinity is defined as 'the extent to which the dominant values in society are 'masculine'—that is, assertiveness, the acquisition of money and things, and not caring for others, the quality of life, or people' (Hofstede 1980) and femininity is defined as the opposite of masculinity.
5. *Confucian dynamism* (or long-term versus short-term orientation) was developed later by Hofstede and Bond (1988). Long-term orientation refers to future-oriented values such as persistence and thrift, whereas

short-term orientation refers to past- and present-oriented values such as respect for tradition and fulfilling social obligations.

The conceptualisation and operationalisation of Hofstede's (1980) cultural values (Fig. 8.1) are intended only for studies at the country level. However, researchers have liberally adapted them for studies at the individual level. Such adaptation, apart from some weaknesses, has provided a new way to consider, describe and measure culture (Bond 2002). Strongly based on Hofstede's contribution, the GLOBE (Global Leadership and Organizational Behaviour Effectiveness) research programme aimed at testing and extending Hofstede's previous findings was created by Robert House in 1991. At first his aim was for an international research project on leadership, but later, the study branched out into other aspects of national and organisational culture. In the period 1994–97 some 170 voluntary collaborators collected data from around 17,000 managers in 951 organisations across the world.

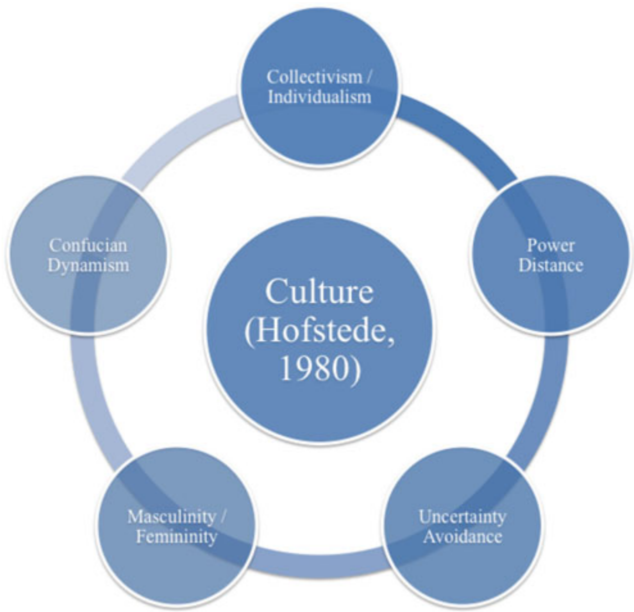

Fig. 8.1 Hofstede's cultural values

The GLOBE study is one of four major cross-cultural research projects carried out in the 1990s. The major constructs investigated in the GLOBE programme are nine attributes of culture that are operationalised as quantitative dimensions: (1) Uncertainty Avoidance, (2) Power Distance, (3) Collectivism I: Societal Emphasis on Collectivism, (4) Collectivism II: Family Collectivistic Practices, (5) Gender Egalitarianism, (6) Assertiveness, (7) Future Orientation, (8) Performance Orientation, and (9) Humane Orientation. These dimensions were selected on the basis of a review of the literature relevant to the measurement of culture in previous large-sample studies, and on the basis of existing cross-culture theory.

We believe that, when exploring an entrepreneurial network, the following two aspects of culture are the most relevant: (1) Collectivism I (or institutional collectivism): this reflects the degree to which organisational and societal institutional practices encourage and reward collective distribution of resources and collective action; and (2) Collectivism II (or in-group collectivism), which reflects the degree to which individuals express pride, loyalty and cohesion in their organisations or families.

Moving on from cultural values, the field of social psychology supports us in offering useful studies and classifications by which to explore individual values and feelings, such as Leung and Bond's (2004) discussion of social axioms. Social axioms are defined as 'generalised beliefs about oneself, the social and physical environment, or the spiritual world, and are in the form of an assertion about the relationship between two entities or concepts'. Social axioms are beliefs at a high level of abstraction; they facilitate the attainment of important goals and help people to understand the world. Using empirical results from more than 40 countries, Leung and Bond (2004) extended the results of the earlier Leung et al. (2002) study and identified five dimensions—cynicism, reward for application, religiosity, fate control, and social complexity—as pan-cultural dimensions of belief that characterise individuals and relate to differences in individual behaviours. Leung and Bond (2004) suggest that people across cultures form similar dimensions of social beliefs because they deal with similar problems. People in different cultures, however, may subscribe to these beliefs at differing levels based on the social logic developed historically by that particular cultural group. The five social axioms, as defined by Leung and Bond (2004) are as follows:

1. *Social cynicism*: It represents a negative view of human nature, especially as it is easily corrupted by power, offers a biased view against some groups of people, has a mistrust of social institutions and a disregard of ethical means for achieving an end. An example is 'A fool and his money are soon parted.'
2. *Social complexity*: It suggests that there are no rigid rules, but rather multiple ways of achieving a given outcome, and that apparent inconsistency in human behaviour is common. An example is 'A face for all occasions.'
3. *Reward for application*: It represents a general belief that effort, knowledge, careful planning and the investment of other resources (Foa 1971) will lead to positive results and help avoid negative outcomes. An example is 'Slow and steady wins the race.'
4. *Religiosity*: It asserts the existence of supernatural forces and the beneficial functions of religious belief. An example is 'We are all in God's hands.'
5. *Fate control*: It represents a belief that life events are predetermined and that there are some ways for people to influence these outcomes. It is interesting to note that lay people accept the logical contradiction between predetermination and their ability to alter predetermined events. In fact, practices for avoiding bad luck are commonplace in many cultures, and the contradiction involved in the simultaneous belief in predetermination and possibilities for altering one's fate may be widespread in everyday life. An example is 'It's all in the stars' (Fig. 8.2).

2.1 Shared Cultural Values and Entrepreneurial Learning: The Case of Compagnia delle Opere (CDO)

Our empirical context is represented by CDO, an association of firms that follow the values observed by the Roman Catholic Church in economic activities (Nanini 2011). Its members share the same norms, principles and values. In 1986, CDO began its activities as an association of entrepreneurs who wanted to share human and economic resources

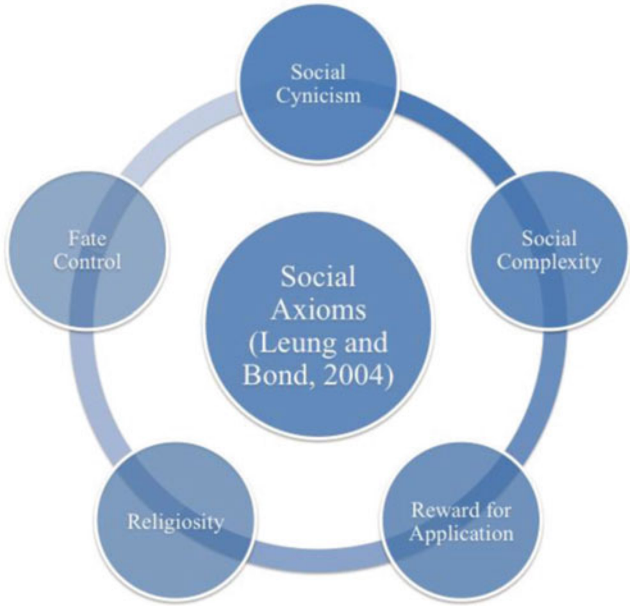

Fig. 8.2 Leung and Bond's social axioms

to help one another. Today, the association has 38 branches in Italy and 17 abroad. The branches across the world operate in Latin America (Argentina, Brazil, Chile, Colombia, Paraguay, Peru and Venezuela), Europe (Bulgaria, Spain, France, Hungary, Portugal, Poland, San Marino and Switzerland), the Middle East (Israel) and Africa (Kenya). When data were collected, CDO had about 36,000 members, mainly for-profit companies. CDO's chief goal is to promote and develop relationships among its members and between these members and non-member organisations. It offers various services to its members, such as commercial and financial agreements, training activities, support for international business, job creation and innovation. This empirical context has been selected because it presents a high level of cohesion and data from previous studies, while a survey conducted in November 2014 reports a higher level of innovativeness among the CDO members than among non-members (Ceci et al. 2014, 2015).

To collect the data to explore the research questions described so far, we conducted a preliminary study of the innovation dynamics occurring in a local branch of the CDO association, conducting 23 interviews—14 with general managers or CEOs, and 9 with those responsible for other functions (e.g. sales, finance, production, marketing) (Ceci et al. 2014). In September and October 2014, we conducted 10 open-ended interviews, with key informants associated with the CDO association and identified by the president of CDO, Dott. Bernhard Scholtz. The complete list of the interviewees can be found in the Appendix. The questionnaire we used was aimed at understanding the critical values that guide the entrepreneurial vision, and how these values are shared within the CDO network.

The interview text was analysed following the classification discussed in the literature review section, to understand which values are the most relevant in the analysed empirical context. Those values are likely to impact on knowledge sharing and entrepreneurial learning. The entrepreneurs learn through their participation in networks in which individual experiences are connected, and shared meanings are constructed (Rae 2005).

The first part of the analysis consisted in identifying the values suggested by the interviewees. Three coders, working independently, manually identified the relevant concepts. Researchers then checked the entire text manually and discussed their results in order to provide a shared list of values. Table 8.1 reports (in alphabetical order) the values emerging from the words of the interviewees. In the remainder of the section, the values will be linked to the concepts identified in the literature. The frameworks used are the

Table 8.1 Values emerging in the interviews

Attitude toward change	Inclusion	Serenity
Autonomy	Individual empowerment	Sharing
Care for people	Mutual co-operation	Solidarity
Catholicism	Openness	Subsidiarity
Enthusiasm	Positivity	Transparency
Freedom	Sense of community	Trust
Gratuitousness	Sense of unity	Trustworthiness

GLOBE values (House et al. 2004) and the social axioms (Leung and Bond 2004).

2.2 Cultural Values Identified by the GLOBE Project in CDO

Institutional collectivism reflects the degree to which organisational and societal institutional practices encourage and reward the collective distribution of resources and collective action. Interviews showed a high level of institutional collectivism, because we found high levels of *subsidiarity*, *collaboration* and *sharing*.

Among the characteristics of societies that have high institutional collectivism are that (1) members assume that they and the organisation are very much interdependent; (2) group loyalty is encouraged, even if this undermines the pursuit of individual goals; and (3) critical decisions are made by groups. These concepts are also present in the interviews, as the reported sentences show: '*CDO is an experience different from a typical association, because it is based on basic principles of sharing and mutual use of knowledge and market … moreover we share opportunities here*.' We believe that this sentence represents an example of how members see the association, and believe in values such as collaboration and the sharing of ideas.

In-group collectivism reflects the degree to which individuals express pride, loyalty and cohesion in their organisations or families. This cultural dimension emerges as a strong predictor of the two most widely admired characteristics of successful leaders. High in-group collectivism societies have characteristics such as: duties and obligations are important determinants of social behaviour, a strong distinction is made between in-groups and out-groups, and people emphasise relatedness with groups. Interviews show a high level of in-group collectivism, because we found high levels of *subsidiarity*. For example, one interviewee pointed out that: '*my own firm was born together with CDO, and I found in CDO interlocutors who helped me to identify our business area*'. It emerges clearly how the personal business experience (the firm) and the association are strongly linked, and the association also plays an important role in business decisions, such as identifying markets.

2.3 The Paradigm of 'Social Axioms' Applied to the Identified Values

On the basis of the values identified in Table 8.1, we constructed Table 8.2, which represents a classification of the values following the framework of the social axioms. Each value has been linked (where possible) to an axiom, and on the basis of the content we identify the characteristics of the social axioms within the association. It emerges that members of the association share a similar view of the world and this facilitates the creation of a 'fit' within the organisational network, which is chiefly responsible for the circulation of ideas and innovations. More specifically, we found three social axioms that are relevant to the analysed context and, we believe, can play a role in enabling innovation: namely, cynicism, social complexity and reward for application.

As detailed earlier, the first social axiom identified by Leung and Bond (2004) is *cynicism*, which represents a negative view of human nature, a bias against some groups of people, a mistrust of social institutions, and a disregard for ethical means for achieving an end. Interviews showed low levels of cynicism and high levels of mutual co-operation, care for people, solidarity and subsidiarity. For example, one interviewee said: '*we are nice people, we always try to have correct relationships with third parties*'. This short extract from the interviews shows how being correct and helping others in business relationships is a valuable attitude within the association.

Table 8.2 Social axioms and values

Cynicism: LOW	Social complexity: HIGH	Reward for application: HIGH
Gratuitousness	Attitude toward change	Trustworthiness
Mutual co-operation	Openness	Transparency
Sense of community	Autonomy	Positivity
Care for people	Freedom	Individual empowerment
Inclusion	Sharing	Enthusiasm
Solidarity		
Subsidiarity		

The second social axiom is *social complexity*. An individual with high social complexity believes that there are no rigid rules but rather multiple ways of achieving a given outcome, and that inconsistency in human behaviour is common. Interviews show high levels of social complexity, together with high levels of autonomy, freedom and openness to change. For example, one interviewee said: '*The CDO is not an association that says: I create the things that you need—CDO says I create the conditions so that you become more and more capable of doing that*.' We believe that in this way the association fosters the autonomy of the firms, enabling them to accomplish their goals in the way that is most appropriate for their characteristics. Others interviewees noted: '*There is the possibility to exchange, in a very simple way and without barriers, ideas, experiences, contacts, relationships, to acquire new knowledge*' and '*If a business owner is curious and has an open mind, he can explore new opportunities here*'. The exchange of ideas is fostered and this facilitates the analysis of problems and solutions from different viewpoints.

