# Capabilities in small high-tech firms: a case of plural-entrepreneurship

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## Abstract

**Purpose** – The purpose of this paper is to address the issue of evaluating the innovative/entrepreneurial capabilities of small firms in high-technology industries.

**Design/methodology/approach** – The approach taken is a literature review and case study.

**Findings** – The contribution of the paper is twofold: in the first part, it is tried to distinguish the different forms of entrepreneurship existing. This leads to determine a form of entrepreneurship, plural entrepreneurship, that is typical in high-tech start-ups. In the second part, it is then tried to evaluate the innovative/entrepreneurial capabilities of a firm in such a framework. This is based on a longitudinal case study of a high-tech start-up where we explore how different dimensions of entrepreneurship coexist and interplay to create a firm's innovative dynamics depending on its initial resources and those added during the firm's growth.

**Originality/value** – The paper is an original attempt to distinguish different notions of entrepreneurship including the notion of plural-entrepreneurship and capabilities in a small enterprise.

**Keywords** Entrepreneurialism, Innovation, Small enterprises

**Paper type** Research paper

## Introduction

The capabilities behind the development of firms have questioned researchers in different fields especially in economics and management. A general consensus has emerged that these phenomena are directly linked to the entrepreneurial activity. Several studies conclude that many high-potential start-ups fail during the first years despite the interest of their innovative product, the adequate business model and the competences of the entrepreneurs and employees. In this work, we try to identify the reason behind this observation. Difficulties during the start-up creation phase and later during the development process are plural. Our argument is that the difficulties come from the combination of entrepreneurial activities needed to start and exploit the firm successfully. Not only must the entrepreneur be innovative by creating a new product or service based on high technology, but also he must also be entrepreneurial in the organization of the new activity, entrepreneurial in the marketing mix and business model elaboration and so on. This need for simultaneous plural-entrepreneurial efforts in the early days of the firm is a major source of firm decay.

In the first section, we review briefly some definitions of entrepreneurship and sort out the most relevant ones for the present case study. We then develop the notion of plural entrepreneurship and compare it with other types of entrepreneurship.

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The definition of plural-entrepreneurship is important because it influences the research design and the selection of the firm to be explored during the case study part of this work.

The next section is a discussion of the case study methodology employed and a presentation of the originality of the firm studied. On the basis of the definitions retained, we use a resource-based perspective, in order to capture the different dimensions of the entrepreneurial activity. This broad approach perfectly reflects the diversity of the problems that the entrepreneur encounters during the creation and development of the firm, and the diversity of resources that must be mobilized. Therefore, it matches the plural entrepreneurship framework. The following section sums up and analyses the interview and archival data. The final section highlights the findings as well as the implications.

*Plural-entrepreneurship and other forms of entrepreneurship*

Research on high-tech start-ups is a growing field of inquiry in the economic and managerial literature. The downturn of many start-ups at the beginning of this century confirmed the need to understand their difficulties for surviving and the specificities of the knowledge-based entrepreneur behind those firms in comparison to regular entrepreneurs. The academic literature defines a high-tech start-up as a young firm (less than eight years) launched by individuals for developing and exploiting (in various forms) an innovation (Shan, 1990; Freeman, 1982). Regular entrepreneurship defines that innovation can be a product, a service, a process, a new commercial or organizational scheme. Knowledge-based entrepreneurship as we encounter it mostly in high-technology firms develops a somewhat different definition, which implies that the firm is a plural innovative bundle.

What is plural entrepreneurship? Forms of entrepreneurship in the academic literature are numerous. According to the authors, one can find the following forms of entrepreneurship.

Academic entrepreneurship (Bercovitz and Feldman, 2008), diffused entrepreneurship (Minkes and Foxall, 1980), dispersed entrepreneurship (Minkes and Foxall, 2003), distributed entrepreneurship (Hsieh *et al.*, 2007), disintegrated entrepreneurship (Royer and Stratmann, 2007), collaborative entrepreneurship (Miles *et al.*, 2005), collective entrepreneurship (Zito, 2001), community-based entrepreneurship (Peredo and Chrisman, 2006, community in the social meaning of the term), corporate entrepreneurship (Burgelman, 1984), intrapreneurship (Carrier, 1996), knowledge-based entrepreneurship (Witt and Zellner, 2007), managerial entrepreneurship (Stevenson and Jarillo, 1990), modular entrepreneurship (Brusoni and Sgalari, 2006), network entrepreneurship (Harryson, 2008), open entrepreneurship (Gruber and Henkel, 2006) and serial entrepreneurship (Hyytinen and Ilmakunnas, 2007).

