

Preface

TECHNOLOGY FOR CREATIVITY AND INNOVATION: TOOLS, TECHNIQUES AND APPLICATIONS

The year 2009 was considered the European Year of Creativity and Innovation (http://create2009.europa.eu/about_the_year.html). The objective of this decision was to “raise awareness of the importance of creativity and innovation for personal, social and economic development; to disseminate good practices; to stimulate education and research and to promote policy debate on related issues”. It is widely accepted that in order to cope with the rapid pace of change while being competitive, companies (and people) must be innovative, create new knowledge and have new ideas constantly. As a matter of fact innovation constitutes an important issue in organizational management in order to be competitive today. It is considered as the most important drive for business (Darso, 2008), providing economic value and “social prosperity through benefits to the individual and society” (European Parliament, 2008). Innovation is often coined with creativity, which can be described as a

process of playing with ideas, thoughts, and possibilities. It is often part of an innovation process, but whereas creativity is inspired activity, innovation is more about the strategic overview in order to create an output that will be used and bought by the customers and clients (Darso, 2008).

In order to be creative and innovative, it is necessary to help people to develop some competences (usually designated as soft skills - creativity, innovation, collaboration, communication, and critical thinking, among others). These are important because, as Chandler and Grzyb (2005:2) refer: “If we are creative, if we are skilled at innovation, we can come up with new ways of approaching situations that have changed”.

Although some persons may be born more creative than others, it is possible to help those less creative to improve their innovative capacities and competences. It is in this context that this book appears. We decided to put together contributions from several scientific areas and from experts covering almost all corners of the world.

This book is divided in five sections: (1) The Process of Creativity and Innovation, (2) Techniques for Creativity, (3) Tools for Creativity, (4) Best Practices and (5) Conclusion.

SECTION 1: THE PROCESS OF CREATIVITY AND INNOVATION

Creativity comes from the Latin term *creo* – to create, make. During the Christian period, *creatio* designated God’s act *Ex nihilo*, “creation from nothing”. *Creatio* thus meant something different than *facere* – to make – and did not apply to human activity. Throughout history this perspective has changed, but very often it was coined with only gifted people. Today it is widespread recognized that creativity should be seen as something that exists in a wider range of professions and people (Andriopoulos and Dawson, 2009: 21).

In the last century some researchers contributed to the development of creativity and to the creative thought. Here, we only present the contribution of 3 of them. For example, Wallas, in his work *Art of Thought* (1926) presents one of the first models of the creative process. It consisted of five stages, namely: (1) preparation – period when an individual may refine his/her goals in response to a particular issue or question or where relevant material from a wide range of primary and secondary sources is collected. The reason is that one needs first to prepare oneself with the relevant skills, knowledge, and abilities in order to be able to refine the problem at hand; (2) incubation – process of subconscious data processing, (3) intimation – the creative person gets a “feeling” that a solution is on its way, (4) illumination –when someone suddenly becomes aware of a core answer to the problem (sometimes it is very difficult to distinguish intimation and illumination, and as such, intimation is designated as a sub stage of illumination); and (5) verification – this period corresponds to the translation of a new idea into a doable solution. Since this early work, other studies followed focused on the process of creative problem solving. For instance, Basadur *et al* (1982) proposed a three-stage model comprising problem finding, problem solving (generating as many ideas as possible) and solution implementation. And this approach is more sophisticated than the one proposed by Wallas (1926) as it not only distinguishes between the behaviours that occur in creative problem solving but also is concerned with the thought processes involved at each stage.

Finally, we would like to refer to the Amabile’s (1983) work. She suggests that while innovation begins with creative ideas, creativity by individuals and teams is a starting point for innovation: the first is a necessity but not sufficient condition for the second. This idea led her to develop her five-stage model and to the identification of key components of creativity at certain stages of the creative process. The first stage is problem or task presentation; the second stage concerns preparation and at this moment the creative person develops or reactivates a data store/background relevant to the problem or opportunity identified. The stage that follows is response generation, and here the individual comes up with a set of possible ideas to the issue in question. The fourth stage is response validation and it refers to the process through which new ideas are verified and validated. The last stage concerns the assessment of the outcome based on tests performed in the previous stage.

Due to the importance of this topic we decided to prepare a set of papers dealing precisely with it. In this section of the book, readers will find studies concerning the identification of practices leading to creativity in high technology industries, an example of how to integrate technology in the creative design process and how development teams learn when they carry on innovation. Aware that there are factors that enable or prevent creativity and innovation, we also decided to include some studies dealing with issues such as the personality traits of individuals and their motivation to contribute to novel ideas and solutions; the role of social relationships and the existence of methods that go against methods to promote creativity and innovation.

