

## A Model of Creativity from the Paradigm of Complexity

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**Abstract.** The ability to create is what distinguishes us from other living things, it is what makes possible to combine the knowledge in an original and useful way in the pursuit of invention and innovation. Creativity can be seen as an essential tool aimed at the production of original and useful solutions for invention and innovation, which in a changing world, is what allows the development of our societies. A review of literature relating to the epistemology of complexity allowed to synthesize the basic tenets of this new paradigm on four main principles: the dialogic principle, the self-eco-organization principle, the systemic principle and the principle of systemic integration of the knower in knowledge. The model of creativity from the paradigm of complexity is built, first studying each of the component parts and then setting the dynamic relationships between each of these elements.

**Keywords:** Creativity, innovation, principles, paradigm of complexity

### 1 Introduction

Creativity is a tool for innovation geared to the production of useful and innovative solutions, and its product are inventions in the case of the technic area, the discoveries in science, and creations in art. To realize these solutions is necessary the proper use of knowledge, ie, the ability to make new combinations and relationships, aspects related to the concept of intelligence. Discovery and invention are two processes intimately linked together, every day new technical tools are invented which scientists use as a support to make new discoveries, which in turn are the scientific basis for the development of new technical inventions. Creativity is necessary and indispensable to the processes of innovation that suppose the successful insertion on the market of useful and new solutions, in all areas at all levels, processes that allow for the development in looking for improvements in quality of life.

This relationship between creativity and innovation, outlined above, assumes that all aspects aimed at improving the creative process will result in

the direct benefit of innovation and, consequently, the improvement in the development of our societies.

Design is the link between creativity and innovation, as a process, design allows for transform the new and useful ideas -creative ideas, into functional applications accepted by society in general. Design is the vehicle to turn a creative idea into an innovation.

### 2 Antecedents

The ability to create is what allows us to advance, improve the quality of life, conceive, design and construct devices, synthesize compounds and medicines, propose new theories, to imagine and develop solutions to problems, etc. While the conceptual study of creativity mainly applies to psychology, its influence is felt in all areas of human knowledge.

To Ross Mooney, creativity must be focused from four different aspects: the created product, the process that creates it, the creative person and the environment in which creation takes place (Mooney, 1963: 331-334).

According to Mel Rhodes, creativity is a noun that names the phenomenon through which an individual communicates a new concept (product). The mental activity (or mental process) is implicit in this definition so too are the external factors that affect the person during the creative process (environment).

Csikszentmihalyi defines creativity as "any act, idea or product that changes an existing field or transforms an existing field into a new one" (Csikszentmihalyi, 1998: 47). For Teresa Amabile creativity is the production of new ideas, useful and appropriate in human activities, from science to art, in education, in business, in everyday life, etc. (Amabile, 1997: 40; Amabile, Conti, Coon, Lazenby & Herron, 1996: 1154).

## 2.1 Creativity as a system

Mihaly Csikszentmihalyi and Teresa Amabile are two of the most influential authors in the study of creativity with regard to new approaches epistemological complexity. They made an approach from a systemic perspective, study the basic components and relationships between these components, conceiving creativity as an emergent property of the system.

The Csikszentmihalyi's central approach is based not only on the individual influences, but also on the interaction with the environment. "We can not study creativity by isolating individuals and their work of social and historical environment in which they perform their actions" (Csikszentmihalyi, 1989: 325). It proposes that the creative process is not checked if only studied as a mental process, and argues that it is a cultural process, social, and also a psychological event (Csikszentmihalyi, 1999: 313).

Teresa Amabile proposes "the component model of creativity", this model comes from the integration of motivation and social environment with the personal aspects relating to creativity previously studied by other psychologists (Hill & Amabile, 1993: 406), and considers that there are three elements, that must be present without exception, to carry out a process of creation: domain expertise or skills, creative thinking or creative abilities and motivation. This theory suggests that the high creative level is directly linked to high levels in each of the components listed above (Amabile, 1997: 42; Hill & Amabile, 1993: 406).

## 3 Creativity from the Paradigm of Complexity

Creativity is a complex phenomenon given the multiples and interdependent factors. Many of these result hard to measure and quantify, even less the relationship between them.

The study of creativity is not exclusive for the psychological field, it is necessary in many and diverse disciplines which require integrating knowledge of each field, that is why is considered interdisciplinary (Martínez M., 2003, pág. 107).