Many of these notions overlap, or are simply speaking synonyms. Figure 1 is a representation that we use to distinguish the different forms of entrepreneurship by plotting them along two axes. The two axes represent the:

(1) location of the entrepreneurial process; and

(2) dimensions concerned by the entrepreneurial process.

The horizontal axis selects the location of the entrepreneurial process, by location we mean how many firms/persons are participating in the entrepreneurial process. Is it just one single entrepreneur or are there several persons belonging to distinct firms?

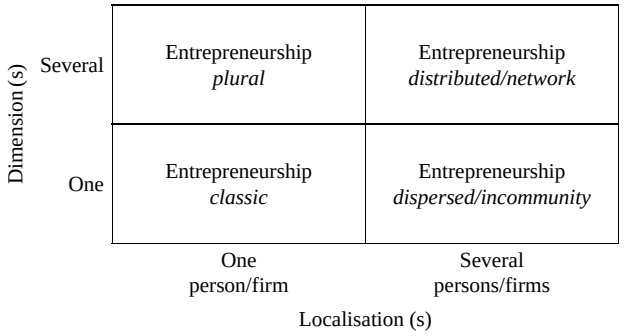


**Figure 1.**
Plural-entrepreneurship and other forms of entrepreneurship

The vertical axis corresponds to the dimensions along which the entrepreneurial process takes effect. Does it modify the product, the business model, the organization, etc.? Are only one or several of these dimensions concerned?

By plotting some of the entrepreneurial forms, we found in the literature on these axes, we obtained the distribution shown in Figure 1.

The easiest situation corresponds to the case where there is one person performing an entrepreneurial act along one dimension. This case corresponds to the classic representation of entrepreneurship. The Schumpeterian entrepreneur leading to the market innovation production corresponds to this situation.

If we have several persons, eventually employed by several firms, we obtain a group of people involved in an entrepreneurial process. This corresponds to the notion of dispersed entrepreneurship or entrepreneurship in community. Dispersed entrepreneurship is a notion put forward by Simon (Minkes and Foxall, 2003). In an engineering approach, he split the tasks necessary to create a new product into different sub-tasks. Each group of engineers had to resolve the problems corresponding to a specific part or sub-task, of the project they were responsible for. More recently, this approach has been developed in organization studies together with the notions of communities (Cohendet and Llerena, 2003). People can be working for different firms, but be involved in the same community. Since different person/firms are linked by the same practice they can contribute to creating a new product, the community is entrepreneurial. A current example of this form of entrepreneurship is the open source community who creates new products by summing up the efforts of several persons dispersed around the world.

In this approach, there is only one dimension concerned, the product (or service) created by the entrepreneurial process. If several dimensions are concerned, and different firms are involved, meaning that some firms are in charge of creating a new product or service, some other firms develop a new business model/market strategy, and/or some firms organize themselves in an entrepreneurial manner around those activities, we obtain a situation of distributed or network-based entrepreneurship.

The links between the firms are essential to obtain the product, to create the appropriate market and to seize all the values created by the entrepreneurial process.

Finally, the last box in Figure 1 that we did not discuss yet is the plural entrepreneurship situation. Plural means that one single firm or person must not only create a new product or new services, but also (if the product is really a novelty), find a new way of commercialising the product (a marketing/business model), and eventually develop an innovative organization of her activities.

Based on the previous consideration, we propose the following configuration of the plural-entrepreneurial dimension able to bring success (or not) in the start-up phase of a high-tech firm (Figure 2).

In this representation, the success of a firm corresponds to the outcomes of plural-entrepreneurial activities. Those activities must join into a coherent business strategy during the start-up phase. Therefore, this view is aligned with the concept of entrepreneurial strategy by Mintzberg *et al.* (1998). They define entrepreneurial strategy as:

> [...] characterized by a visionary process: strategy exists first of all in the leader's mind as a long-term direction, a vision of the future and of the results of the organization. Such a strategic vision tends to be malleable, and due to this, entrepreneurial strategy often appears to be both deliberate and emergent, deliberate from the point of view of its global vision, and emergent in the way in which the details of the vision evolve.

