

# Creativity and Innovation through Multidisciplinary and Multispectral Cooperation

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## Abstract:

*This paper explores the relation between creativity, innovation and new product development in multidisciplinary and multispectral settings. We claim that the development of innovative products benefits from the generation of a high number of creative ideas. Moreover, we argue that the idea generation process can be particularly fruitful within collaborative multidisciplinary environments, where firms and Science and Technology institutions coexist and cooperate. Our approach draws on existing literature to investigate the creativity and idea generation process within the frame of multispectral and multidisciplinary cooperation initiatives, involving firms and Science and Technology related institutions. We then call upon our own empirical work to identify conditions favorable to those processes and some issues that affect the fulfillment of the creative potential that exists in multidisciplinary groups.*

## I. Introduction

Today's organizations need a constant flow of ideas while competing through added value factors like emergent technologies or fast new product development. Competing in the twenty-first-century economy new product development. Competing in the twenty-first-century economy will require constant adaptation to shifting market demands. Failing to fulfill the varied requirements of potential customers may lead requirements of potential customers may lead to their loss to more agile competitors. The most successful organizations will create environments that promote systematic creativity and innovation. This paper argues that multidisciplinary and multispectral cooperative environments for innovation, where firms and science and technology institutions coexist and collaborate, can promote the efficiency of the triad 'innovation creativity-new product development' and contribute to firms' competitiveness. We start by emphasizing the interdependency between creativity, innovation and new product development. We then identify and discuss the main factors that influence this triad in business organizations. We next justify the benefits of multidisciplinary and multispectral networks for innovation in the pursuit of creativity, innovation and product development. The paper ends with the authors' experience with one of those networks. We summarize our involvement in order to enunciate management aspects of the creative process that we believe may be relevant to practitioners and academics in similar contexts.

## II. Relationships between Creativity, Innovation and New Products Development

### Creativity and Innovation

Creativity has been conceptualized as: (a) the individual personality traits that facilitate the generation of new ideas, (b) the process of generating new ideas, (c) outcomes of creative processes, and (d) environments conducive to new ideas and behavior. These perspectives led to multiple definitions of creativity. It is the capacity to generate new and valuable ideas for products, services, processes and procedures; the ability to produce work that is both novel (i.e., original) and appropriate (i.e., useful); for the set of qualities of products or responses that are judged to be creative by appropriate observers. Creativity is a complex and diffuse construct, difficult to define consensually. Innovation is associated with purposeful change an attitude reflecting the capacity to imagine what does not exist or a process with different stages extending from an idea to its implementation. Schumpeter viewed innovation as 'creative destruction' for growth contends that innovation is the recombination of existing ideas. 'the set of qualities of products or responses that are judged to be creative by appropriate observers. Creativity is a complex and diffuse construct, difficult to define consensually. Innovation is associated with purposeful Change an attitude reflecting the capacity to imagine what does not exist or a process with different stages extending from an idea to its implementation. Schumpeter viewed innovation as 'creative destruction' for growth contend that innovation is the recombination of existing ideas. it is the core Organizational process for renewing and optimizing the generation and delivery of outputs claim that innovation is concerned with the initial market introduction of a new product or Process that either disrupts or entrenches existing competencies. Therefore, creativity is identified

with ideas generation, while innovation implies ideas transformation into new products or services. In this sense, innovation is the implementation of creativity results. Thus creativity is part of the innovation process.

### III. From Ideas to Products

Innovative organizations exploit various sources of ideas for new products and stimulate employees' imagination in order to fill the pipeline that nourishes new products. Multidisciplinary and multispectral environments (discussed later in this paper) supplement this intra-organizational capacity and play an

Important role in ideas generation and new product conceptualization. The overall innovation process can be divided into three stages: (a) fuzzy front end, (b) new product development and (c) commercialization.

The fuzzy front end comprises activities (often chaotic, unpredictable and unstructured) that come before structured development processes. This initial idea creation phase is inexpensive compared to later stages of the product development process, thus it makes sense to maximize its output: 'the greater the number of ideas at the start of the new product development process, the greater the probability of successful products'. Selected ideas flow through the 'funnel' of Innovation. During this process, they become constrained and aligned by different organizational factors such as goals, models of change, resources: the further an idea progresses, the more developed and precise it becomes. The most suitable ideas are approved for implementation, while others are reworked, rejected or merged to re-enter the process. It is important to highlight that Ideas become 'suitable' according to criteria that often escape rational analysis, being rooted in intuitive evaluations, internal and external political considerations and opportunistic preoccupations. Once a concept emerges from the fuzzy front end and evolves towards a business plan (which includes product specification, financial analysis and project management), it becomes subjected to stricter development methodologies. We have indicated in this section that the creative capabilities of organizations are essential to their ability to innovate and survive in today's competitive environment and that creativity; innovation and new product development are intimately correlated. In the next section we look into the determinants of creativity and innovation within organizations.

