THE RISING NEW GENERATION OF HIGH-TECH ENTREPRENEURS: AN EXPLORATORY STUDY

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Abstract

Who are the high-technology entrepreneurs: superheroes or jack-of-all-trades? Is there a new generation of young entrepreneurs who “think different” and use new and unexpected perspectives to imagine their business, products and mission? This paper presents some empirical evidences emerging from a multiple case study composed by 20 Italian technology intensive firms. After a review of the high-technology entrepreneur topic, some typologies of the Italian high-tech entrepreneurs are analyzed and finally an elementary classification is proposed in order to clarify the difference between “old” and “new way” entrepreneurship. New trends, behaviours, strategies and business models are explored in order to contribute to the academic debate and the practical knowledge about high-technology entrepreneurship. The last section of the paper suggests a future research agenda.

keywords: high-tech entrepreneur, technology intensive entrepreneurship, case study, jack-of-all-trades, classification
1. Introduction

If a hippie was asked what the hippie culture is, he would answer “a way of life”. If a high-tech entrepreneur was asked to define what a high-tech business is, he would answer “a way of entrepreneurship”. In fact, in small firms, he is not only an innovator (Schumpeter 1934), a pioneer of technology and science fields, a founder, a capitalist, but he is also a careful organizer and a smart manager. Many roles and functions in a single agent: this is really a particular way of being entrepreneur (Oakey 2003, Westhead et al. 2005). Innovative technologies, new business models, ambitious challenges shaped by the knowledge economy and finally the tremendous international competition generate in our countries the need of new people ready to manage successful ideas and founding new business ventures. A novel effort is required to the academic communities and to practitioners in order to describe, highlight and encourage the new generation of high-tech small entrepreneurs who are the real engine of the most successful and innovative businesses in Europe. They are called “new generation” not because of their age status: they are “new” because of their innovative way of thinking. Borrowing the famous payoff used and worldwide diffused by Apple, we could say that the rising new generation of high-tech entrepreneurs is composed by agents of change who are able to think different and use another perspective to imagine their business, their product, their missions. “The ones who see things differently. […] they change things. They invent. They imagine. They heal. They explore. They create. They inspire.” (see note 1)

The figure and the role of the high-tech entrepreneurs have always attracted not only journalists, media experts and story writers, but even many academics and scholars. Is there a thin red line which links James Watt and Bill Gates? Guglielmo Marconi and Sergey Brin? Benjamin Franklin, and Robert Swanson? All of them have been real pioneers: they had a great idea, they started in a small firm context and at the end they have been real agents of change, thus innovators. It is not the aim of this paper to describe their lives and enterprises because they are already popular and well studied. The aims of this work are the following. Focusing our attention on HTSF entrepreneurs, exploring new trends, behaviours, strategies and business models adopted; presenting some empirical evidence on high-tech entrepreneurship in the Italian context; and contributing to the academic debate on depicting the profile of the new generation of high-tech entrepreneurs.

Studying success stories in new industries, in start-up firms during technological innovation waves and in areas of new product innovations in markets still to come, are one of the main challenge of the academic community that focus on high-tech businesses. The internet, biotech and nanotechnologies and many other new industries are per se interesting for the analysis of how new firms emerge and compete (Cassia et al. 2006) Technological entrepreneurship plays a central role in regional transformation (Venkataraman 2004) and high tech small firms are one of the main asset of the globalized economy and the knowledge society. They are not only an important source of profit and employment, but the real locus of innovation. In fact some of them create new technology and contribute to the progress of science, while all of them include scientific applications and technologies in products or processes. New organizational structures, innovative market strategies, pioneer entrepreneurs, are just some of the most evident characteristics of the new technology-based business models which are the real engine of economic change. As Porter (1998) suggested: high-tech businesses “are vital to the upgrading of the competitive advantage, […] because they feed the process of innovation.” Adopting a life cycle model of the firm, small and medium firms are indeed very interesting for scholars and academics, because great players and future champions usually start their evolution as young, small, smart and simple enterprises.

There is growing attention by policymakers on supporting the birth and the development of high-tech industrial clusters and single enterprises (Foo and Foo 2000). Recognizing the rising role of high-tech entrepreneurship, many governments proposed different policies for supporting research, and fostering development, innovation and collaboration between universities, public research agencies and small firms, trying to replicate the history of areas like Silicon Valley,
Cambridgeshire and Boston Route 128. In Italy, which is the scenario considered in this paper, there are many agencies and public centres, financed directly by central or local governments, that support single innovation projects and the collaboration between universities and firms. During last months, the Government started an impressive and ambitious program called “Industria 2015” as main instrument of high-tech industrial policy and implementation of the triple helix model (Leydersdorff and Etzkowitz 1998, Etzkowitz and Klofsten 2005). The program is articulated in organic projects which are designed to encourage the development of a specific type of products and services with a highly innovative content in strategic areas for the development of the country, based on the technological and production targets identified by the Government: energy efficiency, sustainable mobility, life sciences and biotech, new technologies for typical “made in Italy” products, innovative technologies for culture, arts and tourism. An opportunity for all the high-tech entrepreneurs who need support for putting their ideas in concrete form and creating new products, markets or technologies.

