Factorial Connections in the Organizational Innovation: Proposed Systematization

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Abstract
In order to accomplish its innovational objectives, a company needs an optimal allocation of resources based on the appropriate mix of creativity and innovation factors. A multitude of theories, philosophies and approaches exists in the field of creativity and innovation (CRIN). The starting point of our study is the hypothesis of a critical mass for each innovational factor and for the whole aggregate; a second hypothesis states the existence of a critical mixture of organizational creativity and innovation factors.
Our aim is to explore and systemize the arguments for the theoretical validation of these hypotheses and to propose a concrete manner of estimation for the costs and remunerations of innovational factors for an organization. We use the previous studies of Amabile (1998), Bouchard and Bose (2006), Ford (1993), Woodman, Sawyer and Grifin (1993), Nahapiet, and Ghoshal (1998), Lucy Lu (2008), Yuan Li, Yongbin Zhao, and Yi Liu (2006), Ming-Ten Tsai, and Shuang-Shii Chuang (2009), among others, for the conceptual bases of organizational innovation and innovational paradigm.
The study has, as main stages: identification of exogenous variables of creativity and innovation, analysis of each identified factor, identification of each factor's effects (endogenous variables of our analysis), proposed coherent system of factors, as a function of cause-effect type, identification of key action variables for the organization, building possible relations for the estimation of costs and remunerations. From methodological point of view, we used a deductive approach, as well as abductive (intuitional) ones. The complete system of organizational innovation factors includes predispositional variables (sensation, uniqueness, and capability), situational variables (personal change, needs, dissatisfaction and inadequacies) and decisional variables (individual autonomy, personal commitment, control through resources and motivation). The identified matrix could be used by an organization in order to establish the appropriate innovational strategy.
Key words: *innovational paradigms, organizational innovation factors, factorial connections*

Introduction
There are quite numerous approaches of creativity and innovation (CRIN) in organizations. Different perspectives, different philosophies and also different classifications are almost always easy to recognize considering the researcher's country of origin. We are interested, in our approach, to find some common landmarks, in order to obtain a coherent list of creativity factors and organizational innovation variables, which would allow a company to take informed decisions concerning the convenient mixture of those factors and variables, together with the optimal allocation of resources. Our starting point is a research hypothesis based on a previous study (Zait D., Spalanzani A., 2010), which states that it exists a critical mass for each innovational factor and for the whole aggregate; a second research hypothesis states the existence of a critical mixture of organizational creativity and innovation factors. Our aim is to explore and systemize the arguments for the theoretical validation of these hypotheses and to propose a concrete manner of estimation for the costs and remunerations of innovational factors for an organization.
Previous studies (Amabile, 1998, Bouchard and Bose, 2006, Ford, 1996, Woodman, Sawyer, Grifin, 1993, et alii) treated different aspects of creativity and innovation, at a general, theoretical or empirical level, suggesting definitions for the analyzed concepts, influence factors and functional structures of the organization in order to obtain a specified performance. Certain correctives are sometimes necessary. We propose the following axes for our approach:

- identification of main factors (exogenous variables) of creativity and innovation;
- analysis of each identified factor;
- identification of each factor effect (endogenous variables) on creativity and innovation ;
- building a coherent system of factors, as a function of the relation between causes and effects ;
- identification and analysis of key variables that an organization can use in order to valorize creativity and innovational factors ;
- propose principles and evaluation procedures for the dimensions of each intervening variable;

- building necessary relations in order to estimate the costs and remunerations for each innovational factor

The critical matrix we would obtain could be used in order to establish the basic strategy for an organization interested in using creativity and innovation, manipulating factors that the enterprise is able to control. We used as methods the documentary study, a basic logic, analysis and synthesis, as well as abductive approaches in order to build our hypotheses.

