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► **To cite this version:**

Valérie-Inès de La Ville. Collective learning processes in high tech firms: enablers and barriers to the innovation process. Michel Bernasconi, Simon Harris, Mette Moensted. High-tech entrepreneurship: managing innovation, variety and uncertainty, Routledge, pp.69-85, 2006, 9780415380591, 9780415380584, 9780203390146. hal-01845200

HAL Id: hal-01845200

<https://hal.science/hal-01845200>

Submitted on 26 Oct 2018

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Collective learning processes in high-tech firms. Enablers and barriers to the innovation process

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Introduction

The perspective suggested in this chapter was developed within the framework of a longitudinal research undertaken over four years in interaction with COM One, a young French telecommunications company created in 1987 (La Ville, 1996). Both the historical development of the firm since its foundation and its main evolutions during the time of the study have been retrieved and reconstructed through a qualitative research process (Hindle 2004). In 2004, COM One remains a leading French company specializing in the design, manufacture, sales and marketing of telecom products. For 15 years, the company has been designing products for major PC manufacturers and telecom operators, as well as selling telecommunication devices to the growing market of mobile professionals. COM One has designed stylish, simple, user-friendly and intuitive range of products for major companies operating in the professional markets. Certified ISO9001, the company is headquartered in Bordeaux and employs 55 people, including 25 engineers.

Within a nascent company, the development of the technical knowledge - in individual and collective terms - results from the inevitable involvement of the entrepreneurial team in social relations of various natures (Hite 2005). The study of the processes thanks to which the strategic skills of COM One were gradually constituted, put forward the crucial importance of the discussions and the experiments which crystallised around various technical stakes. To

better understand how collective know-how emerges - which found the distinctive skills of the young high technology firm – supposes that we look further into the bond between individual learning and organisational learning. This chapter proposes to replace the collective learning processes at the very heart of the entrepreneurial practice.

The French philosopher Jacques Ellul (1990) usefully reminds us of the etymological distinction between ‘**technique**’ and ‘**technology**’, which is a discourse developed about a technique - whether the latter is already established or under development - in different social settings. This fine distinction helps us to consider the social dimension which makes possible achieving technical innovations within an entrepreneurial setting and implies determining more accurately the concept of context of communication, an integral part of any process of creative collective undertaking. Within a nascent company, the conversational interactions thus constitute the privileged means by which individual and collective know-how are worked out and co-ordinated in order to face the ambiguity caused by the technological explorations carried out by the entrepreneurial team. Indeed, the techniques are not in themselves meaningful: their significance depends on the social contexts of communication which "inform" - give form to - the interpretations that the individuals forge and retain - individually and collectively - about them.

1. Technological entrepreneurship: always a collective creation

Schumpeterian modelling of economic development describes the processes of innovation like a deviation compared to routine behaviour, a deviation which causes a permanent renewal of the economic system through a sequence of cycles of "creative destruction". The interpretation of the writings of Joseph Schumpeter concerning the role of the entrepreneurial process in economic change constitutes a delicate task because successful innovation requires simultaneously a process of breaking-off and the generation of a series of routines.

1.1 – Beyond the heroic High Tech entrepreneur.

Seminal work by Joseph Schumpeter (1934) contributed in spite of itself to define a kind of ideal-type of entrepreneur, the creator of a technological company, a creative and isolated rebel, eager to fight against all odds to prove to the others the superiority his ideas, and the only one able to introduce successfully an innovation - product or new process - on the

