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### **Abstract**

Creation is a crucial notion in the evolutionary framework although creativity hasn't been deepened. Evolutionary theory focuses on accumulated knowledge and routines to explain creation. This paper analyzes the competences needed in a collective creative process. First by suggesting that creativity is a key competence in a theory of change and creation because differences in the individuals accumulated knowledge (technical and cognitive knowledge) can neither explain nor ensure creativity. Second by assuming that creativity goes with knowledge diversity and that competences in the management of diversity are key creativity skills in a collective creation process. The negative and positive effects of knowledge diversity need to be managed in order to favor creativity. Limiting and defining the management of diversity to a general positive perception of diversity underestimates the skills needed to manage diversity.

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## **Introduction**

Evolutionary theory of the firm suggests that firm's members are characterized by their personal cognitive frames and that coherence can be gained through the collective nature of routines. Evolutionary theory is furthermore a theory of change. The firm's main goal is the creation of new knowledge, whereby the firm's competences are defined as its accumulated knowledge and its routines. Knowledge is stored in routines, seen as "recurrent interaction patterns" of the firm (Becker, 2003). Routines have following characteristics: they are "repetitive, collective, self-actuating, a processual phenomena, context-dependant and transferable only to a limited extend, shaped by history and path-dependant" (Becker, 2003). Innovation is an unpredictable mutation of routines. Creation is a crucial notion in the evolutionary framework although creativity hasn't been deepened. Evolutionary theory neglects creativity as a key competence in creation and focuses on accumulated knowledge and routines. This paper questions the competences needed in a collective creative process. First by asking the question if creativity should be considered as a key competence in a theory of change and creation. Second by asking if competences in management of knowledge diversity should be considered as creativity skills in a collective creation process.

Let's start with the role creativity should play in evolutionary theory by analyzing the relations between creativity and technical knowledge and between creativity and cognitive knowledge. The analysis of the role of creativity as an essential competence in creation, complementary to the individuals' accumulated knowledge, conduces to raise two questions. Can creativity be explained by differences in the people's accumulated technical knowledge and do problem-solving heuristics ensure or favor creation? For this we suggest to distinguish between two forms of creativity: inference and deliberation creativity.

Afterwards we study if competences in management of knowledge diversity should be considered as creativity skills in a collective creation process. Neglecting

creativity means also not taking into account accompanying effects like knowledge diversity. The concept of knowledge diversity describes the phenomena of solution diversity in a collective creative process. Knowledge diversity exposes the diversity due to the subjective aspects of creativity and the differences in knowledge between individuals. Recognizing the existence of knowledge diversity in a collective creation process conduces to discuss the competences needed in order to manage diversity and favor creativity. Two further questions arise. What are the effects of knowledge diversity on collective creation and what do we mean by competences in diversity management? By answering both questions we can determine if competences in management of diversity should be considered as creativity skills.

### **Creativity and accumulated knowledge: their respective roles in a creative process**

This paper questions the competences needed in a collective creative process. The first part discusses if creativity should be considered as a key competence in a theory of change and creation like the evolutionary theory of the firm. Discussing this question involves exposing the link between creativity and accumulated technical (practical and theoretical knowledge) and between creativity and cognitive knowledge (mental models, problem-solving heuristics).

Creativity is "the ability to produce work that is novel (i.e., original, unexpected) and appropriate (i.e., useful, adaptive concerning task constraints)" (Sternberg and Lubart, 1999). Koestler (1964, p.121) referred to this process as "bisociation", which he defined as "the sudden interlocking of two previously unrelated skills, or matrices of thought". An action is deemed to be creative to the extent that "appropriate observers" independently reach a momentary consensus judgment that the action is appropriate (Amabile, 1996). Creation has to be strictly distinguished from the judgement of different alternatives given to the human mind (Witt, 1998).

