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**Spin-off firms, labour market institutions and entrepreneurial actors;
hybridisation of science-industry relations and dynamics of entrepreneurial
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Introduction

The “hybridisation” of science and technology is creating a new intermediate space between academia and industry. The creation of this new space has been accompanied by the emergence of new structures, “bridging institutions”, whose purpose is to facilitate the interactive circulation of knowledge and/or competences between the academic and industrial spaces. These are, for example, incubators, TLOs (technology licensing offices), public-private labs, research consortiums, technology-based start-up firms, collaborative research contracts and so on. Clearly, the economic performance of industries, regions and nations is increasingly dependent on their capacity rapidly to incorporate new scientific knowledge into new products or new production processes. This, more or less, is what is meant by the emergence of the “knowledge-based economy” (Foray & Lundvall, 1998).

However, the transformation of an entire system inevitably produces constraints, tensions and conflicts for all the actors, whether existing or new/hybrid, engaged in the process, since they are obliged to leave behind the old rules and regulations and to configure their practices anew. This is especially true when it comes to the financial aspects of research activities. The decline in public funding is undermining the old distributive principles (distribution between public and private sectors, diverse institutions or target priorities etc.). The increasing importance of mixed public-private funding raises questions about the “openness” of new discoveries by academics. Without exception, all types of “bridging institutions” face such conflictive situations to a greater or lesser extent.

Among these “bridging institutions”, start-up firms have recently been attracting particular attention. Indeed, in a number of European countries, universities, national research institutions and even R&D-based multinational companies are being encouraged to establish “incubators”, in order to boost start-up firms with a high technological potential. This is the most direct way in which the scientific “community” – universities and public research organisations notably - can transfer its knowledge and competence to industry. They are, therefore, putting in place a range of support or incentive policies (business plan consulting, IP management, funding aids, marketing etc.), to bridge the huge gap separating academia from commercial activities. Along with such institutional arrangements, administrative measures concerning the personnel status of (public-sector) researchers (paid leave to run an incubator, possibility of return to prior position after launching start-up, compatibility of academic status with private ownership etc.) are also being taken.

In particular, many authors have for a long time been investigating the two main issues that concern start-up firms, namely intellectual property rights and the search for venture capital. Although these issues are important from the public policy perspective, relatively few studies have been done from the viewpoint of the construction of entrepreneurial competence. After all, it seems very important to extend our knowledge of the links between involvement in the launch of a start-up and academic career paths and to ascertain what significance such an event might have for the career development of scientists and engineers.

In other words, we could consider the process of setting up spin-off firms with high technological potential as part of the actors’ professional trajectories and, at the same time, as part of an ongoing process of competence construction. This type of competence analysis combined with studies of professional trajectories could well complement more general analyses of spin-offs.

Thus the purpose of this paper is to present, however tentatively, a typological framework that seeks to classify spin-offs in terms of “competence trajectories”. To this end, we draw on the labour market literature on highly skilled scientific and technical experts (academics, scientists and engineers) and combine it with the institutional setting (environment) of start-ups. In this domain, complex interactions between the “scientific community”, innovation policy agencies and firms play a crucial role in shaping different “incentive mechanisms for the creation of spin-offs” and determining the structure of the “intermediate labour market”. It is one of the reasons why we need both to combine labour market analysis with the general dynamics of innovation and to locate it within the overall context of the institutional configuration of R&D.

The paper begins with a short overview of some selected literature on innovation, from the standpoint of the academia/industry relationship that structures the high-skill or scientific labour market.

In the second part, we will define our conception of the “intermediate labour market” located at the intersection of the academic and industrial spaces and characterise its internal tensions.

Finally in the third section, we will present some empirical studies based on a number of French case studies we have carried out in the last three years and attempt to construct a typological classification of various categories of entrepreneurs.

1. From the conceptual antagonism of the academia/industry relationship to an integrated mode of innovation

i) The production and the use of scientific knowledge and technical competences have long been regarded as separate spheres of action, one the province of academia, the other that of industry. Some scholars have advanced a general model in which the weakness of the links between them was explained by the fact that the two belonged to two contradictory “worlds”. Academic activities (teaching and research) were viewed to be closed in upon themselves, locked into a mode of structuring and organising power dominated by the academic community. Universities provided education, firms provided training: the knowledge and expertise dispensed by these two institutions were considered to be wholly different in nature. It was natural for basic science to develop independently of technology and of social needs.

From this perspective, the academic community is the key actor in higher education and academic research, with this “social circle”, this “invisible college” (Crane, 1969) defining and limiting its own sphere of activity. The disciplinary matrix, the value and rule systems and the conflicts and controversies within the community in question constitute the principle by which this sphere exists. The members of community share a common paradigm and are therefore able to subscribe to the same regulatory mechanisms and to construct common interests and beliefs. These are acquired through contact with other academics and the habits and customs of their particular disciplines. They are transmitted during the socialisation process and shape the behaviour and professional identity of individual academics. The knowledge and expertise that serve as a basis for these various learning processes are usually theoretical, generic and formalised within an academic discipline. Adherence to the rules, values and interests of the community, which is reinforced by the system of symbolic

gratification and by control of the profession, contributes to the construction of the "academic citadel" (Merton 1973, Dasgupta and David 1994). Finally, the academic labour market is auto-generative and reproductive.

Firms, in contrast, could be characterised by a mode of operation shaped by the competition to which their products are exposed in the market place, by short-term profitability and a hierarchical mode of organisation geared to the fulfilment of specific strategic and financial objectives. The researchers/engineers are governed by explicit rules of career competition that could be both external and internal to the firm and under the control of the owner of the capital or of his representative. The knowledge and expertise produced are applied to a given economic objective; they may be formalised but are often tacit and firm-specific. The incentive mechanism corresponds to an usual - and standard - maximization of individual financial gains.

This type of model is based on the simplified stereotype of individual agents as well as the linear trajectories of collective entities (research organisations, firms, laboratories, teams). It takes no account of the interactions between agents and privileges certain occupational categories to the detriment of others. Nor does it take any account of the division of labour or of the way it is organised. On the one hand, it focuses on the links between scientists that exist within the academic community but ignores the role and knowledge distribution between scientists, engineers and technicians as well as the variety of different sources of funding (Callon 1994, Joly 1997). On the other hand, it restricts researchers' activities to those that the academic community recognises and legitimates, that is it fails to take into consideration the relationships that academic organisations, laboratories, research teams and individual scientists have with their environment, and particularly with firms (Latour 1996).

