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THE CREATIVE RATIONALITY AS A KEY DRIVER FOR ENHANCING INNOVATION CAPABILITY

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Abstract

Several recent works point out that design is one of the main driver of innovation. Therefore, it is interesting to analyze how design contributes to these last process. The point of view we present in this communication assumes that design is based on a specific rationality we called creative rationality. This paper aims at presenting its theoretical roots. Creative rationality derives from Vico's notion of *Ingenium*. Creative rationality explains the creation of new artifacts and knowledge by knoting in a ingenious way scattered knowledge. It depends on several cognitive, individual and social variables one can identify, measure, and combine in a unified model. If our hypothesis is relevant, then innovation policies or strategies should improve the effectiveness of such a rationality.

Keywords

Design, creativity, innovation, *ingenium*, rationality.

Introduction

The way we conceptualize innovation has dramatic effects. It explains the purpose and the content of the policies implemented by governments. Thus, the dominant innovation model is what one calls the R&D model (Research & Development model) or the big science model. In such a model, innovation is seen as an outcome of the science. It is no more than applied science. There is no innovation without research breakthrough, discovery, serendipity... Researchers produce new ideas which will then be embedded in products by skilled engineers and exploited by opportunistic entrepreneurs. The innovation process is represented as a linear succession of stages. It goes from the world of knowledge creation to the those of technical application and entrepreneurial know-how. Innovation policies improve the innovation process by strengthening the research and the transfer from science to the rest of the society.

Is this last model always relevant? The answer is clearly no (Dertouzos, Lester, Solow, 1990). Data from the *Innobarometer 2007* survey show that more than 50% of innovative firms innovate without performing R&D. If R&D seems to be an important driver of innovation, it is not sufficient by itself. The comparison between linear model and empirical studies has led theorists to propose a more complex view of innovation process. There is no simple causal relation between the scientific capacities (number of researchers, R&D expenses...) or outcomes (number of articles...) and the rate of innovation (Bonnaure, Barré, 1995). In the mid of the 1980s, the American economist Stanley Kline and the Historian Nathan Rosenberg explained such a paradox by building what they called the "chain-linked model" (Kline, Rosenberg, 1986). Innovation is knoting. It involves several activities tha should be closely associated by different loops. Kline and Rosenberg underlined the key role of design. "The central process of innovation is not science but design" (Kline, Rosenberg, 1986). Without good designers, no innovation. Many recent studies confirm Kline and Rosenberg's insight. Indeed, a recent survey of Swedish companies shows a very interesting fact. Firms that use their design activity as a strategic driver are five times as likely to develop new products as compared to firms that do not do it (Swedish Industrial Design Foundation, 2008; European Commission, 2009). Moreover, these firms developed radical innovation (Irish Center for Design Innovation, 2007 ; Tether, 2009). The practical consequence one can infer from such data is trivial. Innovation policy must not only be focused on research. Design should be one of its targets. Improving European competitiveness requires a shift of focus from exclusive R&D to design, as Finland, Ireland, Spain, Denmark and the United Kingdom have been understood since two decades (Hollanders, Cruysen, 2009).

If design contributes to innovation, then we aim, as design theorists, to understand the reason and the level of its contribution. What is the intrinsic characteristic of the design which makes it a main innovation process driver? Our hypothesis is that design involves a specific rationality. We call it creative rationality. It explains the creation of new artefacts and knowledge by knoting in a ingenious way scattered knowledge. It depends on several cognitive, individual and social variables that should be identified and combined in a comprehensive model.

The remainder of this communication is structured as follows. Section I presents where the creativity is nestled in the design process. Section II shows the origin of the creative rationality involved in such a process. Section III presents a first draft of the creative rationality.

Design as a creative process

Defining design *per se* is a difficult task. However, all researchers and practitioners of the field recognize that design is a non-trivial process. Contemporary design of complex products (planes, buildings, professional software, cars., factories...) involves a large number of stakeholders (Micaëlli, Visser, 2005), skills or firms with varied expertises (Micaëlli, Forest, 2003). Design is also a convergent (if not, it impossible to achieve an outcome) and a satisfying process (Forest, 1999). It is temporally constraint and has its own rhythm, different from those of the sciences (Micaëlli, Forest, 2003). Last but not least, design is seen as a creative process. Its outcome consists of an original, astute and unimaginable result. Such a creativity can be explained because the design intrinsic logic. Its purpose is to create alternatives, not to choose amongst well-defined alternatives.