Creativity is analysed in the context of innovation and has to be distinguished from innovation. Innovation is the output of the creative process. Innovation is also defined as the commercial success of an invention and therefore creativity does not necessarily conduce to innovation. In the case of an innovation creativity appears on different levels: The product's characteristics (new technology, new needs) and/or the commercialization of the product and/or the organization of the innovation process may be creative. Innovative organizations build their own environments. Firms collect information by exploring new behaviors and observing what happens. Innovation emerges not only out of empirical observations of the environment (Daft and Weick 1984, p.288).

Technical knowledge embraces theoretical and practical knowledge. Cognitive knowledge includes mental models and problem-solving heuristics. Actionable knowledge has two components: know how and know that (Ryle, 1949). Know how is similar to practical experience while know that to abstract information. Without the necessary know how, know that has limited usefulness. Mental models are “deeply ingrained assumptions, generalizations, pictures or images” (Senge, 1991) that guide individuals in their understanding of a world and their way of acting in a world that is generally too complex and uncertain to be fully understood (Dosi et al., 2003). Mental models “are no clear-cut constructions with sharp boundaries and put together in fully consistent interpretative models” (Dosi et al., 2003). The kind of problem-solving competences we possess influences the way we perceive the problem and the way we frame the problem shapes the developed problem-solving skills (Lane et al., 1996). Furthermore individuals' preferences are endogenous (Dosi et al., 2003). Knowledge is individually and collectively held (Brown and Duguid, 2001). Individuals' knowledge is evolving, influenced by past knowledge and by the agents' environment (Dosi et al., 2003). Knowledge has the potential to create new knowledge and concerns beliefs and adherence (Nonaka and Takeuchi, 1997).

The question if differences in accumulated knowledge explain creative abilities is first discussed by analysing if creativity is the output of differences in individuals' accumulated technical knowledge and second by studying the role of problem-solving heuristics in a creative process. For this we suggest to distinguish between inference and deliberation creativity.

### ***Technical knowledge and creativity***

Inference creativity is defined as the application of solutions that have already been tested in another context (other disciplines, other markets) and favours the diffusion of already existing knowledge. Technological inference is illustrated by the following example: “For many years physiologists could not understand the purpose of the long loops in the kidney tubules: it was assumed that the loops had no special function and were a relic of the way the kidney had evolved. Then one day an engineer looked at the loops and at once recognized that they could be part of a counter-current multiplier, a well-known engineering device for increasing the concentration of liquids. In this instance, a fresh look from outside provided an answer to something that had been a puzzle for along time.” (De Bono 1968, pp.148-149). The diffusion of an existing product in new markets is also defined as inference creativity. In this case creativity happens on the commercial level of the innovation. Inference creativity assures the diffusion of existing knowledge in new contexts.

Deliberation creativity is defined as the imagination of new solutions on the base of the knowledge held by the individual, where imagination is defined as the “unlimited power of mixing, compounding, separating, and dividing these ideas, in all the varieties of fiction and vision” (Hume, 1975, p.47). « It is the human faculty to combine mental images by composition and division and to create new combinations of existing things or even completely new objectives like centaurs » (Koslowsky, 1990, p.19). The process of search is based on the individual’s knowledge base although the process himself is non-deterministic. This means that the formulated set of alternatives is not given a priori to the human mind (Shackle, 1979). « In going beyond what is already known, one cannot but go blindly. If one can go wisely, this indicates already achieved wisdom of some general sort” (Campbell, 1974, p.7). Deliberation creativity, contrary to inference creativity, cannot be explained by the differences in the individuals’ technical knowledge bases. Creative individuals do not only differ from non-creative individuals by the technical knowledge they possess and holding technical knowledge doesn’t mean having the capacity to create something new in the sense of creativity. Deliberation creativity shows that firms’ ability to

create and innovate cannot only be explained by their accumulated technical knowledge.