The agents in these two "worlds" are supposed to be sufficiently far apart from each other for relationships between them to be sporadic and fraught and to amount to little more than attempts by one to control the other. Thus the academic community is considered to be more or less incapable of understanding industrial needs, while fulfilling a commercial objective or meeting a specific social need is incompatible with its fundamental task of producing knowledge. It responds to social demand, only because it is forced to do so, particularly as a result of cuts in public funding, which have had a negative impact on the quality of its output. Firms, for their part, have no other objective than their own financial profitability and invest only in targeted research carried out externally. From this perspective, relationships between the two "worlds" are possible only through the intervention of "intermediaries" (individuals, organisations or institutions) capable of bridging the gap (Carlson, 1994; Dodgson and Bessant 1996) between firms and academia.

ii) The second model contrasts with the linear view over the links between academia and industry. This approach tends to consider that there are much more complementarities and analogies between academia and industry. Markets and hierarchies inform both systems, their objectives might be compatible, if the compromises were well arranged. Occupational identities of agents in the two "worlds" could be closely related, even though there exists a difference of incentive mechanisms. It is therefore possible to establish networks of productive relationships between the two, linked either to the construction of competences or to the production of knowledge. These networks are both a vehicle for information flows and the means by which the resources of all those involved in innovation are coordinated (Knorr-Cetina 1982). By strategically devising relationships and creating trust between the partners, the research contracts make it possible to extend the boundaries of economic organisation beyond the firm (Cassier 1995, 1997, Estades 1995). Thus Dasgupta and David (1988) or Cohen and Levinthal (1989) note that the increasing co-operation on R&D both between firms and between firms and the higher education and research system may indicate that a new form

of industrial organisation is emerging. This model emphasises the strong and recurrent interactions between the initial socialisation in higher education system and the construction of competences in firms. From this perspective, it is no longer relevant to think in terms of a clear distinction between the basic research carried out by scientists in academic institutions and the applied research performed by engineers in firms. Any analysis must take account of the dynamic of the innovation cycle, the construction of competences, the knowledge flow and the various incentive systems in the integrated and interactive ways. These processes tends, through a multiplicity of feedback loops, to bring into play different functions/expertises/resources within research organisations and firms (Kline and Rosenberg's chain-link model, see Kline and Rosenberg 1986). From this point of view, there are "*grey zones in which academia and industry interbreed*" (Callon and Foray 1997). This non-linear model thus stresses the possibilities to reduce the diverging gaps - cognitive, strategic and occupational etc. - between academia and industry, although reckoning the very existence of tensions and conflicts between interests, norms and values.

iii) The global idea advanced here is that these two models could be put on the historical evolution of innovation systems. Such view is explicitly expressed by the **school of triple helix** (Erzkovitz, Leydesdorf 2000 a and b).

Taking transfer mechanisms of knowledge and competence as their starting point, the triple helix theorists extend the analysis of the innovation dynamics to embrace not only the relations between firms and the academia but also the state. Each of the three helices represents one of the "spheres" (Industry, Academia and Political power) and has its own internal coherence, dynamic, strategy and capacity for change. They argue that while these "spheres" have been for a long time relatively independents each others, in recent years they begin to interact mutually and produce overlapping "spheres" of interference. Thus firms are forging strategic alliances among themselves or with Higher education and research systems. The latter are not only producers of qualifications and knowledge but are also economic agents, as reflected in the emergence of the "entrepreneurial university". The state is opening up itself to various public actors (various groups and institutions) characterised more by the production of public goods at different levels (local, regional) than by their participation in acts of government. Each time these various partners establish relations, the interaction between the different modes of coherence and dynamics produces a range of non-homogeneous and non-synchronised reactions that act upon and disrupt the principles animating the partners' actions. This disruption forces each of the partners to negotiate and put in place a series of "arrangements", both internally and vis-à-vis its partners.

Finally, such repeated interactions end up creating an "overlapping sphere" where various principles, rules and practices hybridise.

The concept of "helices" is very similar to that of "spaces" utilized by "societal analysis" (Lanciano and al., 1998) in conceptualising the context in which the actions are structured and in the highlighting the varying degrees of compatibility between different dynamics. But the triple helix theory, based on the macro-political science, seems to lack eventually the construction of "actor" which behaves in context.

II. Dynamics of Labour market for researchers in an Integrated Mode of Innovation

i) Specific role of high-skilled labour market

We take very seriously the propositions made by the Triple helix theorists as to the emergence of new dynamics of innovation. At least, as a working hypothesis, we could agree with them about the fact that the new forms of science/industry relationship are being forged.

If it is the case, we must ask ourselves the double question of how the scientific labour market is affected by this trend and of how the new actors appearing in the labour market contribute to shape the new space of innovation at the intersection of academia/education and industry.

To do so, we can mobilise many conceptual tools forged by labour economists or sociologists which might be complementary. For example, neoclassical economists use often the human capital theory, implicit contracts theory, signalling theory etc. in the analytical framework of “new economics of science” (Stephan 1998). With the rigorous methods, these approaches produce some significant results and bring interesting insights to the institutional and descriptive analysis of labour market for scientists. Focused heavily on the scientific production with the bibliometric, they however offer little works on the labour mobility of researchers, on the creation of new activities or on the transfer of knowledge between academia and industry.

Sociologists also develop some useful tools like a concept of network which can be used in the analysis of labour mobility. As Callon (1991) stated it, knowledge and competences must take on a tangible form for its circulation: scientific articles, data, patents, technical objects, computer programmes, trainees, engineers, post-docs, etc. These various objects/actors connect each others through networking, which creates the “alignment” process of divergent interests. Although it is the task of the scientific community to formalise or codify knowledge, some knowledge remains tacit: a part of the new knowledge generated remains embodied in human actors in the form of competences. Since knowledge is fundamentally ‘sticky’ (von Hippel 1988) and tacit knowledge is context-dependent, it cannot easily be separated from the contexts or individuals that generated it. Although Callon argues that technical objects are also actors that serve as a medium for human capacities and play a part in constructing networks, it seems to us necessary, nevertheless, to attribute a particular status to human actors such as researchers, post-docs, professors, technical experts and so on. They only have an autonomous/endogenous –although partially- capacity of interpreting the context/object and changing the nature of networks.

That signifies that the high-skilled labour market (academic, scientists, and engineers) plays a specific role, which is not reducible to alignment of objects, in the dynamics of innovation. These human actors could be privileged tools for analysis of the structuration of the hybrid space that is emerging at the interface between academia/education and industry. The human actors are constructed, as occupational categories (scientist, teaching staff, engineers etc.), through the interdependent relationships between, on the one hand, forms of socialisation forged within the higher education and research system and, on the other, modes of organisational behaviour structured by firms’ R&D and human resource management practices. The principles governing the functioning of institutions and of the linkage between the academia, public agencies and firms, which are often unique to a region or country, are encapsulated in these human actors. At the same time, these communities of actors draw on the cognitive resources at their disposal and on the principles governing their professional modus operandi in order to help to specify this hybrid space and to construct specialisations in various technological fields.