Several authors underline the creative aspect of design. "design involves (…) the presence of a creative step (...)" (Archer, 1984). "(…) all designing is iterative, using creativity and compromise to move from a field of possibilities to one unique solution" (Roy, Wield, 1986). "Design is a structured creative process" (UK Department of Trade and Industry, 2005). "Design is a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole life cycles" (ICSID, 2009).

Of course, the precedent list of citations can be extended *ad infinitum*. They can be considered as themselves. However, I believe that they are the symptom of an interesting social phenomenon. They led to substitute the design in the creation, quite as the rational in the inexplicable (Faucheux, Forest, 2008). Creation is no longer seen as a mystical affair. It is no longer related to the myth of a divine intervention (Albert, Runco, 2005). "Plato argued that a poet is able to create only that which the Muse dictates (…), Rudyard Kipling (1937-1985) referred to the Daemon that lives in the writer's pen (…). Many people seem to believe, as they do about love (…) that creativity is something that just doesn't lend itself to scientific study, because it s a spiritual process", Sternberg and Lubart (2005) wrote.

If we study the design process, then we will have a clearer vision of creativity. It is not longer a mystical *fiat*, but an empirical attribute of the design process. Design theorists have been trying to understand it since several decades. "creativity is the synthesis of new ideas and concepts by the radical restructuring and re-association of existing ones whereas innovation is the implementation of the result of creativity" (Heap, 1989). "Creativity as the generation of ideas" (Gurteen, 1998; McAdam, McClelland, 2002). It is "(...) a cognitive process that generates solutions to a task, which are novel or unconventional and satisfy certain

requirements" (Kryssanov, Tamaki, Kitamura, 2001).

Beyond the variety of these definitions, one notes that the creativity is neither considered as non-rational, intuitive, mystical, and inexplicable phenomenon. It is also no longer seen as a state. It is viewed as a process involving the achievement of a set of specific cognitive activities (Wallas, 1926; Guilford, 1950; Boden, 1990). Such a point of view leads to consider the creative process as an object of thought. Thus, the study of creative outcomes is no longer postulate as the point of departure of any study on the creativity. The study of the processes it achieves is required. I conjecture that it will lead to the rehabilitation of a kind of reason the Occidental tradition has forgotten (Faucheux, Forest, 2008). The fierce opponent of Cartesianism Giambattista Vico (1668-1744) has called it *Ingenium*. We can call it creative rationality.

Before presenting creative rationality, let us note an important point. If creativity is a main attribute of the design process, then the relationship between creativity, design and innovation must be studied with a new point of view. We can no longer see design as linking creativity (i.e. new ideas generation) to innovation (i.e. successful exploitation of new ideas) as proposed P.Swann and D.Birke (2005) in their interactive model. Creativity is a core element of design. It is not an outside entity of the design. It does not exist outside or before the design process.

From *Ingenium* to creative rationality

Creative rationality can be defined as the ability to associate in an effective way scattered items (concepts, things, technologies, knowledge domains...). It is the faculty to bring together different perspectives, to make distinct domains closer, to find and explore relations none have previously made. The *fiat* or *Eurêka* effect can be understood as a result of such a knoting (Martindale, 2005).

In his main book titled *Scienza Nuova* (1725), Vico stated that the *Ingenium* explained how the main western inventions of the End of the Middle-Ages and the Renaissance (e.g. Brunelleschi's works) were created. They were not developed following Cartesian methodological principles (i.e. Decomposition), or what we call analytical rationality.

Vico's insight has found an echo in contemporary literature on creativity. It is mainly considered in architectural terms. Creativity seems to be a word one uses to describe the combination of piece of knowledge "To create consists of making new combinations of associative elements which are useful" (Poincaré, 1913 *in* Martindale, 2005:137), "People create new knowledge or ideas by combining and reorganizing existing concepts or categories" (Swann, Birke, 2005). This associative and architectural view induces several questions: What are the knowledge attributes ? Where are these knowledge parts? How to manage the knowledge diffusion, that is to say both the accessibility and the appropriation of these knowledge, to improve innovation process? These questions gave place to a great amount of literature in social and engineering sciences. However, the question to know how such a combination leads to innovation remains open.