1. Important premises

a. It is very important to first define basic concepts: creativity, innovation, the CRIN system. As a fundamental reference we used Schumpeter (1934), who separates the two concepts for which confusions are often made: invention (as the creation of an idea for a new product, for example) and innovation (the commercial development of a product resulting from that invention). Thus, we consider innovation as a result of an invention, even if not all inventions conduct to innovations (Trott, 2002). Innovation = Invention + Exploitation is the equation that allows a better comprehension of the relationship between the two concepts (Roberts, 1997).

For the enterprise, the invention is not an aim in itself, the desired finality is innovation. This is why we are talking about innovative organizations rather than about inventive organizations. Although innovation is essentially the product of invention, we sometimes have intangible products – for example, improved management methods, commercialization techniques and instruments, recruiting or promotion techniques, etc.

In order to be more pragmatic, we should introduce also the connection with the existing demand on the market. Amabile (1988) considered creativity as production of new and useful ideas by an individual or group and innovation as the practical use of those ideas. Creativity exists a priori, it is a quality or value of a certain entity, furnishing an essential condition for the evolution of that entity through positive change; it thus shows the potential to realize, improve, and develop new ideas and new products. This potential is given by the intrinsic characteristics of human intelligence (abstraction capacity, mobility, flexibility, open mindness, curiosity, etc.) In order to become creative, an entity has to estimate this potential and create – through a judgment, not accidentally - the specific structures for the valorization of that potential. Those structures and mechanisms create the so called CRIN system

b. Creativity and innovation can be defined from different perspectives. Since we are interested in organizational innovation, our perspective is that of an open organization (« the inside-outside of the firm »), focusing on a mixed point of view, considering, in an aggregate manner, the resource criteria, knowledge and social capital. The point of view of the individual (including his knowledge) is implicitly considered through resources, knowledge and social capital. Resources are considered a connected system of material, technological, human and intangible elements. This point of view on resources (launched by Wernerfelt, 1984) emphasizes the importance of the correspondence between the resources of the organization and the strategy that connects production with market. Resources are considered the most important source of competitivity and performance for the organization, giving the most significant competitive advantage (Barney, 1991). Even if many critiques existed (Priem and Butler, 2001, Felin and Foss, 2006), the resource criteria is important for any approach of organizational innovation.

The social capital dimension is also important and it has to be considered in connection with the culture and cultural specificity, including the organizational culture. Social capital is defined as the whole system of present and potential resource available for the enterprise through the network of relationships between the individual and the society. This capital has an important contribution for the realization of an innovational policy through the creation and development of human capital (intellectual level) (Nahapiet, Ghoshal, 1998)

This integrative perspective that considers the innovative enterprise and the organizational innovation as a function of three dimensions - resources, knowledge and social capital – is represented in fig.1). These three dimensions (or sources of organizational innovation) are never autonomous or independent, because the enterprise resources include also knowledge (implicit, explicit, tangibles, intangibles) and the social capital is a source of values, norms and knowledge. This is how we obtain the paradigm of organizational innovation.

c. Creativity and innovation at organizational level have been seldom approached distinctly. It is rather normal, since the expression of creativity is always connected with the obtained results, considered innovation's result. This is the reason for which we almost always use the syntagm organizational innovation, even if, quite often, a creative organization is considered innovative.

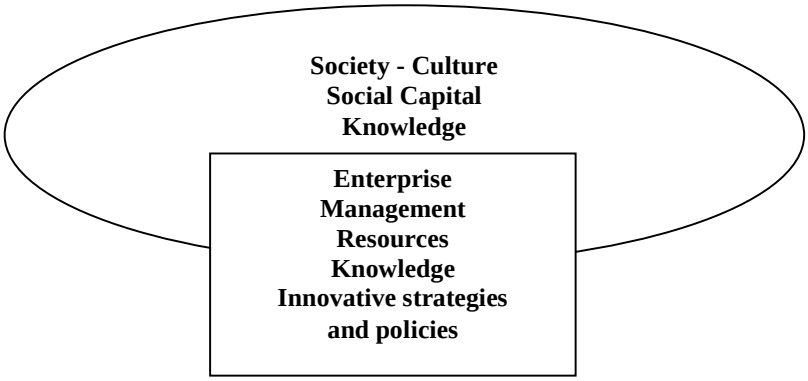

Fig.1. The paradigm of open organizational innovation: integration of the three dimensions