market. But the simplification process through which the ideas of Joseph Schumpeter were popularised directly led to an incarnation of this ideal type. For Andrew Van de Ven, this phenomenon "*is likely to explain why, until recently, the search for features, elements of personality and individual characteristics specific to entrepreneurs constituted the quasi-exclusive orientation of the investigations and the theories worked out in the field of entrepreneurship*" (Van de Ven, 1992: 215). Generally, the theme of the profile of the entrepreneur remains central in all works which examine the phenomenon of the creation of innovating companies, and continues being widely spread by technocratic literature on the competitiveness of small and medium-sized companies. Many stereotypes are still associated to this "thesis of the heroic entrepreneur" which hinder the comprehension of the processes of technical innovation (Mustar 1994). To establish such a striking short cut between the personal characteristics of the entrepreneur and the success or failure of the young high technology company, appears a specious step to us... because the technical innovation does not constitute a purely individual realisation, but supposes a process comprising a dimension of collective creation likely to develop over time. Bruno Latour (1987) demonstrates that active social networks and political struggles constitute an essential part of scientific innovation. In the same vein, Michel Callon (1994) notes that the question of the individual origin of the technical innovation is needlessly put forward, since each study devoted to a brilliant inventor leads, not only to a network linking the actors of the innovation, but also to the intersection of many individual trajectories which give consistency in certain moments and places to a collective project that takes shape and manages to last. Beyond the too often heroic role devoted to the entrepreneur, many studies have stressed the importance of team and organisation building in the process of founding a new venture (Vesper 1980, Gartner 1985, Stewart 1989, Guth and Ginsberg 1990, Slevin and Covin 1992, Cooper and Daily 1997). This perspective has recently led to consider that a major topic of entrepreneurship is the enhancement of the intellectual and creative capital of the nascent or established firm (Ahuja and Lampert 2001).

1.2 – High tech entrepreneurship as a collective creative process

Two neo-Schumpeterian approaches highlight the capital role of the organisation of collective creative actions for achieving success in the process of innovation. Some put forward the discontinuities caused by the technical innovation and consider that the entrepreneurial structures behave in an abnormal way, their role thus being to initiate the cycle of "*creative*

destruction". From this point of view, the "*Minnesota Innovation Research Program*" (MIRP), led by Andrew Van de Ven (1992) (Poole and al., 2000), builds a process theory aimed at explaining the origin and operation of several processes of innovation. The role allotted to the entrepreneurs takes into account their aptitude to manage, according to perceived opportunities, a group of complex processes such as the creation of an organisation, and the mobilisation of rare resources. Another interpretation of the Schumpeterian model is proposed by Richard Nelson and Sidney Winter who examine in greater detail what appears to them: "*to constitute key aspects of the competition in a Schumpeterian meaning - the diversity of the companies, both with regard to their particular characteristics and their experience as well as the cumulated interaction between this variety and the structure of industry*" (Nelson and Winter, 1982: 30). They explain the development of technological innovation by using the concept of progressive evolution: for a given technology, the innovation occurs as the companies explore, and little by little identify new possibilities, that are learnt gradually through a process of modification by trial and error, and sometimes of reinvention. Technology is then no longer conceived as an exogenous element, but rather as a variable which firms manage according to their particular social characteristics and the knowledge capital they have accumulated throughout their existence. These economists regard companies as a set of organisational routines treated on a hierarchical basis, which includes, on a lower level, organisational know-how and the way in which it is co-ordinated, and on a higher level, decision-making procedures aimed at determining what must be carried out at the lower levels. Thus, at a given moment, the routinised practices which are assembled within an organisation, define a set of activities which the company is able to realise with assurance, i.e. its repertory of skills. Richard Nelson (1991) regrets however that the majority of modelling relating to technological innovation has not yet managed to capture the essence of the innovative process, namely its fundamental uncertainty, the differences in opinions, the divergences with regard to identifying practicable paths of development, which appear in any meticulous study of particular technical advances.

In order to better understand the emergence process of distinctive skills within the young high technology company, it seems essential to try to situate the entrepreneur in relation to the multiple networks he is involved in, and to explore the various bonds which he is able to tie with other individuals or organisations during the process of technical innovation. In order to explore the social dimension which is a constituent part of the high technology entrepreneurial process, we carried out an in-depth case study of COM One, a young telecommunications company founded in 1987. Over a period of four years we interviewed, on several occasions,

14 people who took part in the creation of the company and who directly contributed to its first years of existence. This investigation gathered 400 pages of accounts and resulted in an extensive monograph of 100 pages which reconstructs both the history of the firm since its foundation, the main orientations taken for technical development – and their correlated discussions – that took place during the time of the study. As the format of this chapter prevents reproducing extensive parts of this monograph and situating precisely every actor, small parts of the accounts given by the actors are used to illustrate their collective ability to set up meaningful technical innovations.