This paper presents particular evidences from some small and medium Italian high-tech firms, focusing on the role and the traits of the entrepreneur, which is, thus, our unit of analysis. Entrepreneurship is a complex phenomenon. Since the seminal works by Baumol (1968), Low and McMillan (1988), Bull and Winter (1993), Shane and Venkataraman (2000), Gartner (2001), Zahara and Dess (2001) the boundaries of this research field are still in the middle of an exciting debate involving academics, scholars and practitioners. It’s a field where different disciplines, paradigms, perspectives converge: high-tech entrepreneurship can be considered as a particular subset of the main entrepreneurship topic. Reading both rationalistic and constructivist contributions, we can conclude that entrepreneurship is not a pure phenomenon who can be studied exactly (like supply chain or accounting or new product development), but it’s a research field who need to take in account personal skills, psychological motivations, environments conditions. Especially in HT industries, where new markets or niches are created, where ideas become real products, and where the future of our economies and societies is shaped, entrepreneurship is a hybrid phenomenon. Taxonomies (Pavitt 1984, Koberg 1996) and classifications of industries, business models, firms and entrepreneurs, tend to summarize and fix characteristics and properties, in the same time they risk to limit and reduce the richness and newness of the entrepreneurial phenomenon. Thus, following the suggestion of Gummeson (2006), quantitative studies need to be enriched by continuous qualitative and exploratory studies in order to shape an interactive approach which can be useful for both comprehension and prediction. “Research includes a combination of perceptions of reality based on real world data, attitudes, received theory, and persona, whether these are expressed as numbers, equations, letters or words.” (Gummeson 2006).

The rest part of the paper is divided into six sections. The following one is dedicated to an extensive literature review focusing on some theories and results regarding the skills and the traits of high-tech entrepreneurs. The third section presents a theoretical framework used for single and cross case analysis. The framework is enriched by the specification of the Italian context and the presentation of four entrepreneurial typologies. Section four is dedicated to the description of the adopted methodologies, the research protocol and the single case studies. Empirical evidences are shown in the fifth section of this paper, while conclusions and future research agenda are in the last one.

2. The high-tech entrepreneur: superhero or jack-of-all-trades?

Studying high-tech entrepreneurship means finding why and how technologically innovative small and medium firms grow, compete, collaborate and adapt to change in their environments. High-tech entrepreneurs are knowledge creators, agents of change, both pragmatic and visionaries: they usually present long range planning ability and a high degree of flexibility, because they are problem solvers who need to cope with an ever changing environment (Dosi and Malerba 1996). Innate talent or balanced acquired skills? The debate is still on. They have been studied through different theories, research paradigms, methodologies and models. In this literature review we
present the following contributions: the “traits” perspective, the “single industry” perspective, the frequency perspective, the hagiographic approach, the constructivist approach, the Lazear’s theory and the Oakey’s model. Why it is so difficult to study entrepreneurs? Because they are complex units (constructivists maybe would use the words human being) acting on a complex system. The need of high technology management adds complexity to the entrepreneurial research field. Complexity, turbulence, uncertainty (McGee and Sawyer 2003) are some of the main environment conditions who make difficult studying the HT entrepreneurship. Especially in Italy, where some dominant influencing factors are: the role of family, the influence of occupation experience and career, the availability of information and knowledge networks and finally the gender, age, social class, education, marital status and the ethnicity of the entrepreneur (Di Minin et al. 2003).

Since the famous citation by Say, Cantillon and the physiocratic school, the entrepreneur has been recognized as a key actor in the economies and societies. While Kirzner (1973) recognizes her/his ability to spot opportunities by creative alertness, the main role assigned by Schumpeter to the entrepreneur is being agent of change, thus innovator. The Schumpeterian entrepreneur changes the technological possibilities, alters convention through innovative activity and, hence move production constraints (Deakins and Freel 2006). Many other contributions focus their attention on some traditional entrepreneurship topics: the responsibility, the willingness to calculate and accept risks: the imagination and the creation, the pro-activity (McClelland 1961). Deakins and Freel collected many suggestions about the characteristics of technology intensive entrepreneurs, both from empirical research and different theories: need of achievement, calculated risk taking, high internal locus of control, creativity, innovation, need for autonomy, tolerance of ambiguity, vision, self efficacy. As far the author knows, no contribution states that those elements have been falsified in the subset composed by the high-technology entrepreneurs.

Human wisdom tends to categorize. Phenomenon are classified, taxonomies are created. This conceptual routine is useful for learning and for a rational comprehension of the economic and social behaviours. Following this assumption scholars and academics tried to describe and predict the characteristics, traits and skills of the successful entrepreneur. Many “traits” theory, born after the seminal work by McClelland (1961) tried to describe and fix the core traits of entrepreneurs. During last years these proposals have been criticized by other theories which assert the uniqueness of every enterprise/entrepreneur and highlight the importance of environmental factors despite fixed and predictable personal skills. According to this perspective MCPhee (2000) says that “Each business start-up takes place against a backdrop of uniquely intertwined events and the personality of each individual entrepreneur si unique”, while Delmar (2000): “the research results have been poor and it has been difficult to discover any specific traits of entrepreneurial behaviour. And finally Glancy and McQuaid (2000) “Research has failed to identify any traits which are associated specifically with entrepreneurs”. If from one hand we agree with the impossibility to set definitely the traits of the successful entrepreneur, using a nomothetic approach, to the other hand, we should admit the importance that research activity contributes to design robust and shared models. Traits and models are useful to summarize, predict and explain the behaviour, the choices, the reasons and the ways entrepreneurs act, even if they focus only on some aspects of the entrepreneur’s ontology.