### IV. Factors that Influence the Creative Process

We now focus on exogenous and endogenous factors that influence creativity, innovation and New product development in organizations. Exogenous factors are related mainly to the intensity and density of relationships that organizations establish with their surrounding environments. The external environment for innovation within which organizations operate includes the institutional support basis and relevant sets of values and norms the external environment for innovation provides the critical mass required for knowledge spillovers and synergies that favor creativity, innovation processes and new product development. Generally, organizations Have little capacity to actively influence the evolution of external factors Endogenous factors are related to the internal characteristics and organizational culture of firms and, thus, are more easily controlled. They should be the focus of firms' strategic and operational management in pursuing innovation objectives. We have identified in the literature six main internal factors that impact on firm's competitiveness through creativity, innovation and new product development:

#### 1. Organization strategy and resource availability.

The explicit incorporation of innovation in the goals and objectives of an organization is the first step to create attitudes amenable to creativity and to continuous development of new products state that creativity and innovation result from shared visions and missions, centered on future scenarios. Innovation-oriented organizational strategies influence the occurrence of long-term innovation perspectives (encouraging risk-taking and new idea generation) and of short-term project plans devoted to innovation initiatives and creative problem solving. The availability of resources like time, money and people allocated to new ideas and innovative projects contribute to the effective application of the strategy.

## 2. New technologies.

Firms able to develop new technologies can gain competitive advantages through innovative product Developments. This requires research and development (R&D) capacity and willingness to invest in high-risk ventures, two attributes in short supply amongst firms . Alternatively, firms can integrate joint projects with other firms and science and technology institutions. The appropriation of the technology is proportional to the involvement of the firm in the development process. Through cooperation firms can access otherwise unavailable resources and competences, gain long-term innovation perspectives, get support in creative problem solving and idea generation activities and share costs and risks inherent to innovation This is one of the reasons why multidisciplinary and multispectral cooperation environments are important, as explained later in this paper.

## 3. Research &Development intensity.

Research intensity follows the determination of an organization to spend resources on idea generation and product development and increases with its propensity to cooperate with universities and other organizations. It requires well-functioning communication channels (as access to knowledge is crucial for these processes) and active stimulation of innovative organizational cultures. However, as previously implied, firms rarely benefit from organizational structures agile enough to face these challenges.

## 4. Organization culture and communication.

Organizations' cultural elements like routine behaviors, shared values and beliefs, influence the level and frequency of creative occurrences and impact on the free flow of ideas that favor innovation Cultural aspects affect workers' knowledge and satisfaction, and their capacity to communicate and adapt to changes. Openness and dynamic contact between individuals, teams and departments facilitates the acceptance of new perspectives and is a particularly relevant trait in organizational cultures able to stimulate creativity and innovation.

## 5. Organization structure.

The literature on innovation covers thoroughly the organizational attributes that influence creativity, innovation and new product development. Flexibility (e.g., job rotation programmers) and freedom (manifested in autonomy, empowerment and decision making) in organizations are highly regarded values and practices .Working teams and interacting group's impact on the ability Of organizations to stimulate creativity, innovation and new product development. They provide conditions for a dynamic mixture of ideas and ways of work and make available complementary competencies and disciplines that favor creativity and innovation.

## 6. Employee motivation and involvement.

The quantity and quality of human resources allocated to innovation initiatives is crucial to the success of creative ideas. Employees' incentives for idea generation help to focus efforts on product development. Projects and innovation objectives. This is influenced by how risk taking is managed; ideas evaluated; mistakes handled; change dealt with; communication supported; ideas' identification conducted; reward systems established, etc. These factors suggest the relevance of mature strategic and operational management abilities to induce structural attitudinal changes that reinforce creativity and innovation. Our relationship with business organizations, including those that support the Empirical work analyzed in this paper, reveals that those mature capacities are in short supply. We argue that multidisciplinary and multispectral cooperation environments can help firms overcome their strategic and organizational shortcomings in the pursuit of innovation objectives. The next section briefly explores the characteristics of those environments.