### *Creativity and problem-solving heuristics*

“Heuristics are methods, rules or criteria guiding e.g. representation, judgment or action - and include simple rules-of-thumb but also much more sophisticated methods explicitly evoking the use of mental categories.” (Dosi and al., 2003). Using heuristics facilitates problem-solving, but heuristics do not contrary to algorithms guarantee the success of the problem-solving process (Mantzavinos, 2001). Problem-solving heuristics can sustain creativity by creating a favorable framework for creativity. They do however not ensure creativity. Bateson’s (1973) argument on the relation between learning and the individuals capacity to learn, has limited value in a context of creation. Creative activity doesn’t create the necessary problem-solving heuristics to ensure future creativity. Computing theory enforces this argumentation. The rules and procedures solving new problems are unknown and their existence cannot be guaranteed ex ante (Dosi and Marengo, 1994). The existence of a general algorithm optimizing problem resolution is negated, independently from the perfection level of information (Cutland, 1980). Problem-solving heuristics are considered as simple facilitators of innovation. Another element to consider is the process of search himself. Problem-solving doesn’t necessarily start with a clear definition of a problem (Feyerabend, 1983). The problem-solver’s knowledge and beliefs conduce him to follow a certain direction and his knowledge is evolving with the search process himself

The firms’ accumulated knowledge is not able to explain at its own competences in creation. Creativity has to be considered in order to explain creation skills.

### *Creativity and past knowledge*

This proposal doesn't deny the crucial link between knowledge and creativity. The definition of deliberation creativity underlines the key role of past knowledge for creativity. The assumptions on the relation between knowledge and creativity are very diverse in the existing literature. Hesse (1990) advances the concept "principle of the cognitive creation". He assumes that for new problem-solving past knowledge and experiences play limited roles. In Bailin's (1988) view without some sort of reference to past knowledge the developed idea would make no sense to problem-solvers. Koestler (1964) assumes that creativity "does not create something out of nothing; it uncovers, selects, re-shuffles, combines, synthesizes already existing facts, ideas, faculties, skills. The more familiar the parts, the more striking the new whole." Past knowledge can also have negative effects like the phenomena of lock-in (Luchins and Luchins, 1959; Simonton, 1984). Simonton's study shows a negative relationship between formal education and creative accomplishment. Simonton (1984) uses for his study a sample of eminent people that were born between 1450 and 1850. These results have to be differentiated because the link between knowledge and education is not clear and degrees delivered in the past have a different value than today (Weisberg, 1999). The laboratory studies by Luchins and Luchins (1959) have shown that past success conduces persons to adopt habitual modes of thought and when the world changed they were unable to adapt. The ability to forget inappropriate solutions, to discover and combine existing knowledge to appropriated solutions favours creativity. Creativity skills include the ability to break away from previous actions and routines.

## **Creativity's accompanying effects: uncertainty and knowledge diversity**

Neglecting the analysis of creativity means also not considering accompanying effects like knowledge diversity. Creativity goes with uncertainty and knowledge diversity.

### ***Creativity and uncertainty***

The previous developments have underlined the key role of uncertainty in creation. The rules and procedures solving new problems are unknown and their existence cannot be guaranteed *ex ante* (Marengo and Dosi, 1994). In an uncertain situation not only the probabilities attached to the different possible solutions but also the set of solutions are not defined (Knight, 1921). Defining and solving problems are two different levels of problem-solving, both confronted to uncertainty (Dosi and Egidi, 1991). In the case of an innovation uncertainty emerges on the level of products characteristics and/or the product's commercialization and/or its organization. The stage (R&D, introduction to the market, growth, maturity), the type (product, process) and the intensity (new product or enhancement of existing product) determine the degree of uncertainty of an innovation (Bodoin and St-Pierre, 1999). The distinction between deliberation creativity and inference creativity shows that according to the form of creativity used, uncertainty changes. Diffusing existing innovations to new markets is for example less uncertain than creating new products. Defining creativity means considering uncertainty. The degree of uncertainty encountered depends on the characteristics of creativity (inference or deliberation).