Technology intensive firms are often considered as a single set, because they present common problems and behaviours (risk of technological obsolescence, financing, continuous need of research and innovation, marketing strategies, knowledge and intellectual property rights management). Sometimes problems which are typical of a particular industry, does not affect another. For example the time needed to develop a new drug is not comparable with the time to design and develop a new electronic device. So many academics studied technology intensive entrepreneurship in single industries. For example cyber-entrepreneurship (Carrier et al 2004), nanotech-entrepreneurship, or biotech founders or managers (Mueller et al. 2004), internet based business owners (Colombo and Delmastro 2004), green-tech entrepreneurs. This (industry-based) distinction can help on focusing on the different problems of each industry.
Another traditional classification of entrepreneurs which is business-based, considers the frequency in the process of business creation of start-ups. Focusing on what kind and how often start-ups are founded by the entrepreneur, it is possible to divide the subset of the high-tech entrepreneurs in: novice, serial, and portfolio entrepreneurs. (Westhead and Wright 1998, Westhead et al. 2005). Novice entrepreneurs are individual with no prior business ownership experience as a business founder (or inheritor or purchaser) of an independent business, but who currently own an independent business that is either new (purchased or inherited). Serial entrepreneurs are individuals who have sold or closed a business in which they had minority or majority ownership stake, and they currently have an ownership stake in a new single independent business. Portfolio entrepreneurs are individual who have ownership stakes in two or more independent businesses.

Another research flow on the technology intensive entrepreneurship adopts a quasi hagiographic approach, describing single entrepreneurs as myths or geniuses. The role, the importance and the behaviour of such individuals have been often celebrated by non academic literature, media and popular wisdom. Some name, for example Bill Gates, Steve Jobs, Herbert Boyer and Robert Swanson, became worldwide known and models for young generations of entrepreneurs. It is very important to know their stories in order to encourage young people.

This approach, is called by the constructivism the “Schumpeterian legacy”. “In mainstream entrepreneurship research, it is customary to understand entrepreneurship as something extraordinary, and entrepreneurs as superheroes” (Karp 2006). While the rationalistic theory study the personality factors, the background, the choices and the behaviour, the skills of the successful entrepreneur, constructivism exploits different epistemologies and methodologies for exploring “the interior condition of the individual entrepreneur, and the perceived inner realities from which his or her entrepreneurial actions originate” (Karp 2006). Following the suggestions by Gartner (2001) these two completely different paradigms, rationalism and constructivism (Guba 1990), applied in the entrepreneurship field seems to be complementary. Even if this paper doesn’t adopt the constructivist paradigm, we recognize that entrepreneurship and therefore high-tech entrepreneurship are not the fields of icy rationality. Therefore researchers should take in account that sometimes “entrepreneurs act subjectively in accordance with their own perception of reality, they act on the basis of feelings, intuition, and cognition, they engage in construction of a future they believe in and they develop and create according to their convictions and dreams (Karp 2006). There is another perspective and theory which is gaining attention from the academic world and the communities of practice. It has been proposed by Lazear (2004,2005) and confirmed in different contexts and situations by some interesting studies (Wagner 2003, 2006, Silva 2007). Studying the career evolutions of Stanford alumni, Lazear asserts that entrepreneurs must be jacks of all trades who need not excel in any one skill but are competent in many. He asserts that individuals with balanced skills are more likely than others to become entrepreneurs. “Those who have varied work and educational backgrounds are much more likely to start their own businesses that those who have focused on one role at work or concentrated in one subject at school.” (Lazear 2005) He describes the Entrepreneurs like polymaths, who put people together in particular ways and combine them with physical capital and ideas to create a new product or to produce an existing one at a lower or competitive cost. “An entrepreneur must posses the ability to combine talents and manage those of others.” (Lazear 2005)

His idea is that entrepreneurs differ from specialists: the first have a comparative disadvantage in a single skill but have more balanced talents that span a number of different skills. On the contrary specialists can work for others who have the talent to spot and combine a variety of skills. Although entrepreneurs can hire others, the entrepreneur must be sufficiently well versed in a variety of fields to judge the quality of applicants. Does this theory fits with the high-tech entrepreneurship context? An answer will be proposed in section five.

The last model of this review is the contribution by Oakey (2003), which is one of the most balanced and grounded model of high-tech entrepreneurship. In Oakey’s model technical management skills (ability to create and develop the product, ability to lead R&D teams, technical
knowledge), business management skills (accounting, marketing, human resources, strategy, fundraising) and motivation are the three main balanced elements of the high-technology entrepreneur. As we will see in section five, the Oakey’s perspective fits better than Lazear’s theory with the selected case studies presented by the paper. In fact, although technical ability has often provided the scientific knowledge necessary for an individual to become a successful technical entrepreneur, it is important the balanced presence of “the ability to develop business management skills with which to exploit such expertise” (Oakey 2003).

