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«The emergence and growth of an improbable laboratory in economics and management: the case of BETA»

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Notice introductive : **Jean-Alain Héraud**

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Notice pour les 50 ans du BETA

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L'article publié en 2007 par ces deux figures historiques du BETA mérite d'être relu et médité à l'occasion des 50 ans du laboratoire pour plusieurs raisons, que nous allons essayer d'expliciter. Les auteurs - les « deux Patrick » - ont considérablement contribué à l'émergence de ce qu'ils appellent ici *l'improbable laboratoire en économie et management*. Ils ont eux-mêmes particulièrement contribué à l'émergence du champ de recherche bien reconnaissable et internationalement reconnu du BETA qui tourne autour de l'innovation (économie, politique, management de l'innovation, puis de la connaissance, puis de la créativité), mais comme le montre bien la première partie de l'article, le collectif de chercheurs qui va former le BETA s'est construit d'emblée de manière interdisciplinaire. Nous voulons dire par là que ce sont les échanges entre chercheurs de champs différents au sein de l'économie (macro, micro, histoire de la pensée, innovation, gestion…) ainsi qu'avec d'autres disciplines (sciences, mathématiques) présentes dans l'Université Louis Pasteur des années 1970 et 1980 qui sont au cœur de la construction du laboratoire et à la source de sa créativité.

Ainsi que le rappellent Dos Santos Ferreira, Ege & Rivot (2020) repris dans le *Document de Travail Hors Série 2022-01,* l'ULP était à l'époque en création et accueillait la communauté des économistes désireux de s'éloigner de l'environnement de la Faculté de droit pour développer un modèle original de recherche plus proche du standard international des sciences. La question était moins, pour la Faculté en 1970 puis le BETA en 1972, de bénéficier d'un environnement plus riche en moyens financiers, que de profiter d'un nouveau contexte pour pratiquer autrement la recherche et également restructurer les formations sur la base de la recherche. Nous verrons toutefois que le changement de contexte institutionnel, c'est-à-dire l'appartenance à un établissement dominé par les Facultés de sciences dites dures, a constitué un choc créatif et non un phénomène d'assimilation. Certes le BETA est créé à la demande du président Guy Ourisson (un très grand chimiste et un administrateur visionnaire) pour que les économistes, comme les « scientifiques », se retrouvent quotidiennement dans un lieu de recherche collective, mais cette communauté ne fonctionnera pas non plus comme un laboratoire de chimie ou une équipe de médecine, car elle inaugure un fonctionnement décentralisé. Le BETA n'a jamais été le labo « Untel » dirigé par un patron, mais une fédération de petits collectifs en constante interaction. C'est ce qui a fait son originalité et sa force. Les tutelles - l'ULP, et le CNRS à partir de 1985 - ont forcé à choisir un et un seul nom de directeur pour porter le projet du laboratoire sur chaque période de programmation, mais le BETA a toujours préféré communiquer en tant que collectif non hiérarchique, car c'est cela sa vraie nature.

L'article analyse cette « émergence improbable », puis le développement du BETA dans les années 1970 et 1980, avant de se concentrer sur les développements en management (*knowledge management and strategy*) jusqu'aux années 2000. La première partie, jusqu'à la page 59, est

essentielle pour comprendre la genèse du BETA. La seconde retiendra l'attention des lecteurs intéressés par le management, mais aussi celle des chercheurs de toutes disciplines intéressés par l'innovation. Les idées forces structurant la phase d'émergence interdisciplinaire du laboratoire continuent à se manifester dans la construction de la recherche en management stratégique du BETA. Celle-ci, centrée sur l'innovation, la gestion de la connaissance et la créativité collective, est en phase avec une des dimensions centrales de l'approche partagée dès l'origine par tous les fondateurs du laboratoire, à savoir l'interprétation des phénomènes économiques et organisationnels à tous les niveaux (micro, méso, macro) comme l'expression de *systèmes complexes en évolution dans le temps*. Toutefois, comme le rappellent Patrick Cohendet et Patrick Llerena au début de la seconde partie de l'article, la communauté strictement « management » du BETA ne représente que 20% de ses forces vives. De ce fait, le plus intéressant à mettre en exergue ici, à l'occasion de la célébration des 50 ans, reste clairement les parties de l'article consacrées à la phase d'émergence (1971-1985) et à la phase d'institutionnalisation et de consolidation du laboratoire.

Je tiens à souligner que je partage pleinement l'idée que la caractéristique essentielle du BETA des débuts - dont on continue à trouver des traces dans la culture et l'organisation actuelle du laboratoire, malgré l'énorme changement d'échelle - est la coexistence de petites communautés épistémiques fédérées par des interactions permanentes et construisant un langage commun permettant de se comprendre et de s'apprécier par-delà les différences thématiques. Une telle construction « fédérale » explique non seulement la créativité permanente du laboratoire par la confrontation des méthodes et des sujets d'intérêt, comme l'explique l'article, mais aussi son exceptionnelle longévité malgré les inévitables conflits autour des moyens, que ce soit en matière de recrutements, de répartition budgétaire, d'incitation à la recherche contractuelle, etc. Cette culture du dialogue et des compromis tactiques a permis de surmonter une crise majeure autour du positionnement institutionnel au milieu des années 1990. L'enjeu tournait principalement autour du retour à un positionnement plus nettement fondé sur des disciplines théoriques et une plus grande autonomie dans les agendas de recherche individuels, mais la logique de répartition des chercheurs entre deux *composantes* (Thème et Echange) était encore plus complexe car liée également à quelques enjeux personnels. La tradition fédérale a en tout cas permis de sauver l'unité du laboratoire - et de nos jours la structuration en deux composantes a laissé la place à des *axes* à l'intérieur desquels se retrouvent autant des activités individuelles que collectives, des approches théoriques qu'appliquées.

La question centrale du BETA a toujours été de trouver la bonne articulation entre, d'une part, la volonté de répondre scientifiquement à des enjeux économiques et sociétaux, et d'autre part le libre établissement des agendas de recherche disciplinaires. La manière de trouver cet équilibre varie selon les champs et les positionnements épistémiques – en particulier le choix des méthodes : plus modélisatrices ou plus institutionnalistes. L'axe innovation s'est très naturellement construit historiquement sur des modèles cognitifs évolutionnaires, mais les autres communautés tentaient aussi à leur manière d'interpréter l'économie comme *un système complexe en évolution,* en se référant à la pensée de grands penseurs comme Hegel, Hicks, Georgescu-Roegen… La confrontation des pensées keynésienne et néoclassique a longtemps passionné les collègues spécialisés dans l'analyse économique du BETA, sans pour autant choisir définitivement une chapelle ou une approche méthodologique, bien que les fondateurs fussent plutôt keynésiens. Quel que soit l'objet de la recherche, une question est centrale : comment rendre compatible l'appréhension du monde dans toute sa complexité avec l'impératif disciplinaire de la modélisation ? Même les figures du BETA les plus adeptes de la modélisation

mathématique ont toujours eu une certaine réticence à considérer que le rôle du chercheur en économie se borne à produire des boîtes à outils. Le modèle sert à projeter un sens, à argumenter sur un sujet complexe, pas à s'enfermer dans une vision immuable.