The third social axiom is *reward for application*. This axiom suggests the existence of a general belief that effort, knowledge and careful planning will lead to positive results. Interviews show a high level of reward for application, which we believe is correlated with high levels of correctness and transparency. For example, one interviewee pointed out: '*I see CDO as a place where, especially in these years of crisis, little is said about the crisis and much about the importance of change ... the idea that reality is always good, is positive and has values in itself. It allows everyone, from the beginning, to reach out towards change*'.

3 Discussion and Conclusions

In this chapter, we have discussed the role of cultural values in affecting the economic outcome produced in a network of firms. The cultural patterns of the network in which the firms operate affect how the entrepreneurs think and behave, and produce an impact on the firm's economic outcome. We analysed the role of culture using the different theoretical perspectives of social axioms and GLOBE. Empirically, we conducted ten interviews with entrepreneurs in order to gain information on the cultural values shared in CDO, a particular network of firms. The entrepreneurs we interviewed helped us to identify the values that are considered to be the most effective in promoting knowledge sharing, and thereby increasing entrepreneurial learning, conceived as a dynamic process that enables the entrepreneur to recognise and pursue new opportunities (Schumpeter 1934).

From the entrepreneurs' experience, we can derive four summarising lessons about the role of network culture in entrepreneurial learning:

1. To share cultural values in the network makes sharing knowledge a more natural process, increasing elements such as trust, mutual co-operation and solidarity;
2. Sharing knowledge with the other network members holding core values. People do not share their ideas and insights simply because it is the right thing to do. On the contrary, the sharing of ideas is strictly related to the alignment among individuals in terms of beliefs, language and values;
3. Networks are one of the key vehicles for sharing knowledge. However, knowledge sharing requires a sharing culture that needs to be promoted and improved with tools, resources and legitimisation; and
4. Knowledge sharing in a network with shared cultural values has a positive effect on entrepreneurial learning.

This chapter, to the best of our knowledge, is the first work to analyse the most relevant cultural values using different theoretical perspectives. Therefore it has important theoretical implications. First and most important, it contributes to the literature on entrepreneurship, identifying the main cultural values that entrepreneurs consider to be relevant and that consequently affect their behaviour. Those cultural values therefore contribute to the literature that is exploring the antecedents of entrepreneurial behaviour, which may promote knowledge sharing. We also contribute to the network theory by clarifying those cultural elements in the firm's network that are relevant to knowledge sharing.

This chapter has important implications for managers and practitioners. Given the importance of value and culture in promoting knowledge flow, networks should include those organisations guided by people who promote a culture of knowledge sharing

Appendix

		Firms' data			CDO experience		Interview		
		Name	Industrial sector	Activity	Position held	CDO member since	Day	Hour	Length
1	Casiraghi Daniela	Graficart	Manufacturing	Typography	Member of the Directorial Board of CDO local branch	n.a.	18/09/14		Via e-mail
2	Castagnetti Luca	Studio Impresa	Services	Consultancy	President of CDO local branch	1995	19/09/14	10:00	30′
3	Zanella Paolo	Antil spa	Manufacturing	Automation	Member of the Directorial Board of National CDO	1990 (approx.)	24/09/14	10:00	34′
4	Amato Salvatore	Cannone Industrie Alimentari	Services + Agriculture	Consultancy	No relevant position	2009	25/09/14	11:00	23′
5	Airoldi Fabrizio	–	Services	Consultancy	Member of the Directorial Board of CDO local branch	2004 (approx.)	29/09/14	12:00	17′

		Firms' data			CDO experience		Interview		
		Name	Industrial sector	Activity	Position held	CDO member since	Day	Hour	Length
6	Ranalli Giuseppe	Tecnomatic	Manufacturing	Automation	President of CDO local branch	n.a.	30/09/14	11:00	50′
7	Clemente Michele	Oleareia Clemente	Agriculture	Oil production	No relevant position	n.a.	01/10/14	10:30	15′
8	Cavalli Tommaso	K.Group	Services	Consultancy	President of CDO local branch	2006	03/10/14	11:45	9′
9	Lovati Alfredo	Beta80	Services	ICT Solutions	Member of the Directorial Board of CDO local branch	1986	03/10/14	15:30	24′
10	Malvatani Sergio	Sigma Spa	Manufacturing	Self service ticketing	Not a member	–	15/10/14	10:00	10′

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9

Technology-Driven Entrepreneurship in Emerging Regions

Claudio Petti

1 Beyond the USA and the EU

Technological entrepreneurship as a research domain first began in the USA, with the seminal study by Cooper (1971) on the nascent Silicon Valley. Ordinary people and distinguished scholars alike think of this study whenever they come across the term *technological entrepreneurship*. The same is true for European followers, who studied, disassembled, applied and then adapted the basic tenets and tools developed in the USA to their realities. Most of the time, they merely realised and tried to find explanations for the impossibility of replicating Silicon Valley in their own backyard, eventually looking for their own ways to achieve similar successes. This made Silicon Valley not only a role model for technology-driven entrepreneurship, but also a synonym for it, so that almost every attempt to spur technological entrepreneurship, whether in a local setting

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or in a remote part of the world, is often referred to as that area's 'Silicon Valley'.

The consequence of this historical background is that there is a conventional wisdom about technological entrepreneurship that transcends geographical boundaries to embrace a well-defined and universal theoretical model reified by the concept of Silicon Valley. Consequently, most of the theoretical reflection is based on US and, in a more limited manner, EU attempts at applying technological entrepreneurship at the local level and its (potential) outcomes. Moreover, ideas about what technological entrepreneurship is, its rules, conditions of applicability and success, are believed to be so deeply and widely codified that it is even argued that there is no longer much left uncovered or worth studying.

Nonetheless, one may contend that now technological entrepreneurship is extending its reach in very different cultural, institutional and business contexts from its US cradle and its close EU follower. In addition, the USA and Europe share a number of commonalities regarding technological entrepreneurship. These considerations do not lead one to question the 'universality' of technological entrepreneurship models and wisdom, which may be as unlikely as an alchemist's dream of finally getting a 'Silicon Valley' outside the USA. Indeed, looking beyond the US and EU contexts represents a chance to stress-test these models of technological entrepreneurship and their underlying accumulated knowledge.

Therefore, the term 'emerging regions' in this chapter does not have only a geographical meaning but also a theoretical dimension. Moreover, the geographical meaning is a means towards the end of gaining insights into the theoretical one, already well-debated and disentangled in previous chapters. In this attempt, the Chinese case is neither illustrated for its leading role among emerging economies nor as the most active and successful player in technological entrepreneurship within the BRICS countries (i.e. Brazil, Russia, India, China and South Africa). Rather, it is tackled as a huge 'natural experiment' (Barney and Zhang 2009) that, with its cultural, institutional and business environment peculiarities, together with the unprecedented characteristics of its rise, make China the best context in which to discuss technological entrepreneurship outside its usual theoretical milieu, as well as a test-bed to possibly prove or, alternatively, to extend mainstream knowledge.

In more detail, China is currently engaged in what has been called a second transition (Bottelier 2007). This is characterised by a strong emphasis on technological innovation as a key driver of the transformation of the Chinese growth model towards a more sustainable pattern, based on value-added manufacturing, the development of an internal market, and an increasing reliance on domestic innovation capabilities. For this purpose, technology-driven entrepreneurship, as the vehicle that connects technological development with the market, is a privileged means to achieve these objectives. As a matter of fact, the potential impacts of technology-driven entrepreneurship in terms of industry upgrading, the creation of qualified employment, and its overall contribution to the enhancement of the domestic innovation system and growth are huge.

With a descriptive rather than a prescriptive intention, the chapter illustrates in depth the example of technology-driven entrepreneurship in China, with the aim of accompanying the reader through an objective account from which to draw his/her own conclusions. In this endeavour, it may be useful to remind the reader that while technological entrepreneurship is not just about new, small, start-up firms, neither is it just about high technology; the creation of new technology enterprises and the high-tech sector remain the most visible and representative settings of technological entrepreneurship. Therefore, the following account will focus on high-tech entrepreneurship and the high-tech sector. Then, relying on the reader's thorough knowledge gained on the issue, the differences from what he/she might have expected by looking through the lens of mainstream thinking will be highlighted, and finally, considerations on the transient or stable nature of these differences will be made. In more detail, the chapter will use official sources, cases and data collected through field research with the purpose of providing an overview of Chinese technology-driven entrepreneurship. To do so, the context, the actors, the practices and preliminary evaluations on the impact of some key factors will be illustrated and discussed. Then the peculiar features of Chinese technology-driven entrepreneurship and their persistence over time will be examined. The overall aim will be to ascertain whether and to what extent, the Chinese example offers different insights from what is usually believed, written and practised in the West, and whether these insights may represent an extension of current conventional models and knowledge.

2 High-Tech Entrepreneurship in China

The booming of Chinese demand, national research system reforms, strong incentives for technological innovation and low operating costs have created huge opportunity spaces for the release of Chinese entrepreneurial potential. This invitation was one that Chinese entrepreneurs seized with alacrity. In all sectors, from well-known information technology, telecommunications and the internet—where homegrown Chinese enterprises such as Lenovo (computer manufacturing), Huawei (global information and communications technology—ICT—solutions provider), Baidu (Chinese-language internet search provider—ISP) and Tencent (one of China's largest and most used internet service portals) not only ousted their powerful rivals from the domestic market, but are also becoming challengers to be feared abroad—to new materials and renewable energies, the creation of new technological enterprises is relentless. The same is true for the value generated and the capacity for producing innovative components.

In this regard, Chinese statistics (National Bureau of Statistics of China 2013, 2014), reported the existence of 26,894 high-tech enterprises[1] in 2013. After a period of consolidation over the second half of the 1990s, which generated a reduction of half of the high-tech enterprises, the number tripled from 9,758 units in the year 2000. By then, the creation of new high-tech enterprises reached a peak of 28,189 in 2010, with an average of 2,000 new enterprises a year in the whole decade, up to the year 2011, when the number of high-tech enterprises fell again by more than a fifth to 21,682 units. Over the same period, the revenue and profits of these enterprises increased steadily and continuously, almost 30 times for revenue and more than 40 times for profits, in the 1995–2013 period. Over the same period, exports registered a greater than 43 times increase, reaching a third of the overall value of exports in 2013. The growth of the innovative content of the Chinese high-tech industry was even more remarkable. In the same year, the whole industry produced:

[1] Data refer to industrial enterprises above a designated size, with sales revenue over 5 million RMB operating in the manufacture of (1) medicines, (2) aircraft and spacecraft, (3) electronic and communications equipment, (4) computer and office equipment; and (5) medical equipment and meters.

(1) 143,005 patent applications, more than half of which (74,059) were invention patents; (2) 31.3 RMB billion of sales revenues from new products, of which almost 40 % came from exports; and (3) massive investments in R&D that reached more than 180 RMB billion. Overall, according to Chinese statistics, a total of 81,726 enterprises were engaged in R&D activities (i.e. enterprises in the high-tech industry and industrial enterprises having R&D activities), which was more than a 13 % increase over 2012.

This latter component is much more meaningful for the perspective of this work when looking at the role of domestically funded enterprises. These (16,641 units in 2012) accounted for about 70 % of (domestic) invention patent applications filed in 2012. Sales revenues accounted for more than 40 % of total sales revenues from new products, but only 20 % of the export revenues were from the sales of new products (a third of foreign-funded enterprises). With regard to new product development expenditure, domestically funded enterprises accounted for 60 % of overall investments. As a whole in 2012, of the total number of new products produced by the industry, more than 70 % were produced by domestically funded enterprises.[2]

The figures below paint a portrait of the current situation in the high-tech industry in terms of dimension, i.e. number of enterprises and employees (Fig. 9.1); and innovativeness, i.e. the ratio of invention patent applications to total applications, and sales revenues from new products to total revenues (Fig. 9.2), with regard to the different subsectors.

Figure 9.3 depicts the obvious regional differences, synthesising the number of enterprises, invention patent applications, sales from new products and new product development expenditures of Chinese provinces and municipalities.

From these three figures, the predominance of the manufacturing of electronics, communications equipment and medicines, and the polarisation of the phenomenon in coastal areas emerge. The outstanding position of Guangdong Province is something to notice, as well as the outposts in

[2] Even so, the reader should accept these numbers with caution, since by using the OECD/Eurostat (2005) classification, most of the time a new product is intended to be new to the enterprise concerned, or at best new to the market for the product.