3. The theoretical perspective and the research context

Before presenting the case studies and the empirical evidences, the adopted theoretical perspective that we used to analyze the selected businesses and enterprises is now introduced. In the second part of this section, the research context will be described.

From both theoretical and empirical studies we developed an analytic and comparative framework for high technology firms in order to describe them, their competitive advantage, the business models and the future evolution of a single firm, an entire industry or some firms located in the same area. This framework is born from a deep literature review which identified the main topics studied by scholars and practitioners and evaluated the four key elements of every high-tech small business: (a) entrepreneur, (b) technology and knowledge, (d) ecosystem, (d) network and partnerships. The four parts of the framework can be considered as the axes of four dimensional Cartesian coordinates: they let the manager as well the academic researcher or the consultant to focus his/her attention on the fundamental drivers and assets of a high technology small firm.

(a) The high-tech entrepreneur: as stated above, his role is crucial over the entire life of a high-tech business. Some scholars call him/her the cornerstone of an entrepreneurial experience (Adreutsch 2002, Shane and Venkataraman 2000). See the previous section for a deep discussion of this topic.

(b) Technology and knowledge. The word “family business”, which is often used as a synonymous of small and medium business tends to be substituted in the high-tech Italian context by a different phenomenon that is “brain business”. Family is not anymore a central resource for the firm, but knowledge (tacit and explicit) and ideas are the intangible assets necessary for competition and success (Nonaka and Takeuchi 1995). With the general expression of “technology and knowledge” we identify the set of scientific competences, the capabilities to use and exploit them, the ability to transform an idea into a product and to innovate. In our framework we assume that the topics connected with IP rights and their management are part of this section.

(c) The ecosystem is the habitat where HTSF are born and grow. The geographical, social and economic context are important elements because in many cases they offer potential help to the firms. Ideas from universities and public research poles, the presence of skilled labour force, the offer of modern financing opportunities (like business angels, venture capital, guarantee banks) that can support new or promising entrepreneurial ideas (Benneworth 2006, Chorev 2006)

(d) If the ecosystem can be considered as a static element of the framework (in fact it is generally equal for every firm located in the same geographical area), the relationships and the networks built by the firm with the different actors of the economic systems are a dynamic element. Robust and efficient relationships between the firms and clients, suppliers, competitors, institutions, investors, banks and universities are one of the main way to achieve success (Neill et al. 2001, Yli-Renko et al. 2001, Cave 2006).

Every case study has been written and analyzed using this reference framework. The second part of this section is dedicated to the presentation of the research context, in particular some quantitative and qualitative information about high-tech industries in Italy. In this country
propensity towards entrepreneurship is especially high. For example in the north area of the country the self employment percentage is more than one self employed over 10 inhabitants. Italy exhibits a poor performance in high-tech industries with the ratio of research expenditures to GDP being close to 1% that is less than half the value in UE. (Colombo and Delmastro 2004, European Innovation Scoreboard 2007). From a financial point of view the entrepreneurs of Italian new technology based firms use their personal saving to finance their activities and support innovation (Giudici and Paleari 2000) and venture capital funds are not as popular as in other countries of Europe. The economic situation of the country has been well resumed by Di Minin et al (2003): “Italy, despite its traditional inclusion among the most important players in the world economy is a country which lags behind in R&D investments mainly because of its large number of very small firms and an overall lack of large R&D-based companies. Also, while the public research system has good scientific performance in terms of number and quality of publications, it does not generate a much needed intense technological transfer processes.”

In this country, during last years techno-entrepreneurship is grown. Firms based on all those technologies which are changing the world - nanotech, biotech, ICT, green tech - are clustered in some areas of the country. Many corporations, for example in pharmaceutical or chemical industries, have been substituted by small firms who do not control the whole value chain but concentrate their efforts and knowledge over some reduced rings of the chain. New technologies have been imported and created new ways of entrepreneurship. Not only they need more qualified labour force, brains but even new business models. These rising role of high-tech enterprise is supported by the annual report by ENEA (see note 2) (Ferrari et al. 2007). In Italy the 7% of the whole industrial manufacturing population is composed by high-tech firms. More that 90% of the R&D activities are performed within them. The percentage of the Italian high-tech exportations over the global amount of high-tech exportations is 1,96%, while 2,7% is the percentage of high-tech importations over the global amount of high-tech importations.

Based on the ENEA report, on the recent work by Di Minin et al (2005) and on a daily analysis (performed by the author’s research group) over media who present articles and interviews about high technology entrepreneurship, we can conclude that in Italy there are four main typologies of high-technology entrepreneurs. They are:

1) the emergent young entrepreneur: young people with smart ideas, sometimes highly educated, (phD or master degree) who are able to build, in a few years, rapid growing businesses. They are particular diffused in the ICT world (Colombo and Delmastro 2004)

2) former manager or scientist who create a spin-off. This typology is quite popular within the biotech and pharmaceutical world. Biotech in Italy is an industry which is growing, as stated by the Assobiotec – Blossom official report. If at the beginning of the century there were only few biotech enterprises, they are now more than 225, offering14.000 qualified jobs and an aggregate revenue of 4 millions of euros.