Innovating means also mobilizing network partner such as employees, customers, regulators, vendors and sources of finance. These potential partners need to be informed on the innovation in order to decide on their involvement. Innovation goes with strong uncertainty and this explains that little knowledge can be diffused on an idea. Potential innovators need to learn about markets, develop their competences and at the same time they need to establish their cognitive legitimacy. Accepting the nature of the innovation as granted feature of the environment is defined as cognitive

legitimacy. Aldrich and Fiol (1994) draw a distinction between cognitive and socio-political legitimacy. Socio-political legitimacy describes the degree of acceptance of an innovation that is appropriated and in conformity with accepted rules and standards. Suchman (1995, p.574) defines legitimacy in a broader sense as “a generalized perception or assumption that the actions of an entity are desirable, proper or appropriate within some socially constructed systems of norms, values, beliefs, and definitions.” The actor-network-theory joins these assumptions (Callon, 1989; Vinck, 1991). This theory describes the efforts made by the potential innovators in order to convince the potential network members of their ideas by focusing on notions like “interessement”. If little is known about the idea individuals imagine very subjective representations on what could be the appropriate solution. The proposed solutions by different individuals diverge and conduce to what we call knowledge diversity. Knowledge diversity may emerge on firm level but also with the potential stakeholders.

### ***Knowledge diversity in a collective innovation process***

Innovation is often a collective process, inter- or intra organizational. The dispersion of knowledge (Hayek, 1945) explains among others the collective aspects of creativity. The collective aspects of innovation explain the omnipresence of knowledge diversity in a creative process. Diversity favours creativity and creativity favours diversity in collective problem-solving. The concept of knowledge diversity highlights the phenomena of solution diversity in a collective creative process. Satisfying solutions are unknown and the different actors involved in the innovation process do not necessarily suggest the same solutions to solve the new problem or realise an innovation. In the case of an innovation this means that each potential buyer and each potential seller will have their own representation of the ideal product, customer, organization, and market, and the respective relations between these different elements (Smith and Di Gregorio, 2004). Knowledge diversity exposes the diversity that is only due to the subjective aspects of creativity and the differences in knowledge between individuals. Knowledge diversity is complementary and has to be distinguished from diversity of interests treated in the agency theory. Diversity is a large concept that embraces the notions of variety (the number of different categories), balance (relative proportion of the different categories) and disparity

(nature and degree of difference between categories) (Stirling, 1998). The degree of diversity changes with the type of creativity met. In the case of deliberation creativity reaching convergence can be much more difficult than in the case of inference creativity.

First explanations for knowledge diversity in a creative process are the subjective aspects of creativity. These characteristics have been exposed in the previous sections. Deliberation creativity is defined as “the unlimited power of mixing, compounding, separating, and dividing these ideas, in all the varieties of fiction and vision” (Hume 1975). These creative actions are personal to the individual and explain the subjective output of a process of creation.

A second explanation for knowledge diversity emerges out of the differences in knowledge between individuals. In this case knowledge diversity is due to the subjective aspects of knowledge that have also been discussed in the previous sections. Differences in the individuals’ technical and cognitive knowledge sustain knowledge diversity.

In a creative process knowledge diversity emerges on a technical level and on a cognitive level. The solutions proposed by different individuals involved in new problem-solving may be different on a technical and on a cognitive level. Technical diversity embraces practical and theoretical diversity while Drucker (1993) considers only diversity in the individuals’ know how. Creators, decisions makers and project evaluators imagine very subjective representations on what could be the appropriate solution. Both form of diversity play a central role in creation and explain the predominant role of knowledge diversity in an innovation process. The distinction between technical and cognitive diversity is although not so sharp in a creative process. Technical diversity and cognitive diversity often appear together because technical diversity favors cognitive diversity (Raghuram & Garud, 1996; Sessa & Jackson, 1995). Brown and Duguid (2001) suggest that knowledge is hard to circulate between people sharing different practices. “Individuals with different practices have different assumptions, different outlooks, different interpretations of the world around them, and different ways of making sense of their encounters.”. The concept of

cognitive diversity clearly exposes that disciplinary differences aren't the only source for diversity.