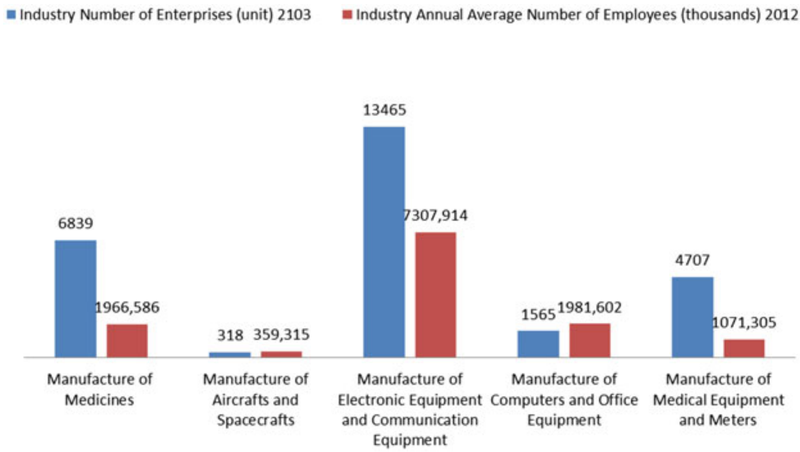

Fig. 9.1 A dimensional picture of the Chinese high-tech industry (2012–13 data). *Note*: Statistics cover industrial enterprises above the designated size of >5 million RMB in revenue.
Source: National Bureau of Statistics of China (2013, 2014)

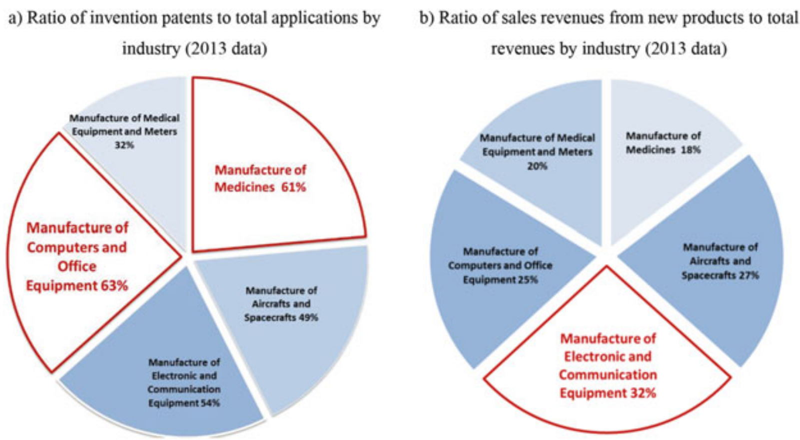

Fig. 9.2 Innovativeness of the Chinese high-tech industry: (**a**) ratio of invention patents to total applications by industry (2013 data); (**b**) ratio of sales revenues from new products to total revenues by industry (2013 data). *Note*: Statistics cover industrial enterprises above the designated size of >5 million RMB in revenue.
Source: National Bureau of Statistics of China (2014)

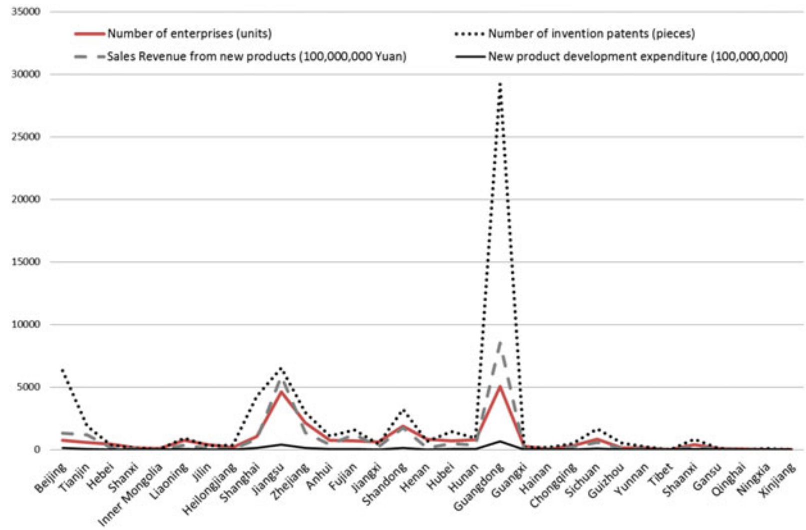

Fig. 9.3 Regional picture of Chinese technological entrepreneurship (2012 data). *Note*: Statistics cover industrial enterprises above the designated size of >5 million RMB in revenue.
Source: National Bureau of Statistics of China (2013, 2014)

the west, notably in Sichuan, Chongqing and to a lesser extent Shaanxi Province, probably evidence of the impact of the Chinese government's *Go West strategy*. This latter evidence leads to the opportunity and the need to review the role of government policies in the rise of the high-tech industry.

2.1 Technology-Driven Entrepreneurship-Related Policies Since the Reform and Opening Policy

The spectacular surge in technology-driven entrepreneurship is the result of more than three decades of effort by the Chinese government to reform the high-technology sector. The modern history of the sector started with the reform and opening policy, through a series of experiments to inject market forces and dynamism into China's centralised planning system. At that time, in the 1980s, policing took place in three main phases, marked by as many turning points.

The first significant turning point was in the second half of the 1980s, with the 1985 Decision of the Central Committee of the Communist Party of China on the Reform of the S&T [science and technology] Management System, the 'Stipulations of the State Council for Furthering the Reform of the S&T Management System' in 1987 and the Torch Programme in 1988. The 1985 decision established a more market-oriented system for research funding, encouraging research institutes to generate additional income through the commercialisation of technology. In synthesis, the government decided to reduce state subsidies for operational expenditure in the majority of research institutes. A new system of hard budgetary constraints provided further incentives for the research institutes' entry into commercial ventures related to technology. It is during these times that Liu Chunzhi and his colleagues Zeng Maochao and Wang Shuhe at the institute of Computing Technology of the Chinese Academy of Science (CAS) realised that S&T research institutions would not receive normal government financial allocations and decided to establish a pilot company to adapt to the coming changes. This company has now become Lenovo. The 1985 decision, together with the inherent difficulty of appropriating the benefits of technology transfer, set the stage for the spur of technological entrepreneurship, led by the most entrepreneurial scientists and engineers, who set up their own companies, first as technical service providers, then as producers of technologies and as traders or local assemblers of imported technology goods. The 1987 stipulations council urged industrial research and development (R&D) institutes to take part in enterprises because the reforms of the 1980s had failed to develop a consistent policy for technology. Policies continued to focus on public research institutes rather than on industry, and the resources went predominantly to state-owned institutes rather than the potentially more innovative non-governmental enterprises (NGOs) (Saxenian 2003). The Torch Program in 1988 aimed at diffusing the technologies resulting from the research carried out by the National High Technology Research and Development Plan, known at that time as the 863 programme (Baark 2001). The main purpose of this programme was to create a supportive institutional environment for the development of new technology enterprises through two means. First, R&D assets were integrated with commercial production within newly created enterprises. These new technology enterprises (or NTEs) were mainly spin-offs of government research institutes, primarily the Chinese Academy of Sciences, and research institutes belonging to central ministries, local government and higher education. The majority of NTEs were engaged in information-technology-related activities (Gu 1995). Second, the Development Zones for New Technology Industries were designated. Most of these zones were able to operate with flexible labour management and wage policies, and they allegedly enjoyed full self-determination with regard to decision-making, profit and loss, marketing, scientific research and other aspects of their business. An important ambition was to generate exports of high-technology products. The first high-tech zone was created in the Zhongguancun area, Beijing in 1988.

The second significant turning point came in 1992 when, after Deng Xiaoping's Southern Tour, the emphasis on independent scientific and technological innovation shifted towards the encouragement of foreign investment and government procurement to provide the technologies and equipment that China needed. For the first time, significant access to the domestic market was offered to companies that brought in advanced technologies, among which were many multinational corporations. This change led to a massive flow of foreign direct investment (FDI) and shaped provinces such Guangdong and cities like Shenzhen into the form in which we know them today. Moreover, the government further encouraged and promoted technological entrepreneurship with several decisions, programmes and legal reforms. One of the more significant government decisions was the 'Decision on Several Problems Facing the Enthusiastic Promotion of Non-Governmental Technology Enterprises' in 1993, which encouraged the formation of entrepreneurial spin-offs from universities or government research institutes. This decision was also important because it recognised that non-state enterprises could play a role in building a new, more market-oriented economy. The 1993 Decision was followed by the 1995 'Decision on Accelerating Scientific and Technological Progress' to promote and develop high technology, train workers and further open the market. The company law of 1994 and in particular the constitutional change in 1999 that established the status of private and non-state-sector enterprises, acknowledging these enterprises' legitimacy and contribution, paved the way towards the recognition of the prominent role that private enterprises enjoy at present in Chinese policies and the economy. None the less, at the beginning of the twenty-first century, China still faced a situation of inadequate investment, excessive reliance on imported technology, insufficient policy support for domestic products, ineffective management of scientific talent, irrational allocation of scientific research resources, a government funding system not up to delivering expected results, and ineffective intellectual property (IP) rights protection. Above all, China lacked a single-minded gross domestic product (GDP) growth-based development policy.

Then, with the issuing of the 'National Mid- and Long Term Scientific and Technological Development Plan Guideline' (2006–2020) also known as the SciTech Guideline by the State Council in December 2005, China's technological entrepreneurship policies marked their third significant turning point. The SciTech Guideline set new principles, above all the independent innovation and business-sector-driven transformation of China into an innovative state. The 11th (2006–2010) and the 12th (2011–2015) Five-Year Plans followed these guidelines, with particular emphasis on new sources of growth, such as innovation by Chinese companies and technological upgrading throughout the economy. Concerning technological entrepreneurship in particular, as well as the identification of priority areas, projects and emerging technologies that provided for new entrepreneurial opportunities, complementary policies were issued including investments, tax incentives, government procurement, creation and protection of intellectual property rights, management of talent, education, and the building of research bases for innovation and management. These policies include not only using government public finance and science and technology agencies to give direct support to firms, especially in hi-tech industries and medium-sized and small firms, but also encouraging and inducing commercial and private funds to invest in the firms for the purposes of scientific and technological innovation. In short, many technology enterprises were created to pursue opportunities in the target industries. Many others benefited from favourable direct and indirect (central and local) government policies for their establishment and operations. The coming 13th Five-Year Plan (2016–2020) seems to follow and reinforce the previous plans' endeavours.

3 How Does It Work?

3.1 The Chinese Technological Entrepreneurship Process

If one wants to sum up China's path towards technological entrepreneurship, it is a history with one main character—the government, and one main theme—linking research with the market. If we think of today's giants, for example, many of them were spun off from government research institutes and higher education institutions. For example, the previously mentioned Lenovo was created within the Chinese Academy of Science. Neusoft, known as China's Microsoft, started as an initiative by three young professors in a two-room laboratory in the computer department of Shenyang's North Eastern University. Another example was the high-speed railway, in which a set of Departments of the Ministry of Railways played the role of entrepreneur.[3] The case of a toy robot designed to interact with one of China's most famous online communities, which I have followed closely since its inception, will be useful here to illustrate this pattern of technological entrepreneurship.

As with many entrepreneurial endeavours in China, the toy robot was not the first attempt of this kind; therefore, it is a typical example of the ways in which technologies are chosen, adapted and integrated to match and seize Chinese demand; in this specific case, the market for online services. The robot was created in a laboratory of a Chinese Academy of Science (CAS) Institute. The laboratory's mission was to develop useful and affordable personal service robots for the mass market. In the pursuit of this mission, the idea of transforming the online community's instant messaging service into a robot eventually materialised. However, this was just one of the factors at play. In fact, this idea originated from a combination of factors. First, market research and analysis were conducted regarding the emerging and promising personal robot industry. Second, the laboratory co-operation with the company owning the community. Third, some key robotic technologies were available in a CAS

[3] For more details about these cases, see Petti (2012).

institute as well as trained intellectual property and technology transfer officers. Fourth, direct and indirect support was available from both local and central government. Finally, the idea was localised in Shenzhen, the first city to experiment with the reform and opening policy, and one of the country's most important high-tech and entrepreneurial centres. Therefore, the development of the robot was not a serendipitous event but rather a well-crafted combination of factors, made to support, and eventually transcend, individual talent. Here the role of the government was much stronger than the one usually attributed in theory, though even in well-known cases, Silicon Valley included, the role of the government, at least at the start, is more downplayed rather than being as low as it has been depicted (Kenney and von Burgh 1999). In addition, in the concept phase, the government's role, mediated through the CAS Institute, was more evident. As a matter of fact, the robot concept was first designed in-house and then jointly developed with the company. In more detail, the CAS Institute provided *in kind* the laboratories, technologies and human resources, as well as a development contract that granted continuous support to prototyping, subsequent development and required R&D efforts, very much like the Lenovo case. The company's role, on the other hand, was determinant, but rather limited. In more detail, the company provided the expertise of its customer design centre and its business development and marketing departments to refine the design of the toy robot's functions and services, and to market the project internally to attract other units to participate in the development of applications for the robot. In about eight months, a mixed company was created to orchestrate the industrialisation of the robot, with both private investment and the CAS Institute's contribution of patents. The legitimacy gained by being linked to the most prestigious research institution in China and one of the country's biggest showcase companies, as well as the organisation of a supply network for the speedy manufacture and distribution of the product, were among the critical factors that ensured a timely exploitation of the window of opportunity. This set of activities could be found in any other part of the world, but with a slight difference in focus. For a number of reasons, such as fierce competition, low entry and imitation barriers, pressure for short-term returns on the part of investors and the fickleness of Chinese customers, windows of opportunity in China do not remain open for long. Therefore, all of the above-mentioned activities needed to be carefully crafted and tuned to fit within this constraint. Ten months after the creation of the company, the first sale took place. Overall, it took about a year and a half from the idea's conception to the market, and an additional six months to reach the break-even point. To sum up, what clearly emerged in this pattern was not only the strong role of the government, which provided directly and indirectly for funds, technology, talents, training, preferential policies, legitimacy and, above all, opportunities, but also the peculiar constraints posed by a munificent, but crowded, hyper-reactive and tricky external environment.