This definition of an entrepreneurial vision, linked to an evolutionary theory of the firm is also very present in the works of Witt (1998, 2007).

The necessity to be entrepreneurial along several dimensions requires a procedural approach to describe the evolution of the entrepreneurial activities. Previous work on that topic developed our knowledge of the common traits on the genesis and growth of firms, for instance they gave us a good understanding of the different phases of the development of firms (following a life cycle model) but by definition this separation in phases (or steps) focuses on the important points in each phase, neglecting somehow the relationships between the different elements and their co-evolution. The picture is then composed of the entrepreneur(s), the innovative products or services, the supporting activities, and the financial resources. The co-evolution of all these elements in relation to entrepreneurship fosters the survival of the firm.

In the following, we present the research methodology and the characteristics of the firm we selected for our case study.

*Research framework and firm presentation*

We saw in the previous section that plural-entrepreneurship is characterized by the fact that a new start-up must be entrepreneurial/innovative on several dimensions simultaneously. For assessing the firm's ability to master all these dimensions, we use

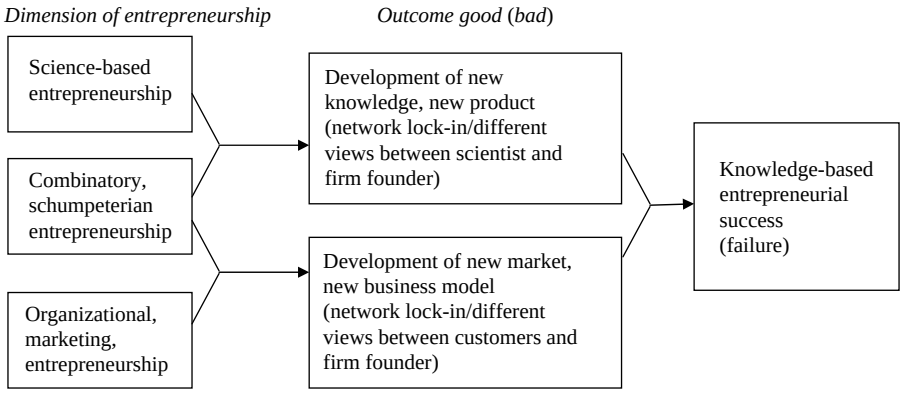


**Figure 2.**
Plural-entrepreneurship and outcomes at the firm level

a longitudinal case study in which we first evaluate the resources of the firm and the evolution of these resources over several years. This approach is completed by several interviews of the founders and employees to confront our results, the actual position of the firm and their views.

In this section, we present the information we collected from the firm and how we link them to our plural-entrepreneurship framework. Then we describe the studied firm.

**Evaluating capabilities in a plural-entrepreneurship framework**

To test the plural entrepreneurship framework we consider two dimensions: the technological dimension where innovation leads to the product/service the firm offers to the consumers, and the business model/marketing dimension, where innovation allows the firm to create a market for its products and services. Each of these dimensions is estimated by a specific combination of resources possessed by the firm. We create the specific combination of indicators by following the literature on innovative small firms and the resource-based approach of the firm and dynamic capabilities (Capaldo *et al.*, 2003; Barney *et al.*, 2001; Teece, 2007).

We create two constructs:

(1) *Technological/product innovation capability (TPIC).* Corresponding to the firm's capability to increase its technological know-how and expertise leading to a product or service innovation.

(2) *Business model/market innovation capability (BMIC).* Corresponding to the firm's capability to enhance its business model and understand the consumers' needs leading to an innovation in the marketing strategy or to the creation of a new market.