Organizational innovation was developed in different perspectives. According to the nature of the obtained or intended results, organizational innovation has the following types (Burges, 1989, Dougherty et Bowman, 1995, et al., apud Ming-Ten Tsai, Shuang- Shii Chuang, 2009): product (new products created), process (new or improved processes), product and process, as well as multiple. If we refer to the structural destination, we can speak about technological innovation and administrative innovation (ibidem). In fact, an organization is almost never involved in just one type of innovation. At the same time, the amplitude and efficacy of every organizational innovation is the result of that structure's management to create and assure the functioning of specific devices, allocating the appropriate resources according to its mission, objectives and competencies. In such conditions, organizational innovation is mainly technological (with tangible results) and fundamentally administrative. There is only one exception: accidental innovation, realized by hazard, by an employee who agrees to make it available for the organization in certain conditions. We can also speak, considering the technological or administrative dominance, about a mechanic or organic innovation. Even if many other models and criteria of classification exist, for our approach we're interested in the separation between technological innovation (products, processes, instruments, technologies, methods or recipes) and administrative innovation (strategies, policies, structures and devices, relations and management techniques).

The level or degree of organizational innovation is not easy to measure or quantify. This is why researchers tried to find indicators able to express a certain innovational output: degree of applicability for the new product or technology, the extension of commercialization, the notoriety of the innovation, position within the sector, innovation's prices, degree of production diversification, delay of production adjustment, existence of creative programs, debates over new ideas, quality of the promotion and marketing activities, adaptation to clients' demands, degree of specialization, remuneration system, brand capability at international level, etc. We can notice the very big number of indicators, we can even consider those indicators as factors for organizational innovation, but we can also notice a large heterogeneity and minimal possibilities of correctly operationalize and measure the intensity of the organizational innovation.

d. Organizational innovation is considered one of the most important factors for the good evolution of an enterprise. Bottom line, the enterprise is either innovative or is not at all, innovation is a perpetual continuum. Every enterprise is different, so different structures and mechanisms, more or less adapted, have been created, but the solutions found were almost always reductionist, omitting or minimalizing certain dimensions, factors or variables. Researchers as well have studied those innovative organizations within those specific realities, not based on a systematic analysis of connections between essential variables. An interesting paradox can be noticed: the enterprise knows itself well, better than those who're analyzing it, but there are also details that escape to the one who analyzes himself. In these circumstances, we can propose a list, not exhaustive, of the solutions suggested in different studies:

- the creation of networks between enterprises, administrations and research institutions (including universities) in order to obtain a synergy effect through the connection between the regulatory structures (state, government, administration), the wealth creation (enterprise, corporation) and the creation of new products (universities as research providers, public research institutions) (Lucy Lu, 2008, Yuan Li, Yongbin Zhao, Yi Liu, 2006). This is especially the situation of those enterprises situated in a well controlled environment, as the China case – a very important reference, but not always possible to apply for other countries or institutions
- creation and development of a "social capital" and a "development software" based on "open source applications" provided by universities or other research institutions (Philbin, 2008). These are external structures, available to the

enterprise as a social contributor to the « social capital ». It is a solution well adapted in those countries with high ethical standards and behaviors, with a coherent stability of the business environment and a social responsibility accepted by all participants. It is also similar to a more general strategy, applied at a national level, concerning the development of the « knowledge and innovation-based economy » through the contribution of national governments (Jordan Declan, 2009)