Though the case just illustrated represents the traditional and original Chinese way towards technology-driven entrepreneurship, an alternative and more recent path is pre-eminently privately initiated and supported. Internet companies such as Baidu, Dangdang (a business-to-consumer e-commerce company), Tencent and many others exemplify this alternative pattern well. These companies represent a second wave of technology-driven entrepreneurship characterised by the creation of Chinese localised versions of well-known websites and businesses imported directly (apart from Tencent) by returnees from Silicon Valley to fulfil the needs of Chinese urban citizens. These entrepreneurs arrived endowed with significant private investments, and their role models had already been proved to work in the large US market. In addition, they profited from their top-notch entrepreneurial education, experience and relationships brought from Silicon Valley, as well as from their local knowledge and connections and their capability to respond quickly and appropriately to sudden market and regulatory changes. Moreover, they could also rely on a latecomers' advantage, which allowed them to cherry-pick from their peers' trials and experiments what worked best and deploy the solution in the huge and booming Chinese marketplace. No wonder their enterprises quickly broke-even (often more quickly than their US counterparts such as Dangdang—China's Amazon) and became the industry's giants, as with Tencent. The latter company is a leading example and forerunner of a new wave of technological entrepreneurship, this time led by a new breed of aggressive, China-trained entrepreneurs and their enterprises. In most cases, these entrepreneurs overcome firms funded by returnees from

Silicon Valley because of their much better local knowledge, connections and intimate understanding of the formal and informal rules of Chinese business. What emerges clearly in these patterns is the role of two other influential actors in Chinese technological entrepreneurship: foreign companies and returnees. In fact, foreign companies still play an important role in the local system of technological entrepreneurship. Foreign enterprises, through exports, licences, investments, localisation of R&D laboratories and co-operative ventures, are still key providers of technologies and innovation, as well as managerial skills. This is not always the case in the USA and Europe, where local actors, originally or from the early days, have taken on these roles. Chinese returnees—or Chinese transnational communities to use Saxenian's (2002) term—on the other hand, were, and still are ,relevant contributors in the country's upsurge in start-ups but are also currently the main entities responsible for patents, advanced research laboratory developments, and the attraction of foreign investment, among others. Again, this is not the case in the USA, by default, because this is where people return from. Nor is it the case in Europe, for the same reasons as for the USA in some countries, and with additional reasons in others. In Italy, for example, the system is rather resistant to returnees and most of the time is unable to leverage their contributions, making the system pre-eminently local. These considerations lead to a more detailed discussion about what can be called the Chinese system for technology-driven entrepreneurship, which refers to the set of actors, their roles, relevance and linkages nested together in technology venturing.

3.2 Actors and Their Roles

What was discussed above highlights that technology-driven entrepreneurship in China is, as everywhere, a set of distributed activities that transcends single individuals or enterprises and is inextricably linked and affected by a particular context made up of a mix of specific conditions. These conditions affect the ways in which technological opportunities come into existence, as well as the capabilities deployed to exploit them through new product development and commercialisation. In fact, as in every part of the world, Chinese entrepreneurs and their enterprises are responsible for the most important part, i.e. the transformation of technologies into new products, services and businesses. However, the returns on this fundamental activity and its economic and societal value-creating potential are dependent on a system of governmental institutions, governmental research institutes, higher education institutions, investors, foreign companies, transnational communities and other relevant organisations that influence entrepreneurial activities both directly and indirectly. Such a system is depicted in Fig. 9.4, which synthesises all the players involved in the transformation of raw technologies into marketable products. The width of the arrows indicates the significance of the contributions discussed, and the dotted line represents the (national) borders of the system.

I have already highlighted the roles of some of these actors. Below is a synthetic description with a particular focus on highlighting the distinctive features compared with their known, mainly Western, counterparts.

In general, the role of enterprises is to exploit new or existing technologies to innovate or improve their products (i.e. goods and services) and production processes, creating profitable business models that are able to realise the value-creating potential of chosen technologies. This is also true

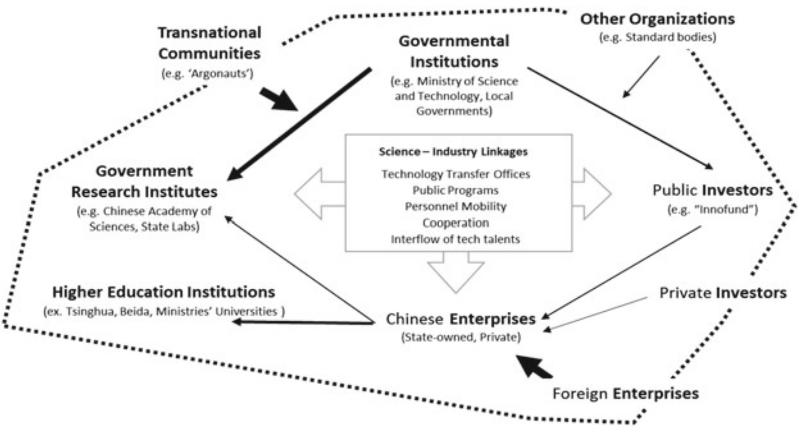

Fig. 9.4 China's technology-driven entrepreneurship at a glance. *Source*: Adapted from Petti (2012)

of China, where enterprises are already the largest R&D performers, as well as being deemed to be the key driving force in the country's efforts to become an innovation-oriented nation. However, this role is performed more on the entrepreneurship/technology-market-matching side rather than on the innovation—technology development side. In fact, most of the enterprises' R&D expenditures are dedicated mainly to experimental development and to applied research, as well as basic research. Therefore, in the statistics, the innovation capacity of Chinese enterprises is still shown as being weak, in the literature as well as in official speeches. In fact, the vast majority of Chinese enterprises are following an incremental innovation model that is more cost- and market-oriented rather than technology-oriented. This situation presupposes that technologies used/integrated/adapted should come from somewhere. As I have highlighted above, there are two main providers: governmental research institutes traditionally and, after the opening and reform policy, foreign enterprises and transnational communities.

The strong relevance of governmental research institutes, which is a legacy of the pre-opening reform and the planned economy, is a peculiar feature of Chinese technology-driven entrepreneurship. Government research institutes provides basic, strategic and applied research, as well as technology diffusion and commercialisation in the enterprises sector. Particularly relevant because of their role in applied research and technology diffusion are the Chinese Academy of Science (CAS) applied research institutes and the State Engineering Technology Research Centres (SETRC). These centres are oriented specifically towards developing expertise concerning a range of products for a particular industry. In addition, there are other governmental institutes and research centres, such as the Development Research Centre of the State Council (DRC), the Chinese Academy of Engineering and the Chinese Academy of Social Science, which provide expert analyses and advice to policy-makers on technological, economic and policy issues.

Turning to foreign enterprises—regardless of the government's drive towards developing independent innovation—such as technology imports, international outsourcing and foreign R&D labs are still playing very important roles. Licences and related agreements still make up a high percentage of manufacturing and unit costs; in fact, foreign invested enterprises are still responsible for about 15 % of the entire country's patent applications and R&D expenses, about a quarter of sales revenues from new products and more than a third of the whole export revenue of new products (National Bureau of Statistics of China 2014). In addition, for some (see Huang 2008), they are clearly essential actors in the Chinese private economy.

Together with foreign enterprises, the role of Chinese transnational communities—by which I mean the tens of thousands of returnees as well as the Chinese and 'argonauts' overseas (Saxenian 2006) that live/d, study/ied, work/ed and travel/led back and forth from the world's high-tech centres to China—are another distinguishing feature of Chinese technology-driven entrepreneurship. These individuals not only acted, and continue to act, as critical links in boosting local technology development capacities through transfer of knowledge and relationships, but they also provide a major contribution to the country's entrepreneurship and innovation.

The fact that these individuals have been, and are, constantly attracted back, either permanently or temporarily, through a system of preferential policies and programmes, is further evidence of the strong role of central and local government agencies. These policies range from priorities in getting permanent residence permits in major cities, the 100/1000 talents programmes, special-purpose institutes for facilitating their activities, and special arrangements that allow professors, for example, to take part-time positions in Chinese universities and travel back and forth. In addition, central and local government agencies are not only the providers of relevant policies, regulations, programmes and incentives (see Fig. 9.4), but they are also the orchestrators of science—industry linkages (such as the Torch programme at the national level or the Guangdong Technology Experts Secondment Programme at the local level). Moreover, the direct influence still exerted by the government on strategic actors in the system, and the government's consequent intervention capability, is another peculiar characteristic that cannot be found elsewhere. I refer in particular to the administration of research activities by the large and numerous state-owned enterprises (with the state-owned Assets Supervision and Administration Commission of the State Council—SASAC),[4] but

[4] 'SASAC performs the responsibility as the investor on behalf of the state; supervises and manages the state-owned assets of enterprises according to law; guides and pushes forward the reform and restructuring of SOEs. SASAC appoints and removes top executives of the enterprises under the

I also refer to the government's strong hold on the education sector (through the Ministry of Education), as well as a number ministry/province and municipality based research institutes and universities (such as the Ministry of Industry and Information Technologies) and even technology investment funds such as the 'InnoFund' (a grant scheme which funds the development or improvement of new or existing products, processes or services with elements of innovation. see www.mosti.gov.my/funds-grants/inno-fund/) for small technology-based firms.

Let us now turn to the investors. A good portion of Chinese technology investors, including venture capital, is public and still characterised by strong government involvement. This involvement takes various forms, such as the establishment and management of specific funds such as the abovementioned 'InnoFund', the support offered through the establishment of science and technology industrial parks, business incubators and specific high-tech programmes. Non-governmental sources—in particular, foreign venture capital and some increasingly powerful domestic private enterprises—are becoming more and more relevant as funding sources for high-tech activities. However, in this regard, the system still claims to be affected by a shortage of funds and professionals, especially in the early stages of investments and regarding small and medium-sized enterprises (SMEs).

On the other hand, higher education institutions make significant contributions not only in the traditional fields of providing knowledge and a skilled labour force for enterprises, but also in what has come to be known as the 'third mission' of universities. Entrepreneurial universities in particular—the most well-known example being Tsinghua University in Beijing—play an important role in technology diffusion and enterprise creation. In fact, many Chinese universities have accumulated experience in downstream activities (applied research and development of prototypes) and have created their own enterprises and developed thousands more in their incubators (OECD 2008).

Finally, there are also industry associations and national standard bodies that provide a variety of means of facilitating technology-driven

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supervision of the Central Government, evaluates their performances, and grants them rewards or inflicts punishments. SASAC also directs and supervises the management work of local state-owned assets.' Accessed November 2015 from http://www.sasac.gov.cn.

entrepreneurship. These actors range from technological standards (such as Intelligent Grouping and Resource Sharing for the homonymous standard IGRS, or the 3G forum for the TD-SCDMA) to linkages with the S&T community at all levels, such as the China Association for Science and Technology.

3.3 Practices

As mentioned above, Chinese technology enterprises, in general, do not rely on radical technological developments. Rather, most of them engage in the improvement and adaptation of existing technologies and products. Actually, whereas it is quite usual to dismiss Chinese technological innovation as being merely the assembly of technologies developed elsewhere, if not imitations or copies, the reality in the field seems to be a little different. According to my own experiences and research undertaken in Guangdong Province since 2011, Chinese technology enterprises seem to be engaged in what closer Chinese observers have called market-oriented innovation (Liu 2008), secondary or business model innovation (Wu et al. 2009, 2010) and creative or innovative imitation (Luo et al. 2011) and imutation (Maksimov et al. 2014). However it is defined, all these terms mean the following:

- the improvement and adaptation (and not mere imitation) of existing technologies and products;
- a response or a solution to a specific local market's needs (such as rural markets) or emerging opportunities (such as the internet or the industries prioritised by government policies and programmes);
- innovation either through lowering costs, but not quality, or customising product features to suit the specific needs of local businesses or final customers; and
- a steady responsiveness to the market.

In this sense, Chinese enterprises are intensely 'technologically entrepreneurial'; that is, they are particularly capable of recognising and exploiting the commercial opportunities of (mainly existing) technologies. In fact, Chinese firms have achieved relative success by adopting their incremental innovative strategies, though not in high-end technology or, with some notable exceptions, in the international market. This commercial success is one of the main reasons for the limitations of the current Chinese enterprises innovation model, but this success is also one of the main drivers that can lead to its evolution. This success is in fact providing the necessary resources to engage in internal technology upgrading, both through internal development and acquisition, as the cases of Lenovo, Huawei, ZTE, Xiaomi and a number of less well-known companies have shown.