Creativity involves secondary effects that need to be managed and creativity skills might include among others the management of knowledge diversity. In order to evaluate the necessity of developing competences in the management of diversity, first the effects of diversity and later the competences needed to manage diversity are defined. An analysis of the positive and/or negative effects of knowledge diversity informs on the necessity to develop competences to manage these accompanying effects of creativity. Defining and limiting competences in the management of knowledge diversity to a general positive perception of diversity would question their role as a key creativity skill.

## **Effects of knowledge diversity and the respective management of diversity**

### *Effects of knowledge diversity in a collective innovation process*

The presence of different skills in a team has been perceived as positive for new problem-solving. Multidisciplinary enhances creativity by delivering new solutions and approaching problems from different point of views (Rahuram & Garud, 1996). Sessa, Jackson & Rapini (1995) suggest that diversity in the perception of a problem favors a process of learning and enriches discovery by new and different solutions. Knowledge diversity may however also harm the process of innovation. Drucker (1993) assumes that cognitive diversity is at the origin of conflicts between the individuals involved in problem-solving.

Conflicts have been defined as perceived incompatibilities (Boulding, 1963), divergent views, or personal incompatibilities between two parties (Coleman and Deutsch, 2000). Ensley et al. (2002) distinguish affective and cognitive conflicts. Cognitive conflicts are supposed to enhance the quality of decision-making because the synthesis of different perspectives is superior to the individual perspective

(Schweiger and Sandberg, 1989; Jehn, 1995). Conflicts start a learning process able to enhance the quality of problem-solving and to create an entirely new solution. The positive effects of cognitive conflicts depend although on the type of task that has been realized. Discussion enhances only the resolution of complex and non-routine problems (Hoffman, 1959; Hoffman and Maier 1961). Cognitive conflicts can also sustain the emergence of affective conflicts even in the case of non-routine and complex tasks. Interpersonal tensions emerging from affective conflicts are defined as counterproductive (Jehn, 1995). Affective conflicts make persons less receptive to the collection, integration and evaluation of others' information (Coleman and Deutsch, 2000). Conflict produces also thinking with restricted judgment and reduced complexity. Explanations for this rigid thinking are, too much cognitive stimulation, anxiety and competition involving the preoccupation with the development of strategies and tactics to prevail in the conflict. The result is that affective conflicts can wipe out the positive effects of diversity (Higashide and Birley, 2002).

Both forms of conflicts go together with creativity. Knowledge diversity is an essential prerogative for creativity and conflicts can therefore not be avoided. Being creative means developing competences favouring the exploitation of knowledge diversity and the management of conflicts. Gathering and taking into account different point of views by limiting conflicts is a critical determinant for the success of creative tasks. Furthermore defining what is meant by management of knowledge diversity and competences in the management of knowledge diversity answers the question if competences in management of diversity should be considered as creativity skills. Defining the management of diversity as a key creativity skill means that creativity is not only the ability to "mix, compound, separate, and divide ideas, in all the varieties of fiction and vision" (Hume, 1975, p.47) or to transfer knowledge in other contexts, but also to exploit knowledge diversity and to manage conflicts.

### ***The management of knowledge diversity and the respective skills***

Group's performance is a function of the group members' knowledge (group resources), the group's ability to manage conflict and the appropriateness of the group's decision scheme (group process) (Bottger and Yetton, 1988). Successful

groups need to favor trust (Coleman and Deutsch) and communication. They should also be characterized by mutual supportiveness and ensure the appropriate weighting of individual contributions into group decisions (Gladstein, 1984). The exploitation of knowledge diversity and the management of conflicts determine both the group's abilities in creativity. Diversity management skills facilitate the communication on the respective differences, favor more realistic and less judgmental reactions to different attitudes (Coleman and Deutsch, 2000) and an appropriate use of the group's knowledge. Managing conflicts means being able and having the opportunity to open up and to understand a problem from various perspectives (Coleman and Deutsch, 2000). The openness to new alternative possibilities has to be accompanied by the ability to close in on a final decision (Coleman and Deutsch, 2000). Problem-solvers need furthermore "communication skills, willingness to communicate, relationship development, self-monitoring, flexibility" (Shaw and Barrett-Power, 1998), "effective perspective taking, empathy and control of egocentricity" (Coleman and Deutsch, 2000).