2. Tackling the question of the social foundations of technological entrepreneurship

Organisational life within high technology companies - be they young or older - is often depicted as a disordered, complex and polymorphic reality: individual attributions are not clearly defined and permanently change in order to closely follow the collective dynamics of the creative process; the judgement of peers constitutes a crucial process of co-ordination which results in reinforcing individual commitment and in developing practices of self-checking and shared authority. In this perspective, technical innovation is then mainly described as an informal process of communication which connects the individualities present within the incipient company, and contributes to reinforce individual learning capacities. This is why, in order to explain the appearance of learning processes at a collective or organisational level, it is necessary to call upon "*leaders*", "*champions*", "*boundary spanning individuals*" - and other neo-schumpeterian inspired conceptualisations of individualities who face the indifference of management or sceptical venture-capitalists (Waldman and Bass, 1991; Bouchikhi and Kimberly, 1994). However, it seems more difficult to unearth frameworks which deal explicitly with the thorny problem of the nature of the bond between individual learning processes and organisational types of learning processes (Kim, 1993). It appeared to us that the constitution of such a link - which cannot only rest on individualities - had to be explored in a more systematic manner. Indeed, considering the way in which the entrepreneurial team manages to be collectively innovative over time, leads to interpret the social phenomena which contribute "to informing" - to giving shape to - the progressive development of distinctive skills and long term dynamic capabilities within the young high technology company (Newbert 2005). The question is no longer then to limit the study of the technological process of entrepreneurship solely to the transfer of knowledge from an individual - the entrepreneur – towards an emerging social group – the nascent organization. It

leads to try to understand how some technical knowledge is developed in a collective way and referred to as a meaningful innovation worth being promoted on the market by the entrepreneurial team.

2.1. The intersubjective foundations of individual learning

The Russian psychologist Lev Vygotsky has brilliantly defended the idea of the social genesis of individual knowledge by showing how the children work out individual cognitive schemes during activities shared with adults or other children in a specific social context (Bronckardt and Mounoud, 1985). The concept of “*activity*” that he forged has the merit of integrating at the same time the social conditions - interactive - and the individual characteristics - cognitive - of the learning process. By engaging in a shared activity and by exploring the intersubjective space that it creates, the individual is led both to open up to an alter ego and gradually to work out his own interpretations of the situation (Levine, Resnick and Higgins, 1993). In the field of organisations, H.A. Simon makes a similar observation: "*What an individual learns within an organisation depends directly on what the other members know (or believe) already and on the type of information available in the organisational environment.*" (Simon, 1991: 125).

The accounts of the engineers at COM One bring many illustrations of their participation in a wide range of activities shared with other engineers, subcontractors, prospective customers, managers, end-users, competitors or administrations... By being involved in projects and relationships as varied as the design of the products, the production possibilities offered by subcontractors, the continuous adaptation to regulatory modifications or the satisfaction of the end-user, each engineer had the opportunity to explore a broad and rich intersubjective space and thus, to objectify a certain quantity of information crucial for the development of new products.

Serge Moscovici also reminds us that the notion of "*social representation*" was conceived to express the social dimension of knowledge forged by the individual (Moscovici, 1994). Indeed, the social representations objectified by an individual during a joint activity direct the practices to come: the social representations held by an individual take into account of the possible reactions of others to his (her) own ideas or actions. It is the performative character of this concept which appears particularly interesting to us: a social representation is not simply a cognitive representation of the joint activity, it takes into account the social imperatives for the continuation of the joint activity. As a result, it directly focuses the individual action according to normative implications aimed at defining the framework for the

reciprocal commitment of the participants to a meaningful relationship which makes it possible to pursue the joint activity.

Nevertheless, we avoid falling into a form of angelism which would consist in considering that the individuals involved in a joint technical activity would tend to work out very similar social representations of the situation, thus contributing to the natural emergence of a strong social cohesion and a harmonious community of practice... The individual learning experiences are not only unequally distributed within the young company, but are founded on contrasting social representations according both to the technical activities to which the individuals have taken part and to the personal history of each participant. For example, the sudden breakdown of the relationships between the designers and the Technical Director, cofounder of COM One, concerning the development of a new product, offers a good illustration of the complexity of an interaction.

The developers recall that during the early days, when the engineering department operated in a very rudimentary fashion, the Technical Director trained them in the development of new products and was directly involved in the projects by working very closely with his team to overcome the difficulties which were emerging. But when a few months later, the Technical Director suggested exploring the possibility of producing out a completely revolutionary product – a modem able to function with a very low level of electricity consumption -, the team of the developers collectively refused to participate in this process of investigation.