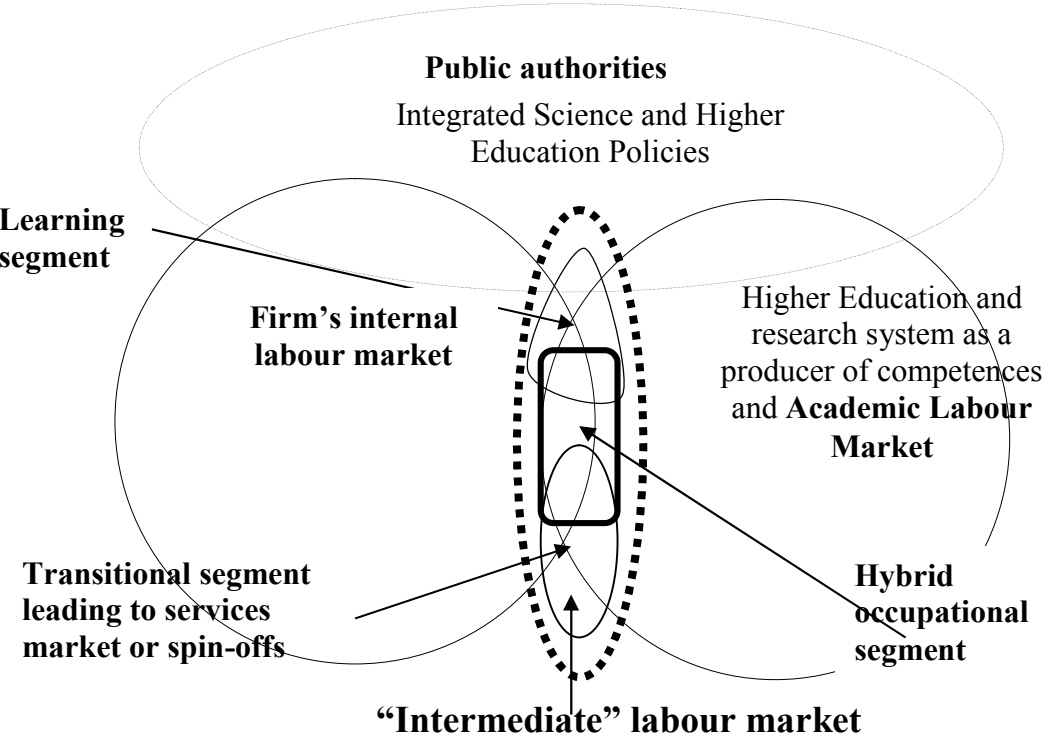
In view of the importance of human actors in the circulation of knowledge, the formation and mobility of the competences embodied in workers - that is properly the labour market issues - become a crucial factor in any analysis of innovation dynamics, particularly in the creation of new starting firms. For this reason, it seems useful to introduce a new notion of labour market with a view to fully seizing this complex, fluid and transient state. We could name it, temporarily, “intermediate labour market” which might help us to capture the new modes of coordination between universities and firms in the domain of co-production and transfer of competences. This intermediate labour market can be seen also as one of the

“bridging institutions” that function as intermediaries in the transfer of knowledge/competences between the academic and industrial spaces. It goes without saying that this mobility, embedded as it is in a set of societal/local contexts, has to be captured across the entire set of institutions that contribute to the production and circulation of competence.

ii) *Hybridisation of the academic and industrial spaces*

As technology and science converge to produce interactive innovation in accordance with the chain-linked model (Kline and Rosenberg 1986), industry and academia, represented by the scientific community within the Higher Education and research, intersect and begin to merge partially with each other. The “scientific” labour market, hitherto divided into the two “worlds” mentioned above, cannot remain unaffected by such a trend. Although these two spaces still have their own aims, their own principles governing the utilisation of results and their own modes of evaluation, their convergence gives rise, nevertheless, to hybrid forms of rules and coordinating practices. It seems to us that at least three new types of segments could be identified, all of them produced by the **hybridisation** of two spaces, which give rise in turn to new modes of functioning, new forms of mobility or new actors at the interface between academia and industry.

Figure -The new scientific labour market: an intermediate labour market based on the hybridisation between academia and industry; Co-ordination effort by the authorities



a) Hybrid occupational segment

The restrictions, relative to their growing needs, on the resources available not only to universities and research organisations but to firms as well, combined with an increasingly

short innovation cycle, have led to changes in their innovation strategy. They are all now seeking to establish partnerships in order to pool resources, minimise risk or increase synergy effects. Thus collaborative relations between research units and firms are proliferating and taking on forms that are increasingly contractual, long-term and productive for both parties. Such collaboration may take the form of a framework ‘research agreement’ laying down the conditions for a series of contracts between the two parties over a stipulated period, a research consortium, a joint laboratory or even jointly funded doctoral programmes, in which the students are jointly supervised by the firm and the research institution to which they are affiliated. These links give rise to networks through which not only knowledge but also, and above all, scientists themselves (private and public-sector researchers or research-active university teaching staff) circulate on a temporary or permanent basis. This increasingly two-way traffic, although generally considered as weak in European countries, compared with USA, constitutes a segment that we denote by the term “hybrid occupational”. It is in this first segment that the greatest share (in both quantitative and qualitative terms) of “hybrid” careers straddling the academic and industrial spaces is to be found.

b) New type of leaning segment

Similarly, the formation of competences is increasingly taking place on a collaborative basis. As a result, a growing share of scientists/engineers is being jointly produced by the Higher education and research system and firms, which is creating what might be called a learning segment. There are two typical scenarios in this second segment. In the first, Universities and Firms tend to co-manage some teaching programme for engineers, or to organise jointly the internship for graduate students. In view of their numbers, they constitute a pool of expert flux that is essential to cement academic or university research units and industrial activities. In the second, increasingly frequent scenario, students are enrolled in programmes whose content is common to firms and academic or university research units; examples would include the CIFRE programme in France and the CASE scheme in the UK. Doctoral students are selected and jointly funded on the basis of criteria negotiated between the academic and industrial partners and their academic progress and/or work in industry are jointly monitored and evaluated. Increasingly, they are guaranteed subsequent employment in the organisation in which they have completed their education.

c) Transitional segment

The **third segment**, which we describe as “transitional” between the academic and industrial spaces, is characterised either by the creation of “new services”, such as consultancy services, that contribute to the innovation process and straddle the academic and commercial worlds, or by spin-offs set up by researchers or universities. Post-doc contracts proliferate in this segment. Located half-way between “training” and precarious scientific employment, such contracts give firms access to a highly skilled workforce, a veritable repository of new knowledge and know-how, without them having to commit themselves to a period of employment greater than one and half years. They also enable research institutes to employ new PhDs to work on projects while they wait for a permanent position or to implement technology transfer projects aimed at industry. Sometimes, the same individual may hold a succession of post-doc positions, particularly in high-tech areas such as the biotechnologies. Nevertheless, this holding of a succession of post-doc positions, which is caused by the “queuing” phenomenon, often makes it more difficult for the individuals concerned to obtain a permanent academic position (Mangematin 2000).