- the development of an affective mentality for the employees, so that they have the specific legitimacy towards their enterprise (Meulen B. van der, 2002). These are situations in which the organizational culture can be considered in an efficient manner for the construction and functioning of innovational devices. The managers' role is decisive, the organizational culture being a possible binder for the employees of well developed countries, with a strong individualist dimension
- the creation of intra-organizational innovation systems in order to promote creativity and innovation (for example an intrapreneurial mechanism of innovation to help and encourage original initiatives from employees (V. Bouchard, C. Bos, 2006). This is also a strong social system, possible to apply in those countries with a certain willingness towards team working
- the construction of complex structures of resources, instruments and processes capable of motivating employees to participate into entrepreneurial projects
- the realization of inter-organizational networks and structures, regrouping laboratories belonging to different organizations (federative structure of research proposed by the Innovacs projects at Grenoble, France), at local, regional, national or international level
- the building of innovation networks specific for multinational companies, having as mission to collect and improve solutions proposed at local subsidiary level, in order to develop new products, processes, ideas, etc. through adaptation (Tony S. Frost, 2001)
- the creation of mixed structures – enterprises, territories (local and regional administrations) and research institutions, including universities (George K. Chacko, 2000). The success or failure of such structures heavily depends on the impact of the enterprise's activities, particularly the innovative ones, and the social performance thus determined (Pavelin Stephen, Porter Lynda, 2007)

As effect, we consider that the solutions concerning the creativity and innovation at enterprise level are always a function of the organizational, economic, professional and cultural specificity. This is an argument for our first basic hypothesis: there is an optimal dimension (or an optimal fork) for every variable of creativity and innovation, as a function of the enterprise specificity (previously evoked). A second hypothesis can be derived: if an optimal dimension of creativity and organizational innovation variables exists, than a matrix of the critical masses of organizational creativity and innovation variables can be build.

2. Systemic analysis of organizational innovation: a proposition

In order to arrive at a list of factors for the organizational innovation, a distinction between factors and variables is necessary. Almost always the two concepts, factors and variables, are evoked without making any difference. The sense we give here will be purely operational: the factor is a characteristic of a process or phenomenon, a dimension or even the phenomenon itself, as a cause or effect. The variable is the factor in movement, in theoretical evolution, when we assign different values in a field of motion where he is considered normal. By giving all possible values from a determined interval to a factor, we obtain the corresponding variable. In our approach, the difference between factor and variable is made in a mechanical manner, according to the context and place within a certain expression.

The enterprise, with all the employees, structures, resources, competencies and know-how is always placed and functions, in a coherent manner, in a multidimensional context, complex and dynamic. This context is formed by at least three universes, inextricably related, interconnected, and having strong influences one on the other, simultaneously acting in a fundamentally objective way. These three universes (connected environments), suggested in fig.2, are: the international, the national (including regional and local) and the market. Through this schema we can now place the three criteria of organizational innovation (previously depicted in fig.1): resources, knowledge and social capital. Resources are explicitly the factor or variable that the management can manipulate directly in order to accomplish its strategy. Knowledge is found both in the enterprise and its environment, including as a form of social capital; it is an implicit variable, difficult to control by management, but not impossible to consider within the strategy. The social capital is the main contribution of the environment (culture and society, especially) to the development of the enterprise and its innovational potential. As a variable, social capital is under very little control from the enterprise. The participation of territories, administrations, governments and history is decisive for the formation and valorization of this capital. The socio-cultural and intercultural knowledge are necessary for valorization.