Indeed, the designers had gradually become aware of the need for better organising and for partially safeguarding the stages of technical development processes within COM One, in order to increase its efficiency and to improve the reliability of the prices and delivery times announced to powerful customers. Confronted with the suggestion to explore a new avenue on the technical level, but which presented *a priori* little chance of success, the pressure felt by the engineers in the design team became suddenly too strong, carrying their level of anxiety to an unbearable level and leading them to call into question the confidence which they had expressed thus far in the Technical Director. The definition of the normative imperatives necessary for the continuation of the joint activity of development under good conditions diverged too much between the design engineers and the Technical Director, making continued collaboration impossible and leading ineluctably to the calling into question of the relationship.

The company's rapid growth as well as the multiplication of projects under development within the design department, constituted factors which brought to light such different social representations that they led to a sudden breakdown of the interaction between the developers and the Technical Director. He had to give up the management of the team of developers and shut himself away in a company office in order to continue his exploratory work. In order to finish his project, he recruited a young developer and signed an agreement with a university laboratory. His work, removed from the daily operation of the design team, made it possible to create a truly innovative product – the "light modem", which represented 50 % of the sales of COM One over three years.

This illustration makes it possible to underline the interest of the concept of “*joint activity*”: it is profoundly linked to the idea of ambiguity of interpretation and presupposes active participation in the interaction in order to forge both intersubjective and autonomous knowledge. The perceived quality of the relationship between the participants directly determines the richness of the intersubjective space explored through reciprocal involvement in a joint activity, as James March and Johan Olsen point out: “*Moreover, we seldom found our interpretations on our personal observations alone; they rest amply on interpretations that others offer to us. Our degree of confidence in the latter clearly depends on the confidence which we grant to their interpreters.*” (March and Olsen, 1975: 155). Thus, a distant or recalcitrant participation by one of the participants in a joint technical activity is likely to impoverish the collective exploration process of a restricted intersubjective space and, as a result, directly limits the interaction’s learning potential for the participants.

2.2. The reframing of technical activities as a collective learning process

This second level our framework tackles the link between individual and collective knowledge forged during conversational interactions intended to interpret the plausible meaning of the various technical activities carried out by the members of the young high technology company.

The permanent conversational effort undertaken in order to share problems, to collectively seek acceptable solutions and to encourage a thorough exchange of opinions in the course of action, is often described as a major characteristic of the behaviour of managers within young innovative companies: “*by taking part continuously with the others in the resolution of the problems which the company faces and by bringing about a language of requirements and activities which is meaningful for all.*” (Burns and Stalker, 1961: 125). Indeed, the root of the word communication clearly contains a social dimension which directly conveys the idea of sharing, participating and pooling, and even sometimes of communion. By allotting an interpretative framework to a joint activity, the participants in the interaction evaluate the degree of their own commitment to allow the pursuit of the interaction. Erving Goffman (1974) shows that each interpretative frame includes a set of normative requirements which define the acceptable behaviour allowing the deepening of the joint activity and thus, directing the learning potential brought about by the interaction. The frame mobilised to interpret the joint activity acts as a “cognitive pilot” by directly guiding the learning capacities of the participants in the interaction. If the framework used by one of the participants proves

to be erroneous, his learning attempts are likely to be misleading and his behaviour could in some cases appear as socially unacceptable for the other members of the interaction.

The process of technical innovation requires a continuous inter-subjective exploration of the interpretative frames likely to be applied to the joint design activity in order to reduce the ambiguity produced by the multiplicity of potentially sense-bearing settings. Karl Weick (1993 b) points out that the design activity often consists in modifying the framework of attention and significance applied to a flow of on-going social practices, rather than to impose an *a priori* stable model of intentions on actions undertaken to achieve a pre-defined goal. Thus, during the process of high tech entrepreneurship, it is through conversational interactions that the ambiguous significance of the techniques under development are collectively explored, and that the commercial possibilities of a technical innovation are discussed, or that endeavours are made to find an acceptable technical solution to meet the requirements defined by a customer.