3) the academic entrepreneur. After too many years dedicated to education and pure research the Italian universities are slowly discovering their third mission: supporting the firms and the economic system in order to increase competitiveness. A proxy of this shift is the number of universities and projects presented to the National Business Plan Competition (called Premio Nazionale Innovazione). In the year 2003, only 5 universities and local business plan competition presented projects, while in the last edition (2007), 32 Italian universities presented projects, thanks to the network and the support of 14 preliminary local business plan competitions. While Academic entrepreneurship as studied by Gibbons et al. (1994) is becoming more and more popular and universities are considered part of entrepreneurial system (Spilling 1996) the model of an entrepreneurial university (Clark 1998) and the idea of research groups as quasi-firms (Etkowitz 2003) are unfortunately still far from the Italian context.
4) “family entrepreneur”: we use this term to identify individuals who inherit or buy a business. They are often the son of self employed artisan or small entrepreneur, active in a traditional industry. This new generation of entrepreneurs are the main responsible of the evolution of the previous firm from traditional products to innovations rich of technology upgrading and improvements.

A simple matrix (Fig. 1) can be drawn in order to present synthetically the situation of the Italian industrial system. This matrix is useful and intuitive in order to understand what the author calls the new generation of high-tech entrepreneurs. On the left we can consider the traditional division between mature and high-tech industries. Defining them is not in the scope of this paper, while a huge debate is still on, proposing different definitions and classifications of high-tech. Deakins (1996) for example stated that any approach to define high-technology or new technology small firms is fraught with difficulty. According to the OECD classification, In this paper we consider “high-tech” the following industries: ICT, biotech, nanotechnologies, advanced machinery, automation, robotics, advanced chemicals, green-tech (energy and environment), microelectronics, biomedical and pharmaceutical. Close to the previous definition, we consider that a single business is qualified as high-tech if it involves new and sophisticated technologies as far as the products or the processes concern. The two columns of the proposed matrix refers on a generic old way of being entrepreneur and a new way of being entrepreneurs. The distinction between these two ways is one of the aim of this paper, and will be clarified by the obtained empirical evidences. The matrix, in fact, follows the assumption presented at the beginning of the paper, regarding the presence of entrepreneurs who are able to “think different” and creating something new compared to the past. The matrix is coherent with the work by Bruyat and Julien (2001) who divide general entrepreneurship into 4 main subfields: reproduction (of products, processes, strategies and business models), imitation, development and adventure. The matrix will be enriched in the “empirical evidence” section of the paper and a difference between old and new way will emerge.

<table>
<thead>
<tr>
<th>traditional and mature industries</th>
<th>“old way” entrepreneurs</th>
<th>“new way” entrepreneurs</th>
</tr>
</thead>
<tbody>
<tr>
<td>high-tech industries</td>
<td>reproduction</td>
<td>development</td>
</tr>
<tr>
<td></td>
<td>imitation/emulation</td>
<td>adventure</td>
</tr>
</tbody>
</table>

Fig. 1, adapted from Bruyat and Julien (2001)

4. Methodology and Presentation of case studies

According to Yin (2002) and Flyvberg (2006), the exploratory nature of this study suggests the use of a qualitative methodological approach, and in particular the multiple case studies research tool. This choice seems to fit with the questions underlying the paper and let the authors to describe the new generation of Italian high-tech entrepreneurs. In fact the inductive research helps the possible emersion of new situations and behaviours of the economic and social actors, while case studies let the researcher to highlight differences and similarities within the samples considered. Finally the choice of case studies is supported by the explicit suggestion of Eisenhardt (1989) inviting the academics to use this tool for providing freshness in perspective to an already researched topics (in this case high-technology entrepreneurship) and in the early stage of research on a topic (in this case the new way of entrepreneurship). Multiple case studies research is furthermore a useful tool to understand the complex nature of entrepreneurship, as recommended by Gartner and Birley (2002). Many quantitative studies are actually available to describe the traits, background and skills of the
entrepreneurs, but this one is looking for new emergent phenomena we could difficulty managed by quantitative tools. The main limit of this approach is the possibility to present general determinants of phenomena through a limited number of cases. This limit can be widely accepted because the goal of the paper is stimulating new path and research ideas, not building a general theory about high tech entrepreneurship.

As recommended by Miles and Hauberman (1994) the first step of sampling is setting boundaries that define the population. It is clear that our population is composed by the Italian high technology small firms. The definition of high-tech enterprise is given in the section above while the definition of SME is based on the EU criterion. The category of micro, small and medium-sized enterprises is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million €, and/or an annual balance sheet total not exceeding 43 million euros. This study is composed by 20 case studies. They have been selected by a wider population that comes from the overlapping of two sets of firms. The first is composed by a database of 200 high-tech firms located in the Vicenza area, in the North-East of Italy. The high-tech small firms of the Veneto region, are a potential interesting empirical context for our research. They are approximately more than 900. The area is heavily industrialized: small and medium enterprises are more than 98% of the entire firm population. Like many other non high-tech regions of Europe, the Veneto region is shifting from the traditional fordist paradigms towards knowledge-intensive economy.