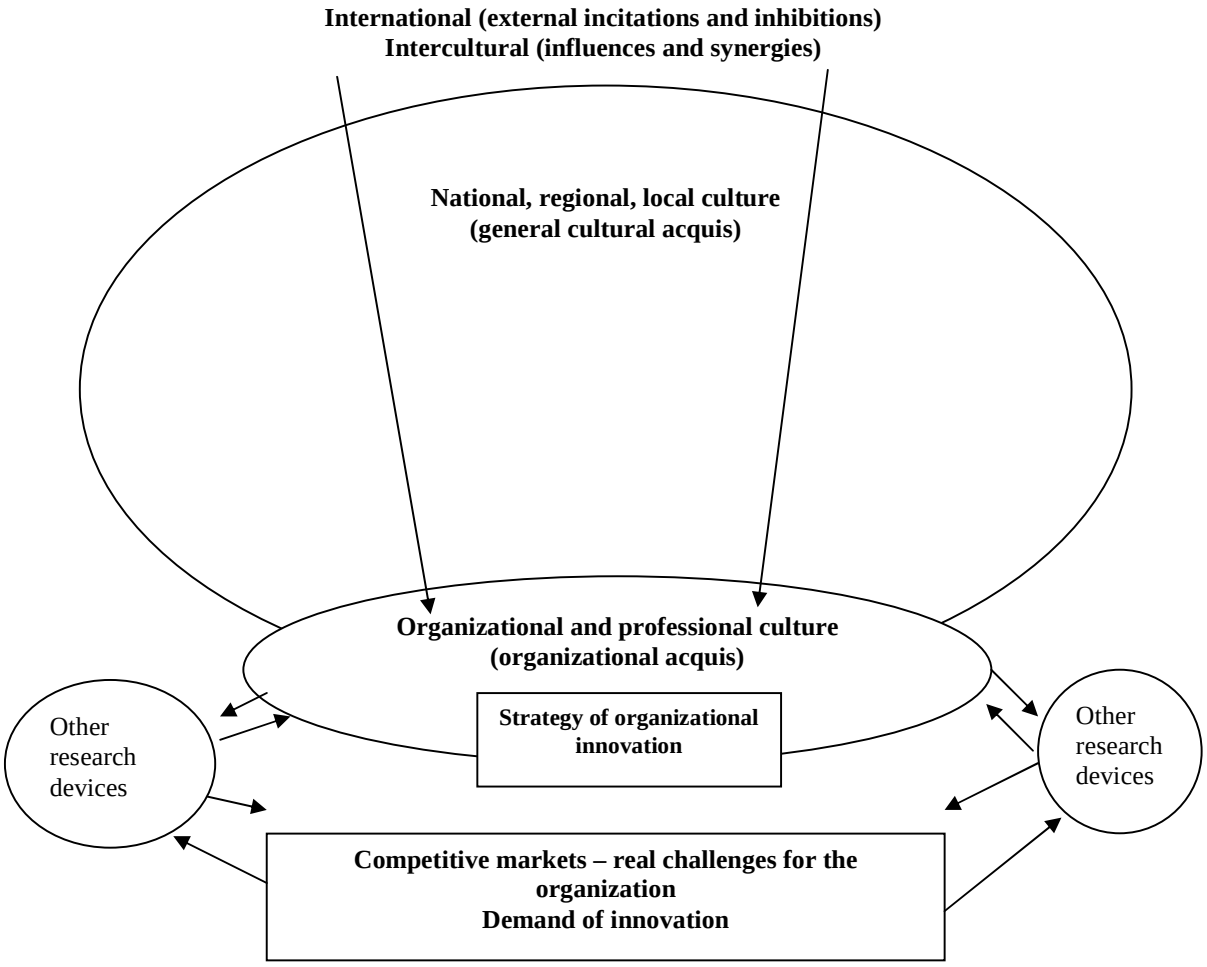

Fig. 2 Interactions to consider for building a strategy of organizational innovation

The open organizational innovation (as a fifth stage of evolution for the organizational innovation) makes possible that new solutions for the enterprise are found by interfering the market with the production through research and development activities. The enterprise is in the middle, with its basic reason to be : profit, wealth – even if we don't forget about the important societal reasons, as well.

3. Important connections

If we consider the enterprise or organisation as a structure that brings together the interests of specific groups (owners, managers, employees, communities), the original needs are classical: food, cloth, communication, freedom, power, yield, profit, wealth. The schema we propose in fig.3 can help us to better connect organizational innovation with incentives and identify the factors and variables that favor this innovation. In order to satisfy the needs, both the individual and the enterprise have to engage in actions and activities for obtaining products and sell them on the market. The organizational innovation is the most important lever from a twofold perspective: it allows the covering of a need and it generates a new need, thus creating new demands etc. Through this kind of reasoning we can identify the essential connections between needs and innovation, as represented in fig.3.