In this case there is two possible ways. The first, simplification, is to divide the problem into very small parts and consider each of them isolated, delimitating and simplifying them, leading to reductionism.

The second way is to accept the problem as a complex whole and try to understand it without the intention of searching a deterministic way, so this would lead to the first way.

The synthesis process whereby it was possible to associate the different principles, tenets, or

commandments of the paradigm of complexity, allowed the integration of four major groups: the dialogic principle, the principle of self-organization, the systemic principle and the principle integration of expert knowledge. Of these, the third, the systemic principle, provides the structure of the paradigm of complexity. According to this principle each of the elements of the system is interlinked so that new properties emerge that are not fully present in each of the separate parts or elements.

With these concepts in mind it is possible to structure the creativity as a system in which the central element, the creative process is influenced and influences on each of the other elements of the system: the person, the environment and the problem which are wrapped in a web of relationships in which the characteristics and behavior of each element will depend on the characteristics and behavior of other elements and the whole system as an organized whole.

Importantly, each of these four elements of the study are themselves systems, and each will consist of their own inter-related elements, as set out the principle of recursion in general systems theory.

### 3.1 The elements of the system

Creativity is inherent in the person (Figure 1), it is in the brain-mind system of the person where original recombinations of knowledge occur, originating ideas. The sub-system person covers also all aspects related to personality traits, the knowledge of the particular area of work, as well as knowledge of the methods or heuristics that support the creative development, it also includes aspects of motivation, which as mentioned earlier in reference to the work of Amabile, involve internal and external aspects to which we should add the possible combinations, feedback or interactions between motivational factors.

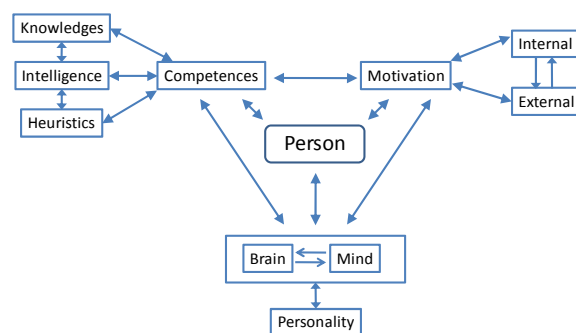


Fig. 1. The person as an element of the system

The context surrounding the person is highly significant, and is represented in the scheme by another subsystem (Figure 2), which will cover aspects

related to the physical, psychological, social and cultural environments, in which creativity as a process unfolds. Importantly, each of these components influences the others, so, for example, the physical environment might influence aspects of the psychological environment in which the creative process undertaken by the person takes place.

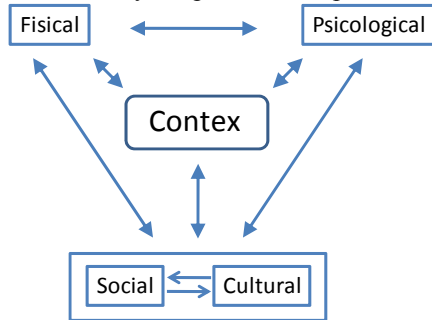


Fig. 2. The contex as an element of the system

The influence of the problem as a subsystem is related to the nature of it, and obviously with the preparation that the person has under his belt to face it (Figure 3). The problems can be stated or, on the contrary, unknown, in which case you first have to formulate them and it is the latter of particular significance because it requires creativity to raise and resolve them satisfactorily. It has been used the term "problem" to distinguish from the product, because the product is already a solution to the difficulty posed, the problem is prior to the creative product, and although the analysis can focus on features that prove or not as a creative product is the problem that motivates a person to do the creative input.

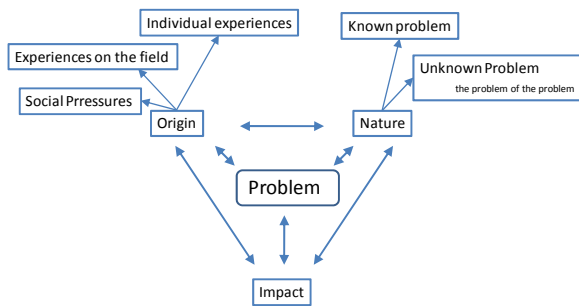


Fig. 3. The problem as an element of the system

The central subsystem refers to the process, which includes aspects, phases, stages or steps between the problem situation and its solution.