In the meantime, most of the Chinese enterprises' entrepreneurship and innovation efforts are geared more towards acquisition and limited adaptations of existing technologies to produce cheaper, simpler, good-enough and customised products rather than on the development of radically new ones. In the Chinese setting, understanding and responding rapidly, accurately and in a timely fashion to market needs is more important than technology development (Liu 2008), and tailoring the original business model from advanced economies to local customer preferences and the market infrastructure (Wu et al. 2010) is the way to do it, at least in the first versions of a product. At the very least, the ability to develop rapidly an appropriate product and put it on as many shelves as possible, and the ability to quickly design and manufacture upgraded versions of the product before imitators catch up, are paramount, probably more than seeking legal protection of intellectual property. Therefore, the weak protection of intellectual property (IP) rights is just one of the reasons for these practices and, as I shall show in the next section, apparently not the main one. The other reasons lie in a number of aspects that makes the Chinese market very different from the one in which US and EU technology enterprises work; among these being its vastness, its hyper-competitiveness, the availability of foreign technologies, and the country's current export-based model (Liu 2008).

In any case, all of the depictions cited converge on the consensus that innovation and entrepreneurship in Chinese enterprises is an incremental rather than a radical business model. Instead of being technology oriented, it is focused mainly on the refinement of existing concepts and incremental innovation to lower costs, improve efficiency or appeal to local tastes. A few sectors, such as the internet industry, illustrate these diffused practices, which are detailed in Table 9.1 above, along with relevant examples.

Table 9.1 Key practices of Chinese technologies' ventures in the internet industry

Practices	Leading examples
– Looking to the West for business models that can be imported successfully	Baidu
– Integration of existing features of well-known Western sites	Weibo, Renren
– Micro-innovations with original features tailored to local customs	Ushi, Hudong
– Tapping into the local market's huge emerging and unmet needs	Dangdang, eHi
– Quick business model shifts, decision-making, flexibility and pre-emptive moves	Baidu, Renren
– Online and offline	Chinacars, RedBaby
– Linkages with and within Chinese communities in the West and Guanxi	Ushi
– Raising ample finance from Western-anchored venture firms	All of the cases above
– Astute local managers with Western know-how and experience	All of the cases above

Source: Fannin (2008, 2011)

4 Key Influencing Factors

Practices are the most noticeable effect of Chinese technology-driven entrepreneurship. While the above-mentioned practices can give a rather good idea of what Chinese technology firms do, and what is strange is that they cannot give a detailed picture of what Chinese technology-based entrepreneurship really is: the how and why they do what they do. A closer look at what is happening inside Chinese technology firms, and more specifically to the main factors influencing technological entrepreneurship, can help with this. Table 9.2 below synthesises the results of the case studies I carried out in Guangdong Province[5] with the

[5] Case studies were selected following theoretical sampling, with the main objective being to gain an overview of the different typologies of technology-based enterprises active in different sectors. Guangdong-based companies operating in high-technology sectors, producing or using information, microelectronics or new material technologies were selected for the study. The final sample of companies surveyed was composed of six small-to-medium-sized companies and four large enterprises. Eight were private/incorporated, and two were public-owned enterprises. Five of them were new technology ventures—of which two were at the start-up stage—and five were established

Table 9.2 Factors influencing technological entrepreneurship (six case studies)

Enterprise characteristics	**Network attributes**
Entrepreneur's leadership and industry experience (+) Availability (–) and management of R&D talent (+) (Soft/people-oriented) knowledge management (+) R&D and innovation management (+) Business model innovation (0) Capital budgeting (0) Integrative (internally integrated and externally adapted) and customer-oriented organisational culture (+)	Strong ties (–) and declining influence of informal networks and arrangements, i.e. *guanxi*, against contractual arrangements (0) but unaltered relevance as a network governance mechanism (+) Co-design and co-development (upstream) relationships managed by strong ties but with increasingly flexible arrangements (downstream) for customisation and commercialisation (+)
Formal institutions	**Overall environment**
Specific—local or targeted—support policies (+), i.e. tax reductions, setting of R&D priorities and funding, talent attraction and mobility, ad hoc interventions IPR law enforcement not relevant (0) or slightly negative since enhancement is believed to be beneficial to innovation and collaboration activities (–) Instability of policies (–)	Environmental munificence (–), i.e. huge market and growth and accessibility of foreign technology Local (Shenzhen) context (+), because of the availability of technology universities, talent, specialised suppliers, exhibitions and fairs, foreign and domestic investment and professional service firms, proximity to customers and international markets (through Hong Kong) and peculiar entrepreneurial culture National business culture (–)

objective of investigating the effect of four categories of factors identified in the relevant literature that are likely to have an influence on technological entrepreneurship in Chinese enterprises. In Table 9.2, the '+' signs indicate an overall positive influence, the '–' signs indicate an overall negative influence and '0' indicates the non-relevance of the factors surveyed.

technology-based firms. Four enterprises were operating in information technology, three in telecommunications, two in new materials and one in pharmaceuticals, producing a variety of products and services, mainly for the electronics, automotive, internet and health-care sectors.

At the individual level, the roles of entrepreneurs' leadership clearly emerged as being related to shaping the company's key processes and its culture (with the latter assimilated in three cases into the culture of the founding entrepreneur) and 'his capability to make risky decisions', especially with regard to investments and new, ambitious projects. Predictably, experience in the industry was argued to be a key component of entrepreneurs' ability to identify and exploit technological opportunities. The negative effects of the shortage of key technical personnel—also a result of strong turnover—in conjunction with the emphasis found on the motivation, attraction, training and retention of key R&D personnel (i.e. talent management) highlighted one important constraint to technological entrepreneurship.

At the organisational level, considering both the emphasis found in human factors and the inner characteristics of Chinese culture, it is not surprising that the soft/people-oriented knowledge management process was the most influential process, together with an internally integrated and externally adapted organisational culture. Knowledge management was described as a 'set of mechanisms enabling the management of people, knowledge transfer and the socialisation of the company's culture and values' or as hingeing on 'periodical sharing meetings' and 'mentorship' rather than a set of procedures, still less the software tools to manage the flow of knowledge within the organisation, which went almost unmentioned. Organisational culture generally was presented as balancing internally oriented features (with concepts such as 'harmony' or 'superior enabling context') with externally oriented ones (with concepts such as 'innovation' or 'learning and knowledge orientation') and was generally characterised by a strong customer orientation. A more process- and procedure-oriented dimension emerged in relation to the R&D/innovation management process, obviously unanimously expressed as being influential. On the other hand, business model innovation emerged as not being relevant. In fact, very few changes to a limited number of components were reported and, in hindsight, most of them were mere adjustments to the initial business model rather than a planned and recurrent practice. The same was true for the capital budgeting process, described mainly as being 'leaders' stuff', and even when found to be a structured process (in the pharmaceutical company), it was characterised as a standardised 'due diligence process in the industry', which ultimately relied on the leadership's final say and its willingness to take risks.

Concerning network-related factors, the negative effect of strong ties on technological entrepreneurship was noteworthy. In fact, strong ties were seen as being a helpful channel through which to obtain the necessary resources to exploit opportunities, though not sufficient either to secure the right resources, or to make these resources productive. This negative stance is not what can be expected in theory and, again, seemingly contradicts received theory; this outcome was coupled with converging descriptions of the declining influence of close personal relationships, or *guanxi*, in comparison to contractual relationships. The former has even been argued as 'becoming a liability at the firm level since belonging to a network of *guanxi* may prevent the development of other *guanxi* or entering into other networks'. Therefore strong ties are not only costly to obtain and maintain, but are also binding and constraining; this is consistent with received theory, being something akin to the risk of being locked into a relationship because of strong ties (Johannisson 2000). None the less, in some interviews, close personal relationships emerged as still being very useful to the running of businesses and partnerships more effectively. More specifically, such relationships are beneficial 'to ensure timely shipments of supplies, better access to better supplies at a lower cost' and to obtain 'privileged information and a better engagement of distributors in promoting the company's products'. Therefore, the effect of personal relationships on technological entrepreneurship was twofold, less and less relevant, and even detrimental, as a business development mechanism, especially with regard to personal relationships with government officials, and positive when used as a network of governance mechanisms. Thus, eventually, the Chinese case began to follow the received theory track.

Turning to system-level factors, predictably, specific support policies were indicated as having a strong influence on technological entrepreneurship, and were found to be positive overall with regard to (local) tax reductions and export incentives, (national) priority settings and related projects and programmes, direct support through funding, and in-kind resources and technologies. However, since subsequent statistical analysis did not confirm this positive correlation, it may be more likely that these effects are felt rather indirectly or produce their effects in conjunction with other factors. This finding actually makes sense in practice. Take, for example, knowledge management. It may well be that the effect of specific support policies that provide tax incentives for importing technologies depends on a company's existing knowledge as well as its capability to manage this knowledge in order to take advantage of external technologies. This idea actually emerged from the case studies interviews, where it was mentioned that: 'though we got our technology from the government, we have to work hard to bring it up to our needs'.

In contrast, weak intellectual property rights (IPR) protection emerged as having less importance than expected, and this was substantiated by further statistical analysis. In fact, weak IPR enforcement, though recognised to be so, was not perceived (by almost all the interviewees) to be particularly detrimental to technological entrepreneurship. This is an important difference; for example, with their Western counterparts, where most of the time IPR enforcement is the main issue. From a practical perspective, it is a testimony that the IPR issue may have been somewhat overemphasised in the debate, at least from the perspective of Chinese technology firms. Therefore there are different perceptions that need to be understood and taken into account. However, more in line with their fellow Western entrepreneurs, a strengthening of IPR enforcement was generally seen as being positive for its beneficial effects on the innovation and capacity-building side. As one interviewee put it, 'It will force enterprises to move from imitation to more innovation … and push many copycat companies out of business, but this will be temporary and in the end, the companies which would have developed internal capabilities … will be rewarded.' In addition, negative impacts were signalled on the collaboration side. This is one explanation why somewhat counterintuitive findings reported a negative impact of clustering on innovation (Zhang et al. 2009), and why, for technological components, foreign partners are often preferred to Chinese ones. On the other hand, whereas the perception about the impact of specific policies was generally positive, the instability of policies emerged as a facet of them having a negative effect on technological entrepreneurship, which may be considered as a rationale for the inconsistency of statistical findings. One of the interviewees went into detail, giving an example from her industry in which her company had twice been affected by the imbalance between initially loose regulations followed by stricter ones. At the beginning, it was 'very easy to register a new product, since very few changes were needed to brand a product as "new" … creating excess of supply'. Then (at the time of the case), stricter regulations were developed for the compliance of new products coupled with regulators' pressure to keep prices low, which 'augmented the cost of product development while at same time reducing margins'.

Finally, as regards the overall environment, it is in this category of factors that most of the 'whys' of current technological entrepreneurship practices can be found. Some of the discussions led to the argument that the huge domestic market, its growth and the availability of foreign technologies 'on the shelves',[6] coupled with the 'need for speed' and the returns of 'foreign technology with Chinese design' stifle the innovation component of technological entrepreneurship. In the words of one interviewee, 'The huge domestic market and its growth do not produce enough pressures to change.' Thus, quite paradoxically, the abundance of critical resources needed by enterprises to operate in their environment has become a detrimental rather than a conducive factor. The stellar quotations and results obtained by Chinese versions of Google, YouTube, Facebook and others are one testimony to the relevance of these factors at work. Another idea of their magnitude can be obtained by comparing the performance of two of the cases analysed, representing an innovator and an imitator, respectively, with the revenue per employee of the latter being more than five times that of the former. On the other hand, the local context, in particular the Shenzhen context, was found to have a very strong positive influence on technological entrepreneurship. More specifically, this influence is related to: 'the proximity to customers … and to international export markets, thanks to the proximity to Hong Kong, Macau and Taiwan', 'its availability of research centres, suppliers and investors', and 'its peculiar, diverse, youth and dynamic entrepreneurial culture based on hard work and efficiency'. This finding is more in line with conventional, technology-driven entrepreneurship contexts and theory. The same was true for the local conditions that emerged

[6] This situation is what Castrogiovanni (1991) would refer to as *environmental munificence*.

as stifling technology-based entrepreneurship. This was the case of the national business culture, which was most often described as being conservative and in general not conducive to enterprising and innovation activities because of, for example, the indirect and hierarchical style of leadership, communication and teamwork.

4.1 Is Chinese Technology-Driven Entrepreneurship All That Different?

The main question of this chapter was to ascertain to what extent Chinese technology-driven entrepreneurship differs from the one usually written about, practised and believed to be in Silicon Valley and in Europe. To answer this question, we need to consider whether all of the above is radically different from what we should have expected by examining it through the lens of mainstream thinking. Alternatively, whether cases like the ones discussed simply demonstrate that Chinese enterprises are merely in a transitory state from incremental, imitative, market-oriented or secondary business model innovations towards more significant, indigenous and technologically oriented innovations.

In the first regard, at least four distinctive traits that characterise Chinese technology-driven entrepreneurship emerged in the previous discussions:

1. The singular relationship between government, science and industry inherited from the pre-opening reform period and in particular the strong relevance of government research institutes, which continues to provide to potential entrepreneurs a kind of one-stop-shop for technologies, infrastructures, funding and complementary assets;
2. The relevance of foreign enterprises, which, regardless of the significant improvements of Chinese research and innovation capabilities, as well as the new drive given to 'indigenous innovation', are still a vital provider of technologies, patents and managerial expertise;
3. The contribution of the Chinese transnational community, still behind a great many patent applications and referred publications, newly launched technology-based enterprises, research laboratories, institutes

and internationally developed collaborations and, at the same time, attractors of government support, foreign direct investment and local talent pools, as well as being providers of research and managerial expertise to the system; and

4. The distinctive characteristics of the environmental and institutional context in which this activity is being carried out.