Thus the “scientific” labour market is evolving from a form in which there was a clear distinction between academic and industrial careers towards increasingly less “pure” and increasingly more “mixed” or “hybrid” forms.

iii) The emergence of the “intermediate labour market”?

The existence of these various, mutually interacting segments might be leading to the construction of a new type of labour market in which the networks through which scientists and high-skilled experts circulate and new career paths, such as those offered by academic spin-offs for example, are disrupting the previously well-established mobility system. It is not therefore inappropriate to use, as at least working hypothesis, the concept “intermediate labour market” to denote this new form of market, because it is the product of different dynamics jostling up against each other in a new hybrid space and because at its core lies the threefold relationship between industrial, academic and public actors as we saw it (Ezkovitz, Leydesdorf 2000).

From our point of view, the intermediate labour market denotes a set of coordinating mechanisms by means of which two (or more) partners are able to procure the human resources, competences or expertise required to generate new ideas or realise innovations. This notion goes beyond the general definition of the labour market as a system for allocating the production factor “labour” through pure price mechanisms. It is a notion in which the principles governing markets and those governing organisations interpenetrate, reflecting a process of hybridisation between what economists customarily describe as the “external market”, in which adjustments are effected through both the price mechanism and the free choice/movement of individuals, and the “internal market”, whose rules (embodied in incentive systems) guide the construction of career paths over time. This hybrid space is essentially structured around the use of mobility networks, which give tangible form to the compromises that emerge from “bilateral governance”¹ - in the sense of the term ascribed to it by Williamson (1985). Within this space, and despite differences arising out of frequently contradictory institutional objectives, the strategies of universities and those of firms, together with the individual choices made by students and researchers, come up against each other in order to determine common interests.

In our view, the methodological and analytical value of introducing the concept of “intermediate labour market” into our analysis is threefold.

a) It allows us to focus not on the exchange of already formatted or certificated competences but on the **co-production of resources or competences**, which is playing an increasingly central role in the non-linear model of innovation. The notion of the intermediate labour market takes us beyond the rules governing market transactions in order to describe the institutional arrangements that enable resources to be shared and knowledge and competences to be jointly produced at the interface between academia and industry.

b) It helps us to take account of the fragmentations of this intermediate space that necessarily arise out of the tensions between the principles animating the academic and

¹ We are in fact dealing here with “trilateral governance” if we include the state as an actor intervening in science or higher education policy. This last actor, whose activity varies in intensity from country to country, has the capacity to structure the intermediate labour market by various means, including grants, research funding, management of university posts and so on.

industrial spaces, which are sometimes complementary and sometimes contradictory. Since the compromises between the two worlds are always fragile, there is a need for flexibility that leaves its mark on the intermediate space. The fragmentations frequently manifest themselves as pairs of opposing characteristics, such as precarious/stable, statutory/non-statutory, education-training/work, wage work/non-wage work and so on. The intermediate labour market can impart an overarching meaning not only to a particular configuration of the various segments but also, and above all, to their permanent reconfiguration, since the boundaries of each segment remain porous, permeable and shifting.

c) It enables us to incorporate into our analysis the temporal aspect of the overall dynamic. The adjective “intermediate” denotes the positioning not only at the interface of two spaces (the mediating function) but also between two states in the evolution of organisational forms. For example, a spin-off from academia evolves over time, moving, if it is successful, from the status of publicly-funded researcher/project group to a standard corporate form, via an intermediate status such as ‘company founder nurtured in academia’, ‘new start-up consisting of a founding team’, ‘unincorporated’ company and so on. As that example clearly demonstrates, the notion of the intermediate labour market is a tool for analysing a temporary state that exists prior to the solidification of an organisational form. In this sense, our approach is closer to that adopted by Callon (1995), which involves studying ‘*knowledge in the process of being created*’ (competences here in our case) by making a distinction between the “cold” world of economists, that is the market, and the “hot” world of sociologists, that is the space in which the creative activity takes place.

III Empirical studies of entrepreneurs; a typology of spin-offs and the intermediate labour market

The main idea that will be developed in this section is that the establishment of a spin-off is analogous to the construction of a ‘bridging institution’ between academia and industry and it is influenced by and, at the same time, influences individual trajectories in the intermediate labour market.

We take the view that spin-offs are located at the intersection between institutional and individual strategies and that these strategies are themselves the driving force behind the construction of the actors involved. Thus the institutions in question are part of either the academic space (universities, foundations, public-sector research institutions) or the industrial space (corporate R&D departments). The individuals or groups that set up spin-offs either come directly from one or more of these institutions or are direct users of the knowledge produced by them. The various forms of mobility associated with this process, the acquisition of knowledge and know-how that takes place and the construction of professional identities that occurs when spin-offs are established interact with the other tendencies observed in the intermediate labour market, such as the positioning of researchers, professors, engineers, doctoral students, post-docs etc., who are located within the same hybrid innovation space but in different segments of the labour market.

Thus our own deliberations are focused mainly on the founders of spin-offs, although other elements of the phenomenon also impact on the labour market (recruitment of collaborators etc.) as the newly established companies develop. The aim of our analysis is to reveal the organising principles driving the setting-up of spin-offs in terms of ‘entrepreneurial types’. This leads us also to examine the mechanisms institutions and individuals make use of when setting up spin-offs. However, we will focus particularly on the career trajectories of the

founders of spin-offs, on their labour market mobility and on the nature of the resources they accumulate in the course of their careers and which prove indispensable when it comes to establishing spin-offs.

In this paper, we have adopted the definition of ‘spin-off firms’ put forward by H. Desmoutier (‘Contribution à l’étude des entreprises de haute technologie’, Ph.D. thesis, Université des Sciences sociales, Toulouse in 1971) and used by practitioners in France: ‘*the founding of a technology-based company whose activity is linked to that of the incubating organisation*’. In this definition, therefore, the establishment of spin-offs is a ‘cross-cutting’ activity (Daval 2000) common to higher education and research systems and to firms. It reflects the diversification strategies adopted by these institutions but requires the intervention of actors with an entrepreneurial bent, which itself is manifested in a variety of ways, and in possession of a range of resources. These different strategies determine the extent and type of mobility in the intermediate labour market. After all, spin-offs are not only companies in the making but also a source of employment, not just for their founders but for their employees as well.