However, to choose the relevant interpretative frame is not an easy task and very often, the individuals hesitate as to the frame which they must use to correctly interpret the direction of the technical joint activity and to anticipate its possible evolutions. Under these conditions, any information, no matter how small, can result in discrediting certain frames and in confirming others: the interpretative frames are indeed very vulnerable and are the subject of misunderstandings in practice. Erving Goffman shows with meticulousness how the frames are constantly manipulated during daily conversations and can be, in certain cases, voluntarily transformed in order to induce a desired behaviour on part of the participants in the interaction.

It was possible for us to observe at COM One how the Technical Director and the design engineers had proposed two antagonist frames – that we label “originality” versus “safety” - which, having functioned as cognitive pilots supporting the divergent interpretative processes, led to a sudden breakdown in the social relationships between the design team and the Technical Director. At COM One, various frames “informed” - gave shape to - the research and new product design processes, - for example, to ensure that the prototypes could be correctly reproduced in order to guarantee a smooth passage to a large scale production, or to lower the costs in order to be able to access foreign markets -, and directed the definition of the priorities to be considered by the engineers in their ordinary design practice.

By handling various interpretative frames, managers find themselves in a situation where they can influence the collective process of exploration of the various interpretations which can be called upon for a technical problem, with the aim of supporting and of accelerating the

innovative efforts within the young company. It seems interesting to decipher which types of frames are used in various situations such as, for instance, when a prototype - an incomplete version of the desired product - is presented to a customer, or when the innovative efforts are directed towards the realisation of an “incremental innovation” versus a “radical innovation”.

To activate a relevant frame is not always easy... Putting forward a frame of “emergency” can result in privileging reflexes rather than reflection in the exploration of technical difficulties, leading to give priority to well mastered techniques within the company in order to ease and accelerate the outcome of the design process. Nevertheless, such a choice contributes in the long run to exhausting the creative potential of the young high technology company. On projects presented using frames which do not place the emphasis on urgency, the engineers are more likely to explore techniques with which they are less familiar, an investigation stage which makes it possible to enrich the technical repertoire as well as the collective learning capacities within the company.

In order to channel ambiguous joint technical activities going on within the young high tech company, the processes of collective setting and redefining relevant interpretative frames continuously take place mainly through conversational interactions... As they cannot be stored in files or precise written procedures, these interpretative frames are maintained thanks to their constant re-use in practice, in the pursuit of joint activities and of conversations and, quite simply, through the constitution of managerial, behavioural and interpretative routines (Weick 1995).

2.3. The institutionalisation of routines enables the formation of dynamic capabilities

The permanence of these interpretative frames is directly related to their continuous use in practice and conversations within the young high technology company. Thus, the concept of “*frame*” can only be understood in a relation of co-presence of the participants in the interaction. Conversely, the emergence of some distinctive skills within the young high technology company presupposes the permanence of such interpretative frames beyond the initial protagonists involved in a joint activity... and must consequently be connected to the concept of “*organisational memory*” (Walsh and Ungson, 1991). Anthony Giddens explicitly deals with this problem in his theory of structuring (Giddens, 1987). The interpretative frames used during the process of investigation and product design are created and maintained during

joint technical activities even though they simultaneously contribute to directing and channelling these same joint activities. The structuring process refers to the production and the reproduction of relations of interdependence (social systems) through the use of rules and resources (structures) during joint technical activities. This concept of "*duality of structure*" expresses the idea that the rules which control the social systems are at the same time the conditions and the results of the activities undertaken by the participants in the interaction. This idea is directly applicable to the discourses dealing with technical dynamics of which Karl Weick has given a fine analysis: "*Technology is both an a posterior product of lessons learned while implementing a specific technical system and an a priori source of options that can be realized in a specific technical system.*" (Weick, 1990: 5).

The stabilisation of these practices also presupposes the capacity to use the information in a systematic way in an attempt to influence and to control the process of reproduction or transposition of the interpretative frames used to give a direction to the joint technical activities. Thus, the processes of memorisation reinforce the reproduction of ordinary practices and make it possible to perpetuate the social imperatives needed to pursue relevant technical joint activities within the company. It is through ordinary conversations that the process of collective memorisation organises individual perceptions and gives a coherent texture to the community of exploration that constitutes young high technology companies. And when the structures (rules and resources) are accepted, used and placed in a daily context, they are stabilised and end up being institutionalised...