Chapter 1, *A Benchmarking Study on Organizational Creativity Practices in High Technology Industries*, by Fernando Sousa and Ileana Monteiro, aims to provide a benchmarking list of initiatives that deal with the development of corporate or organizational creativity and innovation in the emerging sectors of bio-technology, nano-technologies, information and communication technologies, and eco-innovation, together with companies of other sectors, perceived as good examples of organizational innovation. Twenty-two interviews made by telephone addressing specific strategies in three domains: creative management, creative people management, and creativity management were conducted to top management in these organizations. Results indicate that high technology organizations, dependent upon financial support, do not seem to concentrate on corporate innovation, and do not have alternatives to budget reductions made in R&D, due to the present financial crisis, in order to innovate. The remaining companies provided several suggestions as to the way corporate innovation systems can be built and sustained within the framework of the future European innovation policies, devoted to workforce development, the service sector and the SMEs.

Chapter 2, *Integrating Technology with the Creative Design Process*, by Joshua Fairchild, Scott Cassidy, Liliya Cushenbery and Samuel T. Hunter, examines how specific technologies may influence performance at each stage of the creative process, and provides specific recommendations for how technology may be used to facilitate the development of creative solutions. This research is justified by the fact that in our fast-paced world, organizations must continually innovate in order to stay competitive. At the same time, technology is continually advancing, and tools to facilitate work are frequently changing. This forces organizations to stay abreast of current technologies, and also puts pressure on employees to use the technologies available to them in order to devise innovative solutions that further accomplish the organization's goals. To date, there has been little research on how such technologies may best be used to facilitate such creative performance. The present chapter addresses this gap by integrating a model of the creative process from the psychology literature with technology literature from engineering and information technology.

Chapter 3, *Problem-Solving Style, Problem Complexity and Knowledge Generation: How Product Development Teams Learn When They Carry on Innovation*, by Corrado Io Storto, presents the findings of a study aimed at investigating how the fit between the problem-solving style of a product development team and the cognitive environment induced by the perceived problem complexity affects the amount and type of knowledge generated. It is assumed that organizational knowledge is created as a by-product of collective creative technical problem-solving, when people work together to deal with unfamiliar and unexpected situations. Two major outcomes emerge from the analysis of experimental data: (1) different cognitive environment patterns are more conducive than others to organizational learning; (2) there is some fit between the cognitive environment pattern and the team technical problem-solving style, as some cognitive practices and social behaviours adopted during technical problem-solving are more effective than others in certain cognitive environments. Particularly, practices and behaviours that are more associated to creativity have a not negligible weight in the generation of knowledge. Ninety-one cases of technical problem-solving occurred during product innovation within the 35 small firms were studied.

Chapter 4, *Towards a Theoretical Framework for Creative Participation: How Personal Characteristics Influence Employees' Willingness to Contribute Ideas*, by Natalya Sergeeva and Milan Radosavljevic, investigates some recent developments and proposes a conceptual framework for creative participation as a personality-driven interface between creativity and innovation. To retain competitiveness, succeed, and flourish, organizations are forced to continuously innovate. This drive for innovation is not solely limited to product/process innovation but more profoundly relates to a continuous process of improving

how organizations work internally, requiring a constant stream of ideas and suggestions from motivated employees. Under the assumption that employees' intrinsic willingness to contribute novel ideas and solutions requires a set of personal characteristics and necessary skills that might well be unique to each organizational unit. The chapter explores personal characteristics associated with creativity, innovation and innovative behavior. Various studies on the correlation between creativity and personality types are also reviewed. The chapter provides a discussion of solutions and future development together with recommendations for the future research.

Chapter 5, *Cultivating Innovation through Social Relationships: A Qualitative Study of Outstanding Australian Innovators in Science and Technology and the Creative Industries*, by Ruth Bridgstock, Dr Shane Dawson and Professor Greg Hearn, describes and explores social relationship patterns associated with outstanding innovation. In doing so, the authors draw upon the findings of 16 in-depth interviews with award-winning Australian innovators from science & technology and the creative industries. The interviews covered topics relating to various influences on individual innovation capacity and career development. Authors found that for all of the participants, innovation was a highly social process. Although each had been recognised individually for their innovative success, none worked in isolation. The ability to generate innovative outcomes was grounded in certain types of interaction and collaboration. Authors outline the distinctive features of the social relationships which seem to be important to innovation, and ask which 'social network capabilities' might underlie the ability to create an optimal pattern of interpersonal relationships. Authors discuss the implications of these findings for universities, which we argue play a key role in the development of nascent innovators.

Chapter 6, *Methods against Methods*, by Marc Stierand and Viktor Dörfler, intends to clarify some issues about creativity and innovation methods, since it is believed that the term is often misunderstood. For the authors, neither creativity nor innovation is guided by a method. There are only methods against methods that can help the extraordinary individual to step faster and easier into a state of mind that is conducive to creativity, but which has no effect on whether the creative output becomes an innovation. In order to support this claim, the authors outline three major reasons that seem to be responsible for making people believe that such methods for creativity and innovation exist. Then authors present their understanding of creativity and continue with a discussion on the systemic character of creativity and innovation. Finally, the authors show that there are no methods for creativity, but methods against non-creativity by explaining in particular how one of these methods against non-creativity works. What the authors outline here is a necessarily one-sided and partial view. Their aim is not to convince the readers that they are right but to make them think by presenting one possible consistent approach.