Our sample consists of some fifteen spin-offs from the higher education and research system (HERS), mainly in the IT sector, two spin-offs with their origins in HERS/industry collaboration and five spin-offs from large companies in the pharmaceutical and micro-electronics industries. We will not make any a priori distinctions between them, despite their diverse origins. We will consider only the initial period of their transition/ transformation into companies (Lanciano-Morandat, Nohara 2003), roughly the 3 to 5 years between the conception of the project and the setting-up of the company. For us, spin-offs are not a final outcome but rather a set of processes that have to be explained if they are to be fully captured.

Two types of indicators are used to construct models of both spin-offs and the ‘entrepreneurial types’ who set them up. The first is the nature of the conjuncture between the strategies adopted by individuals and those adopted by institutions; the second is the links that exist between the knowledge and know-how deployed and the spin-off’s strategy for protecting intellectual property.

Given the limited number of observations, it is not our intention here to draw any quantitative or normative conclusions from this provisional analysis. Our aim rather is to test our approach and, if possible, to construct a taxonomy that could subsequently be extended to a larger sample of cases.

III-1 The conjuncture of individual and institutional strategies

Founders of spin-offs bear the stamp, on the one hand, of a set of characteristics that are a product of their ‘socialisation’, family background, education and academic experience or career profiles and, on the other, of the knowledge and expertise they have acquired over time. These personal characteristics, which constitute their value system or ‘mental model’, define the possible choices and influence the strategic choices individuals make.

However, a decision to set up a spin-off also depends on the strategies adopted by the parent institutions as well as on the broader environment of the ‘*innovative milieu*’ of which they are a part. When setting up their spin-offs, founders may be in one of a number of different situations vis-à-vis the parent institution. They may have tenure or be working under

contract or may even be trainees or post-docs; they may also be young or experienced researchers, from an academic or more technical background, and so on.

We have identified four broad types of ‘dominant founder choice’ and four types of institutional strategy.

As far as spin-off founders are concerned, the nature of the strategic choices can be divided into two broad categories: those animated by the ‘pull’ principle that is offensive or proactive choices, and more defensive ones made in response to an environment. The ‘pull’ category includes those founders whose initial desire is to set up a company or who wish to create equity or assets for themselves; the ‘push’ category, on the other hand, includes those whose aim is to create their own jobs and those who, for want of any better option, take the place of an institution in order to carry an innovation through to completion.

As for the institutions, the strategies they adopt may be either implicit or explicit. By ‘implicit’ we mean that the institution has no clearly defined strategy for setting up spin-offs but that opportunism (adaptation to its environment, a shot in the dark on the part of its managers) eventually leads it to do so. Two cases can be identified. The first is a situation in which institutional restructuring has led to job losses (e.g. companies dealing with overmanning or universities reducing the number of non-tenured staff), the second a situation in which individuals set up spin-offs without the agreement of, or indeed in opposition, to the institution.

Explicit strategies may take several different forms:

- An institution may set up network structures in order to externalise part of its activity while at the same time maintaining very close links between the parent company and the spin-off. The motivation may be economic (risk reduction in the case of certain very radical innovations) or linked to a perceived need to concentrate on a company’s core business.

- An institution may support the establishment of a spin-off in order to maintain links or to keep options open for the future. Three cases can be identified. In the first, the project is a very risky one, and while the institution is interested in the outcome, the risk incurred is judged to be too great. In this situation, the institution maintains links in order to be in a position to endogenise the innovation if it succeeds. In the second, the project has been subcontracted from the institution; its purpose is to extend the institution’s operations to a sector or location where it has hitherto not been represented. In the third, several institutions are involved in the project (platform, hybrid public/private units, etc.).

- An institution may promote the establishment of a spin-off without any intention of maintaining specific links with the new company. The spin-offs set up may or may not receive aid from the institution, but there is no plan for the links to remain in place. In many cases, the institution’s objective may be to support a public development policy in a sector or area of activity. This type of project is often supported by public money.

Combining the individual and institutional dimensions produces the following matrix (Table 1).

Table 1: The conjuncture of individual founders' strategies and those of institutions²

Founder's strategy Institution's strategy (university, national lab or firm)		PULL strategy		PUSH strategy	
		i) Entrepreneurial strategy	ii) Asset- building strategy	iii) Job creation	iv) Desire to carry an innovation through to completion
I – Implicit strategy					
I-a. The institution lets part of its workforce go		4		22	
I-b. Establishment of a spin-off without agreement of or assistance from the institution		15, 19, 16	14		
II – Explicit strategy					
II-c. Externalisation in order to create network structures	II-c-1 for economic or financial reasons		-		
	II-c-2 with a view to concentrating on core business	6, 23		9	2, 8, 3
II-d. Support the establishment of a company in order to forge links	II-d-1 leaving the founder to take the risks				5, 20
	II-d-2 extending operations through subcontracting		13	1	11
	II-d-3 establishment of a unit in which several institutions are involved	18			21
II-e. Promoting the establishment of a company without retaining links	II-e-1 Development of an economic environment	7, 10, 12, 17			

III- 2 The link between the various types of knowledge and expertise and a spin-off's strategy on the protection of intellectual property rights

However, the position of spin-offs and their founders also proves to be very different depending on whether or not the founder has produced the scientific or technological knowledge the firm has been set up to exploit. The type of protection for intellectual property they favour depends on the nature of the innovation the spin-off is going to implement (radical, incremental, organisational, market), the type of knowledge and expertise deployed and the state of the competition. This initial positioning within the parent institution interacts with their dominant individual choices and helps to shape their plans and business models. This incubation is also the source of tensions and conflicts between the institution, the founders themselves and those supporting and monitoring the project, in many cases because of the considerable incompatibility between their interests and values. Consequently, as the actors gradually adjust to the new situation, the options for action that emerged out of the initial plan may be altered slightly or even changed altogether as the new company is

² The numerals in the boxes correspond to the various spin-offs surveyed. The detailed analysis is set out in the annexe.

established. The process of setting up a spin-off is rather like a learning process during which the actors sort through the possible options by trial and error.

Thus the establishment of a spin-off involves the transfer (or duplication) of a certain amount of knowledge from the parent institution to the new entity. The parties involved, namely the parent institution, the founder and the spin-off itself, each need to protect these various resources, whether by legal means or otherwise, particularly in the case of the intangible assets, such as knowledge, competence and expertise, they are bringing to the project. Depending on the type of knowledge and expertise in question, the intellectual property rules that will be negotiated take different forms, as Table 2 shows.