Très tôt, dans l'ensemble des communautés composant le BETA, on s'est rendu compte qu'un point commun à tous était la conceptualisation du *temps* en économie. D'où le premier séminaire commun qui a profondément marqué les trajectoires individuelles et collectives. Il peut paraître surprenant que ce soit le seul grand séminaire interne qui n'ait pas abouti à une production collective synthétique. Le BETA n'a en effet jamais publié une encyclopédie sur le temps en économie ! Mais tous les chercheurs de cette époque ont bénéficié d'une manière ou d'une autre de ces rencontres où l'on s'écoutait par-delà les différences de langage, de formalisme, de culture. Sans ce séminaire, je n'aurais sans doute pas orienté ma thèse vers l'économie des ressources naturelles épuisables, Gilles Lambert n'aurait pas écrit la première thèse de gestion du BETA sur les options réelles, Jean-Luc Gaffard n'aurait pas développé une longue et fructueuse collaboration avec Mario Amendola sur la notion de traverse en macroéconomie, etc.

L'article Cohendet & Llerena (2007) énumère beaucoup de projets de recherche de type contractuel qui ont joué un rôle fondamental dans la constitution et la vie des collectifs particuliers de chercheurs du BETA en économie et management de l'innovation, très souvent dans un contexte européen, en interaction avec des équipes étrangères. Il est bien montré que les unités actives pour la construction des plateformes cognitives, au moins dans la phase d'émergence, sont des communautés de connaissance et non des individus ou des institutions. Il y avait là pour le chercheur individuel une dimension de risque et un « coût irrécouvrable » à assumer, car travailler avec les autres chercheurs, construire un langage commun et convaincre les autres communautés de la validité de concepts émergents prend du temps. L'institution (le laboratoire) doit aussi rendre des comptes aux tutelles et organismes d'évaluation, lesquels ne ressemblent guère à des « capitalistes patients » et sont prompts à interpréter tous ces efforts de construction des plateformes cognitives comme du temps perdu. Au sein même du laboratoire, il a fallu parfois argumenter pour convaincre que travailler pour un projet contractuel appliqué n'est pas forcément une perte de temps dans le processus d'avancement de la connaissance théorique, ni dans la progression des carrières individuelles.

Un exemple important (et curieusement peu développé dans l'article de 2007) est le programme d'évaluation des retombées économiques des projets spatiaux en Europe entre les années 1970 et 1980. L'équipe responsable, largement pilotée par Patrick Cohendet lui-même, a trouvé auprès des acteurs rencontrés sur le terrain des éléments fondamentaux pour la conception d'une théorie de l'innovation technique et organisationnelle des firmes. Ces chercheurs ont aussi, ce faisant, construit par la pratique une méthode encore qualifiée de nos jours de « méthode du BETA » pour révéler les impacts des politiques technologiques. Il faudra, dans un prochain Document de Travail de cette série du jubilé, rendre justice à des collègues comme Laurent Bach ou Mireille Matt qui ont contribué à cette belle aventure. Notons qu'un collègue chimiste de l'ULP, Marc Ledoux, a également joué un rôle non négligeable dans le pilotage des projets concernés, preuve que les collectifs de chercheurs formant les communautés de connaissances peuvent traverser les frontières institutionnelles et se jouer des rattachements disciplinaires.

The emergence and growth of an improbable laboratory in economics and management: the case of BETA[1]

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Abstract

The aim of this contribution is to trace the process by which such an improbable research unit, the BETA at the University Louis Pasteur, has emerged and grown and to stress the interesting outcomes. The paper can be read as a case study on the emergence and development of a 'knowledge creating community'. Such an analysis requires the understanding of the micro-dynamics of the complex co-evolution between four different elements in the production of research: small epistemic communities as active units of production of specialised knowledge in different domains of economics and management, the lab as a research institution, the University as the locus of collective representation, and key individuals as boundary spanners. In particular, the analysis of this evolution reveals the importance of the earliest stages of the collective effort that necessitates the interaction and coordination of dispersed actors. From these interactions progressively emerged a coherent unit of production of knowledge with shared codes, a common 'code-book', and shared experiences. The real recognition of the lab as an institution came much later (récognition by the French CNRS - 1985). From this moment, the lab as an institution had to show its capability to sustain both cumulative progress and some turnover of personnel.

Keywords: research unit; knowing communities; boundary spanners

Introduction

In 1971, a new 'Faculty of Economics and Management' was created within a scientific and research-based university in Strasbourg, the University Louis Pasteur. The President of the University, Professor Guy Ourisson suggested to the newly appointed Dean of the Faculty of Economics and Management, Professor Jean-Pierre Daloz, to create a research laboratory in economics, according to the format of existing labs in science or engineering. This was not an obvious idea. Labs in chemistry or physics are generally large ones for very natural reasons such as the common use of specific large equipments, but in economics the standard rule at that time (may be still now) was that the research was done by isolated professors, working on their own, with the help of research assistants. However, the President insisted: he advocated 'the concept as the price' to be included in a research university, but also emphasized motives such as the need to build a large structure in economics to allow interactions and team work and to take advantage of future European projects in economics and other social sciences.

So, the Dean and one younger colleague, Professor Jean- Paul Fitoussi, drew the perspective of what this research unit could be: by respecting the theoretical and formalised approach, by considering in particular interaction with mathematicians and statisticians of the University, and also empirical

[1] The authors thank Monique Flasaquier for her help in the writing of the final version of the paper.

approach, by proposing in particular interaction with engineers, chemists and physicists of the University. In 1972, in a famous ‘wynstub' of Strasbourg, on a corner of a napkin at the restaurant, they coined the name of the suggested unit: BETA (Bureau d'Economie Théorique et Appliquée), and with a small team of three research assistants, they launched the venture...

Today BETA is one of the biggest research units in Economics and Management in France, including more than 200 persons, on two sites, Strasbourg and Nancy, among whom around 80 university staff and full time researchers from CNRS. It is one of the characteristics of the French research system to be organised in research labs, but it is however rare in social sciences. As a big lab in economics the case of BETA is not unique in France; Toulouse and Marseille have units of similar sizes, but certainly the history of the process of growth is a unique one.

BETA covers a large field of competences. From macroeconomics and the microeconomic foundation of macroeconomics to innovation and knowledge management, it includes research on the economics of risks (environmental and technological ones), innovation and science policies (economics of science, assessment of innovation policies), on skills, employment and the labour market. Methodologically, BETA has developed quantitative approaches (in particular econometrics, and more recently experimental economics and agent-based model- ling) but also strong competences in the history of economic thought and applied field work (case studies, interview-based studies…); spanning from main stream (in particular microeconomics) to heterodox approaches (especially evolutionary ones). As initially designed, BETA is a platform for team-oriented research, mixing essentially economics and management, with a strong theoretical and conceptual content, often related to other scientific domains such as mathematics, statistics and even life sciences and other sciences when science and innovation policies are considered. The platform has been particularly able to develop sufficient scientific credibility to become one of the major French players in terms of European research projects, contributing and coordinating since the beginning of the 1980s large European research and doctoral training projects. Among the most relevant and recent ones:

- the co-ordination by P. Llerena with B. Verspagen from ECIS (Eindhoven TU) of a network of excellence called DIME (Dynamics of Institution and Markets in Europe, http://www.dime-eu.org/), but also an active participation to a second, one PRIME (Policies for Research and Innovation in the Move towards the European Research Area, http://www.prime-noe.org);
- the collaboration to a European research project coordinated by F. Malerba (CESPRI) in knowledge-based entrepreneurship (called KEINS, http://www.cespri. unibocconi.it/);
- or a more than 10-year-old European wide doctoral training programme on Economics of Technological and Institutional Change (ETIC).