It is however possible to go further by mobilizing the Hatchuel and Weil's (2002) C-K theory. It stands that the creative reasoning is based on the mapping between two spaces. The space C represents the space of the concepts. The space K represents the space of the knowledge. According to them, the design reasoning begins by a disjunction K-C transforming propositions of K into concepts. It ends with a conjunction C-K. This last one transforms a concept into knowledge. The concept contains then a set of properties which allows it to acquire a logical status in K

C-K theory postulates thus that without knowledge, expansion of concepts is impossible. Without concepts, the designer investigates objects the definition of whom never changes.

Hatchuel and Weil's theory depicts the dynamics of the combination. The key aspect with regards to C-K theory is the focus on knowledge production without which novelty cannot appear. The reality and the role of knowledge production has been empirically tested in a study conduct on innovative companies of the French region Rhône Alpes (Forest, Serrate, 2009). This study leads thus to put in perspective the importance granted to the diffusion of knowledge in innovation policy.

However, a complete theory of creative design reasoning can not occult the limits of the human rationality. Herbert Simon (1916-2001) showed in various empirical and theoretical works. These limits have two rationale (Simon, 1955, 1976). The first one depends on our limited knowledge of the environment. The second one is the impossibility for a designer to process all the available information and all possible options he can address. His attention and his computational capabilities are indeed limited. The bounded rationality aims not to show that individuals (e.g. designers) are irrational in their decisions. It is to highlight that the entire range of potential options is never practically accessible. Human mind has a limited ability to generate and compare alternatives. The expansion underlined by A. Hatchuel and B. Weil must be then a bounded process.

Nevertheless, extend the C-K theory by integrating the bounded rationality it is not sufficient. Computationalist approach of design remains a "egocephalocentric" theory. This last one minors the question of the social inscription of the knowledge production. We need a model to have further knowledge about the design reasoning. This model should take into account the cultural, historical and social inscription of the design process. This aim is not a pure theoretical stake. It is also a practical one. By fostering creative rationality, one could improve design, and then innovation.

Basis of a creative rationality model

The aim of these last section is to present a draft of a possible model of creative rationality. This model is based on two main hypothesis. Without knowledge, an ingenious combination can not occurs. Without challenging problem, the creative rationality can be effective.

The knowledge production, noted **I**, resulting from the creative rationality of an actor I (i=1,...n), is a function of the knowledge he owns (Km_i). Let us assume that there exists a relationship between Km_i and, on one hand, the current state of knowledge in society (Ks), on the other hand, his initial knowledge. Such a knowledge can be

acquired attending a certain curricula or through working experiences[1].

The scope of the expansion process depends on the variety of the parts of knowledge bringing together. This characteristic determines the more or less innovative level of the combination. "In recent literature there is increasing consensus that resource heterogeneity provides a clear potential for learning and innovation" (Nooteboom & *alii*, 2007). If we have access to the same part of knowledge, we will investigate concepts which the definition never changes. "Little progress would be made in a world of clones" (Maskell, 2001). Theoretically, the combination is not based on a collective activity. However, in current design situations, such an activity is required. Our contemporary knowledge is specialized [2] and complex product development requires the cooperation of different actors, skills, knowledge domains, scienes, technologies... Experience shows that it is very difficult for an actor to master several disciplines. I is thus a function of knowledge held by the different design actors implied in the process. The design actors population being noted A={1,…,n} at a given time t, one can have this production function: $\mathbf{I}=f(Km_i t).Kst$, with i=1,...,n.

Two points must be underlined.

First, each actor is endowed with a vector of knowledge. However, the potential of the interaction is not an addition of the knowledge these vectors contain. One must take into account the complementarity of the knowledge vectors. Some knowledge can indeed be substitutable. Besides, the design project require, for every actor, only a part of his knowledge vector.

Moreover, if the variety offers potentialities and opportunities for interesting expansion, these last one can occur only if the cognitive distance (Nooteboom, 2000) is not too important. Nooteboom points out an interesting idea. The "cognitive distance" provides an opportunity to learn from others who, according to their own experience, interpret, understand, and estimate the world differently. If the cognitive distance is increasing, then opportunities of new combinations favourable to innovation will appear. Beyond a certain threshold, the cognitive distance becomes to long and lead directly to a common misunderstanding. The absorption capacity of a design actor is indeed a decreasing function. The more the cognitive distance increases, the more it is difficult to understand each other. The lack of a common language, shared values or shared perception induce a cognitive cost. The interaction can fail.

The innovation depends then a parabolic function of the cognitive distance in the form of an inverted U (Nooteboom & *alii*, 2007). Fig.1 represents the graph of this function. The summit of the parabola represents the optimal cognitive distance between the actors. This optimal distance is the distance: (1) which is wide enough to allow the innovation and (2) weak enough to allow effective cooperation. At this point, many efforts would be required to overlap ambiguities and eliminate mutual misunderstandings.