The second set consists of another database, composed by more than 100 high tech enterprises who have gained during last years visibility on national media. The overlapping let the researcher to take in account the contribution of emerging and well known business from all over the country as well as other unknown entrepreneurial experiences co-located in the same geographical area. The 20 cases have been strategically selected within the considered population, according to Flyvberg (2006) on basis of size, industry, products, innovative activities, geographical equilibrium and personal knowledge of the entrepreneur.

A robust research protocol has been built in order to guarantee the reliability of the collected data. The cases are based of semi-structured interviews with the entrepreneurs. Starting form the his personal story and career, the interview covered the following topics: story of the firm or previous business owned/managed by the entrepreneur, the products, the market, innovation activities, networks, industrial and economic ecosystem (see section 3) and technology and knowledge management. The analysis of the annual reports, the website and other information available on the Internet have been performed before and after the meeting with the entrepreneur. A single case study has been written for every enterprise by the researcher, in order to summarize and fix the interviews and the entrepreneur and the author’s personal opinions and considerations. A feedback mechanism has been exploited: every single case has been red, rectified or amended by the entrepreneur. The following figure presents the firms involved in the research and some information about them.

<table>
<thead>
<tr>
<th>Ref.</th>
<th>industry</th>
<th>products</th>
<th>employees</th>
<th>turnover (mln €)</th>
<th>Year of establishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>chemicals</td>
<td>Monomers and polymers</td>
<td>25</td>
<td>45</td>
<td>1984</td>
</tr>
<tr>
<td>B</td>
<td>biotech</td>
<td>Bioactive molecules from plant cell cultures, biomedical application of silicon</td>
<td>31</td>
<td>0.4</td>
<td>1999</td>
</tr>
<tr>
<td>C</td>
<td>robotics</td>
<td>Robot humanoids</td>
<td>/</td>
<td>0.025</td>
<td>2005</td>
</tr>
<tr>
<td>D</td>
<td>Advanced machinery</td>
<td>Machinery and equipments for steel manufacturing</td>
<td>100</td>
<td>20</td>
<td>1977</td>
</tr>
<tr>
<td></td>
<td>Services</td>
<td>Description</td>
<td>Value 1</td>
<td>Value 2</td>
<td>Year</td>
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<tr>
<td>E</td>
<td>Diagnostics and analysis for arts</td>
<td>21</td>
<td>0.8</td>
<td>1997</td>
<td></td>
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<tr>
<td>F</td>
<td>Acoustics</td>
<td>Loudspeakers</td>
<td>18</td>
<td>10</td>
<td>1983</td>
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<tr>
<td>G</td>
<td>ICT</td>
<td>Networks and IP services</td>
<td>40</td>
<td>2</td>
<td>2003</td>
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<tr>
<td>H</td>
<td>Green-tech</td>
<td>Eolic turbine generators</td>
<td>/</td>
<td>0.087</td>
<td>2002</td>
</tr>
<tr>
<td>I</td>
<td>Advanced machinery</td>
<td>Machinery and equipments for leather manufacturing</td>
<td>98</td>
<td>17</td>
<td>1972</td>
</tr>
<tr>
<td>L</td>
<td>Medical devices</td>
<td>Innovative lancet</td>
<td>18</td>
<td>3</td>
<td>1988</td>
</tr>
<tr>
<td>M</td>
<td>Advanced machinery</td>
<td>Machinery and equipments for leather</td>
<td>20</td>
<td>10</td>
<td>1911</td>
</tr>
<tr>
<td>N</td>
<td>Internet</td>
<td>Web farm, e-commerce, web services</td>
<td>25</td>
<td>1.5</td>
<td>2000</td>
</tr>
<tr>
<td>O</td>
<td>Security</td>
<td>Video surveillance and security equipments</td>
<td>110</td>
<td>18</td>
<td>1986</td>
</tr>
<tr>
<td>P</td>
<td>ICT</td>
<td>Access gateways, IP video station</td>
<td>150</td>
<td>75</td>
<td>1993</td>
</tr>
<tr>
<td>Q</td>
<td>Medical devices</td>
<td>Diagnostic devices</td>
<td>50</td>
<td>11</td>
<td>1998</td>
</tr>
<tr>
<td>R</td>
<td>Biotech</td>
<td>Drugs discovery and molecular validation</td>
<td>43</td>
<td>9.8</td>
<td>2001</td>
</tr>
<tr>
<td>S</td>
<td>Services for new enterprises</td>
<td>Support for new venture foundation and their development</td>
<td>23</td>
<td>0.2</td>
<td>2007</td>
</tr>
<tr>
<td>T</td>
<td>Biotech</td>
<td>Drugs discovery and molecular validation</td>
<td>50</td>
<td>2.5</td>
<td>2002</td>
</tr>
<tr>
<td>U</td>
<td>Electronics</td>
<td>Engines and automations</td>
<td>36</td>
<td>3</td>
<td>1978</td>
</tr>
<tr>
<td>V</td>
<td>Automation</td>
<td>Centrifugal machines</td>
<td>20</td>
<td>5</td>
<td>1983</td>
</tr>
</tbody>
</table>

Fig. 2 case studies presentation

5. Empirical Evidence

The first empirical evidence is that all the considered entrepreneurs present a skill that Venkataraman (2004) calls talent. In his view, totally confirmed by the case studies, talent is able to generate an idea, develop it, start a company, make a prototype, obtain the first customer, develop products and innovations and compete in the rough and tumble world of competitive markets. Of course this is a skill which “old way” and “new way” entrepreneurs both show.