The aim of this contribution is to trace the process by which such an improbable research unit has emerged and grown and to stress the interesting outcomes. The paper can be read as a case study on the emergence and development of a ‘knowledge creating community'. Our view is that such an analysis requires the understanding of the micro-dynamics of the complex co-evolution between four different elements in the production of research: some small epistemic communities as active units of production of specialised knowledge in different domains of economics and management, the lab as a research institution, the University as the locus of collective representation, and some key individuals as boundary spanners. In particular, the analysis of this evolution reveals the importance of the earliest stages of the collective effort that necessitates the interaction and coordination of dispersed actors. In these earliest phases, the lab is not a real institution: it is a space for sharing knowledge in which diverse small epistemic communities interact. From these interactions progressively emerged a coherent unit of production of knowledge with shared codes, a common ‘code-book', and shared experiences. The real recognition of the lab as an institution came much later (in 1985, with the

recognition by the French CNRS). From this moment, the lab as an institution had to show its capability to sustain both cumulative progress and some turnover of personnel.

The phase of emergence of BETA (1971-1985)

Our purpose is to explicitly refer to a model of collective building of knowledge in order to interpret 35 years later the history of the emergence and growth of an improbable research unit, at the interface between economics and management.

In the emerging phase of production of knowledge what the observations and empirical works show is that the active units for building a cognitive platform at the early stage of new ideas are generally neither the individuals, nor the institutions, but the knowing communities of agents that are committed to the creation and accumulation of the new forms of knowledge[2] As we will see later, individuals and institutions also play an important role in the microeconomics of collective creation, but the fundamental cognitive building of the codes and grammar that will equip the novelty requires the active functioning and interactions of knowing communities.

The initial set up of BETA was to create on a voluntary basis a new 'knowledge community' in opposition/contra- diction to the, at the time - in the 1970s - usual individualistic model of knowledge production specific to law departments where economists used to be located. This new model under construction aimed at being a collective one, 'in-house' (i.e. located in a specific geographical space within the university building) and theoretically and analytically led research. The BETA knowing community was originally based on small epistemic groups specialised in dispersed competences such as of course economics (J.-P. Fitoussi), but also in the history of economic thought (P. Chamley), statistics and mathematics (J.-P. Daloz). It was also supported and substantiated by a group of younger fellows such as J. Arrous, P. Cohendet, R. Dos Santos Ferreira, R. Ege, J.-L. Gaffard, J.-A. Héraud, R. Larue de Tournemine and E. Zuscovitch. Basically, they paid for the sunk cost of creating the foundation of a common cognitive platform.

The central question is why these small groups decided to spend time and energy working together in building a collective enterprise rather than following the natural tendency of pursuing their individualistic works. Our view is that, beside their friendly types of ties and relationships, the members of these small groups were all convinced that in these mid-1970s the moment had come in economics to reinterpret the notion of economic change. There were reasons related to the economic situation

[2] A knowing community (Boland and Tenkasi, 1995) can be defined as a gathering of individuals who accept to exchange voluntarily and on a regular basis about a common interest or objective in a given specialised field of knowledge. Through this regular exchange, common cognitive platforms and common social norms are built that assure the cohesion of the community and guide the newcomers' behavior. Knowing communities can deal with knowledge in different ways: some may focus on the accumulation and exploitation of a given field of knowledge (communities of practice, Lave and Wenger, 1990), others may focus on the exploration of a new field of knowledge (epistemic communities, Cowan et al., 2000). The focus in this contribution on a research unit seems to naturally highlight the role of epistemic communities that are the basis of the academic milieu and whose task is directly targeted on the production of new knowledge. However, it could be misleading to solely focus on these epistemic communities. The building of a 'grammar of usage' to equip the inventive idea also requires the interaction with communities rooted in the daily practice such as communities of practice, that might be found in traditional work divisions and departments, or that might also cut across functional divisions, spill over into after-work or project-based teams, and straddle networks of cross-corporate and professional ties. Knowing communities play an important role, because they can take charge of some significant parts of the sunk costs associated with the process of generation or accumulation of specialised parcels of knowledge. These costs correspond for instance to the progressive construction of languages and models of action and interpretation that are required for the implementation of new knowledge, that cannot be covered through the classical signals of hierarchies (or markets).

and reasons related to the theoretical challenges in economics at the time. The economic situation at that time was marked by the energy crisis, the rise of environmental issues, and the increasing importance of innovation as a key of competition. The theoretical issues were the challenges raised by 'going beyond equilibrium', dealing with increasing re- turns, finding the dynamics micro-foundations of the general equilibrium, reinterpreting the Austrian theories of the dynamics of production, taking benefit of new methods in mathematics, statistics or physics such as optimal control, random Markovian processes or percolation theory.

To illustrate how a common grammar was progressively built by these dispersed epistemic groups aiming at a better understanding of the process of economic change, one can refer to the example of the theory of percolation and its use at BETA. In the mid-1970s René Thom, well known as the inventor of the catastrophe theory, and who had a position at the University of Strasbourg, gave a conference about the process of change. He mentioned the importance of the percolation theory developed in physics by Broadberst and Hammersley in 1956. Percolation can be described by a disordered contagion where the aggregation of micro-variations on a network can bring about a threshold level and a qualitative modification of the entire network. Immediately this concept found a profound echo in all the small communities that were working together. Some found through this concept the foundations of the formation of irreversibilities in macroeconomics or in the production function along the perspective developed by Georgescu-Roegen[3]. Some found this model particularly useful in the theory of diffusion of innovation to explain how the accumulation of incremental (minor) innovations could lead to the formation of a major innovation. This was in contradiction with the traditional theory of innovation, for which incremental innovations follow the discovery of and the setting up of a major innovation. What the percolation model suggests is a step-by-step process of agglomeration of small incremental innovations that reach a threshold giving birth to a radical innovation. Some used this concept to explain why a given technology might fail to percolate (because some agents are not likely to be responsive to the choice of other members of the network, in other words because the site percolation probabilities are degraded). Some used this concept in an empirical work done by BETA on *the economics of new materials*[4]: in the case of composite materials applied to the car industry, it was shown that the composite materials had been introduced step by step in car bodies for substituting metallic materials. The introduction of composite materials was done in a given part by imitating the former solution. Then, there came a moment, when the agglomeration of composite parts was such that it required a complete reconception (a radical innovation) of the whole body of the car. The percolation threshold was attained. In short, the concept of percolation naturally became a piece of the common grammar that contributed to strengthen the links between the diverse epistemic groups constitutive of BETA.

To illustrate how an 'inter-temporal' grammar was also constituted, across generations of researchers, the concepts of *irreversibility/flexibility* of decision and option value are really significant. At the end of the 1970s, two of the young researchers around the founders of BETA, P. Cohendet and J.-A. Héraud using in particular optimal control techniques, got to use the 'option value' as a measure of the value of flexibility, respectively in environmental and natural resources economics, following the very

[3] This concept was in particular developed in Ehud Zuscovitch's Ph.D. 1984 'A meso-economic approach to technical progress, diffusion of innovation and industrial learning', which appears as one of the most influential pieces of work ever done at BETA. See also Willinger and Zuscovitch (1988).