Each of these constructs corresponds to a specific combination of resources between four main categories: entrepreneurial resources (C1), human resources (C2), resources linked to external network (C3) and economic resources (C4). Table I presents a list of all the different items we observed, and indicates how we combined the different items to obtain an estimation of the two constructs:

(1) *C1.* The entrepreneurial resources combination contains indicators related to the entrepreneurs at the origin of the firm. We account for the numbers of entrepreneurs (C1.1), the more they are, the more they can distribute the different entrepreneurial activities among them, therefore we found this item relevant for both concepts studied. We also distinguish their domains of expertise (C1.2), between market knowledge involved in the business model, technical knowledge necessary for the product innovation, and management experience necessary for organizational innovations. The more entrepreneurs with previous knowledge in one of these dimensions, the more probable it is that they succeed to innovate in this specific dimension. We consider these items as mutually exclusive with regard to the two constructs. As in this case study, we do not search for organizational innovation, we had the management experience item to the BMIC concept, following the hypothesis that this kind of experience upgrades the business model formation capabilities of the entrepreneurs. Finally, we study the involvement of the entrepreneurs in the dimensions, to see if the entrepreneurs are distributed equally in all the dimensions or if they are predominant in one of them (C1.3 and C1.4).

| Resources observed | Linked to BMIC | Linked to TPIC |
|---|---|---|
| *C1. Entrepreneurial resources* | | |
| C1.1. Number of persons forming the entrepreneurial group | √ | √ |
| C1.2. Entrepreneurs' know-how | | |
| C1.2.1. Percentage of entrepreneurs with technical knowledge | | √ |
| C1.2.2. Percentage of entrepreneurs with market knowledge | √ | |
| C1.2.3. Percentage of entrepreneurs with business and management experience | √ | |
| C1.3. Involvement of entrepreneurs in technical activities | √ | √ |
| C1.4. Involvement of entrepreneurs in marketing activities | √ | |
| *C2. Resources linked to human resources* | | |
| C2.1. Total number of employees | √ | √ |
| C2.2. Percentage of technical/product developers | √ | √ |
| C2.3. Percentage of internal developers having a graduate degree | | √ |
| C2.4. Job rotation | √ | √ |
| C2.5. Training | | |
| C2.5.1. Marketing and management training | √ | |
| C2.5.2. Technical training | | √ |
| C2.6. Percentage of internal persons involved in marketing activities | √ | |
| *C3. Resources linked to external network* | | |
| C3.1. Use of non-proprietary tool or external development | | √ |
| C3.2. Intensity of technical collaboration with other firms | | √ |
| C3.3. Intensity of commercial collaboration with other firms | √ | |
| C3.4. Implication of users | | |
| C3.4.1. Users are involved in technical problem detection phase | | √ |
| C3.4.2. Users are involved in innovation/creativity phase | | √ |
| C3.4.3. Users are involved in diffusion/commercialisation phase | √ | |
| *C4. Economical resources/indicators* | | |
| C4.1. Total profit deriving from firm's technology/product | √ | √ |
| C4.2. Total profit due to non-proprietary technology and product | √ | |
| C4.3. Total profit coming from other activities | √ | |

**Sources:** Capaldo *et al.* (2003); Mohr *et al.* (2008); and Burger and Guittard (2008)

**Table I.**
Resources employed to evaluate the BMIC and the TPIC

(2) *C2.* The human resources combination contains indicators related to the type and quantity of human resources available in the firm. We consider the total number of employees and the percentage implied in technology/product development, and those implied in marketing activities (C2.1, C2.2 and C2.6). We expect that a higher number of employees and a larger percentage involved in one of these activities lead to higher innovation rate and a better success probability. We also take into account the diploma of the developers and the training of the developers and other employees during their stays at the firm (C2.3 and C2.5). We also expect that job rotation influences the probability of innovating in one of the dimensions.

(3) *C3.* The resources linked to external network combination contain indicators related to the contact the firm is able to create and to maintain with other firms and with consumers/users. We look for the existence of non-proprietary technology as a factor explaining exchanges with other firms (C3.1) and if there is collaboration, whether the collaboration is of a technical nature (C3.2) or a commercial nature (C3.3). The relation with other firms are not the only important ones, relations with users can be of critical importance for firms.

Following Burger-Helmchen and Guittard (2008), we distinguish between the involvement of users for technical problem detection, creativity and innovation, and commercialization/diffusion of the product (C3.4).

(4) *C4.* The economic resources clusters summarize different profit indicators. We distinguish three sources of profit. Profit coming from the firm's own technology/product (C4.1), profit coming from a non-proprietary technology and that is directly linked with the main product of the firm (C4.2) and profit coming from other activities but that are not dependent on the core technology of the firm (C4.3).