The performed single and cross case analysis confirms the presence of the 4 typologies presented in the theoretical perspective. The young emergent entrepreneur runs firms E, F, L, N, P. The former manager or scientist is present in cases H, M, Q, R, T. An entrepreneur with academic background runs firms C, E, S. And finally enterprises A, D, I, O, U, V are owned and managed by a “family entrepreneur”. The confirmation of the four typologies is not the only result obtained by the cross-case analysis. There are, in fact, other interesting findings and evidences.

First of all we find in our samples a particular form of academic entrepreneurship: the shift from the traditional student or full time professor who dedicates completely to business, to a new form of part time professor-entrepreneur. Traditionally the idea of academic entrepreneurship includes undergraduate students and professors who suspend or close their experience in university by founding a new venture. In fact some of them, after the first revenues and profits find
entrepreneurship and running their firms or working on the business projects, more interesting and profitable than studying or doing research. Even professors or researchers in universities or public centres often decide to dedicate their whole time to business. The situation seems quite different in the considered subset, where academics involved in start-up activities continue to work in the university thanks to part time contracts or different forms of collaborations and in the same time they try to run their enterprise. Thus they do not abandon their chairs and research activities within the university and thus they become hybrid entrepreneurs, half professor and half business owner. Despite some problems of time management cited by the interviews entrepreneurs, this hybrid situation seems to be particularly useful, because it guarantees a real osmosis between the enterprise and the research labs.

Secondly, during our analysis (cases B, C, F, H, N, P, Q, T) we found that close to the Schumpeterian idea of the entrepreneur as innovator, in the Italian high-tech small firms there is an emerging phenomenon. A key role should be assigned to informal teams of co-innovators who support directly the entrepreneur in order to manage technology and general marketing problems caused by innovation projects. We call them “internal angels”: people who do not necessary have the idea, but help the entrepreneur to transform it into a product. They are not only engineers or specialists, but even managers or marketing people who are close to the owner and are essential for the successful introduction of innovations.

The third interesting element that emerges is the “open way of thinking” of the some interviewed entrepreneurs. They build an open and networked enterprise. In some the case studies is not rare finding research labs open to third parts or clients, or other firms. For example case U is the only firm who posses in a wide geographical area, an anechoic chamber which is actually open and available to other firms for test activities and R&D. Another firm, labelled as I, opens its test room, with equipment and machinery, with the same purpose. This open mentality is confirmed even by the intellectual property right management: entrepreneurs of the “new way” are really conscious of the opportunities in terms of potential innovation and profit coming from an open approach to this area (Chesbrough 2004).

After the analysis of the traits of the interviewed entrepreneurs and the financial data and annual reports, we can assert that the industrial subset considered by this study shows a marked inclination towards the so called “giving back” behaviours. In fact, despite the idea and the imagine of the high-tech entrepreneur as a rational and pragmatic technologist, many of the entrepreneurs are visionaries and conscious of their social mission. Part of the firms shows an evident attitude towards corporate social responsibility (cases A, B, D, F, I, N, P).

The last empirical evidence is strictly linked with the already cited Oakey model (2003) and the jack-of-all-trades Lazear ‘s theory (2005). All the considered cases confirm the model proposed by Oakey where technical management skills, business management skills and motivation are the three main balanced dimensions of technology intensive entrepreneurship. A reconciliation of the two theories could be find in the domain of high-tech entrepreneurship if we consider the entrepreneur as a master of integration, as the individual who knows enough from many learned trades and skills to be able to bring disciplines together. So the Lazear figure of speech could be shifted to “jack of all trades, master of technology”, highlighting the central role and the relevance of mastering technology in high tech businesses.

Cross case analysis have been useful in order to enrich and complete with some key words the 2x2 matrix presented on Fig.1, especially in the lower part. The completion of the upper quadrants is not made through the performed case studies. As stated in section three, we focused our attention only on high-tech small and medium firms, while the two upper cells regard entrepreneurs and firms belonging to mature and traditional industries. The completion of the upper quadrants is thus based on literature contributions. We report them briefly because they are useful to understand differences between old and new way of being entrepreneurs.
<table>
<thead>
<tr>
<th></th>
<th>“old way” entrepreneurs</th>
<th>“new way” entrepreneurs</th>
</tr>
</thead>
</table>
| **traditional and mature industries** | family business, traditional italian clusters  
competitive advantage: cost reduction and incremental innovation  
keyword: reproduction | firms who won the challenge of innovating in declining and mature contexts, through effective internal and external R&D, radical innovation, cooperation with universities and public or private research centres, a mature and conscious management of intellectual property  
keyword: development |
| **high-tech industries** | they don’t trust intellectual property rights, they think local and not global, they don’t adopt open innovation in order to broaden the innovation opportunities. They are too much technology focused, and sometimes neglect financial aspects and marketing. They replicate business models and strategies valid for mature industries even in new industries  
“Open entrepreneurs”, the professor-entrepreneur hybrids, entrepreneurs socially involved and responsible and the jack of all trades, master of technology  
keyword: adventure |