[4] The Economics of New Materials , Cohendet P., Ledoux J.M., Zuscovitch E. (eds), Springer Verlag, 1989. This study can be considered as a good illustration of the BETA way of doing collective research, associating for an ambitious EU research project theoretical development on evolutionary economics with empirical works supervised by a group of leading scientists from the University of Strasbourg, including the Nobel Price Winner in Chemistry 1992, Jean Marie Lehn.

elegant papers by Henry (1974a, b) and Arrow and Fischer (1974). The 'option value' appears then as a concept at the limit between the traditional decision theory *à la* Von Neuman and the approach in terms of limited rationality. Actually the option value is the result of comparing the value of, in the one hand, the decision obtained by an optimisation process ignoring the relative degree of flexibility of decisions and the increase of information, with, on the other hand, the decision integrating them (Favereau, 1982). The vein was then extensively explored in analytical terms by Llerena (1985) and Willinger (1988), the former exploring the application on investments (capital goods in particular) and the latter, the role of information in the axiomatic decision theory. On the more applied side, Lambert (1988) explored, with the support of EdF, the French national electricity supplier, one of the first applications on the energy choice problem in industry. These research projects (in particular applications) are forerunners of the so-called real option value literature, starting from Arrow and Henry's contributions, instead of the Black and Scholes's in finance. For BETA, option value and flexibility became important elements of the potential codebooks, linking the understanding of macro-economic phenomena (in particular business cycles - Bernanke (1983) for example) to knowledge economics and the organisational dimension of the firms (Cohendet and Llerena, 2003, for example). It is then relatively easy to understand that very recently similar concepts have been used in the domain of industrial dynamics by Burger (2005).

Percolation, option value, and some other concepts such as standardisation/diversity in networks, codification of knowledge, incentives in knowledge-based firm, or knowing communities, became progressively constituents of the common grammar at BETA that allow members of the lab either those close to mainstream economics, or those adopting a more heterogeneous profile in economics, or those working in the field of management, to set up and regularly enhance a common platform for discussions, but also to take benefit of this platform to progress in their specialised discipline. The building of a common grammar has also been facilitated by the collective participation of members of BETA of diverse origins (mainstream economics, evolutionary economics, organisational business and management, etc.) to collective long-term research projects. As an example, a three-year project on 'the economics of networks' financed by France Telecom in the mid-1990s generated the publication of a collective book (Cohendet, Llerena, Stahn, Umbhauer (eds), The Economics of Networks, 1998) that integrate contributions in standard microeconomics[5], theory of games[6], evolutionary economics[7] or experimental economics[8]. Another example is the TIPIK project on codification of knowledge carried out for the EU in the late 1990s and from which numerous contributions in economics[9] or in management[10] or in standard economics[11] were derived, some of them published in the two special issues of *Industrial and Corporate Change*, (Vol. 9, No. 2, 2000) and of *Research Policy* (Vol. 30, No. 9, 2001).

To sum up, there was thus a real need to write a new and ambitious codebook on how economics could deal with the issue of change, but to be quite frank, after about 35 years of patient endeavours marked by the publication by members of BETA of numerous articles and books, this ultimate codebook has not been written (and most probably will never be). However, this is not what matters in this story: What was a key issue was that the founding members of BETA *intended* to write it and

[5] Hubert Stahn, 'Networks externatilities, cost functions and standardization', in Cohendet et al. (1998), p. 265.
[6] Gisèle Umbauer, 'Can neighborhood protect diversity?', in Cohendet et al.(1998), p. 167.
[7] Ehud Zuscovitch, 'Networks, specialization and trust', in Cohendet et al. (1998), p. 243.
[8] Bounmy K., Vergnaud J.C., Willinger M., Ziegelmeyer A., 'Information externalities and learning with sequential interactions', in Cohendet et al. (1998), p. 307.
[9] For example: Ancori et al. (2000).
[10] For example: Creplet et al. (2001).
[11] For example: Koessler (2001).

gathered their energy in such a perspective. What also mattered was that each small epistemic group accepted the price to be paid to this collective endeavour, in particular the unavoidable risk to depart from the tradition of their initial discipline where orthodox colleagues would certainly not understand their heterodox adventure. Indeed, members of each epistemic group at BETA are naturally anchored to a traditional subdiscipline in economics or management, and from the very beginning of BETA they have had to explain insistently to their colleagues in Paris and other places why they accept to spend so much time and efforts to 'work with the others!' and discard the individualistic view about knowledge production in an innovative field to favour a collective and heterogeneous research programme.

The role of knowing communities in this collective research process is essential: they achieve a process of progressive codification of knowledge, starting from a phase where the actors do not know the characteristics of the novelty, do not know each other, and do not possess the capabilities to communicate in order to reach a phase where the novelty is equipped with sufficient shared understanding and codes to become economically viable. Thus, the development of the novelty requires the progressive building of a common base of knowledge, a model and a 'grammar' to be able to interpret tests, experiences and contexts of usage.

In such a perspective, the above discussion suggests that an essential part of the process of production of knowledge can be interpreted as resulting from the dynamics of interactions between knowing communities. These interactions can be approached through the principle of 'translation/enrolment' elaborated in particular by Callon and Latour (1991). According to these authors, the innovative diffusion of ideas (for example from the lab to the market) can be seen as a process of progressive contagion of communities, where each community makes efforts to 'command the attention' of other communities to convince them of the relevant interest of the knowledge it has elaborated.

The first step of the collective work was to organise a series of contributions and collective discussions of the issue of 'Time in economics', more precisely on what some of the main authors in economics (Schumpeter, Marx, Marshall, Arrow, Georgescu-Roegen, Hayek, Hicks, etc.) had to say on that issue[12]. This was a way to confirm BETAs ambition: to work on the innovative field of economic dynamics, in particular related to knowledge creation and innovation processes. This exercise was also an occasion to reveal that the initial phase of the building of a common codebook between heterogeneous communities is not in general smooth and rosy: there were many conflicts and 'coups de gueule' in the corridors and meeting rooms. Indeed the process of the building of a cognitive platform in a new domain of knowledge is a process that requires intense and sustained efforts of mutual conviction, of learning by intrusion in the domain of others, of painful compromises, and of severe frustrations not to be understood by the others.

However, steps by steps, the constitution of a common 'grammar' and 'codebook' at BETA took place. In the early 1980s the most important elements of a collectively accepted 'codebook' and procedural behaviour emerged:

- taking seriously into account the belonging to a research and scientific university; that is the necessity to have both theoretical and empirical research intertwined;
- publication in international and refereed journals - it seems nowadays obvious, but it was not at all in France in social sciences at the time;

[12] Unfortunately, very few pieces of work were written and published from these extremely rich debates. One of the publications is Ege and Dos Santos Ferreira (1998).

- team-based research projects (funded in particular by the European Commission, but also by large companies such as EdF or France Telecom);
- strong theoretical and formal training background (in statistics, mathematics, mathematical economics, etc.) in order to keep contact with and understanding of the developments in the field, both in management and economics; but also a common language and knowledge for mutual understanding between orthodox and heterodox approaches in economics and management.

This essential process of progressive codification is not a linear one. As we have seen, it generally involves an early phase during which the founders encounter misunderstandings and find it difficult to convince. However, it also generally requires the intense involvement of specific individuals, acting as boundary spanners, to facilitate the dialogue between knowing communities.