Notions like legitimacy (Aldrich and Fiol, 1994) and actor-network-theory (Callon, 1989; Vinck, 1991) expose that managing diversity means also convincing people of one's own ideas and creating common visions. Leadership (Witt, 1998) and the entrepreneur's ability to create "symbols, ideologies, languages, beliefs, rituals and myths, aspects of the more cultural and expressive components of organizational life" (Pettigrew, 1979, p.574) are key competences to create common visions. Leadership is defined as the entrepreneur's ability to propagate business conceptions through informal communication. Informal communication has contrary to formal communication, much less institutional support to influence individuals. The adoption of the entrepreneur's business conceptions emerges through a process of social learning rather than formal instruction (Witt, 1998). Business conceptions guide group members' behavior and are the output of a collective consultation. They are not strongly constraining because of uncertainty and in order to leave room for initiatives and creativity. "Eloquence, persuasiveness, patience and persistence, the capacity for gaining sympathy and confidence" as well as the features of the business conception and the internal organization of the firm favor the diffusion and adoption of the firm's business conceptions. In a broader sense common business conceptions may be related to the notion of common mental models, allowing to form explanations and

expectation about the tasks to be realized in order to coordinate the different actions and to adapt to common aims (Cannon-Bowers, Salas et Converse, 1993, p.228).

These discussions expose that diversity management skills cannot be described by a general positive perception of diversity. This proposal underestimates the efforts needed to favor the exploitation of diversity, the management of conflicts, and the propagation of visions as well as the creation of common visions. Actors involved in innovation processes need training in the management of diversity. Competences in the management of knowledge diversity are key creativity skill. Valuing diversity may be linked to the level of competences in diversity management detained by the firm. Knowledge diversity management is however not a guarantor for the selection of the optimal solution. The high degree of uncertainty and the selection mechanisms influence both the final result.

According to these different characteristics of knowledge diversity management cannot be reduced to a process of evaluation and decision. Considering the different point of views in the resolution of a problem favors a process of knowledge sharing and learning, even for decision makers and project evaluators. New solutions are created out of this process of knowledge exchange. The Bayesian decision model is inappropriate to describe this type of learning and decision. Bayesian decision-making is probabilistic and limited to information processing (Dosi et al. 2003). Each decision-maker is defined by its own given partition incorporating the individual's knowledge on its environment. Exploiting knowledge may however also induce an evolution of the partitions of those individuals involved in the creative process. Agents may converge to a solution that was inexistent for them at the beginning of this sharing process.

## **Conclusion**

The present paper has questioned the competences needed in a collective creation process. Evolutionary theory focuses on firm's accumulated knowledge and routines to explain creation.

First were discussed the relations between creativity and technical knowledge and between creativity and problem-solving heuristics. This analysis determines the role played by creativity in a creation process. The notion of deliberation creativity shows that firms' ability to innovate cannot only be explained by their accumulated technical knowledge. Furthermore problem-solving heuristics are considered as simple facilitators of innovation. Firms' accumulated knowledge is not able to explain at their own creativity and innovation. Both analyses suggest that creativity should be considered as a key skill in the evolutionary framework.

Second were described the accompanying effects of creativity like knowledge diversity. Afterwards was questioned if the ability to manage knowledge diversity is a key creativity skill in a collective creation process. The discussion of the negative and the positive effects of knowledge diversity exposed the necessity to develop competences in diversity management. The exploitation of diversity, the management of conflicts, and the propagation of visions as well as the creation of common visions go with specific abilities. A general positive perception of diversity is insufficient in order to sustain these actions. Innovation needs individuals that are trained in the management of diversity and these competences belong to the creativity skills of an organization.

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