In Italy the upper left quadrant is populated by small-medium enterprises, often clustered in industrial districts (Beccatini 1990, Porter 1998). In such firms entrepreneurship, leadership and management are based on family, personal networks and the ability of the owner in technology management. The competitive advantage strategically obtained by the entrepreneurs consist of cost reduction and incremental innovation. The upper-left entrepreneurs tends to replicate other similar entrepreneurial experiences, according to the suggestions by Bruyat and Julien (2001)

The upper right quadrant is the area of the emerging businesses in mature industries, well studied and described in a recent contribution by Cassia, Fattore and Paleari (2007). The quadrant is populated by entrepreneurs and firms who won the challenge of innovating in declining and mature contexts, through effective internal and external R&D, radical innovation, cooperation with universities and public or private research centres, a mature and conscious management of intellectual property. Renewed market reputation, technology upgrading, knowledge based organization, changes in cost structure can drive firms belonging to mature industries to success, growth and a long life. The introduction of such innovations and changes is often made by entrepreneurs who think and act in new ways. Following a kirznerian approach, and the suggestions of Shane and Venkataraman (2000) Cassia et al. (2007) describe this new way of entrepreneurship in mature industries focusing on the following three phenomena: the arising of sources of opportunities, both explicit (market niches) and tacit (undiscovered needs), the identification and evaluation and finally the deployment of resources aimed at the exploitation of new opportunities. “Emerging business are the results of entrepreneurial ideas that emerge where others are unable to capture the weak signals of change or do not yet perceive the presence of an underlying regular trend in what are otherwise seen as obvious anomalies”. (Cassia et al. 2007)

As far as the bottom-left quadrant (new industries, old way entrepreneurship) is concerned, few firms of our set belong to it. In this quadrant we potentially find internet, biotech, nanotech, software, ICT, green-tech, energy, medical devices entrepreneurs who show an old way of thinking the business an the whole enterprise. For example they don’t trust the help provided by intellectual property rights, they think local and not global, they don’t adopt open innovation (Chesbrough 2004) in order to broaden the innovation opportunities. They are too much technology focused, and sometimes neglect financial aspects and marketing. They replicate business models and strategies valid for mature industries even in new industries. This choice creates a mismatch: new products
and processes need new way of thinking, organizing and configuring the business.. This “old school” entrepreneurship can however successful because of technology supremacy or because the exploitation of niches or new markets.

The fourth quadrant (lower right) is the most interesting, and its entrepreneurs have been described at the beginning of this section. In this quadrant we find the real pioneers, those entrepreneurs who create new products and processes in frontier fields and experiment new ways of managing businesses and running enterprises. Here we find visionaries and global thinkers, builders of star and networked enterprises. Focusing on the particular Italian context we find the “open entrepreneurs”, the professors-entrepreneur hybrids, entrepreneurs socially involved and responsible and finally the jack of all trades, master of technology, as mentioned above.

6. Conclusions and future research agenda

This exploratory study presents some empirical evidences of a new generation of high-tech entrepreneurs. Their newness is not linked to their age but to their way of thinking and running their business. The standard typologies of the high-tech entrepreneurs have been confirmed by the case studies, and some new perspectives and phenomena have been presented. The bottom-up approach limits the presentation of general determinants or aspects of phenomena because of the small number of the cases, but this is coherent with the aim of the paper, which is stimulating new path and research ideas, not building a general theory about high-tech entrepreneurship.

The performed exploratory study needs to be broaden and deepened. The evolution of the classic four typologies of the Italian high-tech entrepreneur need to be compared to other European and non-European models and researches. The incidence and the diffusion of the rising generation of the “new way” high-tech entrepreneurs must be studied through ad hoc surveys and quantitative methods. Exploratory studies on high-tech entrepreneurship should be encouraged in order to find new phenomena, to update taxonomies and classification and to provide better comprehension of the rapid changing high-tech business environment.

The main empirical evidences emerged in the last paragraph can be an interesting agenda for further research. The possible correlation between corporate social responsibility and high-tech core of the business can be explored. The role and the importance of co-innovators can be an interesting research field for academics, scholars and practitioners who study both innovation activities and informal or formal organizational paradigms. Finally, the actual body of knowledge about academic entrepreneurship can be enriched by studying the hybrid figure of the academic entrepreneur who runs the business and in the same time teaches or researches within the university.

Notes

(1) advertising slogan created for Apple Computer in 1997 by the Los Angeles office of advertising agency TBWA\Chiat\Day
(2) ENEA is an Italian public agency, funded by the Italian Government, operating in the fields of energy, the environment and new technologies, in order to support Country’s competitiveness and sustainable development

Acknowledgments

The author thanks the entrepreneurs who participated to this study and reviewed the single cases. A special thank to professor Moreno Muffatto for his comments and encouragement.
References
Beccatini G, (1990), *The Marshallian industrial district as socio-economic notion*, in Industrial Districts and Inter-firm Co-operation in Italy Eds F Pyke