It is at this stage that the role of key individuals may be a determining factor. Two communities may interact directly through random meetings of members of both groups, and this interaction certainly could be favoured by some mechanisms such as the repetitiveness of interactions between communities or by a high degree of quality of communication between communities. However, although these conditions may contribute to lower the cognitive distance between communities, they do not guarantee the spontaneous building of a common grammar and codes between heterogeneous units in the long term. Therefore, the role of specific individuals playing the role of 'boundary spanners' (Allen, 1977; Tushman, 1977; Cohen and Levinthal, 1990), is of key importance. Those individuals are generally members of a given community who have progressively acquired a reputation (frequently they are the 'stars' of the community) and who have the ability and authority to express and translate the concern of their community into the language and representation of other communities. As an example, Girvan and Newman (2001) illustrated the property of community structure in a scientific network, where people are working together in tightly knit groups between which there are only loose connections.

It is interesting to distinguish two types of boundary spanners: internal or 'in-house' and external ones. In-house boundary spanners play their role from within (among communities inside the research unit) and from inside to outside interfaces. Among them, J.-P. Fitoussi, one of the founders, strongly connected micro to macro approaches and opened the door to modelling techniques as 'usual' tools in our research[13]. R. Dos Santos Ferreira has taken over this role until today. In addition, R. Dos Santos Ferreira provides an important articulation between analytical models and the history of economic thought, developed by R. Ege in the tradition launched by P. Chamley[14]. J.-L. Gaffard and P. Cohendet connected innovation economics to micro and macroeconomics[15] and more recently P. Cohendet did so for microeconomics of innovation and knowledge management[16]. More significantly, E. Zuscovitch was one of the major 'boundary spanners' of BETA; he built a common ground of discussion between traditional, mainstream approaches and evolutionary, heterodox ones. He set up one of the main characteristics of BETA scientific production: critical analysis of the 'commonly accepted' wisdom of our scientific domain.

This characteristic can be easily reported by the set of 'outside boundary spanners' who benefited to the development of BETA's knowing community. Some examples:

[13] Fitoussi (1974).
[14] Dos Santos Ferreira (1998) and Ege and Dos Santos Ferreira (1998) are a more recent example of this interface.
[15] In particular, Gaffard (1978).
[16] In particular, in Amin and Cohendet (2004).

- N. Georgescu-Roegen, in connection with J.-P. Fitoussi (see in particular Fitoussi and Georgescu-Roegen, 1980) and J. Arrous[17], is certainly the most significant 'boundary spanner' and deeply influenced most of the research agenda of BETA, in particular related to novelty, innovation, irreversibility and the representation of production processes.
- More specifically related to a critical view of macro- economics, with a strong Keynesian flavour, A. Leijonhufvud played in Strasbourg a relevant role.
- W. Hildenbrand and more recently A. Kirman are the spanners related to the field of General Equilibrium Theory and in general the approaches to complex and multiple interactions among economic agents.
- M. Amendola, R. Nelson and G. Dosi are playing a crucial role in the domain of innovation and institutional economics, in particular related to innovation and technological progress. It is worth mentioning the development of the economics of science supported by strong interactions with R. Nelson and his questioning about the role of scientific understanding in economic growth and development. G. Dosi has played in addition a specific role as a link between insider and outside spanners: R. Dos Santos Ferreira, P. Cohendet and A. Kirman for example.
- K. Pavitt had a similar role, more specifically oriented towards industrial dynamics, innovation microeconomics and managerial approaches. This has been complemented since by links and collaborations with the 'Ecoles de Paris' in management' that is C. Midler (Polytechnique), A. Hatchuel (Mines) and P. Lorino (ESSEC), and by intense exchanges with S. Winter and B. Kogut.
- Two examples of the visible mark of the presence and role of this boundary spanners:
- The research on the economic impacts of the ESA (European Space Agency) programmes induced the organisation of a conference where among the participants some of the inspiring personalities could be found: N. Georgescu-Roegen, E. Mansfied, M.D. Intriligator, H.R. Hertzfeld, R. Sherman, but also M. Amendola and K. Pavitt.
- On 'flexibility, information and decision', P. Cohendet and P. Llerena published in 1989, a book with the participation of M. Amendola, J.L. Gaffard and O. Favereau.

Even if all these 'boundary spanners' are active in very different fields of research, all of them share one common characteristic: they are very critical or even heterodox to their own 'epistemic communities', which is now the case of BETA.

The role of boundary spanners played by the leading persons (both inside and outside), is to assure the circulation and building of common knowledge between communities.

The phase of institutionalisation and consolidation of BETA (from 1985)

Once the progressive process of building common knowledge that has been detailed above has started, then by a progressive contagion of communities the building of a common base of knowledge can accelerate through different tests and the elaboration of diverse codes. These micro-additions to the common base then add up and speed up to reach a level of percolation in the system, as we have seen above, which corresponds to a situation where the novelty is fully equipped with a code and grammar leading to a potential economically viable institution.

What the above model suggests is that the process of research is far from being restricted to the sole role of talented individuals, or far from being controlled by the strategic vision of institutions

[17] See Arrous (1981). Georgescu-Roegen wrote in 1979 the preface to the published dissertation of J. Arrous (Arrous, 1978).

(University, Public Research Organisation, etc.). Institutions are instances where contracts are signed, where people are hired or fired, where broad competences are managed. They are not the active units of elaboration of this common base indispensable for the development of new knowledge. The active units that undertake the codification process are in our view the diverse knowing communities that participate in the process of research production (as well as the small set of active individuals who play the role of boundary spanners between communities). The story of the production of new knowledge, at least research, could thus be interpreted as a process where individuals, institutions and knowing com- munities interact, each contributing through its activities of knowledge to mitigating the limits and possibilities of failure of the others.

At the level of institutions, two institutions played a significant role in the development of BETA: the University Louis Pasteur, as already mentioned and the CNRS, the largest French national research organisation.

University Louis Pasteur (ULP) did induce the initial mood towards team-oriented, scientifically validated research practices. As such, the proximity of 'hard' science research units did allow the diffusion and enlargement of a common 'community of scientific practices'.

In 1985, BETA was recognised by the CNRS (as an associated research unit) and became a joint research unit between ULP and CNRS in 1990. This followed a serious scientific assessment, which since then has been taking place every 4 years.

As such, both institutional supports had been the sign that BETA had entered a phase of scientific stabilisation and at least national and somehow international recognition.

Once the codebook that equipped the creative ideas is about to be achieved, a new phase of the research process can take place: the phase of diffusion. In the phase of emergence, the production of externalities (in particular to the newcomers in the lab) was negligible. Members were engaged in processes of conviction, translation and enrolment from one community to another, which con- tributed to internalising the externalities. The externalities were internalised through the process of controlled communication that lies behind the building of a common base of knowledge to make the innovation understandable and viable. In the new phase of diffusion, the question of externalities matters. Our view is that the intense work of codification that took place in the preceding period largely determined and shaped the nature of the next phase of the research process. Will the novelty lead to core references or a core literature in the field? Which community will integrate and make use of them as references?

As Cassier and Foray (2002) underlined, 'collective invention produces a new boundary, an original partition between a set of co-ordinated agents and the rest of the world. The question of dissemination of results and thus of the social returns to collective research…raises the question of the composition of the group (those agents who have participated to the period of research), that is, the internalisation of knowledge externalities…'

Many ways are possible to do so, in addition to the usual publication diffusion process:

- the dissemination of ideas and practices via training (especially doctoral training), personnel outgoing mobility (from J.-P. Fitoussi at the OFCE in Paris and J.-L. Gaffard in Nice to more recently M. Yildizoglu in Bordeaux and M. Willinger in Montpellier) and incoming mobility (recently: R. Cowan and M. Becker);
- the participation in and coordination of national thematic networks. In France, the involvement of some researchers from BETA in the network called 'ECOSIP' with P. Lorino, C. Midler and A.