## V. Multidisciplinary and Multispectral Cooperation Environments for Innovation

By multidisciplinary and multispectral cooperation environments we mean settings, formal or informal, that bring together organizations from different entrepreneurial sectors and science and technology institutions, around common goals. The linked organizations combine multidisciplinary competencies and localized complementary productive activities, integrating the diverse knowledge sets and skills needed to create and bring to the market complex technologies and products. They benefit from the physical proximity of their members, facilitating the exchange of knowledge rooted in individuals. The characteristics of such cooperation environments for innovation can be synthesized into three dimensions: diversity (of actors and competencies), coherence (respecting the integration of complementary activities) and interactivity (strong cooperation relationships). These characteristics maximize the benefits of cooperation and guarantee that learning effects and levels of inventiveness are enhanced, due to higher cultural, technical and knowledge differences between the actors involved. When successful, these multidisciplinary and multispectral environments play important roles for firms and organizations. They offer opportunities for leaders to respond actively to various challenges such as knowledge creation and competency development; the promotion of linkages between relevant actors; the creation and strengthening of common innovation support structures; the alteration of organizations' cultures and behaviors towards continuous innovation and to higher levels of interconnectedness and the mobilization of resources to execute more complex research and new product development projects. Such collaborative arrangements for innovation stimulate the fluency of knowledge processes and the creation of idiosyncratic competences relevant for research and joint product developments. As innovations in one sector can spill over to other sectors, the chances of efficient knowledge utilization for innovation increases. The associated creativity is also higher and more radical ideas may occur. Specialized support is quickly identified and made available, problem solving is fast and the efficiency of the development processes is high. Additionally, multispectral cooperation processes provide better conditions to elude the communication constraints typical of single-sector competitive environments. The involvement of scientific and technological institutions brings to these collaborative environments updated theoretical knowledge and imaginative perceptions and multidisciplinary human resources that allow vigorous competency crossing. Knowledge processes become intense and knowledge creation frequent. In these circumstances, the quality, variety and availability of knowledge open recombination opportunities that lead to original products and processes. The increasing complexity of new product development requires intricate and multidisciplinary solutions that benefit from interdisciplinary research practices. Such R&D activities are put into practice by interdisciplinary teams, which are facilitated by multidisciplinary cooperative environments. We argue that multidisciplinary and multispectral cooperative environments reinforce creative competencies and allow for rich combinations of otherwise disconnected pools of ideas. They have been found to contribute to better exploitation of limited research capacities and to the development of valuable and more radical ideas and solutions adjusted to the increasing complexity of problems. Therefore, they are more effective in the pursuit of creativity, innovation and product development than monodisciplinary and monosectoral environments.

## VI. Creating and Exploiting New Ideas: Empirical Aspects

In the previous sections of this paper we have discussed creativity, innovation and new product development processes and we argued that multidisciplinary and multispectral environments provide interesting frameworks to enhance fuzzy front end productivity and to generate opportunities for idiosyncratic innovation. We next analyse findings from a research project based on a multidisciplinary and multispectral innovation network in the habitat meta-sector. The case deals with a multidisciplinary/multispectral network for innovation involving 11 firms and 10 departments from one university, put together to conceive a futuristic house. We were particularly interested in the relationships between creativity, innovation and new product development in this multidisciplinary and multispectral context, and in the conditions that maximize the benefits to the firms involved in the network. This case is still ongoing; results, while instructive, are as yet preliminary. We used exploratory research methods, and we employed essentially qualitative approaches, e.g. participant observation, interviews, record analysis, to collect data. We applied triangulation methods to ensure internal validity. Note that the network excludes direct competition (no two companies belong to the same industrial sector), and that good conduct (including confidentiality reassurances) and intellectual property codes have been agreed upon. So, trust and confidence allowed for open and frank discussions among participants and between participants

and the research team. For further details on this case. Our research indicates that this network is enhancing creative processes. The combination of distinct mindsets, working styles and interests is providing fertile grounds for creativity along the path of development of new products. As described by Saur et al. the network set up a specific structure in charge of applied research and development. Creativity, new product development and innovation are central to this learning structure. The strength of the overall approach followed by the Network we studied was expressed by the fact that in less than two years it was able to identify and bring to advanced stages of development six complex, radically innovative, highly multidisciplinary products. In the next sub-sections we briefly look into the following three phases of the innovation process: (a) new idea generation, (b) idea classification/selection, and (c) new (product) concept generation and development. We do not focus on idea generation and selection *per se*, as the techniques used are well established; we rather evaluate those techniques in the light of our multidisciplinary and multispectral Environment. We also suggest some implications for the management of innovative processes.