To appreciate the evolution of the firm and of these resource combinations, we obtained documents aimed at investors, at different phases of the firm, where the aims, products and market of the firm are presented. To understand these documents and sometimes the real motivation behind them that do no always show through these factual data we conducted several semi-directive interviews with the entrepreneur and the management team.

We had also access to an amount of information coming, among others, from reports, press releases, advertising articles, etc. Since these data can have different origins (internal or external to the firm), we verified their mutual coherence. In the following, we describe the firm under the name F.

## The firm selection

The firm studied, to be considered as a plural entrepreneurial attempt, had to be a high-tech start-up with at least an innovation in the product and one additional dimension (marketing, organization, etc.). To select such a firm we used a firm set built in the context of the research project "Keins" on knowledge-based entrepreneurship. To be relevant we had to ensure that the firm founder was a knowledge-based entrepreneur, we did that by selecting a firm where the founder was also the owner of the patent at the origin of the firm.

We sought a firm founded by people whose main reason for starting the venture was the willingness to develop their own business conception independently of the business conception of their previous employer. We also looked for a firm having relations with different networks and who gave importance to the knowledge they had obtained from their previous work on customers' needs, the technology, the suppliers, competitors and institutions (by looking at the financial help they obtained). Finally, to be relevant on the plural-entrepreneurial schema, the founders of the firm must consider of critical importance their specific technological knowledge and marketing/organizational entrepreneurial activity. The founder of firm F, met all these criteria.

Firm F was created in August 2000, by entrepreneurs A and B. Both are owners of the patents at the origin of the firm. Entrepreneur A is now CEO of the firm and supervises the international development of the firm. Previously, he was employed as an international brand manager for a major phone company, among others he was in charge of the system convergence between different phone operators. Before that he worked as information technology (IT) consultant for McKinsey. He holds a master diploma in IT engineering. Entrepreneur B is now CSO of the firm. He was previously employed as a project leader for developing new products by a major telephone operator.

Before that he worked in the field of technical development for another major phone manufacturer in California. He holds an engineering diploma. Both entrepreneurs have an MBA from a major international business school.

Firm F is active in the field of multi-country mobile telecommunications, providing initially its services in France, Luxembourg, Belgium and The Netherlands. In 2007, the firm entered the UK market and plans for 2008 to expand its operation to Germany, Switzerland and two non-European countries. The firm offers services addressing two different target groups. First, it serves the end-user segment, providing a multi-country contract solution which allows frequent travellers to reduce roaming costs significantly. Second, firm F offers to other enterprises that want to create their own brand of phone services to share its spectrum of license agreements and their know-how. Thanks to the unique, patented, technology firm F allows the customer to avoid expensive roaming fees.

Roaming is a general term in wireless telecommunications that refers to the expansion of connectivity services in a geographical location different from the original home location where the service was registered. Roaming occurs when a wireless service subscriber uses the facilities of another wireless service provider than the one he subscribed to. This second provider has no direct pre-existing financial or service agreement with this subscriber to send or receive information. The typical example of roaming is in the use of cellular phoning when a phone is in a location where its wireless service provider does not provide coverage (for example, another country). Roaming fees are traditionally charged on a per-minute basis and they are typically determined by the service provider's pricing plan.

The business idea is based on several patents which allow to have numerous regional numbers, e.g. a French and a Belgian one, on the same SIM phone card. The user has to choose one active line; logically depending on his location. The other lines are on inactive mode, they can receive calls which are forwarded to the active line. For example, if the user is located in France, his French line is active, he can call at local rates (ranging from 14 to 22 cents per minute for domestic calls), receiving calls to his French number at no cost and calls to his Belgian number for a forwarding cost of 18 cents per minute. Compared to an average roaming price of 85 cents per minute, possible cost reductions for firm F's customers are obvious. Furthermore, the consultation of the voicemail from the subscribed country is free. In addition, thanks to a unified message service, customers can access and manage their messages (voicemail, fax and emails) not only from their mobile phones but also from the internet or any other phone. Roaming outside the subscribed countries is charged at the average industry price.