Hatchuel among others played a crucial role in the constitution and stabilisation of research activities in management at BETA;

- the participation in and coordination of international networks such as the Network of Excellence called 'DIME' ('Dynamics of Institutions and Markets in Europe') funded by the EU.

Some recent achievements of BETA in the area of management

About 20% of the BETA team is working regularly on the field of management, mostly in the domain of knowledge management and strategy. The emergence of a subgroup of researchers in the domain of management was first a natural outcome of the process of constitution of the lab. It came essentially as a spin-off of many empirical studies carried out since the beginning of the 1980s to assess the economic impacts of research activities in Europe. BETA conducted for different instances such as the EU or the European Space Agency a series of research projects to measure the indirect economic effects of large-scale projects in Europe (Esprit, BRITE-EURAM, Eureka, Space projects, etc.). These studies required in-depth interviews in industry with CEOs and project managers throughout all European countries. Most of the main companies in the high-tech domains in Europe have thus been visited by BETA members since the beginning of the 1980s. This leads to the constitution of a unique database of industrial practices in the domain of management of innovation, and of long-term relationships with industrialists of different high-tech domains. A second reason for the development of a subgroup in management at BETA derived from active work carried out at the end of the 1980s to reinterpret the economic theory of the firm, within the knowledge based vision of the firm, where the firm is conceived as a unit of creation and development of knowledge (such as in the evolutionary theory of the firm). There is a natural transition from an economic theory of the firm to a theory of strategy. To quote Porter himself, the issue in any debate on strategy is the underlying vision of the theory of the firm: 'any effort to understand success must rest on an underlying theory of the firm and an associated theory of strategy' (1994: 423). And a significant amount of BETA young researchers naturally followed this route.

To illustrate the work done in management, the main purpose here is not to be exhaustive but to illustrate some recent achievements in the area of management of knowledge. We focus on two cases: the first one is related to the role of property rights in the innovation process and the second one on the co-construction of competences and the positioning of firms. Both cases indicate how strongly intertwined the economic and managerial perspectives are.

Towards a reappraisal of the role of property rights in the innovation process

As Zuscovitch pointed out repeatedly (1998, in particular), there is theoretical and practical evidence that supports the hypothesis that there is a rather strong appropriability in the processes of development of new technologies. This spontaneously stronger appropriability, based on the need for a collaborative dimension in the building of a common knowledge base, accelerates the rate of technological progress as a whole. What some of our research outcomes (Penin, 2004, 2005; Cohendet et al., 2006; Cohendet et al., 2006) suggest is that the hypothesis of a strong appropriability is particularly valid at the beginning of the research period (i.e. the 'up-stream' phase of the innovation process). This important fact was recognised by Winter (1993) who, while acknowledging that the patent system can increase incentives to innovate, suggests that intellectual property rights do not lead automatically to a more successful resource allocation. In particular, he underlines the fact that inefficiencies might especially occur during the very first phases of the creation of a technology trajectory.

According to him, when a pool of innovators explores a new technology trajectory, the availability of older patents might block the slow build-up of a common base of knowledge required for the creation of such a new trajectory.

In the phase of emergence of new ideas of invention and of creativity, most of the empirical works and historical analyses have shown that what matters is the progressive building of collective knowledge and understanding be- tween actors. At this stage, there is neither a common language nor a common representation between the different players. The group of agents who succeed in expressing and formalising an innovative idea is confronted with a main difficulty: not the risk of being copied (at no cost), that is the degree of appropriability, but the risk of being misunderstood by others (including agents belonging to the same institution). It is therefore the risk that their procedures and experiences will not be reproduced by others. Without a collective effort to reach a critical mass of common understanding between the different actors committed in this emerging phase, the innovative process cannot be viable. The group of agents at the origin of an innovation must undertake considerable efforts to alert other actors or communities in order to convince them of the usefulness and potential of their research project. In fact, to use a classical reference to the economic literature, these features of the emerging phase of the process of development of innovation are not captured by Arrow's vision. In Arrow's perspective, the producer of knowledge acts in isolation: nothing is said about the complementary forms of knowledge necessary for the producer of knowledge to invent, and nothing is said about the community of agents who supported him in the process that led to knowledge creation.

To be more precise, as Callon (1999) emphasised, in the phase of emergence the production of knowledge tends to exhibit exactly the reverse properties to the ones postulated by the traditional approach: knowledge is essentially rival (it is extremely difficult to reproduce new knowledge in a place which is not where the invention has been first realised) and exclusive (the novelty relies heavily on the tacit knowledge of the forerunners). In this context of emergence, knowledge is also essentially specific (it can be absorbed and used by a few other agents only) which is the opposite of the traditional vision that postulates that knowledge has a high degree of generality (knowledge with a high degree of generality can be potentially used in various contexts by a large variety of agents: all the agents of the economy have the full capability to absorb the innovative idea emitted by the producer of knowledge).

This vision of strong appropriability seems to be contradicted by the increasing demand for property rights, which is addressed in all sectors and all countries. Our view (Cohendet et al., 2006) is that there is no contradiction, when considering the diversity of motives for firms to hold a patent. Among the motives, and beside the right to exclude, patents are also fundamental instruments of signalling allowing the producers of a piece of knowledge to have their competences to innovate recognised by others. In that case, patents play a fundamental role of coordination of innovative activities. As a label of recognition of competences, patents offer possibilities to be accepted in innovative networks or certificates of guarantee for firms to receive seed money from banks or specialised institutions. Moreover, we argue that the signalling motive is in general the highest motive in the phase of emergence of innovation, when the actors do not know each other. As the process of innovation matures and tends to reach the phase of stability, the signalling motive relatively weakens, while the exclusion motive increases. To a large extent, the period of research could be seen as the one leading a creative idea from a stage where it relies on purely appropriable knowledge with a minimal economic potential to a stage where it is patentable with a strong economic potential.

The vision of strong appropriability seems also to be contradicted by the current practice in some specific sectors such as the pharmaceutical one, where the demand for patents as a means of exclusion

is prevalent, even in the earlier phases of the process of innovation. According to us, this fact is explained by the sector context-dependent characteristics of the use of property rights. These sectors are the exception rather than the rule. In a few sectors, the nature of novelty relies essentially on codified statements, even in the earlier phases of the process of innovation. A new drug relies on a small number of molecules that can be easily reproduced if one 'steals the formula'. In this industry, the context of production of knowledge is such that the exclusion is of prime importance. This is in line with Zuscovitch's conception of technological innovation (1998) that takes place within a particular structure, a specific context of industrial products and production processes that occurs differently across industries and over time. Figure 1 illustrates how the two main dimensions of the nature of invention, the codified/tacit dimension, and the emerging/stabilised phase of the innovation process, leads to four main contexts of modes of usage of patents.

- Firstly, the fundamental distinction between tacit and codified knowledge clearly suggests that the tacit context in which knowledge is created has an influence on appropriation conditions and on the ability of patents to increase incentives. For example, in those domains where codified aspects of knowledge seem to be prevalent (chemicals, pharmaceuticals), where the extent of what can be patented is clearly established, understood and accepted by all actors concerned, then the role of patents as an instrument to increase incentives is strong. On the contrary, in contexts where the tacit dimension seems to prevail (such as software or services for example), the incentive role of patents tends to be weakened.
- Secondly, knowledge-based economics provides a new role for patents, in response to the important needs for coordination of the actors in the first stages of the innovation creation process. In the emerging phases of a new innovation, the need to build a common knowledge base is strong and therefore strategies of collaboration tend to overcome strategies of exclusion. As soon as innovations become more mature and situations are stabilised, languages are shared, the importance of patents as an instrument of exclusion increases. It comes out of this analysis that the role of patents is highly dependent on context, sectors and their specific evolution. In mature sectors where the technology is tested and coordination already ensured, actors will tend to favour a traditional patent strategy, while in emerging sectors, the construction of strong intellectual property rights based mostly on exclusion may induce devastating effects.