Table 2: Type of knowledge and form of protection for intellectual property

Holder of the property rights	Combination of type of knowledge and form of protection			
	1) tacit knowledge and know-how without protection for intellectual property	2) formalised knowledge protected by a patent	3) tacit knowledge and know-how and purchase of a licence	4) tacit knowledge and know-how associated with a patent
A) founder(s)	16			3 (2 jointly with the parent institution and 1 with the institution and another institution)
B) individuals who have contributed to the innovation but are not involved in the spin-off (may or may not be employed by the institution)				1 (jointly with the institution and the founder)
C) the institution involved in setting up the spin-off			2	4 (of which 2 jointly with sole founder and 1 with sole founder and another institution)
D) another institution				1
Total number	16	-	2	5

Of the 23 spin-offs investigated, not one was established solely on the basis of formalised knowledge protected by a patent. In other words, all the transfers of knowledge were supported to varying degrees by tacit knowledge and know-how, which is why the mobility of the actors involved in knowledge transfer, and more especially in the establishment of spin-offs, is crucial. In this regard, several significant trends can be observed:

- The vast majority of the spin-offs investigated (16 out of 23) were set up without any formalised intellectual property, with only tacit knowledge and know-how being transferred. Most of the companies were set up to exploit incremental innovations in either products or services (12 cases) or in expertise (3 cases). Even in the one case in which the innovation being exploited was a radical one, there was no protection of intellectual property. There are two reasons for this. Firstly, the founder wished to maintain absolute secrecy in a highly competitive market (patents of course are in themselves a source of information). Secondly, there is little point in patenting such information because so much tacit knowledge is required in order to implement it.

- Only 2 of the spin-offs were set up on the basis (among other things) of a licence. Both of them were the result of collaboration between a company and a public research establishment. The companies in question sold the licences to the spin-off and as a result the founders themselves, by virtue of their mobility between the two institutions, were the

mediums for the transfer of the tacit knowledge and know-how required to use the licence. By retaining the patents, the parent companies remain involved in the type of activity being developed by the spin-offs. The issues at stake in the two cases are different, however; in one case, the innovation is a radical one, while in the other it is incremental.

- Only 5 of the spin-offs were set up on the basis of a patent (among other things). A strategy of this kind, revolving essentially around a patent, turns out to be relatively rare in our sample. We do not know whether this reflects selection bias (predominance of IT sector, among other factors) or a French societal characteristic. In any event, spin-offs in this group were set up to exploit a radical innovation (2 cases) or to market a product or a service, or even in response to extreme competition in the market (3 cases). The intellectual property rights are usually held by the individual founder(s) and by the parent institutions.

III-3 Constructing a typology of spin-offs

The various aspects analysed up to this point provide a basis for constructing an initial typology of spin-offs. The conjuncture of the individual founder and the parent institution, the type of knowledge and expertise underpinning the establishment of the new entity, the mode of intellectual property protection and the ties such protection may or may not create between the parent institution and the founder all feed in to the construction of four models of spin-off firms.

In most of the cases, there is no harmonious ‘match’, and the strategy of one or other party is decisive. In some cases, the parent institution’s strategy will be ‘weak’, which gives free rein to that of the founder, or at least creates a space in which individuals are able to implement the strategies they have developed. In other cases, it will be ‘strong’ or ‘determined’, meaning that it seeks to dominate that of the individual founder or to impose its own (Table 3).

If this observation is cross-linked with that presented in Table 1,

- then the cases in which the parent institution’s strategy is ‘weak’ equate to the implicit form of institutional strategy and, irrespective of the type of individual actor involved (A1 and A2), to that in which the parent institution leaves the founder of the spin-off to take the risks (C1) or is seeking to extend its operations through subcontracting, or even to that in which the institution, encouraged by considerable public incentives, supports the establishment of a spin-off in order to contribute to the development of a particular economic environment (D).

- Conversely, the cases in which the parent institution’s strategy is ‘strong’ equate to two specific cases. In the first, the institution is pursuing an explicit outsourcing strategy in order to set up a network (B1 and B2). In the second, the parent institution sets up a platform or unit for external collaboration (C3).

- In models I and IV, there is no doubt as to who is the dominant actor. In the former case, it is the individual entrepreneur, while in the latter it is the parent institution. This lack of ambiguity increases the spin-off’s ability to become a company in its own right. On the other hand, in models II and III, both partners can claim to be the dominant actor. In case II, neither the institution nor the founder really wishes to have full control, which impedes the firm’s future development; in case III, there is a possibility of tensions and conflicts emerging between the two partners’ interests and value and an ensuing struggle for control of the spin-off.

	Individual 'pull' strategy	Individual 'push' strategy
Parent institution's strategy weak	<p style="text-align: center;"><u>Model I</u></p> <p>The individual founder's strategy prevails over that of the parent institution; the incremental innovation is underpinned by tacit knowledge and know-how; the spin-off has real potential for developing into an independent company and creating jobs. These jobs will be created in the external and intermediate markets, depending on the individual case.</p> <p style="text-align: center;">*</p> <p>2 'entrepreneurial types' emerge: the entrepreneur/manager and the entrepreneur/independent expert.</p> <p>10 examples were identified³</p>	<p style="text-align: center;"><u>Model II</u></p> <p>Both the parent institution and the founder are more interested in the objective (employment or innovation) than in the process of establishment itself. The innovation may be radical and protected by a patent or licence, or incremental and not protected. The spin-off's future is very much open; usually falls within the scope of model I or III</p> <p style="text-align: center;">*</p> <p>3 'entrepreneurial types' emerge: the expert in an innovative niche, the nomad and the temporary founder.</p> <p>5 examples were identified⁴</p>
Parent institution's strategy strong	<p style="text-align: center;"><u>Model III</u></p> <p>The individual founder's strategy and that of the parent institution are both substantive and may lead to disputes (1 case) or to a division of power. In both cases, the innovation is incremental. In the case in which a dispute arose, there was a patent held originally by the parent institution. The spin-offs in question have a chance of creating jobs in the external and intermediate markets.</p> <p style="text-align: center;">*</p> <p>2 'entrepreneurial types' emerge : the innovative academic/scientist and the industrial founder</p> <p>3 cases were identified⁵</p>	<p style="text-align: center;"><u>Model IV</u></p> <p>The parent institution's strategy is dominant: it seconds one of its permanent managers to take charge of the spin-off. Whatever the individual's legal status, this secondment does not mean that the link with the parent institution is broken. On the contrary, the spin-off may be no more than a temporary phase in the individual's career, who may return to the parent institution after a period with the spin-off. In 2 cases out of 5, the innovation is radical and in 3 cases it is protected. The spin-offs' mission is to create jobs and to recruit in the external market.</p> <p style="text-align: center;">*</p> <p>1 'entrepreneurial type' emerges : the 'assigned' founder⁶</p>

³ 4, 15, 19, 16, 14, 13, 7, 10, 12, 17.

⁴ 1, 5, 11, 20, 22.

⁵ 6, 23, 18.

⁶ 2, 3, 8, 9, 21.

IV–Typology of start-up according to four ‘entrepreneurial types’

From within these four models of spin-off formation, several entrepreneurial types emerge. We will examine each one in turn.