Firm F is a mobile virtual network operator (MVNO). An MVNO is defined as a company providing mobile subscription services under its own brand name without having a spectrum licence (the firm does not have her own mobile phone network). The firm target a market niche which is not well served by the incumbents by settling an agreement with major national phone operators, buying a package of phone minutes and reselling them to individuals and firms adding specific services.

Firm F has agreements with major national phone operators in different countries where the firm provides her services. Firm F does not only target the retail business its agreements but also include the right to resell their interconnection right to other MNVOs, which makes the company a mobile virtual network enabler (MVNE).

An MVNE provides infrastructure and services to enable MVNOs to offer services to end-user customers.

In January 2002, the company has also launched a mobile service under its own brand targeting international frequent travellers and bringing 30-100 per cent price reduction on GSM mobile roaming charges plus improved seamless services.

## Results

### *General results*

As mentioned earlier, the purpose of this research is to understand the evolution of the different entrepreneurial resources activities, looking especially at the differences between the initial and the current situation.

The development of firm F is relatively smooth when we look at the variation of the resources and the results obtained. The distinct feature of firm F is that she constantly acted in such a way as to exploit her patented technological base. Unfortunately, but not surprisingly for the founders, the quest for profitability took several years. Launched in 2000, firm F reached profitability for the first time in 2004. Meanwhile, the firm had to raise €5.3 million at different steps of development between 2000 and 2006 and had to manage the financial crisis of the IT sector between 2001 and 2003. Since her start in 2000, firm F has almost doubled her turnover each year, reaching €6.2 million in 2005. Employment has grown fast since the launching of the MNVE activity, amounting today to more than 60 persons, which represents three times the enrolment at the beginning of 2005.

We can draw a number of observations from the analysis of the knowledge-based entrepreneurial behaviour. The founding team made a realistic and suitable analysis of the market and conceived an appropriate technology. This probably is due to their previous experience in neighbouring industries and commercial training. It is also worth noticing that market entry was eased by some major national players with whom the entrepreneurs had contacts before the launching of the firm.

As in every case study carried out after the start of the firm, it is difficult to reconstruct the original ambition and to draw the mindset of the entrepreneurs at that time on the basis of documents and interviews. Also, we cannot tell whether the evolution of the firm and of its capital corresponded to the real intended plan. However, the initial plan seems to us to be coherent and the final outcomes are close to the initial mindset we deduced. The major source of variation is related to the time horizon. This variation can be in disfavour of the firm (time to be profitable) but also favourable (time to develop other activities around the initial project). In the following, we link these to the evolution of the resources of the firm.

### *Plural entrepreneurial activity-oriented results*

In this study, we identified two types of entrepreneurial activity that enabled the firm to overcome the problems a start-up faces in her early days: a technological science-based entrepreneurship (patenting activity), a business model/marketing entrepreneurship (to communicate about a new type of product). There was no real innovation in the organization of the firm. We could add also a combinatory entrepreneurship activity (the tying together of the new technology and a new type of business model).

Tables II and III show our initial estimation and evolution of the resources linked to the TPIC and the resources linked to the BMIC.

| Resources observed | Initial evaluation | Evolution |
|---|---|---|
| *C1. Entrepreneurial resources* | | |
| C1.1. Number of persons forming the entrepreneurial group | 2 | = |
| C1.2.1. Percentage of entrepreneurs with technical knowledge | 100% | = |
| C1.3. Involvement of entrepreneurs in technical activities | Average | = |
| *C2. Resources linked to human resources* | | |
| C2.1. Total number of employees | 2 | 60 |
| C2.2. Percentage of technical/product developers | 80% | – |
| C2.3. Percentage of internal developers having a graduate degree | 100% | = |
| C2.4. Job rotation | Slow | = |
| C2.5.2. Technical training | Seldom | + |
| *C3. Resources linked to external network* | | |
| C3.1. Use of non-proprietary tool or external development | Yes | = |
| C3.2. Intensity of technical collaboration with other firms | High | + |
| C3.4.1. Users are involved in technical problem detection phase | No | Yes |
| C3.4.2. Users are involved in innovation/creativity phase | No | No |
| *C4. Economical resources/indicators* | | |
| C4.1. Total profit deriving from firm's technology/product | High | – |