Figure 1. The context-dependent modes of usage of patents (From Cohendet et al., 2006).

	Knowledge essentially codified	**Knowledge essentially tacit**
Emergent phase	Strong exclusion Strong coordination	Weak exclusion Strong coordination
Stabilised phase	Strong exclusion Weak coordination	Weak exclusion Weak coordination

Crossing those two dimensions allows us to define very different industrial contexts, in which the role of patents differs strongly.

Co-construction of competences and positioning of firms: how the competence-based approach is connected to the industry[18]

One of the main pieces of criticism on the competence approach to the firm bears on its inward orientation and its lack of connection to the environment, the market and the industry. As Collis and Montgomery emphasise: 'With the appearance of the concepts of core competence and competing on capabilities, the pendulum swung dramatically in the other direction, moving from outside to inside the company […]. The external environment received little, if any, attention, and what we had learned about industries and competitive analysis seemed to disappear from our collective psyche' (1995: 59-60). The inward looking perspective of the competence approach is probably the most challenging criticism (and is at the basis of the tautological and circular reasoning identified by many scholars as indicated previously). How to set a strategy without a strong reference to the industry, the market, and competition forces? How to consider the industry and the competition in the competence perspective and even more importantly how to define strategic positioning? This is the very locus of opportunities and threats in the language of strategists. How to assess and value strengths and weaknesses without any benchmark? The key issue of value is indirectly connected to the absence of a clear link to the environment and to the market. If resources are not valuable by themselves, how to maintain that one resource is valuable and could lead the firm to a dominant position? Here, the connections between management and economics come into the picture as an important research competence mix.

It has been underlined that one critical difference between the Porterian approach and the competence-based approach is that the former gives priority to the analysis of strategic positioning issues by developing a vision where industry conditions are the main drivers of firms' strategic activities for creating competitive advantages. As for the latter approach, it has been criticised for having put too much emphasis on the internal environment of the firm by focusing on 'inward' concepts such as resources, core competences and capabilities without taking into account precisely enough the external environment and how these concepts are inherently linked to competitive advantage and strategic positioning issues (Collis and Montgomery, 1995).

We have shown (Amesse et al., 2006) that such a criticism (which is relevant in a classical context) falls out of the stream in a knowledge-based vision of the firm. Our main argument rests on the assumption that the knowledge and competence construction dynamics at the firm and industry level is a dialectic process. Strategic positioning in this context derives from a process of co-construction of distinctive and common competences by appropriately managing the tension between cooperation and competition. We will illustrate and discuss actual examples of such coordination modes through the case of modular platforms.

The dialectic process between distinctive competences (at the firm level) and common competences (at the industry level)

The evolutionary theory that underpins the competence- based approach is not silent on the relationship between firm and industry. However, contrary to the classical Porterian vision, the industrial landscape is not a clear scene with a given industry within which firms position themselves. For the evolutionary theory, there is a co- evolution of the macro-level (industry) and micro-level (firms). One of the crucial questions in evolutionary approaches to the firm is the link between the diversity and heterogeneity of competences between firms at the micro-level and the emergence of common patterns of behaviour or common characteristics at the meso- and macro-levels (Nelson,

[18] This dimension (and this section) owes a lot to another 'boundary spanner': F. Amesse from HEC Montreal.

1991; McKelvey, 1998). The aim is to better understand how one level influences the other and how learning results from a co-evolutionary process of competence building at the individual firm level and knowledge diffusion and accumulation at the industry level. By focusing on knowledge characteristics such as tacitness, cumulativeness, path dependency, the evolutionary approach focuses on the localised and non-transferable dimension of firms' knowledge bases. Such a characterisation of knowledge is also put forward in order to explain the idiosyncratic structuring of internal routines and selection procedures on which firms rely to determine their possible technological options and innovation opportunities. On the other hand, the evolutionary theory emphasises the industry-wide aspects of knowledge by referring to the 'generic' body of knowledge (Nelson, 1987) as the common features of technology, understanding of problems, problem-solving heuristics, beliefs widely shared among firms in the industry or even a group of industries. Dosi (1982) used the technological paradigm and techno- logical trajectory concepts in order to underline the fact that such generic knowledge bases are highly structured, and tend to evolve along structured trajectories. This collective aspect of knowledge refers mainly to general knowledge, in the sense that it is applicable to many situations, codified knowledge and common knowledge which can easily be shared among a large set of firms in a sector (i.e. engineering or technical communities within or across industries).

By emphasising the idea that certain aspects of knowledge are unique to individual firms (tacit knowledge, routines) whereas other aspects are shared among a larger group, evolutionary theories raise the question of the way these two dimensions interact and co-evolve. They principally underline the importance of better understanding the two-way knowledge flow that characterises this co-evolution. On the one hand, aggregate and structural forces, such as sector level determinants (Pavitt, 1984; Tidd et al., 2001) or technological regime characteristics (Malerba and Orsenigo, 1996, 2000) influence and offer guidelines to the actions of individual firms. In turn, what individual (or group of) firms learn influences the common patterns of behaviour to the extent that knowledge is diffused and accepted as relevant by the industrial system. In other words, 'when knowledge and problem-solving approaches are shared in a larger group, macro dynamics of learning influence micro decisions'. However, by internalising shared knowledge firms rely on their idiosyncratic competences in order to try to make such knowledge 'more and more their own and doing so, either make codified knowledge into tacit and/or use codified to improve tacit' (McKelvey, 1998)[19].

Co-construction of competences: organisational and cognitive platforms

In rapidly changing environments where interactions within and across firms are organised less in relation to stable products than in relation to technologies and knowledge bases that products (might) mobilise in unpredictable ways, co-construction of competences be- comes a priority of industrial dynamics. The problem is how pragmatically firms can develop principles of coordination and cooperation in order to sustain the co-construction process between distinctive competences (firm level) and collective competences (industry level). A first possibility is to consider that these principles are an emergent property of self-organisational dynamics. Given the multiplicity of actors, rapidly evolving knowledge sources and the necessity of flexibility, under such a scheme the system can hardly reach stability and it can take a long time to build the appropriate level of trust and knowledge infrastructure (if we have in mind relationships within a group and not only bilateral relationships). A second possibility is to design explicit and dedicated collective governance structures through which

[19] The co-construction of distinctive and common competences can be analysed by the knowledge creation and conversion spiral at the ontological dimension proposed by Nonaka and Takeuchi (1995). Processes of socialisation and externalisation contribute to the emergence of common knowledge at the group and inter-organisational levels that in turn through a process of combination and internalisation of such knowledge create distinctive competences.

firms can fine-tune the degree of cooperation and competition according to the industry wide challenges they must tackle. Our claim is that platforms represent a device to build the so-called principles of coordination and rules of cooperation. Although we admit that the emergence of structures within industries may have self-organisational attributes, managerial and entrepreneurial effort and cognition play an important role in making self-organisation viable. The way platforms come to be promoted and organised mirror such managerial and entrepreneurial efforts. Borrowing from Schumpeters' terminology, we may interpret platforms as devices mobilised both for organised creative destruction and creative construction.