### ***Generation of New Ideas***

The challenge was to generate new ideas for futuristic concepts/products for dwellings. Idea generation sessions, conducted in the university and firms, used a combination of brainstorming and brain writing. In the university, from almost 80 interested individuals, five heterogeneous groups of 12 to 15 persons were put together. Participants were carefully selected, ensuring high heterogeneity in terms of hierarchical levels and functions/disciplinary areas involved. Five creativity sessions were held and around 700 ideas were collected. Similar exercises were conducted in the firms. Behavior was similar to the academic brainstorming/brain writing sessions in terms of creativity flow, yet the number of ideas was smaller and they tended to be less innovative. This may be due to lower group heterogeneity, lack of multidisciplinary/multispectral participants and a more pragmatic, market orientated focus. We ended with more than 300 ideas. Besides the sheer number, the most remarkable features of the 1000-plus ideas list were their diversity and quality (radicalism and feasibility)? We believe this was a direct result of the diversity of the multidisciplinary and multispectral network. It is important to note that close follow-ups of creativity sessions were essential to improve the creative process. Participants' opinions were important. Given their heterogeneity, general rules were difficult to come by. In our case, Also, the importance of using various creativity techniques, some compensating for disadvantages of others, seemed greater in the multidisciplinary and multispectral context than in more homogeneous ones. After the idea generation exercise, the objective was to exploit the 1000-plus ideas portfolio. Ideas were arranged according to criteria like function performed, organization that could use them, innovativeness, feasibility, thus creating thematic sub-portfolios and Ensuring multidisciplinary/multispectral cross-fertilization. They were then selected and incorporated into lists tailored to each organization. Those lists were sent to firms, to be used for the identification of new products. We explored two convergence techniques to conduct selection processes in those firms. Firms were asked to participate in convergence sessions to decide what products to develop. However, in spite of apparent faith in the quality and rationality of those convergence techniques, participants adopted intuitive decision processes, making spontaneous choices based on their own strategic perspectives. Convergence tools seemed to be too systematic for the job at hand. Participants (top managers and production and marketing heads) were familiar and comfortable with unstructured decision approaches. It was clear that firms were able to deal with the diversity generated in the multidisciplinary and multispectral context without elaborate decision processes. However, we believe it was crucial to pre-select and prearrange ideas to ensure multidisciplinary and multispectral cross-fertilization. Besides, sound back-stage pre-selection comforted decision makers with the conviction that preselected ideas resulted from rigorous, 'scientific', approaches.

### ***Conception, Generation and Development of New Products***

The first objective of this phase was the integration into encompassing products of ideas that survived the selection phase. This required conceptual proximity amongst those ideas, which was facilitated by the previous arrangement of ideas according to specific criteria. For example, ideas related to 'kitchen, cooking' could provide a basis for a 'kitchen of the future product'. A kitchen concept would be prepared and proposed to interested network members, taking advantage of the complementarities of their skills and competences. The concept would then be reconfigured according to their organizational strategies. More focused creativity sessions would deal with the main characteristics of the 'kitchen of for example, new ideas/solutions for how to move a kitchen inside a house would be generated. These sessions followed the

organized brainstorming/brain writing model or, more often, took place in informal ambience where spontaneous comments and suggestions molded the shape of the product. One such creativity session led to 170 ideas, 37 of which survived preliminary evaluations. Product development was then initiated, using a modified stage-gate approach and episodically, the TRIZ problem solving methodology. The network was invaluable in this phase. The variety of problems to be solved, and of technologies, skills, knowledge, know-how, equipment's to be called upon, fell outside the scope of a single firm or department. The multidisciplinary and multispectral environment Provided the diverse mindsets, attitudes, materials and utensils that the development of complex, multispectral products required. It is relevant to highlight that the integration of ideas from prior, abstract creativity sessions, into multidisciplinary products allowed for designs that exceeded single organizations capacities, through cross-fertilization processes made possible by the multidisciplinary and multispectral network. Besides, to a greater degree than in homogeneous environments, the new product development process could accommodate new suggestions and changes in any of its phases.

## VII. Conclusions

This paper has looked at the path leading from idea generation to product development. It reports on work in progress, and so some conclusions are still preliminary. Our empirical research shows that multidisciplinary and multispectral networks can play important roles in members' competitiveness, provided they exhibit diversity, coherence and complementarity. We have noticed excellent results in terms of quantity, quality and diversity of ideas in the early idea generation phase. In the ideas' selection phase, we perceived the need to let rational methods coexist with intuitive decision processes. And in the product development phase, we noticed that the diverse mindsets, attitudes and skills in the network contribute greatly to its flexible problem solving capacities. In general, we have realized that the multidisciplinary and multispectral network is helping firms overcome managerial shortcomings that inhibit the control over endogenous factors that influence creativity, innovation and new product development. We thus contend that multidisciplinary and multispectral cooperation networks provide a good framework. For creativity and innovation. They are particularly relevant when firms decide to build competitiveness upon products that cross traditional sectors' boundaries. However, they also raise management challenges, both at network level and within each participating organization. To face those challenges, firms will have to accept human and financial overheads that will be justified only if the returns are convincing. We believe that when dealing with creativity, innovation and new product development there are no clear-cut solutions or ideal approaches. The effective process requires continuous re-tuning to get the balance right. This means to add or remove structure, to advance or retreat in the 'funnel' of innovation, to eliminate and recuperate ideas. Organizations need to be creative and innovative in the Management of creativity and innovation.

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