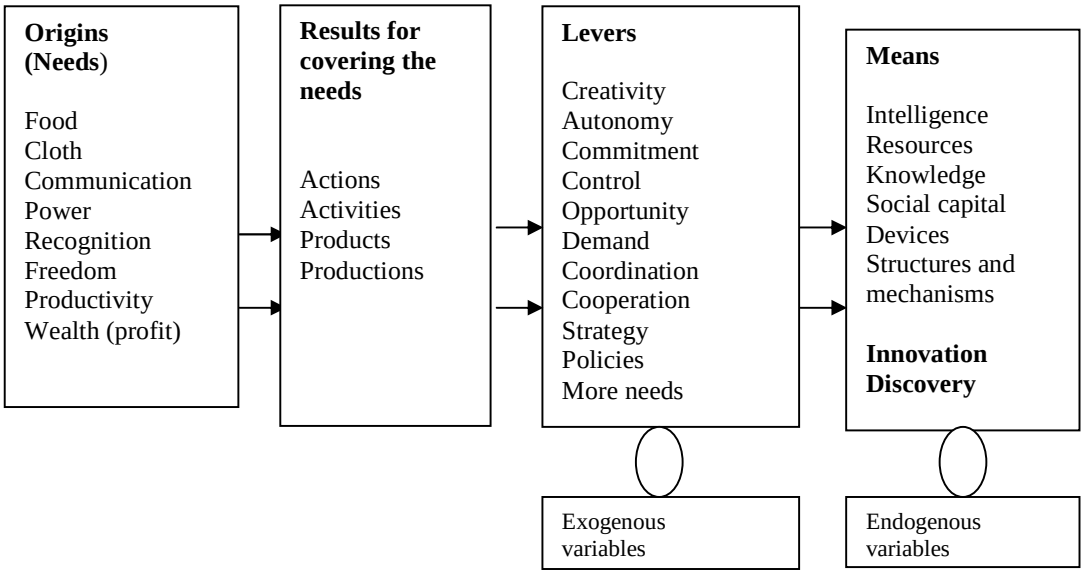

Fig. 3 Innovative factorial connections

In an open system, endogenous variables are also interconnected. Innovation as a mean for covering needs is the main endogenous variable of the model, together with other factors or endogenous variables – resources, knowledge, social capital and various mechanisms and devices. In order to separate influences, we will keep organizational innovation as endogenous variable, in relationship with a group of first rank exogenous variables – but we have to keep in mind that in an open system the position of a variable can change from one category to the other. It is the case for resources, knowledge and social capital – endogenous in a first stage, exogenous in a second one, etc...

4. Systematization of innovational variables

In order to identify, organize and prioritize the factors of innovation as endogenous variable (dependant), we use especially the reference of Burns (2007), who tries to give an exhaustive list of sources for the innovational behavior or « motivation for variation ». He uses the previous studies of Spence (1994), McAlister & Pessemier (1982), and others, emphasizing two groups (or the so called sources of « variety seeking »): predispositional sources (direct ones) and situational sources (indirect). This system, however, is not complete; it lacks a group of sources that we consider very important for the organizational innovation: the decisional factors, where we find variables as disposition, coordination and control from management, resources, autonomy, commitment and motivation. Now we have a complete system of factors or variables of organizational innovation, with three distinct groups:

- predispositional variables: sensation, uniqueness, capability;
- situational variables: personal change, needs, dissatisfaction, inadequacy;
- decisional variables: individual autonomy, individual commitment, control through resources, motivation.

Predispositional variables or sources concern the individual as he is, with his propensity towards novelty (curiosity, variety, diversity, uniqueness). The main internal motivations for innovation are the quest for sensational and the quest for uniqueness. The two sources can be found in different proportions, with an intensity dependant on heritage and environment, not only on social and economic factors. It is interesting that among those factors there is not only one which could characterize a certain intelligence level or a specific intrinsic quality of the individual which could determine him to innovate. However, in every individual we have a fundamental binomial: native intelligence and active acquis, the first one inherited, the second one acquired through learning, experiences etc. This binomial is a complex variable of innovation, an interface between heritage (true predisposition) and those conditions offered by society so that the individual can positively evaluate. This is how capability is obtained, and we have the three predispositional variables as exogenous ones.