Nevertheless, unintentional consequences are likely to appear since the participants in the interactions have only a partial understanding of the social system in which they are involved (Giddens, 1987). For example, within COM One, the progressive routinisation of collective practices of investigation and development caused the institutionalisation of certain skills at the expense of others being formed ...

Through the product design process for its customers and the development of a very specific know-how relating to the different regulatory standards operating on the European telecommunications markets – before 1998 -, COM One collectively forged a series of routinised practices which reinforced the perceived originality of its competitive position as a specialised subcontractor.

But in parallel, the efforts made by COM One to develop its own products and to set up a distribution network on the European market remained sporadic, with little coordination and did not give rise to collective practices routinised within the company. Thus, the marketing of COME One's own products was postponed on several occasions, reinforcing the mistrust of the distributors who were tired of waiting for the promised

products and who finally decided to give priority to other competitors to constitute their own range.

This decision of course increased the natural tendency within COM One to regard the design projects on behalf of powerful industrial customers as a priority ... and also further convinced the commercial team charged with creating a European distribution network that the routinised operation of the design team would not make it possible to take into account the requirements related to the launching of COME One's own line of products.

Given the series of routinised practices which is gradually set up within the young high technology company, a multiplicity of institutionalised orders emerges and gives form to a complex series of distinctive capacities. The main stake facing the entrepreneurial team then consists in controlling a dynamic balance between the various institutionalised technological routines in order to reinforce the individual and collective learning capacities and to ensure that distinctive skills can emerge, take shape, evolve, and become more and more complex in the long term.

For Richard Nelson and Sydney Winter, "*the idea of "organisational genetics" raises a major challenge: to manage to understand how the continuity of a routinised behaviour acts to channel organisational change.*" (Nelson and Winter, 1982: 135). The process of reframing, partly triggered in an intentional way by the managers, or simply emerging from the joint technical activities in which the members of the young company are involved, achieves this dynamic balance by allowing the social representations and strategic discourses to evolve and to work out a series of ambiguous plausible worlds which call for increased collective investigations. Thus, within the young high technology company, the significance granted to the techniques and the potential uses which result from them, depend on the interpretations enshrined in the social practices which are regarded as acceptable and enriching within the entrepreneurial team.

3. Managing technical equivocality through rhetorical interventions

This chapter logically leads to the proposal of studying the rhetorical devices (Simons 1989 ; Potter, 1996) - used within the teams of research and design to convince their participants to increase their efforts of exploration in a direction and thus, to make them accept collectively that certain technical possibilities be thoroughly examined whereas others remain unexplored... Ellul's (1990) distinction between 'techniques' and 'technologies' suggests

another way of conceiving technology as the collective rhetorical ability to frame a technical activity.

According to Michel Meyer, rhetorical dynamics are the means through which people negotiate the distance among their interpretations about a specific matter, a precise problem (Meyer 1993). This definition reminds us that this concept integrates the contextual social conditions in which the discourses are enshrined. This perspective makes it possible to better understand the various rhetorical dynamics present in the inter-subjective dialogical spaces created by the joint technical activities in the young high technology company.

This definition of technology opens tracks of research to look further into the concept of "technological idiosyncrasy" sketched by Richard Nelson and Sydney Winter : *'It does imply that it is quite inappropriate to conceive of firm behavior in terms of deliberate choice from a broad menu of alternatives that some external observer considers to be 'available' opportunities for the organization. The menu is not broad, but narrow and idiosyncratic'* (Nelson and Winter, 1982 : 134). This notion embraces the specific way in which technical advances are collectively explored and interpreted within the entrepreneurial firm. The idiosyncrasy confirms the importance of the entrepreneurial team, an original social community which, in order to evolve and perpetuate itself, gradually works out a series of normative requirements. The latter directly direct the efforts of technical exploration allowed and developed within the young high technology company (La Ville, 2000).

3.1. Coping with contrasting technological idiosyncrasies

Under which conditions does a plurality of "technological idiosyncrasies" reinforce the design of competitive techniques and when is it likely to constitute an obstacle for the development of distinctive dynamic capabilities within the young high technology company? The answer should not be sought in a hypothetical logic of intrinsic development of the techniques, but rather in the comprehension of the possibilities of exploration offered by the social contexts or the interpretative frameworks to which the engineers refer when they make irreversible technical decisions.