In an extreme synthesis, the strong drive and direct involvement of central and local governmental agencies, elsewhere referred to as the role of the 'developmental state' (Johnson 1999) on the one hand[7] and a mainly incremental, market-driven, secondary as well as overall reactive innovation model of enterprises on the other, seem to be the defining characteristics of Chinese technology-driven entrepreneurship.

Concerning the alterative question, i.e. whether all of the above is a transient state towards technology-driven entrepreneurship as we know it, or is rather the durable characteristics of the Chinese context or, even, a new model, we should consider the following:

1. If we look back towards the first steps of today's champions such as Lenovo, Huawei, ZTE or to the toy robot case illustrated—with its quasi technology-oriented innovation strategy aspects coupled with strong market orientation; and
2. If we consider the ongoing evolution of market regulations and institutions, such as the recent third revision of the patent law and the latest, more sophisticated, pro-innovation policies, such as the new criteria to evaluate the provinces' leaders by considering more than mere GDP growth.

In the light of these characteristics, it seems that the differences emphasised might be just temporary effects of the transitional state of China (see Altenburg et al. 2008; Xie and White 2006) and/or the results of contingent characteristics of the Chinese market, such as its size, exceptional

[7] However, the role of the Chinese government, given its socialist roots, is even stronger than the one originally analysed in Japan and in other Asian economies, which share with China a Confucian tradition but not a political system.

growth and, again, the transitional and half-way market model of the country.

In fact, this might well be the case. Many think that China will eventually converge with the way things are conventionally being done in the USA and the EU, and this thought also applies to technology-driven entrepreneurship. The argument made in this regard is usually that China is importing heavily from the West, and not only technology and machinery, but also know-how and practices. Moreover, the hi-tech sector is highly standardised around the world, so what is going on in Chinese companies is not so different from what is occurring in an American or a German company. However, despite being sound and reasonable, this argument could not be the definitive answer. This is because it is often made from far away, and is partially biased. The underlying idea is that China's impetuous modernisation process—following a similar pattern to that found in other Western countries or closer in both time and distance, in Japan and among the Asian Tigers—will lead China to resemble the USA, Europe, Japan or its Asian neighbours. Moreover, it confuses the historical precedency of the Western countries' modernisation with its uniqueness and universality.[8] Yet China is very different, for example, in terms of the continuity of its culture and substantial homogeneity of the political system and state organisation, at least since 221 BC when Qin Shi Huang unified the country. In addition, its population size, especially when compared to Japan, might allow, among other factors, for the country to climb the value-added ladder while at the same time maintaining a low cost base. In addition, its recent ascent to a position of primacy on the world stage is not the one of a debutante, but of the return of an old power, the oldest still on duty. Finally, yet most important, the world is not the same as the one in which Europe, the USA and Japan were shaped to became as they are now. The financial crisis recently experienced and its political implications on the world's balance of power is just one of these differences. On the other hand, very convincing arguments have been built and documented regarding the fact that Chinese modernisation happened following not only the historical path of previous modernisations, but also the standard rules of economic

[8] This is an argument that has been questioned masterfully by Jacques (2009).

theory. Moreover, the recent well-debated imbalances and slowdown can be interpreted as a deviation from the conventional rule of capitalism and markets that are rooted in policies of the 1990s, when China as we now know it took off (see Huang 2008).

In other words, this second question is much trickier, and it is not possible to take a clear position now, as some differences—for example in the availability of private risk capital or IP protection, seem increasingly to be becoming similarities. Some other differences, such as the strong role of the public sector, still seem to be firm. Some similarities, on the other hand, such as the strong focus on independent technological innovation and science—industry collaboration have completely different supporting premises, visions and modalities.

At present, the situation is in flux, since the debate is still open and can be rather fierce. The Chinese 'experimental' approach fuels the debate too, sometimes taking initiatives that closely follow textbooks, and at other times displacing observers with audacious and unorthodox moves, and at yet other times just seem do so. However, by taking a bird's eye view, a commonality can be found in that all of the above belongs to a huge action-learning process, from which not only China, but also the rest of the world, can profit. In this sense, Chinese 'experiments' are actually a chance for all to reflect on what we think we know or may take for granted with regard to a topic such as government or market failures or *laissez-faire* versus industrial policies. This reflection would definitely enrich our knowledge, regardless of what is happening in China, no matter how brand new, re-emergent, or disguised we may think it is.

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10

Technology-Driven Entrepreneurship Within the Framework of Regional Development Policies

Pasquale Del Vecchio and Marco De Maggio

Technology-driven entrepreneurship is largely recognised as a knowledge-intensive process and strategic asset for the competitiveness of individuals, organisations and regions. In this perspective, governments and supra-national institutions have recently launched programmes for promoting the nurturing and development of technology-driven entrepreneurship, aware that regions and countries present different performances in promoting and sustaining innovative entrepreneurial processes. There is an urgent need to understand how and through which instruments governments can sustain the creation of technology-driven entrepreneurship. In this chapter, we focus on the European context, by starting with an understanding of the pillars and objectives of the Smart Specialisation Strategy as the political framework supporting the intelligent growth of the European regions up to 2020. The achievement of the ambitious objectives of Smart Specialisation is based on the entrepreneurial

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discovery process, starting from the valorisation of the key enabling technologies to create new entrepreneurial ventures as well as to renew and make the existing ones more competitive. The dynamics enabling this process of intelligent growth are coherent with the current debate on innovation ecosystems and the systemic approach to regional development. Aimed at providing an explanation of those trends and scenarios, the chapter will present some implications for the political agendas of institutions and researchers. After the identification and analysis of some best practices at the European level, the chapter explores a set of actions useful for defining a set of priorities for a political agenda able to support the development of entrepreneurial attitudes and behaviours, mainly in small and medium-sized enterprises (SMEs), in universities and in public institutions.

The chapter is structured as follows. The first section is devoted to an explanation of the political and strategic framework of smart specialisation that developed as a result of the policy for cohesion launched by the European Union (EU). Aimed at overcoming the gap in competitiveness registered by the European regions by leveraging the excellence of their research systems, smart specialisation arises as strategy to create socio-economic value.

The second section describes the fundamentals and pillars of Smart Specialisation Strategy, with a focus on the entrepreneurial discovery process as the driver of intelligent growth and the analysis of some examples of national agendas for the implementation of the Smart Specialisation Strategy addressed towards the definition of future perspectives and approaches.

Starting from a discussion about innovation ecosystems being a suitable environment for the valorisation of the knowledge and collaborative processes supporting the emergence of technology-driven entrepreneurship, a review of the institutional and scientific debate on innovation ecosystems is provided in the third section. This highlights their role as an opportune locus for creating technology-driven entrepreneurship as well as the contribution that a systemic approach to innovation can offer to aid the process of intelligent growth of regions.

In the fourth section, three areas of intervention are described as priority actions for promoting and sustaining the development of technological entrepreneurship in the regions. Those actions are addressed toward the instilling of innovative behaviours and mindsets, mainly into SMEs, universities and public institutions.

1 The Regional Development Policy in Europe 2020: The Effort Towards a New Innovation Policy

The Lisbon Strategy represents the main strategic framework for the recent development of the EU member countries, being aimed at overcoming the stagnation in economic growth by the employment of different policy initiatives, according to the varying socio-economic contexts of the EU members. It was conceived as an ambitious reform programme to answer the global challenges coming from the rise of the USA and Japan in the knowledge-based economy and in the areas of information and communications technology ().

Its approach to regional development policy moved from the assumptions of the endogenous growth models, suggesting that countries develop along their own characteristic growth paths, thanks to the presence of increasing returns and externalities generated by investment in knowledge, human capital and commercially oriented innovation, considered to be the most powerful means to technological progress and productivity growth (Romer 1994).

The Lisbon Strategy was renewed in 2005, but a few years later, while proposing more ambitious goals for development, it saw the rise and diffusion in Europe of the global financial crisis and the emerging need for short-term crisis management measures. In a strong connection with the European Cohesion Policy, in this phase it was oriented to empower the research capacity of the EU, to diffuse a culture of entrepreneurship and to sustain ICT advancement, employment and modern social support systems.

In 2008, the need emerged to plan a Lisbon-style strategy for 'post 2010' to ensure a continuous effort towards the completion of structural reforms, sustainable development and social cohesion: a public consultation designed the vision of Europe in 2020, a general strategic framework for what came to be called 'Strategy Europe 2020'.

The need to construct a new economic model for European countries became clear when the economic crisis spread, highlighting several structural weaknesses within the European economy. The project 'Strategy Europe 2020' began in March 2010, with the aim of facing the main ongoing challenges focusing on these thematic priorities: create value by knowledge-based growth; empower people within inclusive societies; and develop a competitive, connected and sustainable economy (OECD 2013).

An expert advisory group for the production of the report 'knowledge for growth' was charged with updating public policies of investment in knowledge and innovation (research and development (R&D) and education). It pointed up the opportunity for national and regional governments to concentrate their efforts only in domains able to create synergies with local production assets to prepare future capacity at the national level and offer interregional comparative advantages. This proposal was entitled 'smart specialisation' and was adopted as Agenda 2020.

2 The Smart Specialisation Strategy: Entrepreneurship and Innovation as the Basics of the Regional Development Policy

In 2013, the European Commission's (EC's) General Regulation Framework for European Structural and Investment Funds (ESIF, no. 1303) stated that the production of a 'Research and Innovation Strategy for Smart Specialisation (RIS3)' had to be considered mandatory for each public administration owner of an ESIF Operative Programme. It aimed to work on the principle of the concentration of the financial resources allocated in research and innovation policies to maximise the impact of structural funds. Since this rule has regulatory force, each region/country has to develop its own RIS3, characterised by a unique entrepreneurial approach as an essential part of its wider regional development strategy within the Cohesion Policy.

Even so, the arguments related to the development and implementation of the RIS3 apply outside European boundaries, involving other foreign countries interested in defining a strategic approach to deal with the economic crisis exploiting the different regional dynamics in innovation-driven and knowledge-intensive activities.

RIS3 is a policy framework for the innovation-driven growth of territories. The concept, developed by a group of academic experts and led by Dominique Foray (Foray et al. 2011), is quite simple, but its implications are in fact rather complex, because of the following issues: the role of scientific, technological and economic specialisation for the development of comparative advantage and economic growth of the regions; the identification of the relevant domains to build a present and future comparative advantage for the region; and the strategy management and governance, giving a central role to regional governments, private stakeholders and entrepreneurs for the process of translating RIS3s into economic and social outcomes (OECD 2014).

This approach has several original key factors. First, the RIS3 is a transition strategy. The source of growth of regions is no longer identified in the accumulation of capital but in the structural changes coming from the transformation of economic activities through a process of updating traditional industries and selecting promising new fields of activity.

Second, its 'entrepreneuriality', despite traditional industrial and innovation policies, is based on 'entrepreneurial discovery', an interactive process in which market forces and private domains discover, and produce information and knowledge about, new activities, while the role of the public actors relies on the examination of the results and the support to achieve its potential and maximise its value. Entrepreneurs are seen as the only actors able to combine scientific, technological and market knowledge to identify the most promising activities for regional growth.

Third, the attention to 'business functions', the innovation strategy of regions that are not leaders in scientific or technological domains, has to focus on strategic activities, ranging from product design to production, distribution and after-sales support (Porter 1986), independently of the industries in which they are conducted.

Fourth, 'specialisation and diversification' do not represent an oxymoron. RIS3 takes into consideration each activity emerging within the innovation ecosystem able to express regional development potential in the future. Since the object of specialisation is the activity and not the industry, it aims to concentrate resources on those business functions that could diversify services and products in the global market to exploit territorial comparative advantages.

Fifth is the role of general-purpose technologies. Each region can benefit from these technologies by identifying its proper distance from the technological frontier: regions that are closer to it will specialise in their production, invention and combination, while the most distant ones will specialise in those activities that can be transformed through their application, to improve their processes, products and services, and to boost firms' competitiveness.

Last is a feedback mechanism involving all the regional stakeholders. A sound monitoring system should ensure that all the stakeholders are provided with evidence and knowledge about the transformation effect of the strategy over time. As the strategy design is the result of an entrepreneurial discovery process, the measurement of the effectiveness of the strategy implementation will enable entrepreneurs to revise choices and deepen alternative solutions to the allocation of public resources.

2.1 The Entrepreneurial Discovery Core Process of the Smart Specialisation Strategy

The Smart Specialisation Strategy relies on a complex process of design, because of the difficulties related to:

- discovering and selecting adequate domains of future regional specialisation that focus on the fields where new R&D and innovation initiatives are complementary to the other productive assets of the region, and show the potential to develop regional capability and interregional comparative advantage
- correcting the several co-ordination failures among economic agents that generally block new strategic initiatives, or the transition from an existing one to a new one, from growing and consolidating as solid drivers for regional development (Foray et al. 2011).

Smart specialisation is based on an entrepreneurial discovery, a process aimed at recognising the best developments of R&D and innovation of a region or a whole country (Haussmann and Rodrik 2003).

The most original item of smart specialisation as a policy approach is related to the process of prioritisation and resource concentration. While traditional industrial and innovation policies are based on centralised planning procedures, supported by scientific theories and methodologies, they did not pay attention to the most important source of experienced knowledge able to solve the problem: the entrepreneurs.