Now, a system can be build, by going back to origins – the needs we were talking about, that can be classified into two categories:

- fundamental needs (those we usually find in a Maslow pyramid)
- specific needs (sensational, uniqueness, capability)

The main problem is the operationalization of these variables – how could we measure them? Our proposition is to aggregate every group in just one variable, which can be expressed as an intensity index, considering the situation of the enterprise. For the first group, the aggregated variable is an index or degree of covering of basic individual needs at the enterprise level, using the Maslow pyramid in order to establish weight coefficients for every need. For the second group, the aggregated variable is similar, considering the specific needs, influenced by cultural characteristics (country, region), organizational and professional cultures (aside from personality or psychometric tests designed to measure the need for uniqueness or other personality treats).

Situational variables (sources) concern the effects of different circumstances, rather stable, which act in favor or against innovational willingness and access. A first source is *personal change* (perception, choice, etc.). This personal change can have as starting points different modifications in constraints (revenue, resources, basic needs), esthetics (taste, preferences), needs' diversification, prices modifications, emotional situation changes, etc. (Mc Alistaire & Pessemier, 1982; Van Trijp, 1995, apud Burns, 2007) A second situational source is *the multiple need*, a diversification and multiplication of expectations and choices that push the individual towards innovation. *Dissatisfaction with existant products* is a third situational source of innovation, starting with a gap between individual's expectations and received or perceived satisfaction. There is also a fourth situational source, the *inadequacy of the product* due to the functional limits of the product.

Decisional variables can be identified at group or organizational level, where structures and devices are used in order to mobilize the innovational resorts for obtaining performance and increasing profit and wealth. Four such variables exist: motivation, individual autonomy, individual commitment and control through resources. They are internal variables, very important, since they are the only ones that the company, through its management, can control.

Motivation is a key variable, through which the management connects the person with the mission and objectives of the enterprise. It is a specific motivation for innovation, not a general one, and can be intrinsic (positive reactions towards certain tasks, special interest, pleasure etc.) or extrinsic (the need to avoid unpleasant consequences, control). The first one works as an incentive, the second one as an inhibitor for creativity and innovation (Amabile, 1988). For an individual engaged in innovational activities, the security of the job is by far less important than the intellectual challenge (Sauerman H., Cohen W.M., 2009). *Individual autonomy* is very relative and connected to many other variables, as job complexity, available resources, degree of integration of performed tasks etc. The most important thing is that this autonomy is a cultural consequence as well, has a cultural specificity, since it's related to individual perceptions, culturally sensitive. If we refer to Hofstede's dimensions, two are particularly important for autonomy: individualism/collectivism and incertitude control. Burns (2007) suggests even a hypothesis concerning a relationship between the motivation for diversity and the existence of a creative social structure (named « creativogenic social structure »). We can add an argument to support this hypothesis: since individual creativity depends on the cultural specificity, we can not speak about an optimal individual autonomy for innovation, but about a certain degree of individual autonomy appropriated for the specific analyzed culture**.** *Personal commitment* is as complex as individual autonomy and even more volatile. Commitment is influenced by motivation, it's a product of dissatisfaction towards the accomplishment of the innovational task and perceived improved status in case of success (Hornsby, Naffziger and Kuratko, 2009) The perspective of an internal recognition (remuneration, more important role, new tasks and responsibilities) or an external one (notoriety confidence, social or political affirmation) can determine individual or group commitment. *The control through resources* is the most important decisional factor for the organization. There are two main directions of allocation and, implicitly, of control through resources: the awarded level of resources (not financial ones) for innovational tasks and the following of those allocations.