I-a ‘The managerial entrepreneur’

This group comprises engineers or (non-academic) managers who, faced with the weakness of the parent institution’s strategy, set up their own company. The new company may or may not receive support from the parent institution or the state. The founder has industrial and managerial experience, acquired within the parent institution. In the course of his career, there have been many indications of the value he attaches to the function and status of company director and entrepreneur. The new company depends more on his management abilities or market experience, combined with his entrepreneurial or asset-building ambitions, than on scientific findings or explicit know-how. The spin-offs set up in this way may either become companies in their own right or disappear very quickly. The transition between the status of spin-off and fully-fledged company is often relatively unproblematic, since the founder has a manager’s intuition or sensibility, which is not always the case with academics who set up spin-offs. When they have stabilised, they may emerge as medium-sized companies that create jobs and recruit largely in the external market in accordance with the customs and constraints associated with that market. Some founders set up a number of companies as they pursue their asset-building strategy. Others take on the role and status of ‘proprietor’ or ‘boss’, thereby demonstrating their attachment to the company they have founded. This founder profile is not significantly differently from that of other entrepreneurs who set up companies not based on technologies.

I-b ‘The expertise-based entrepreneur’

The researchers who can be placed in this category have somewhat varied career profiles, but they all share an entrepreneurial strategy and individual expertise in incremental technological or organisational innovations. For example, two of them who did their post-doc training in the USA came to value the dynamic of the American research system, which allows two-way traffic between the public and private sectors, as well as the ‘business minds’ of American academics. Then, taking their Ph.D. theses as a starting point, they designed a product that was not scientifically very interesting but was easily marketable. Their spin-off was set up on the basis of this product. Another used his general scientific and technical expertise to set up his own consultancy business in the area of science-industry relations. He is assisted by public funds and is contributing to regional economic development.

All those in this category relied on their own individual tacit knowledge and expertise, acquired in the course of their education and in their careers within the institution, and on their ability to develop incremental innovations as the basis for setting up their spin-offs. In most cases, this knowledge is not protected from the competition, since it is too closely linked to the founder’s own experience. Like their counterparts in the previous type, these founders have a particularly positive notion of the entrepreneur. The companies they set up have a certain degree of stability but do not create many jobs. They may be either one-man companies set up to enable the founder to escape self-employed status or very small

companies that use the intermediate market in order to make as much use as necessary of the competences of young researchers hired on temporary contracts.

II-a 'The involuntary entrepreneur'

The personal and professional status of this type of founder is indeterminate when the spin-off is set up. In many cases, he is a doctoral student or temporary contract researcher who knows he has little chance of a permanent position in his institution or a researcher on a permanent contract more interested in innovation than in basic research. In any event, he is likely to be somewhat on the margins of the research team.

Consequently, he is more concerned than his colleagues that the research project they are engaged in should lead to an actual innovation. The basic motivation for his behaviour seems to be an interest in technological adaptation to the market rather than purely academic evaluation of their work. He thinks he knows what has to be done in order to fill the gap between research and the market by introducing a product or service or a range of specific products. It is this technological capacity that underpins the start-up company. Positioned in a niche market and deploying tacit knowledge and expertise that may or may not be patented, the spin-off is seldom destined to develop into a large company. It usually remains a very small company and employs few people apart from its founders; any new hires are recruited in the intermediate market and offered temporary contracts. It achieves stability by virtue of the 'symbolic' rather than actual ties it maintains with the parent institution. This type of founder does not set out with the ambition of becoming an entrepreneur but in the process of establishing the spin-off and transforming it into a company, he may become one.

II-b 'The nomadic' founder

He is usually a tenured researcher but may also be a researcher on a temporary or other precarious contract who, on the basis of his qualifications and research record, is able to achieve some degree of economic stability when he so wishes. He is more interested in his scientific or academic work than in implementing an innovation, but he takes the view that the two go hand in hand. Consequently, he chooses to move between academia and industry, and the establishment of a company is one vehicle among others for this mobility. The spin-off is not necessarily set up with a view to becoming permanent; once the product or service has been diffused, its scientific or technological capabilities tend to be constructed on the basis of a mobile labour force employed by the parent institution or remunerated by means of gifts or donations. It does not seem destined to create permanent jobs. The type of innovation the spin-off was set up to exploit may be radical and may also be supported by the holding of a patent, in addition to tacit and specific knowledge and expertise.

II-c 'Temporary founder'

This type of entrepreneur emerges when the spin-off is set up by a group working together. He may be one of the founders, but he is more a temporary supporter than a manager of the spin-off. Affiliated to the parent institution, and in some cases joint holder of the patent on which the spin-off is based, he devotes only part of his time to the spin-off and quickly returns to his career within the parent institution once it has been set up. He may sometimes retain a financial interest, even though he is no longer actively involved in the group. In any case, he is contributing to the parent institution's strategy of extending its networks of influence within its environment.

III-When a strong institutional strategy is combined with a ‘pull’ strategy on the part of the founder, the role played by network structures in the productive system becomes fundamental. The institution seeks to use the founders’ individual capabilities to create such networks or to extend their scope to encompass research, while individuals make use of the institution’s investments and knowledge in order to implement their entrepreneurial or asset-building strategy. The conjuncture of the dominant but not necessarily compatible strategies adopted by the founder and the parent institution may be a source of tension and conflict.

III-a ‘Star scientist entrepreneur’

This entrepreneurial type is the one that receives most media attention. He is a recognised scientist who uses his reputation and his previous work (which may be formalised in a patent) to set up a spin-off. He receives some initial support from his institution, which enables him to develop a highly innovative (radical) area of activity linked to knowledge or expertise developed within the institution. This makes him an example for others within the network organisation to emulate. However, his reputation and the media interest in his innovation may encourage him quickly to seek his independence from the parent institution. The spin-off is likely to remain a small company. It meets all its labour requirements in the intermediate market, employing researchers temporarily seconded from their institutions, contract researchers hoping for a permanent position and doctoral students.

The founder’s entrepreneurial spirit is not confined to setting up one company. This is one project among others, which may possibly constitute a source of future employment for the young researchers affiliated to it. He does not leave academia and continues to be active throughout the intermediate space. If he does not wish to remain a managing director permanently, the institution takes steps to find a replacement for him in this capacity.

III-b ‘The opportunistic entrepreneur’: the industrial entrepreneur

This type of entrepreneur is usually an engineer or manager, seldom a researcher. As in the previous case, he has an entrepreneurial strategy that the institution’s policy enables him to implement. In contrast to the previous case, however, the knowledge and expertise deployed in the spin-off are tacit and general (incremental innovation, organisational knowledge) and his entrepreneurial abilities and desire for independence bring him into conflict with the parent institution’s strategy much more quickly than in the previous case. Soon after its establishment, either the spin-off will rejoin the parent institution’s network, making its founder more akin to the entrepreneurial type in model IV below, or the entrepreneur will sever his ties with the parent institution and become a managerial entrepreneur, as in model I.