Entrepreneurial knowledge is wider than knowledge about science and technology, since it involves a knowledge of markets, of potential competitors, and of all the aspects related to the launch of a new activity. Starting from existing resources, capabilities and productive system and focusing on R&D and innovation investments, regions will able to excel.

This integrated knowledge is fundamental to discovering which kinds of 'business innovation', not only technological, might have a major impact on regional territory in the future, providing insights into the correct business orientation for moving in the right direction.

The actualisation of the entrepreneurial discovery process is the most challenging part of the strategy, since it needs to gather and analyse differing information from entrepreneurs or that embedded in firms and private or public institutions. While traditional policies required an appropriate level of information to justify financial support, and tended to intervene in vertically integrated industries developed around stable technological paradigms, RIS3 acknowledges informational asymmetries and recognises the level of maturity of certain activities and the associated risks for public policy intervention. It uses an explorative approach to sustain entrepreneurs in identifying their own knowledge-based assets at the regional level, and governments to pick up market signals by using methodological tools from branches of business and innovation management, such as technology foresight and roadmapping, and public—private partnerships.

The outcome of Smart Specialisation Strategy is not merely the technological innovation of the region but rather a transition in the regional economy pattern that is identifiable as a 'structural change'. It consists of a cumulative process, linking the present and future strengths of the regional economy in a set of activities and fields, and providing new knowledge about the future economic value of innovation (Foray 2013).

The patterns of structural change can be classified into four main categories:

(a) *transition*, by discovering that a new promising field of activities can be developed, starting from the existing productive system settlement, involving R&D and engineering, and manufacturing capabilities;
(b) *modernisation*, when entrepreneurs recognise that the development of specific technological applications can improve significantly the way that traditional industries support regional competitiveness, in terms of both efficiency and quality;
(c) *diversification* related to the discovery of potential economies of scope and spillovers between established economic activities and new ones to be developed, which can be assisted by supporting private entrepreneurial initiatives to exploit the economic value of R&D activities and the launch of new ventures; and
(d) *the rise of a new production field* concerning the discovery of a significant potential of future activities new to the region by the exploitation of R&D and innovation, and the capability to create promising related business activities. The complexity and risks associated with this orientation imply that when the region lacks the required R&D resources and management experience, these should be acquired from other regions and combined with local intellectual assets.

Policy intervention is needed in this perspective, not only to face the failure related to the incomplete appropriability of the economic value of innovation, upon which traditional innovation policy is focused and affecting mainly pioneer ventures, but also to create the conditions for multiple microsystems of experiments and discoveries to emerge (Foray and Rainoldi 2013).

It concerns addressing the co-ordination failures that could threaten the transition from the entrepreneurial discovery to the set of activities able to trigger a structural change in the regional economy, providing the necessary public goods, specifically a human capital update. In addition, this will allow the removal of structural and regulatory obstacles to facilitate the rise of new ventures, to support the diffusion of knowledge about the economic potential of the new activities to boost the spontaneous dynamics of emulation and imitative exploitation to maximise the impact of the selected specialisation within the region.

2.2 Smart Specialisation Strategy in European Countries: Perspectives and Approaches

The design of regional and national Smart Specialisation Strategies that is still ongoing requires a long and complex process of capacity building and information sharing, involving the European regions. For this reason, in 2011, a reserved Platform hosted by the Institute for Perspective Technological Studies (IPTS) in Seville—part of the Joint Research Centre of the European Commission—has been created to assist the development, implementation and review of the strategies, providing information, methodologies, expertise and advice to national and regional policy-makers, promoting mutual learning and transnational co-operation, and contributing to academic debates around the concept of smart specialisation (http://s3platform.jrc.ec.europa.eu/home).

Below are shown some insights from the preparatory work of the Smart Specialisation Strategies of England, France, Poland and Hungary provide some evidence of the different approaches followed by these countries, looked at from the viewpoints of entrepreneurs, local intermediary actors and innovation interfaces, and of the weight of political orientation towards the creation of context conditions to facilitate innovation, such as developing qualified human capital and improving the venture capital support system.

2.2.1 The Case of England

In designing its proper Smart Specialisation Strategy, England recognised the specific key role played by its Local Enterprise Partnerships (LEPs) in the development policy of the country. These are strongly concerned with planning the strategy to invest the allocated ESIF for the period

2014–2020 in deep integration among the different regional stakeholders, ensuring the necessary entrepreneurial dimension to the discovery approach.

LEPs have been created, boosting local innovation ecosystems, picking up the collaborative leadership and culture of innovation emerging at the local level, building and strengthening local capabilities, and stimulating supply chains to invest and collaborate. LEPs are identified as the primary agents of the smart specialisation of the country.

Each LEP is committed to preparing a Strategic Economic Plan related to a specific geographical area, including a proposal to support innovation, according to both its distinctive traits and national policies on growth, based on the recognition of all available resources to maximise synergies between ESIF and other funding sources. Each LEP is responsible for the arrangement of the investment strategy for a definite amount of structural funds and, in particular, for the identification of activities and projects to carry out, for the creation and support of networking with local stakeholders, to find supplementary funds, and for the implementation, monitoring and evaluation of these projects.

Technology entrepreneurship is a crucial topic for the UK's development and innovation strategy. Among the national funds complementary to the ESIF, in fact, a primary role is played by a venture capital 'fund of funds', established in 2009 and called the UK Innovation Investment Fund (UKIIF). This, following the best US fund models that allow investments at all stages of business, is aimed at supporting investments in innovative enterprises that show significant growth opportunities, mainly technology based and working in specific fields, such as digital and green technologies, the life sciences and advanced manufacturing.

As for the distance from the technological frontier, England is one of the main European leaders in the development of general purpose technologies (GPTs), enabling the modernisation of production processes and increasing productivity and performance in traditional industries. England shows a substantial comparative advantage in production and commercial exploitation of the so-called 'eight great technologies': large data and energy efficient computing; robotics and autonomous systems; satellites and the commercial applications of space; life sciences, genomics and synthetic biology; regenerative medicine; agriscience; advanced materials and nanotechnology; and energy technologies. In 2011, the UK Innovation and Research Strategy for Growth pointed clear and different roles for private and public stakeholders, assigning the first ones the commercialisation of emerging technologies and leaving to the government and public organisations the creation of a fair environment for their production and combination.

The awareness of the relevance of overcoming disciplinary separateness and investing in human capital to maximise the growth potential coming from the commercialisation of science and new technologies was expressed in 2014 in the UK's Government Science and Innovation Strategy, called *Our Plan for Growth: Science and Innovation*. It identified among the fundamental national priorities, 'the need to accommodate and foster higher levels of collaboration between disciplines, sectors, institutions, people and countries; the need to recognise the importance of place, where people and organisations benefit from mutual proximity; the modern demand for openness and engagement with the world'.

The government, in a strong connection with industrial and research institutions, selected the sector strategies related to aerospace, nuclear, oil and gas, information economy, construction, automotive, professional business services, offshore wind, agritech and education.

2.2.2 The Case of France

French regions face the Smart Specialisation approach, relying on their consolidated experience in developing 'Regional Innovation Strategies'.

In 2007, at the beginning of the previous ESIF programme cycle, the European Commission (EC) and the French government agreed that each region should develop its characteristic strategy for innovation, following a methodology defined at the national level. The programming cycle, begun in 2007, showed a shift in the way ESIF is used for these policies that is at present consistent with the objectives of the Lisbon Strategy and the new Europe 2020 Strategy. The main goals of regional strategies were to develop and diffuse a wider concept of innovation, to stimulate the debate between institutions and socio-economic actors about innovation context and trajectories, and to promote co-ordination among regional, national and European innovation policies.

Later, the experience of designing and implementing these regional strategies were capitalised in the RIS3 cycle, during which French regions acknowledged the need to focus on increasing the efficiency of innovation systems in all their components: the quality of human capital, the effectiveness of innovation management and, above all, the strength of co-ordination between the multiple stakeholders, such as universities and research institutions, incubators, technology providers, '*poles de competitivité*' (competitive clusters), and social partners. In particular, the effort to improve this co-ordination encouraged some regions to adopt a 'business' or 'key function' approach to the innovation support represented by the Objectives and resources contracts, thought to facilitate stakeholder co-operation, the empowerment of regional innovation agencies and the reinforcement of the connections of regional development agencies within the innovation ecosystem.

Within the design of the regional innovation strategy, the need to build and diffuse a new innovation and entrepreneurship culture emerged, rethinking educational courses and designing new policy tools to spread managerial and other non-technological skills for innovation, recognised as the most critical factors for the innovation capacity of small and medium-sized enterprises (SMEs).

2.2.3 The Case of Poland

In Poland, the strategy for National Smart Specialisation (NSS) is an integral part of the Enterprise Development Programme 2020. It includes all the strategic choices and the policy tools to support the development of innovation and entrepreneurship within the country, consistent with the Strategy for Innovation and Economic Efficiency (SIEE), called *Dynamic Poland* (Namzeti Innovacios Hivatal, 2014).

The NSS is based on *InSight 2030*, the Technology Foresight for Polish Industry document on the National Research Programme (NRP), and was conceived as an open document, suitable for periodical adjustment, based on regional context changes and the outcomes of monitoring activities.

Entrepreneurs had a central role in the design process of the Polish NSS. The strategy was developed through a two-stage consultation by the Ministry of Economy about the technological fields chosen for Polish industrial policy by 2030, the selection of sectoral programmes carried out by the National Centre for Research and Development (NCRD) supporting enterprises in defining research projects topics, and support to cluster activities linking entrepreneurs and institutions to identify research, development and innovation priorities.

Eighteen priorities for smart specialisation have been identified at the national level, representing five thematic areas: (1) Healthy society; (2) Agrifood, forestry/timber and environmental bioeconomy; (3) Sustainable energy; (4) Natural resources and waste management; and (5) Innovative technologies and industrial processes.

2.2.4 The Case of Hungary

Hungarian Smart Specialisation aims to create necessary conditions to allow government, economic stakeholders and social partners to co-operate in finding adaptation solutions to rapid changes in the business environment, through an open and continuous process of analysis, learning, alignment and strengthening of the innovation ecosystem.

The National S3 Strategy is included in the national RDI Strategy, called *Investment in the Future, National Research & Development and Innovation Strategy 2013–2020*, which was adopted in 2013. Aimed at strengthening the innovation ecosystem, it promotes the application of direct, indirect and market instruments in a co-ordinated way; moreover, the different forms of interventions concern all the stages of the innovation cycle, from knowledge production to commercialisation—that is, in company start-up stages, product development processes and marketing, as well as in the construction of manufacturing capacities.

The creation of new ventures require specific instruments in their different stages of development. In their early phase, they need to be supported by instruments able to substitute the market financial stand, such as non-refundable direct financial grants. For start-up and spin-off projects taking the role of the fundamental innovation engines of regional policy, suitable support takes the form of ensuring the accessibility of the business services of publicly-funded incubators, the stimulus to venture capital intervention, and the establishment of guaranteed funds. In the later stages of the innovation cycle, the support of the trading houses can assist those enterprises willing to export their products in modelling market access.

The establishment of technology incubators is viewed as the main pilot intervention, representing a business environment where any kind of intellectual capital can provisionally assist technology start-ups, guaranteeing survival and early stabilisation. The Hungarian government and business operators agreed on a programme f to experiment with domestic business incubators to comply with both the needs of technology start-ups and governmental requirements. It is intended to have a positive impact on the number of brilliant innovative ideas reaching the production and marketing stages, on the increase in the amount of private capital invested in R&D, and a change in young people's attitudes towards entrepreneurship.

3 Innovation Ecosystems and Technology-Driven Entrepreneurship: Priorities and Implications for the Political Agenda

The Smart Specialisation framework made the nurturing of technology driven entrepreneurship mandatory for regions and countries. This is expected to contribute at the enhancement of socio-economic wellness of developing areas and to consolidate and sustain the positioning of the more competitive ones. Trends and dynamics characterising the competitiveness of regions in the scenario of the knowledge economy show significant correlations between entrepreneurship level and the overall performances of regions (Asheim and Coenen 2006), as confirmed by the recent debate on the geography of innovation (Asheim and Gertler 2005; Romano et al. 2014); as an emerging configuration of the world (Technopolis Group Belgium, Fraunhofer ISI and Maastricht University (UNU MERIT) 2011; Wintjes and Hollanders 2010, 2011) based on the performance of innovations.

Identified as the main cause behind the shift from the 'managed' to the 'entrepreneurial' economy (Audretsch and Thurik 2001; Thurik 2008), the technological change has impacted the global dimension of the markets, the reorganisation of corporations and the centrality of knowledge (Thurik et al. 2013). All these elements call for a new political agenda able to interpret the new scenario and provide suitable solutions.

As recalled by the Smart Specialisation Strategy concept, the achievement of the ambitious objective of the intelligent, sustainable and inclusive growth of the European regions by 2020 requires a political framework able to:

- promote a set of actions inspired by the collaborative and multi-stakeholder model of the knowledge triangle; and
- support the enhancement of technological entrepreneurial attitudes in existing companies, mainly SMEs, and in the universities aiming at working to reinforce their third mission, and in public institutions.

It is the essence of the so-called European Paradox, a not proportional capability of the European system of research and innovation of transforming the excellence of its scientific knowledge and research outputs into valuable valuable products and services (EU COM 955688). This means that greater investment does not necessarily translate into stronger economic performance.