Here are complemented the concepts related to each of the creative elements of the system outlined in Figure 4.

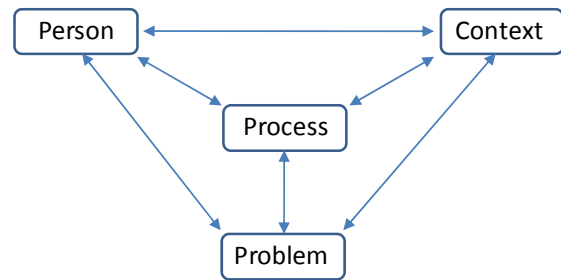


Fig. 4. The creativity system

### 3.2 Assembling the system, relationships

To find the relationships between each of the elements of a systemic vision of creativity from the perspective of the paradigm of complexity, a series of case studies are analyzed on people whose creative production is notable for its originality and transcendence. Each of these people brings not only knowledge related to their area of expertise, but also the way each one, in particular, has to solve the different situations that are presented.

Semi-structured interviews were conducted, flexible and dynamic in a suitable environment. Encouraging, so, colloquial dialogue in which the interviewee would feel comfortable and address the issue freely. Some of these interviews were conducted via video conference through the Internet and were recorded for later analysis. In addition to the interviews, data from other sources is taken into account: books, articles, videos, films and information from various sites on the Internet network, some personal and other institutional.

The creative contributions of the interviewees are from many different fields of knowledge. A brief summary of each of the case of studies analyzed is presented next:

- Crisis Management, Alcatraz Project: Alberto Völlmer, an engineer and president of a company, his contribution is the proposal and implementation of a social project with very good results in reducing crime levels in the area, which directly benefits the communities surrounding the company.
- The experience of living what you think: Manuel Grases, engineer, has raised numerous innovation projects in industry.
- Democratize intelligence: Luis Alberto Machado, politician that attempts to change the world by bringing creative thinking skills and intelligence to all sectors of the population from the highest level of national government.
- The development of a residential concept: José Rafael Oráa, architect, has developed an

innovative system for building houses, his company has designed and built some 700 personalized housing units within the concept established.

- Environmental chemistry, scientific research: Monica Krauter, chemist, developed and patented an extraction process of vanadium refining waste that could change the global market.
- Sower of illusions, National System of Young and Children Orchestras of Venezuela: José Antonio Abreu, economist, 30 years ago proposed the idea of bringing music to the popular sectors, has organized the National System of Young and Children Orchestras of Venezuela, and among the obtained distinctions is the Prince of Asturias Prize in 2008.
- Humor and creativity: Laureano Márquez, BA Political Science, has been highlighted by a wise and timely humor.

The structure of the proposed model has the characteristics of open systems, defined in terms of energy and information exchange with the surrounding environment (Figure 5). A description of the proposed model is presented next, according to the open systems features:

- Sinergy or totality: creativity is an outcoming of the effective interaction of the different subsystems, therefore it is not possible to explain its appearance by analyzing each of the parties separately.
- Interrelationships: the existing links in the creativity system occur between subsystems that make it up and between each of them and the environment, and these relationships involve exchange of energy, matter and information.
- Equifinity: regardless of the starting point, creativity as a systemic whole is aimed at finding original, useful and relevant solutions.
- Differentiation: each of the subsystems included in the proposed model deals with its particular functions, has a separate purpose, however, creativity emerges from the dynamic and effective interaction between each of these subsystems.
- Negentropy: creativity is concerned with establishing a new order that resolves a particular problem situation, in that sense the energy and information exchange with the environment allows the creativity system this original and productive reorganization.

- Growth or purpose: the relationships between each of the elements, which are in turn systems and form the proposed model of creativity, are dynamic, implying a constant evolutionary transformation that allows continuously nurtured in their exchange with the environment and in his own creation.

With the analysis of each case study in particular, a map of relationships was built, that contains the relations between each of the elements of the proposed model of creativity.

The relations between each element of the system come from the superposition synthesis of relationship maps product of the analysis of the case of study considered.