Through our in-depth study of COM One, we have been able to identify various forms of technological idiosyncrasies that are likely coexist during the process of high tech

entrepreneurship which aim at establishing differentiated innovative paths and contributing to producing communication contexts with quite contrasting normative implications:

a) *a defensive technology* : in that case, collective innovative efforts aim at preventing that certain technical know how developed within the young high technology company be easily imitated by other competitors.

b) *an imitative technology* : the collective innovative efforts are intended to supplement certain technical know-how developed within the young high technology company, in order to integrate new sources of valorisation within the framework of interactions where the young company lets itself be guided by some of its influential partners;

c) *a submissive technology* : pushing the young high technology company to follow frantically the rhythm of innovation and the requirements imposed by the technical evolution specific to the activities of certain external stakeholders, - customers mainly (Reuber and Fisher 2005). In this case, the young high technology company is likely to exhaust its resources - inevitably very limited - in following the requirements of certain customers without being able to develop a really original technical know-how likely to be appreciated by other potential customers.

d) *an insular technology* : allows the young high technology company to develop its own range of techniques which it can enhance in an autonomous way. The risk of this approach is to privilege too narrow a frame in the course of the collective action which reduces the scope of the innovative efforts, limiting as a result the future possibilities of enhancing the innovation carried out;

e) *an influential technology* : aims at promoting certain standards in the environment through different lobbying attempts. This type of framing mobilises the know-how of institutionalisation that the young company develops during the first years of its existence. It leads to the imposition of a technical standard that the company developed and which under certain circumstances might become a world standard.

These different types of innovative behaviours develop simultaneously according to the personality and tacit knowledge held by the participants as well as their involvement in

several relational networks (Hite, 2005). They structure very distinct interpretative frames, whose normative requirements produce very contrasting visions as to the human or financial, or technical choices to be made as a priority. These technological idiosyncrasies also contribute to define what is at stake for the pursuit of collective innovative efforts.

3.2. Partially directing collective technological improvisations

To wonder about the dominant technological idiosyncrasies during the entrepreneurial process results in conceiving the rhetorical dynamic which connects individual cognitive schemes and collective interpretative frames. This prospect brings an explanation as to the various modes of structuring of distinctive skills which can appear during the young high technology company's development. A difficult task for strategic management then consists in locating, proportioning, influencing and balancing these multiple technological idiosyncrasies which develop simultaneously, because each one of them structures a stage open to certain forms of collective improvisation.

The collective improvisation indeed confirms the ambiguous bond of interdependence which links the actors and allows the active exploration of a common ground of action. Karl Weick points out that in the theatre and in music, improvisation - i.e. the simultaneity of co-ordination and individual expression - is possible only because the various actors have an equivalent understanding of what is occurring and of what that could mean (Weick, 1993 a; Weick, 1998 ; Miner and al., 2001 ; Crossman and al., 2004). Thus, if an innovation is to see the light of day, it seems necessary to operate on the socio-cultural frame of interpretation in order to support the emergence of new collective improvisations in practice. But at the same time, it is advisable to control the evolution of the level of ambiguity and anguish caused by such a reframing process. The entrepreneurial team must thus take care to set up dialogical devices intended to encourage communication, the possibility of leading collective investigations and of confronting interpretative frames.

The dialogical or staging devices can be either of formal or abstract nature: fictitious boards of directors, scenarios of a business plan, presentation of various prototypes, training sessions, working on new contractual proposals, seminars to explore the axes of development which appear accessible to the company, think tanks on the installation of means of co-ordination between departments, etc. The acceptance of ambiguity is a factor of innovation because when interpretative frames are multiple or partially ambiguous, individuals feel free to experiment, to test possibilities likely to turn out erroneous and to try several types of

collective improvisation. The entrepreneurial team must take care that the socio-cultural framework which guides the innovative efforts does not drastically reduce the level of ambiguity in the precise fields where it seems necessary to support the emergence of new forms of collective improvisation.