The platform structures and strategies adopted by firms mirror different forms of knowledge production and exploitation requirements at the company and intercompany levels. This perspective leads us to consider the dynamic capabilities of firms according to how the nature and intensity of relationships and knowledge flows among firms are managed in order to sustain the co-construction process. We define platforms as generic organisations through which firms resort to different relational mechanisms (markets, hierarchical networks, communities, partnerships, etc.) in order to appropriately manage knowledge creation and coordination in inter-organisational settings. Thus platform management requires from firms to consider organisational mechanisms not in isolation but in complementary ways in order to deal with the cross-sectional and positioning issues stressed by Porter. What determines competitive advantage in this framework is the capability of firms to combine dynamically and in appropriate ways different organisational, communication and interaction modes to sustain the co-construction process.

The reason why platform organisations may be particularly well suited in the co-construction of competences can be attributed to their particular effectiveness not only to flexibly and rapidly resort to and combine both internal and external knowledge but also to align in an efficient way distinctive and common competences. The distinction made by Kogut (2000) between two approaches to network analysis can be useful to better qualify the ‘raison d'être' of platform organisations. The first approach emphasises the individual advantages gained by firms in accessing external knowledge. This vision of networks focuses on the distinctive benefits individual firms derive by extending their relationships and their opportunities by accessing network resources. The focus is on the distinctive capability of firms to combine internal and external knowledge on their own. The second approach, as Kogut (2000) under- lines, allocates part of the value of a firm to the capability of its embedded network. ‘The network is itself knowledge, not in the sense of providing access to distributed information and capabilities, but in representing a form of coordination guided by enduring principles of organiza- tion'. As one takes into account the systemic dimension of learning one shifts from learning at the firm level to network level learning where the ‘the structure of a network implies principles of coordination that not only enhance the individual capabilities of member firms, but themselves lead to capabilities that are not isolated to any one firm'.

With respect to the distinctive and common competence co-construction process, we can underline two important incentives for platform learning. First platform learning concerns specific contexts where new knowledge created individually is only valuable when shared with other firms. In this case firms can only exploit effectively their distinctive competences once part of their private and proprietary knowledge becomes common knowledge. In this case, participation in platforms through disclosure eases the diffusion of knowledge at the network level and speeds up the emergence of common competences to improve the coordination process within the network. Platforms thus represent a collective device to facilitate knowledge transfer and assimilation as well as to control learning dynamics at the industry level (Cohendet and Llerena, 2003). They are the loci where firms decide to channel their efforts to the development of industry- specific public goods or public routines

that improve the coordination of private (individual or intra organisational) routines (Langlois and Savage, 2001) according to their distinctive competences.

The second aspect is related to the fact that participation in the platform gives individual firms the opportunity to access common competences and knowledge bases that have been collectively developed and which reside and are maintained at the platform level. It is as a participant in a platform that firms can have access to an important part of what is called network knowledge and participate in the collective learning process. In other words, being part of platforms and having the possibility to value knowledge residing within them is an effective way to better orient and develop new distinctive competences and capabilities. In fact as a firm's capability is considered to be more than the sum of the knowledge or competences of its members, in a similar way capabilities at the platform or network levels can be assumed to be more than the sum of the knowledge of the members or firms being part of them. The difference generates what we can call the platform knowledge rent and may dissuade members from adopting opportunistic or free rider behaviours at the risk of not only losing access to the platform knowledge but also the opportunity to value and further develop their distinctive competences. As noted by Kogut (2000), 'the preservation of co-operation is maintained because exclusion to the club deprives the defecting member from sharing the group rents'.

Why is it relevant?

The competence approach has been, for the last 15 years, heavily questioned as to its capacity to be a legitimate theory of strategy. Clearly, such an approach to strategy is the result of many streams of thought not always well integrated and sometimes contradictory especially, for example, as to the key role of top management and the influence of the environment and the market (the strategic competence-based approach vs the evolutionary competence-based theories).

The competence approach, because of its inward orientation, is more or less clearly differentiated from the mainstream thought in strategy and namely the I/O framework as developed by Porter in the 1980s. It is not always clear what differentiates an activity from a resource or a competence as the basic unit of strategic planning. The competence approach has been seen more and more as a complement to the standard framework enlightening the cumulative learning process of the firm in performing activities.

Recalling the premises of Porter that a theory of strategy is framed by a theory of the firm, we tried to demonstrate that the I/O framework and the competence approach do not refer to the same theory of the firm[20]:

- The I/O framework refers clearly to the firm as a processor of information as theorised by the transaction cost theory. Such an approach is not designed to accommodate the basic characteristics of knowledge.
- The competence approaches refer to the firm as a processor of knowledge as theorised in the literature on the knowledge-based economy. In such a case, it is not activities that shape and drive competences or resources. Competence comes first and shapes activities and products.

In such a perspective, the competence approach is not basically 'inward' and disconnected from the industry and the environment. Such a connection is not done on the basis of the division of labour in a stable environment as in the I/O framework but on the basis of knowledge in a dynamic environment. The positioning of the firm on the market is the result of a co-evolutionary and dialectic process. The firm is both contributing to the development of a common knowledge base for the industry and

[20] See also Cohendet and Llerena (2003) and Becker et al. (forthcoming).

differentiating and positioning itself through the development of its own knowledge base. The firm is managing a dialectic process through which it competes and cooperates with other firms in evolving systems.

The perspective developed here (i.e. competence approach as a theory of strategy based on a vision of the firm as a knowledge processor and connected to the environment through a co-evolutionary process by which the division of knowledge occurs and the positioning of the firm is defined) is very well adapted to the type of environment we are living in. Most scholars point to competencies in an environment of technological change, continuous and disruptive innovations, blurred industry frontiers, and emerging markets.

What next? After 35 years…

As we have seen, a major component of the process of emergence and stabilisation of BETA has been the search and the construction of a 'code book'. It is fortunate that it is still under construction, as it has to be considered as an open-ended process. It leaves open the possible contribution to it by younger and/or new colleagues. There is still a lot to be said on entrepreneurship, the role of communities, the articulation between hierarchical structures and knowing communities…and more broadly the challenge of the 1970s are still ahead of us, and still difficult to handle in economics and management: energy crisis, environmental issues, increasing importance of innovation. There is a lot of work to be done at the frontier of economics, management and sociology in trying to explore the implications of the recent progresses in the theory of knowledge and the theory of networks. The theoretical challenges remain to be able to 'go beyond equilibrium', dealing with increasing returns, and to understand micro-founded dynamics. Doing so means in particular to be able to generate new areas to be explored and to keep a certain degree of variety in order to fuel the evolution of BETA.

For BETA as an organisation, a research unit, the challenge is to integrate new contributions and questionings but to keep the 'spirit' of exploring new approaches, in a subtle equilibrium between a more or less mild 'heterodoxy' in both economics and management on the one side, and conservative and disciplinary organised institutions (most of them in France national) on the other. The perspective is thus quite different from the perspective taken during the phase of emergence where the interactions between small epistemic communities progressively shaped the building of the lab as an institution. Now the institution must in turn nurture, favour, enact the working of active communities of knowledge, which implies the acceptance of some chaos and self-organisation within a formal structure. To keep and/or to have new challenging 'boundary spanners' are certainly among the most crucial elements for the evolution of the knowing communities constituting BETA.

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