Referring to some of the personal traits: for example perseverance and curiosity, are always present in the creative personality as indicated by the literature in this regard. Stresses the comment of architect Oráa, on that perseverance is a virtue that allows other to come. In all cases there is also a strong self-confidence, which is necessary to bring the idea from conception to production as a solution to the problem situation encountered. The internal motivation and the ability of persuasion, expressed by a passion for what you do, are essential to create synergies and build teams.

In general, the context presents a situation that motivates a person in accordance with aspects of their personality, skills and experience. This problem can also be generated by personal concerns coming as a product of research made in a particular field of knowledge.

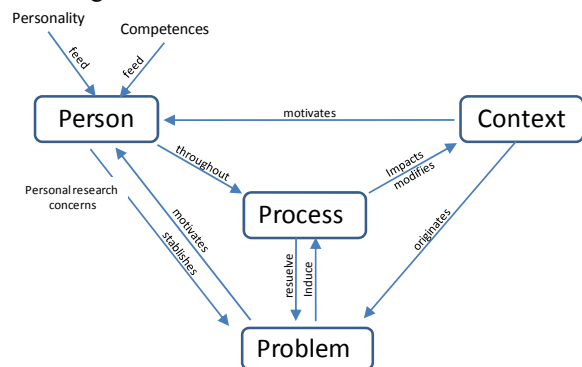


Fig. 5. Creativity from the paradigm of complexity

The individual, based on their knowledge, professional skills and personality characteristics, solves, modifies or impacts the context through the creative process, which in turn influences and motivates the person in a feedback loop, allowing reinforce knowledge , skills, personality characteristics

and mainly the internal motivation to undertake new challenges, problems or opportunities.

The relationship between the problem and the process is, in general, bidirectional, ie, the problem leads to the process and the process resolves the problem. The dynamism of the creative process requires constant feedback and adjustments for the other elements of the system and that is why the dynamic conditions of the problem also induce changes or adjustments to the creative process that undoubtedly will also depend on the dynamic conditions of the person that leads it, to produce the necessary solutions or contributions that modify the context that caused the initial problem situation.

#### 4 Concluding Remarks

The starting point of the process of innovation is represented by the detection of an opportunity for improvement, and invariably requires the production of useful and innovative solutions to rectify these situations, this input comes from creativity. Creativity produces new ideas for the development of technology and invention, for discoveries in science and in art creations, which according to the obtained success; innovation will become capable of producing substantial improvements in society and culture.

The gestation of the idea occurs in the brain of a person, but today, given the speed with which changes happen, it is impossible for one person alone to timely develop this idea enough to put it in the market in a timely and successful way, that is why it requires the collaboration among various professionals from different areas.

It is therefore possible to conclude that creativity is an essential tool for the production of useful and innovative solutions, associated to the innovation processes that lead to overall development of society.

The paradigm of complexity provides the epistemic structure needed to integrate this network of dynamic relationships. This new paradigm includes the study of the elements as individual entities and the map of the existing dynamic relationships between each of these elements.

The systemic principle provides the structure of the network of dynamic relationships between each of the elements that make up the creativity system; the principle of integrating the knower within the knowledge integrates subjectivity into the new model, that is, creativity depends as much on the person that produces it as on the person who interprets it as such, is not a phenomenon capable of being isolated objectively; the dialogic principle allows the causes to be also consequences and vice versa, for example the

way creativity influences and changes its surroundings, produces useful and new contributions that modify the context, and in turn this context modifies and influences on the creative process in various forms; and the principle of self-organization is linked to the production of self-organized dynamic relationships that occur during the creative process as useful and original reorganizations of knowledge.

Thus, the model of creativity from the perspective of complexity paradigm proposed in this paper displays the general pattern of dynamic relationships between each of the elements of the system.

The proposed approach is not a predictive model; the proposed model is intended to explain the emergence of the creativity as a product of networks of relationships and dynamic interactions between each of the elements that shape it. Each of these interconnected networks depend on the particular state of the systemic elements that produces them; in turn, these systemic relations networks influence in each of these elements, ie, interactions influence and are influenced by different states the elements that make it up.

The main contribution of this research concerns the construction of a model that describes and explains the creativity from the perspective of the paradigm of complexity, which arises as an emergent property, product of the dynamic and self-organizing interactions between individual elements that integrates it, which according to the principle of system recursion, are in turn, systems themselves.

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