**Table II.**
Resources linked to the TPIC

| Resources observed | Initial evaluation | Evolution |
|---|---|---|
| *C1. Entrepreneurial resources* | | |
| C1.1. Number of persons forming the entrepreneurial group | 2 | = |
| C1.2.2. Percentage of entrepreneurs with market knowledge | 100% | = |
| C1.2.3. Percentage of entrepreneurs with business and management experience | 50% | + |
| C1.4. Involvement of entrepreneurs in marketing activities | Average | = |
| *C2. Resources linked to human resources* | | |
| C2.1. Total number of employees | 4 | 60 |
| C2.2. Percentage of technical/product developers | 80% | – |
| C2.4. Job rotation | Slow | = |
| C2.5.1. Marketing and management raining | Seldom | = |
| C2.6. Percentage of internal persons involved in marketing activities | 20% | + |
| *C3. Resources linked to external network* | | |
| C3.3. Intensity of commercial collaboration with other firms | Very high | = |
| C3.4.3. Users are involved in diffusion/commercialisation phase | No | Yes |
| *C4. Economic resources/indicators* | | |
| C4.1. Total profit deriving from firm's technology/product | High | – |
| C4.2. Total profit due to non-proprietary technology and product | Low | = |
| C4.3. Total profit coming from other activities | Low | + |

**Table III.**
Resources linked to the BMIC

*The resources linked to the technological/product*. One of the founders of the firm took on the technological entrepreneurial activity. Therefore, he himself is the main resource of this category. At the launching of the start-up, the main technology was created, only some practical problems still had to be solved. The most urgent critical task was to obtain the patent (which is not entrepreneurial). Despite the fact that both entrepreneurs had a technology background (100 per cent in item C1.2.1, Table II) only one of them was involved in the technical activities on a daily basis (average on C1.3).

The total number of employees has grown strongly since the launching of the firm. Because at the beginning of the firm both entrepreneurs had a technological background, subsequent hiring of employees logically decreases this percentage. Over the last two years, the major part of the hiring had to do with the sale and adaptation of the products to the need of the consumers or administrative tasks (C2). For facilitating the implementation of firm F's products and services some non-proprietary features were added. Therefore, the firm has frequent relations with the major phone companies (C3.1 and C3.2). The firm geographical expansion leads to a growing quantity of relations the firm has with such phone operators. From the launching of the firm to today, the main part of the total profit of the firm is derived from the firm technology and her main product/service. But expansion of other activities naturally implies a decline in this proportion.

*The resources linked to the BMIC*. When starting their firm, the entrepreneurs had to choose between a wide range of possible business models, each entailing advantages but also technical, legal and managerial challenges. They chose to focus on one type of activities at the beginning of the start-up activity, and deliberately ignored some other forms of activities they could perform with the patented technology. The resources dedicated to the implementation of the business model and adaptation of the product to the different markets were those which grew fastest in the firm (C2.6). The contribution of users to the diffusion of the product was at the beginning of the firm very limited. Later, the firm engaged in some viral-advertising and proposed several sponsorship actions to the consumers (C3.4.3).

*The importance of the plural-entrepreneurial organization of the firm*. This part of the study explored the configuration, evolution and organization of the plural-entrepreneurial firm. This approach enhances research on entrepreneurial networks and dispersed forms of entrepreneurial activities (Minkes and Foxall, 2003). Such an approach certainly extends our understanding of organizational inertia and adaptability capacities and helps to explain the dynamics of start-up firms. Let us say some words about the effects of the plural-entrepreneurial configuration on the performance of the firm.

We identified two main entrepreneurial activities, but they did not receive the same amounts of resources and time from the founders. Resource allocation between the plural-entrepreneurial activities is certainly a source of performance (and survival) of the firm. As we expected the technologically oriented entrepreneurial activity and marketing entrepreneurship were important in the early stage of the firm. The firm already had a technology (but to be patented) at the beginning but still had to develop the technology and overcome many minor practical problems. Another task appeared to be crucial: the coordination of all the elements of novelty to obtain coherence in the activities and cohesion between the employees. The need for coherence and cohesion was also pregnant in the relation with the partners (a limited number at the beginning).