5. Relationships and necessary estimations

At this point we have all necessary elements in order to organize the factors/variables of organizational innovation. Following the logic that we developed for our approach, we can hypothesize that a modification in the allocation of remuneration for each innovation factor determines a certain modification of the expected result, and this modification is not linear, but it corresponds to the nature of the factor and the specific conditions of the enterprise/organization and its environment (markets, social capital, cultural specificity). In order to obtain the formal relationships, we need the clear position of each variable.

Endogenous variables (dependant or exit variables) are behavioral dimensions which push towards innovation: predispositional and situational at individual level, decisional (autonomy and commitment) at organizational level. As exogenous variables (independent or entry ones) we have the control through resources and different motivational levers. With the two groups of variables we can build a basic relationship for the factorial innovational connection (1):

(1) $y_j = f(x_i) + \varepsilon_{ij}$, where:

y_j is the level of the result expected for a particular innovation, if we use the amount x_i for the factor i of innovation; ε_{ij} is an estimation of the residual between the theoretical value and the real value of result y_j related to variable i. At the level of a factorial innovative system, the formal relationship could be (2):

(2) $Y = f(x_1, x_2, ..., x_n) + \mathrm{E}$, where:

Y is the total result (benefit, profit etc) expected from that innovation, remunerating the respective factors with the corresponding amounts $x_1, x_2, ..., x_n$; E is the total residual between the theoretical value and the real one for Y. In principle, we have (3) :

(3) $Y = \sum y_i + \sum \varepsilon_{ij}$,

but in reality the final theoretical result Y is a complex aggregation of partial functions y_j. The suggested relations are econometric type, emphasizing a stochastic dependence between the specific variables. But our aim is to also suggest a manner of estimation for the remuneration cost of each factor involved in innovation.

In principle, we can accept the idea that each factor has a marginal cost and gives a marginal effect. Thus, there is a marginal productivity for each factor, with the same type as the elasticity effect y in relationship with a variable x_i (4):

(4) $E_{y/x_i} = \Delta_{y_i} \Big/ \Delta_{x_i}$, where :

y is the effect of the innovative activity (benefit, profit obtained through innovation) ; Δ_{y_i} is the augmentation effect due to the innovative activity, in relationship with previous realized benefits; Δ_{x_i} is the supplementary effort (cost) necessary for the factor x_i in order to obtain the augmentation Δ_{y_i} of profit through that innovative activity. This relationship (4) can help us to estimate the maximal remuneration (cost) of the respective variable (x_i) according to the profit she will bring to the enterprise. Thus, if we fix a benefit margin for the enterprise at 3/1, the remuneration of the factor x_i can have the maximal level of 1/3 Δ_{y_i} . In practice, though, it is very difficult and always relative to estimate the real levels of the expected effects and corresponding costs for each factor/variable of innovation. In principle the best way of estimating the real effects of innovation is to measure the revenues brought by each innovation from the market (Ashish Sood, Gerard J. Tellis, apud Michael F. Wolf, 2008) Good recommendation, difficult to apply. At the management level it would be useful to have acceptable estimations for every relationship of this type. Thus, the idea is to establish a reasonably correct « fork » for the corresponding remuneration of each factor/variable, not only for the motivational ones, but for the others, as well: autonomy, commitment, and control through resources).

Conclusions

Creativity and innovation are two dimensions inextricably related and through their connection many different issues can be solved. The factors that influence the two variables can be identified, explained and individually measured only at a generic and relative level. However, it sounds logical to define and estimate a certain critical mass for each factor, always in a specific combination that could bring the best results. Such a critical mass could than be integrated in a critical matrix of innovation, considering the characteristics of each system/enterprise and each problem that needs to be solved. All that we did in our present approach was to suggest the general dimensions of the most important innovational factors that could be used to build such a critical matrix – if it exists. The next step would be to gather data on similar innovation types from similar industries, but different organizational cultures, national cultures, environments etc. and try to build and validate the specific measurement instruments (scales and indexes) that would bring us to the critical mass matrix of innovation.

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