[1] One must considers the depreciation of the knowledge acquired through experience. The development of knew knowledge and technologies accelerate the obsolescence of its parts.

[2] According to Adam Smith (1723-1790), the knowledge specialization is the logical outcome of the division of labour. It is then a prerequisite for further knowledge creation (Maskell, 2001).

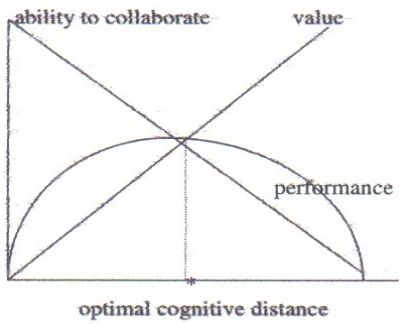

Fig.1. *Cognitive Distance Optimum.*

The main result we can take into account by applying Nooteblom's model is that creative rationality is drive by the bounded rationality principles and by the cognitive distance between design actors. We can add that their personality, their respective experience or expertise must be integrated in an unified model of creative rationality. Several studies based on creative actors have shown that they master their domain to overcome it. According to J.R.Hayes (1989), an average period of 10 years is required to master a domain (Fig.2, A). Then during 15 years a strong creative productivity can occur (Fig.2, B), followed by a period of stability of 20 years (Fig.3, C), before declining (Fig.2, D).

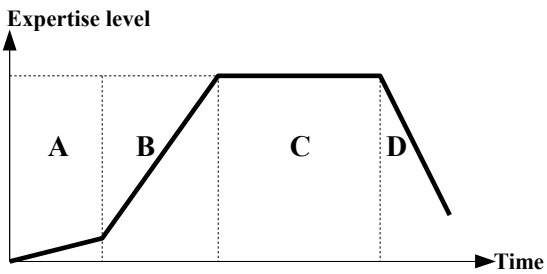

Fig.2. *Expertise Maximum.*

The effectiveness of the creative rationality is also conditioned by the environment in which designers realize their working activity. Many works have already stressed the influence of the social environments on individuals' creativity level.

Family environment — It seems that exists a positive correlation between a individual recognized as creative and and the age of his (her) parents, his (her) born order (Simonton, 1992). Other sociologists state that an intense creative life would be incompatible with a family life[3].

Communitarian environments — *F*rom the field dynamics point of view, "each variation in a field's characteristics will affect how creativity develops within its confines or how the confines are changed to accommodate new visions of the domain. The field is the source of acceptance or rejection of potentially creative contributions (...)" (Feldman, 2005).

Macro environment — Other macro-social factors drive individual creativity. It is the case of the religious values and context, the type of society (democratic *vs.* authoritarian), the political context (war *vs.* peace), the economic situation (penury *vs.* wealth, monopolistic situations *vs.* competitive ones...), etc. For example,

[3] Sorr has studied the lives of Kant, Wittgenstein and Newton. He underlined that "they showed a lack of close involvement with other human beings" (Storr, 1988, in Policastro, Gardner, 2005).

Richard Florida (2002) postulates that the attractiveness of the creative class depends on the tolerance index associated with the city and the urban style of life. According to him, members of the "creative class" prefer open-minded and tolerant places.

Conclusion

This short communication aims at showing a first glance to what we call creative rationality. Such a concept is required to understand how design contributes to innovation. Creative rationality explains the creation of new artefacts and knowledge by knoting in a ingenious way scattered knowledge. It depends on several cognitive, individual and social variables.

Of course, the proposed model is just a draft. It should be refined and completed. Indeed, in its current shape, our model does not consider the personality traits of the designers which interact. It neither considers the influence of the geographical and relational proximity between the designers. It does not take into account the cost of knowledge acquisition, sharing, sustaining...

The elaboration of such a model is the prerequisite to identified the main parameters and possible condition to foster creative rationality. By this way, it also raises the question of relevant indicators and metric. A main issue is the definition of I. Patents are usually used as a proxy to measure innovation. The lack of indicators to measure design and creativity has already been stated (DTI, 2005; Hollanders, Cruysen, 2009). Nevertheless, the way of measuring the impact of design and creativity on countries' innovation performance remains a opened question. More and more researchers recognize that patents is a poor metric of knowledge production.

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