This configuration of plural-entrepreneurial activity proved advantageous for the performance of the firm because it gave her the capacity to be connected with a diverse set of external partners in a broad range of important firms and to integrate all the information internally.

The combinatory entrepreneurial task was performed by several people, with different levels of implication in the firm: the two founders, and the main financers. This was the only entrepreneurial activity carried out by several people. First, this

focalization allowed the firm to avoid being overloaded with tasks and problems. The overload occurs when too many tasks must be coordinated by a small number of individuals. Second, they focused on a business model that was new, but close enough to their previous activities in major phone companies. Therefore, they could use their former relation network and build on it to obtain new focused relations. At the same time, the entrepreneurs could feel assured by one of the major financers who approved their business model strongly so that the two founders could focus on their main entrepreneurial activities: science-based entrepreneurship for one, and marketing entrepreneurship for the other. The combinatory entrepreneurship existed because there where other forms of entrepreneurship that needed to be coupled with resources and competences in a new manner.

Discussions with the founders in summer 2007 also showed that during the period when only one of the entrepreneurial activities was followed, the firm did not do well. The firm had to manage to align the entrepreneurial activities, but each activity needed to be focused on one task and needed specific resources and training. It thus seems important for both theory and practice to be concerned about the factors that constrain and enable a firm to identify and adapt the entrepreneurial activities to changing knowledge, environment and resources.

This also suggests that it can be fruitful for researchers to consider the interplay between different forms of entrepreneurship. Plural-entrepreneurship is generated and maintained by individuals. As our study tries to show strong and cohesive ties at the individual level have a positive effect on the firm performance and we believe that the more heterogeneous the entrepreneurial tasks, the more important the cohesion between the individuals.

## Conclusions and implications

Some issues emerge from the analysis of firm F. There is a clear need for adapting the commercial behaviour of the firm to the technological innovation (Mohr *et al.*, 2008). The emphasis on the marketing and organization setting as an entrepreneurial activity was necessarily contemporaneous with the technological entrepreneurial task.

One of the major problems at the beginning of the firm was the anticipation of the adoption pace of the services provided to the customers. In contrast, the organization which needed to be implemented was relatively well anticipated. This rather smooth development comes probably from the fact that the major patent and the major technological development were obtained shortly after the foundation of the firm.

The objective was to deepen our understanding of knowledge-based entrepreneurship on the basis that such a kind of entrepreneurship must almost simultaneously be flanked with other forms of entrepreneurial activity. The high-tech start-up we analysed showed that actually this is true and that the evolution of firm F was mainly a plural-entrepreneurial attempt in the first years, and that it turned out to be more managerial along the several dimensions observed at the same time. This represents a significant evolution, therefore we observe a strong modification of the firm between its infancy and today's development phase (still too early to speak about maturity phase). Again we emphasise the importance of the triplet technology, product and market and the related entrepreneurial tasks and the more standardised activity of financing.

It is clear that failing in one of the above triplet elements would have been a hard blow for the firm hindering her development and profitability. Therefore, the plural-entrepreneurial activities must be conducted in a coherent way. In this case, there was a lack of control from above. It did not harm the firm because the founders had a similar background and a common view of the development of the firm. This common background is the main reason for the coherence of the firm's decisions: in the absence of this common background the control could have been given to a general manager (responsible for task allocation in a knowledge-based firm, Cohendet and Llerena, 2003) or sometimes to the financer.

This discussion raises clear opportunities for further research on plural entrepreneurship. We see three main directions of work.

In the first place in this work, we made a very direct assumption on the integration of knowledge and information by the firm. We assumed that the two founders worked perfectly together. What happens if this is not the case? What governance should be chosen?

In the second place, once we assume that these different forms of entrepreneurship exist, can we classify them in order to know which one is the more efficient, the least costly, the most creative? Are there specificities in some industries, which imply that one type of entrepreneurship gives better results in that industry than another?

And finally, our sole case study on plural entrepreneurship is not sufficient and further case studies in different industries would also certainly enrich our understanding of the pathways between users and innovation linked to new forms of entrepreneurship. In particular, these future case studies should explore the links between the lone firm, or lone entrepreneur and other elements of the environment. For example, could those firms rely on users and user communities to achieve sufficient efficiency in some entrepreneurial dimensions?

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