In the light of the multiplicity of potentially significant interpretative frames and the feeling of anguish which accompanies it, non-verbal communication and chit-chat constitute invaluable sources of co-ordination: they make it possible to maintain a certain social order which guarantees the direction of the efforts carried out by the participants to continue their collaboration. This perspective also takes into account the emotions and the emotional ties which give rise to multiple collective improvisations and which directly contribute to the collective definition of the potential value of a new technique.

3.3. Preventing interpretative blockages to enhance on-going improvisation

Is the entrepreneurial team not in a situation of permanent improvisation with regard to customers or partners with whom it wishes to maintain and develop lasting bonds in order to promote its innovative potential? During the high tech entrepreneurial process, the members of the young company are confronted with a great complexity of meanings, in particular with regard to the potential value of the technical innovations accomplished during collective improvisations.

However, the process of retrospective sense-making is extremely vulnerable: it is about a collective attempt, always precarious, to order the flood of actions in progress (Weick, 1995). The collective exploration of certain interpretative frames is thus likely to worsen or to be blocked, causing a brutal halt in the capacity for collective improvisation. In particular, when conflicting interpretative frames emerge from the participation in joint technical activities, thus causing two interdependent phenomena (March, 1991).

- First of all, an unbearable increase in the anguish within the initial team, which is no longer able to operate a satisfactory collective interpretation to continue the common exploration undertaken?
- Then, the incapacity to bring to a successful conclusion collective improvisations since the methods at the origin of conflicting interpretative frames limit the possibilities of experimentation of new behaviours with the result that a possible

failure will not be assumed in a collective way, but used to call into question the finality of the interaction itself. This can lead the manager to support the breaking away of technical teams having developed interpretative frameworks which are too conflicting, in order to allow the re-creation of differentiated socio-cultural contexts, fully ambiguous and more propitious for the appearance of new forms of technological improvisation.

The main contribution of this approach is to explain why the entrepreneurial team cannot claim to control the substance of the collectively built entrepreneurial project: its contents will always be partly beyond its control, because it is not possible for it to control completely the framing and reframing processes carried out collectively in practice (Shotter, 1990). Moreover, the entrepreneur does not intervene without risks in a rhetorical register with the hope of reducing the vulnerability of the young high technology company. The additional costs that are likely to appear in various forms - such as difficulties in developing large-scale production batches based on a new technique; opening of the market at a slower rate than expected; under-estimation of the commercial investments necessary to promote the products to the target concerned; insufficient capitalisation, etc. - can be in particular due to an inefficient or badly controlled reframing process by the entrepreneurial team. The reframing, a rhetorical process by nature, is based on the handling of an infinity of criteria such as urgency, need, complementarity, contradiction, competitiveness, the assertion of the paradoxes, etc in order to trigger the collective search for new interpretative frameworks making it possible at the same time to maintain ambiguity at an acceptable level and to pursue a collective undertaking through improvisation.

We have suggested various lines of reflection aimed at considering the rhetorical dimension which characterises the strategic management in high tech entrepreneurial settings. These openings constitute a heuristic framework likely to help the entrepreneur and the research and design teams to become aware of their priorities to lead the development of the high technology company.

Conclusion

As a very provisional conclusion, stress must be placed on the dialogical nature of the technical skills which enable the young high technology company to emerge in a lasting and

justifiable way in a competitive field whose contours are also built through a multiplicity of interactions between various actors or stakeholders, both internal or external (Barhami and Evans 1989 ; Klofsten, 1997, Johannisson and Monsted, 1997 ; Rueber and Fischer 2005 ; Hite, 2005). Thus, the gradually instituted entrepreneurial process always remains a fragile, singular and provisional order, but also evolutionary because it is constantly being constructed within the particular social community formed by the entrepreneurial team.

Rhetorical dynamics appear then as a central part of the activity of the entrepreneurial team because they open more or less rich inter-subjective spaces allowing the development of collective capacities of exploration within the young high technology company (La Ville (de) and Mounoud, 2003). These same rhetorical dynamics – by achieving a collective legitimization of some interpretative frames at the expenses of others - lead to a progressive reduction in the range of techniques being explored, a process which is absolutely necessary to the support the collective exploratory capacity of the nascent high tech firm. This social phenomenon of collective sense-making contributes directly to the emergence and the institutionalisation of some distinctive capacity held by the young high tech company: it constitutes a singular process of technological actualisation among many other possibilities (Coninck, 1994)

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