Technology-driven entrepreneurship, discovering and investing in opportunities emerging from knowledge and technologies is essential for both knowledge diffusion (Audretsch et al. 2008) and the translation of innovation from the laboratories into economic performance through the critical transformation of new knowledge into viable products and technologies.

3.1 The Importance of Investing in the Creation of Innovation Ecosystems

The 'innovation ecosystem' setting is a favourable locus for creating and nurturing technology-driven entrepreneurship, and for the implementation of the Smart Specialisation Strategy at the territorial level.

Considered as a comprehensive framework to facilitate integration among the different categories of actors operating in a certain territory, innovation ecosystems are identified in recent literature on the systemic approach to innovation as a suitable environment for activating virtuous processes of knowledge creation, diffusion and absorption. By promoting the execution of an integrated system of research, innovation and education, they can boost technology-driven entrepreneurship by creating new knowledge, by applying novel combinations of existing knowledge, or by recombining existing knowledge in new ways (Romano et al. 2014).

Focusing on the importance of guaranteeing the socio-economic sustainability of the actions promoted, the reports of supranational institutions, as OECD (2010) has highlighted, are contributions that the innovation ecosystems can offer in:

- stimulating interactive learning networks to boost innovation in SMEs;
- facilitating the involvement of universities in regional innovation systems;
- reinforcing the capacity for knowledge absorption by companies, mainly of SMEs;
- creating new employment opportunities and sustaining labour mobility, a useful means for accelerating knowledge flows;
- promoting the cross-fertilisation of technologies for their wider application;
- encouraging the openness to external knowledge;
- designing and executing training programmes for start-up entrepreneurs by leveraging their technological knowledge with a deeper market expertise; and
- promoting corporate entrepreneurship and university spin-offs.

The three main characteristics of the innovation ecosystem identified by Romano (2013) are:

- a strong and innovative entrepreneurial culture, able to stimulate creativity and the capacity for assuming risks;
- a continuous flow of ideas and individuals: people moving easily from one organisation to another, from research centres to enterprises and vice versa; and
- an informal network operating as a transmitter of information and ideas.

The innovation ecosystem is a local environment of actors with a global projection in which new ideas are generated and where entrepreneurs transform them into socio-economic value (Romano 2013). They can also be described as a community of individuals with different background and expertise, moving from the creation of new knowledge assets to their valorisation in entrepreneurial processes. Within them, the entrepreneurs and their organisations, the research institutions, the universities and the financial institutions, are primary actors of the innovation and usage of the knowledge.

Consistently with the recent debate on the perspectives from the Triple (Etzkowitz and Leydesdorff 2000) to Quintuple Helix (Carayannis and Campbell 2009, 2011), such environments are required to assure:

- the presence of an excellent public—private partnership, involved in the development of innovative entrepreneurship focused on emerging social and market trends and on collective and interactive learning processes;
- the international mobility of the actors involved, based on global networks of collaboration, and research activities inspired by the principles of openness and collaboration to solve problems; and
- the sustainability of the actions as well as the adoption of systemic and holistic approaches to the ecosystem's issues.

The innovation ecosystem can boost innovative entrepreneurship by creating new knowledge, by applying novel combinations of existing knowledge or by recombining existing knowledge in new ways (Romano et al. 2014). In sustainable innovation ecosystems, the following factors are expected to converge:

- scientific knowledge, often based on deductive processes and formal models (basic research);
- applied problem-based knowledge, often developed through inductive processes (applied research and experimental development);
- reuse of or challenge to existing settlements;

Finally, in consideration of the knowledge-intensive profile of technology-driven entrepreneurship, learning is the most relevant process. In such a dynamic environment, continuous contact between successful entrepreneurs, groups of excellent academicians and institutional actors supporting the development of the knowledge-intensive entrepreneurship is expected to provide the opportunity for enriching their own training through practical contextualisation, encouraged by the direct experiences of entrepreneurs and managers operating in different sectors. People involved in the processes of an innovation ecosystem will acquire capacities and competencies to (Romano 2013):

- connect knowledge with practical experience on issues relating to the dynamics of growth of regions to innovate, and the rules that govern the knowledge economy;
- initiate, design and execute dynamic projects for the development of entrepreneurship and innovative smart specialisation of territories;
- act as agents of change in the territorial systems, imagining creative solutions to complex challenges with social and environmental considerations;
- combine technological opportunities with complex social and environmental challenges; and

- perceive the meaning of radical innovations in training and in the process enabling the creation of human capital with profiles of innovative entrepreneurship.

4 Towards an Entrepreneurial Society: Main Areas of Intervention

The centrality of human capital in the emerging dynamics behind the competitiveness of regions in the scenario of the Smart Specialisation Strategy allow us to derive useful implications for the activities of innovation ecosystems as well as to identify the main area of primary intervention.

The policy debate about the Smart Specialisation Strategy approach is consistent with the wider one about the responsibility, role and areas of intervention of the governments that have recently received the interest of a growing number of researchers and scholars. In this perspective, some authors investigated the need for a political agenda able to sustain the entrepreneurial development of a nation that, shaping the abused field of start-ups and spin-offs, is really able to promote not only economic development but also a largely diffused social well-being. It is the goal behind the framework proposed by Mazzucato (2013, 2015) in her study on the issue of the entrepreneurial state, as a new paradigm of public intervention directly into the strategic business of a nation, as well as a metaphor of a renewed way to conceive, execute and evaluate public policies.

A further novel element is offered by the need to work to improve the quality as well as the number of enterprises. For this purpose, in a recent work of 2015, Erik Stam highlighted that the ecosystem is a suitable framework to sustain this process of enhancement as well as to drive the transition towards the entrepreneurial economy. Entrepreneurship is, according to Stam, not just a result of the ecosystem, because entrepreneurs are important players both creating the ecosystems and assuring their successful operation and growth.

Consistent with the European Agenda for the Smart Specialisation, the promotion of innovation ecosystems is expected to work for the nurturing of innovative entrepreneurship, starting from the valorisation of Key Enabling Technologies (KETs) as enablers of that process of growth, towards the objectives of intelligent, sustainable and inclusive development of the regions (EC 2012; Foray et al. 2011; McCann and Ortega-Argilés 2011).

The creation of such innovative environments requires a renewal of the assumption of responsibility from the political agenda at all the levels of government, beyond the general support of the entrepreneurship, and towards the responsible response of governments to develop policies for an entrepreneurial economy (Thurik et al. 2013). In this perspective, Thurik et al. (2013) argues that because of the pervasiveness and radicalness of the modern technological revolution, the priority for the political class is to renew itself and its traditional ways to conceive its own role and actions. Three main actions have been identified by the authors:

- removing the barriers to entrepreneurial entry;
- facilitating the mobility of resources, mainly labour and capital; and
- speeding up national markets towards internationalisation and globalisation.

Furthermore, in this perspective of continuous change, the next move for the political agenda will be from regional 'entrepreneurship policy' towards an 'entrepreneurial regional economy'.

Looking at the European area, at the present time a great opportunity has arisen in the form of the Smart Specialisation Strategy.

It promotes a place-based and technology-driven process of development, starting from an understanding of regional vocations. The centrality of innovative entrepreneurship on the agenda for smart growth arises from the contribution that entrepreneurship provides in transforming technical knowledge into socio-economic value.

In promoting the adoption of a dynamic learning strategy based on the valorisation of the processes of learning, knowledge creation, and of the knowledge created within the 'knowledge triangle', three main areas of immediate intervention arise (Romano 2013):

- the creation of a mass of young people able to operate as innovative entrepreneurs;
- the evolution of organisations interested by and mainly the universities towards an entrepreneurial configuration;
- the reinforcement of the innovation capacities of existing enterprises, mainly of SMEs.

4.1 Young Talents

Regarding the creation of a critical mass of young people, the innovation ecosystems described previously will act as laboratories for the diffusion of a more distributed attitude and competencies in the entrepreneurial ideation.

Specifically, the learning path with which they will be actively involved will provide awareness of globalisation and of the competitiveness in the global scenario not based on the availability of natural resources, cheap labour or other traditional factors of competitive advantage. Furthermore, they will sensitised regarding the centrality of brain power as a lever for competitiveness, as well as the importance of intelligence, the ability to organise, a positive attitude towards continuous innovation, and supporting the development of the most significant industries. The immersion into a knowledge-intensive environment will stimulate creativity and innovation, including a recognition of the social and sustainable value of the organisations. Young people will be involved in the exploration and comprehension of the new dynamics of the labour market and the characteristics of the paradigm shift from an economy based on 'manufacturing' to a 'mentofactoring' one, by taking on board a consciousness of their working and professional opportunities as 'knowledge workers'.

4.2 Entrepreneurial Organisations

The impact on the entrepreneurial profile of the organisations interested in, and their evolution towards, a more entrepreneurial configuration is possible through the valorisation of the young people in their organisational structures, as well as for their active participation in collaborative activities within the ecosystem. This involvement will represent all the organisations interested in having an opportunity to deepen the meaning of the competitive dynamics in the scenario of the entrepreneurial economy and the impact of these on the organisational and strategic configurations of their structures. The focus on universities, as one of the most relevant categories of organisations interested by the evolutionary process towards an entrepreneurial configuration, is an interesting field of speculation. The archetype of Entrepreneurial Universities is an issue of great relevance in the current scientific and institutional debate on the evolution of the mission and organisation of universities in general. For this purpose, the Smart Specialisation Strategy provides useful guidelines for addressing the evolution of universities towards an entrepreneurial configuration more suitable to interpret the new demand of competencies emerging in the market. Such a new configuration presents elements of radical innovation in their own actual organisation, processes and contents to promote the connectivity with all the players responsible for regional growth. In pursuing the achievement of an entrepreneurial organisation, universities are called on to contribute to the development of human capital and power in the regions, attracting young talent and enhancing the mobility of researchers and students to industries and research centres, national and international, and to promote innovative entrepreneurship and the development of economic activity and growth through the creation of enterprises on the initiatives of students and researchers. But if this means a change in traditional processes, the achievement of full entrepreneurial configuration also requires a revision of the universities' consolidated structures, as highlighted in much international literature (Gibb et al. 2009).

More significant features that make the entrepreneurial university substantially different from the universities of the twentieth century can be identified as follows:

(a) The traditional university has two objectives: research and education. Research is pursued with the aim of the advancement of science. Scientific results are public, thus allowing everyone to benefit equally. Efforts to apply the knowledge created are considered counterproductive to the objectives. Education is pursued to create future scientists and scientific professionals.

(b) For the entrepreneurial university, the exploitation of knowledge and know-how becomes a third objective of the university. Indeed, universities are seen as the cradle of new entrepreneurial activity in addition to the traditional tasks of research and education. Education is pursued to create scientists, scientifically educated professionals and entrepreneurs.

(c) In traditional universities, research and education are monodisciplinary: they are conglomerates of faculties. In the entrepreneurial university, research is largely interdisciplinary, and the creativity is considered a driving force of similar importance to the rational scientific method. Its departments or institutes are interdisciplinary units that focus on a particular field of interest and have an entrepreneurial nature.

(d) Traditional universities exchange information with the scientific world, but they have no formal links with other organisations; in contrast, the entrepreneurial universities collaborate with industry, private R&D, financiers and other universities.

(e) In traditional universities, education is usually open only to young students, but the entrepreneurial universities are multi-cultural organisations with a wide array of students, including young people and adults.

(f) Traditional universities are generally institutions of national pride. The national language is used for the written and spoken word. The entrepreneurial universities operate in an international scenario, and based on the usage of international languages.

4.3 Innovative SMEs

Regarding the impact on the enhancement of the innovation capacity of SMEs, the involvement of the young people in a process of continuous learning will have the positive effect of fostering the creation of valuable learning networks, competencies and skills, thus enabling the innovation capacities of the companies, mainly of the SMEs.

Such a contribution is fundamental, mainly if we consider the structural deficit of innovative entrepreneurship that characterises some European regions, and mainly those defined as southern and traditional regions of the EU. In such contexts, the lack of innovation, both radical and incremental, results in a lower performance by the companies and in a lower level of socio-economic well-being.

Incremental innovations lead to modifications and improvements in products and production systems with a lower intensity. Employing existing technologies and standards to generate improvements in products and services present predictable costs of development and market potential. This can generate a wide spectrum of opportunities for competitiveness of firms and sectors that do not necessarily require large investments. Based on new applications of existing technologies, the process of innovation sustaining the growth and competitiveness of SMEs can be inspired and developed directly by employees. Interesting insights can also be derived from final consumers of goods and services.

5 Conclusions

The creation of an entrepreneurial society is a challengeable perspective for European regions and countries.

The capillarity of its diffusion and the nature of its strategic framework make the Smart Specialisation Strategy is an opportunity that governments are called to capture to reignite competitiveness and rebuild socio-economic wellness.

With the aim of highlighting a set of priority actions for the future agenda of governments called to afford those challenges, in this chapter we have recalled the main pillars of the Smart Specialisation Strategy as the instrument for intelligent growth in Europe. The importance of adopting a systemic approach for regional development, supported by evidence coming from the literature on innovation ecosystems, has been debated in this chapter as an enabling infrastructure for creating a mass of young talent able to operate as actors of change, for instilling into organisations and universities alike more entrepreneurial behaviours and attitudes.

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