IV ‘The salaried founder’

This entrepreneurial type is a permanent employee of the parent institution. He is temporarily seconded in order to set up the spin-off but has no explicit intention of making his career there. The spin-off is a means of outsourcing part of the institution’s innovation activity and establishing an extended labour market.

Some provisional conclusions

The various spin-offs analysed have very different prospects. Some of them have business models that provide for the development of a lasting small or medium-sized firm (models I and IV), while others are envisaged as temporary structures that may either disappear or be reintegrated into an institution, whether they achieve their objectives or fail to do so (models II and III). This diversity shows that spin-offs are a complex social construct, which depend in part on the state of the hybrid innovation space. Thus the image of Californian spin-offs which, exploiting the exclusive rights to market a radical scientific invention granted by a patent and backed by business angels undaunted by enormous risk, succeed in transforming scientific knowledge and start-up capital into huge profits or fortune with an IPO, is not the one that dominates the scene, at least not in France. Of course, this type of success exists in France, but is far from being the norm in our case studies.

As we have observed, this complexity arises out of the interdependence that is created through the interactions between institutional and individual strategies. Because of the possible incompatibility between the choices made by the two partners and the values to which they subscribe, these interactions may in turn give rise to tensions and conflicts. Thus the various modes of establishing a spin-off seem to be determined by, and to play a decisive role in, the construction of various 'entrepreneurial types'.

To return to the intermediate labour market, the founders' strategies are also very diverse when it comes to recruitment. Some look to the external market, while others favour the use of the resources available in the intermediate market. Those spin-offs that are intended quickly to become companies in their own right put in place their systems of work organisation, hierarchical systems (usually very traditional ones) and the necessary categories of human resources in accordance with a strict plan. The founders, who tend to be engineers or managers by profession, favour the external labour market as a source of new recruits and also make use of the various types of employment contract permitted under national regulations (permanent, fixed-term, temporary, etc.). Those spin-offs set up as temporary units tend to make considerable use of the intermediate market because of their need for highly specialised knowledge that quickly starts to become obsolete. The founders of these enterprises are very familiar with the flows of highly specialised labour in the intermediate market and with the rules of the partner institutions. They have sufficient cognitive proximity to attract students, post-docs and contract or self-employed researchers and thus to derive maximum advantage from the job flexibility that characterises this market.

The links of variable strength maintained with the parent institution determine the forms of human resource management within the spin-offs. Thus those that fall within the scope of models III and IV are more influenced than the others by the parent institution's internal labour market (company or academic labour market) and develop what might be called a company internal market. Similarly, those spin-offs in which entry is based solely on a specific innovation or technology or by a single level of qualification are in effect operationalising the notion of occupational labour market.

However, within these broad trends, which lead us to make distinctions between various types of spin-offs and founders, the movements and changes in the labour force associated with the establishment of spin-offs take place in different segments of the intermediate market, whether it be the learning segment, which plays an important role in

model II, the transitional segment leading to service market in model IV or the hybrid occupational segment in models II and III.

More generally, this paper has sought to examine the embeddedness of the intermediate labour market in a complex industrial whole in which the industrial dynamic is given due consideration.

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Annexe

Analysis of the movements caused by the establishment of 23 spin-offs in

	Founder's choice	Institution's strategy	Type of knowledge associated with type of IP	Type of knowledge transfer associated with an innovation	Founder's occupational profile	Labour flows S-I or I-S
1	Group 4+3 then 1	IId2	4 a+c+d	Radical technological	Academics/PhDs INRIA researchers No professional experience other than INRIA but experience in the USA	On set-up 5S-I then 3 I-S balance S-I 20 120 jobs created
2	Individual 4 then 2	IIC2	4 a+c	Radical technological	Academic/PhD INRIA researchers No prof. experience apart from INRIA	On set-up 4/5 S-I Balance: 30 jobs created
3	Group 1 and 4	IIC2	1	Incremental technological	Engineers, PhDs, academics/ Inria researcher Experience in RF and in industry	20
4	Group 1 then 2	IA	1	Incremental technological	Academics/PHD students No prof. experience other than INRIA	2 then 30
5	Group 1 and 4	IId1	1	Incremental technological	Engineers Technical experience and management in spin-off as employee	22 then 32
6	Individual 1 and 2	IIC2	1	Incremental technological	Engineer Technical experience and management in spin-offs as employee and founder	10 then 14
7	Group 1	IIE1	4 a+c	Marketing of an innovative product	Engineering PhDs INRIA researchers and engineers No prof. experience other than INRIA and USA	6 then 10
8	Group 4	IIC2	3 c	Product Incremental technological	Engineering PhDs, Technical and managerial experience in large companies and in public sector	4
9	Group 1 and 3	IIC2placements for students	4	Provision of high-level services Incremental technological	Academic/PhDs Diverse experience	3 then 12
10	Group 1	IIE1	1	Provision of high-level services Incremental technological	Engineer, academic on CIFRE grant. Management experience in large company.	2 then 4
11	Collective 4	IId2	1	produit de haut niveau Technologique incrémentale	University academics/doctors -researchers INRIA	3
12	Group	IIE1	1	High-level product	Engineers, experience in	5 then 12

	1 et 2			and service Incremental technological	spin-offs and in USA	
13	Group 4 and 2	IId2	1	Incremental technological; adaptation of a product to a specific market	Engineer, experience in large companies, contact with financiers and head of Eurécom development unit	7
14	Group 1 and 2	I b	1	Production of equipment Incremental technological	Lecturer/researchers (engineers, professional paper/thesis, experience in technical centres) + PhD students	4 to 33
15	Group then individual 1	I b	1	Suppliers of products for large company and then for industrial area	Engineer, experience in large company and in regional economic and R&D policy	1 then 50
16	Individual 3	I b	1	Expertise in patents	Lawyer, experience in patent management	1 then 4
17	Individual 1	IId1	1	Management of research priorities	University professor (physics) with experience of S-I relations	1 then 15
18	Individual	IId3	1	Expertise in biotechnologies at local level	Academic researcher, government experience in field of technology.	1
19	Individual 1	I b	1	Suppliers of products to large company and then to industrial area	Engineer/PhD, experience in several large companies, first experience of a start-up	1 then 13
20	Group 1 and 4	IId1	3 d	Radical technological	Academics/ PhDs, experience in RF and in research in large companies and in associations in different countries	5 then 40
21	Group 4	IId2	1 (secrecy agreement)	Radical technological	Academics/PhDs, experience in RF	5 then 30
22	Individual 3	I a	1	Incremental organisational	Engineers/PhDs Experience in corporate sector	1 I-I then 10
23	Individual 1	IId2	4 c	Incremental technological	Academics/PhDs Experience in spin-offs as employee and in corporate sector	1 I-I then 20