SECTION 2: TECHNIQUES FOR CREATIVITY

All creativity processes start with a problem that requires a solution, which means that the first task is to correctly define the problem. The accuracy of this problem definition will affect the quantity and quality of ideas generated in the subsequent stages. The next step is generating as many ideas as possible because one assumes that the probability of coming up with a good idea increases with the number of ideas. The question now is to know if there are techniques that can help the individual to solve a problem or to increase the number of ideas generated. In this part of the book readers will find three studies that bring some light to this discussion.

Chapter 7, *Methods to Improve Creativity and Innovation: The Effectiveness of Creative Problem Solving*, by Fernando Sousa, Ileana Monteiro and René Pellissier, focuses on the development of organizational creativity, using the CPS methodology, aiming at demonstrating its effectiveness in using the individual and team divergent thinking improvement in identifying organizational problems. A study was undertaken using problem solving teams in seven companies, in which each individual was submitted to a pre-post test in attitudes towards divergent thinking and asked to express the evaluation of the method. All the information reported in the sessions was recorded. The results indicate a change in attitude favourable to divergent thinking, the provision of a professional, efficient method of organizing knowledge in such a way that can help individuals find original solutions to problems, and an important way to lead teams to creativity and innovation, according to companies' different orientations.

Chapter 8, *An Interdisciplinary Workshop for Business-Idea Generation*, by Astrid Lange, describes a workshop concept for small groups that aims at the qualification for creative business-idea generation in interdisciplinary teams of academics. The chapter's aim is to provide a theory-based and application-oriented description of the workshop, including a first-hand report on implementation. The chapter starts with a description of theoretical contributions and underlying research results to illustrate the workshop's framework. Next is a description of the aims, methods and target group follows, as well as the organizational settings and training methods. Then the chapter will focus on the realization of the workshop. Finally, authors discuss the workshop concept's scope of application.

Chapter 9, *The Structure of Idea Generation Techniques: Three Rules for Generating Goal-Oriented Ideas*, by Stefan Werner Knoll and Graham Horton, discusses the important role played by idea generation techniques in the innovation process. Until recently, the space of techniques has been unstructured, and no clear guidelines have been available for the selection of an appropriate technique for a given innovation goal. Authors use an engineering approach to study and develop idea generation techniques with the aim of obtaining more structured and rigorous guidelines for generating ideas. One objective of this approach was to identify and understand the fundamental mental principles underlying an idea generation technique. In this chapter, the authors show how three such principles suffice to cover a large range of published idea generation techniques and suggest how these can be used to improve the utility of idea generation within the innovation process.

SECTION 3: TOOLS FOR CREATIVITY

In creativity and innovation, although the individual is important, usually he / she is part of a team which supports, nurtures and often delivers his / her vision and goals. The importance of the team leads us to organize a section in this book dealing with the tools to promote creativity but used in the context of a group. Here, readers will find studies concerning the use of brainstorming supported by a system for problem solving, the development of a tool to assess the organizational culture towards learning (the support of creativity and innovation) and the use of technology in knowledge management

Chapter 10, *Experience with Self-Guiding Group Support Systems for Creative Problem Solving Tasks*, by Gwendolyn L. Kolfschoten and Calvin Lee, explores the use of brainstorming to improve creativity. Brainstorming can be supported with Group Support Systems (GSS). However, GSS are most successful when offered in combination with facilitation, or at least training. Unfortunately, facilitation or training will impose a barrier to use such systems. In this chapter, authors evaluated the use of a GSS for a multi-step, creative, problem solving task. The groups using this GSS got no training, had no GSS

experience and got no support, other than a 1 page log-in instruction. With this limited instruction and no training all participating groups handed in a report with the results of their brainstorm, using the tool. In this chapter, authors will report the process, the way it is embedded in the tool, and will report the results of our exploratory questionnaire among the participants.

Chapter 11, *The OLC Questionnaire: A Measure to Assess an Organization's Cultural Orientation towards Learning*, by Teresa Rebelo, and A. Duarte Gomes, is centred on the psychometric qualities of the OLC questionnaire, which has the objective of measuring the orientation of organizational culture towards learning – a kind of culture that promotes creativity and innovation in organizations. Hence, it includes description and discussion of its conception, assessment of content validity, and the main construct validity studies already carried out. Its bi-dimensionality in terms of internal integration and external adaptation processes and its potentialities for research and intervention are also discussed, as well as future research directions to continue its journey of validation.

Chapter 12, *Knowledge Management and Innovation: Mapping the Use of Technology in Organizations*, by Leonor Cardoso and A. Duarte Gomes, explores the role of technology in organizational knowledge management, inasmuch as it provides new forms for holding and exchanging information and knowledge in intra and inter-organizational contexts. The potential of technological means is therefore emphasized as tools supporting the various organizational processes related to knowledge, and questions arise concerning their comparative or relative relevance for increased innovation and creativity. In a sample of 1275 individuals belonging to 50 Portuguese organizations, the use of technology plays an important part in terms of the organizational processes related to knowledge management, but this is limited above all to those which are formally instituted and based on knowledge of a mainly explicit nature. In addition, this study highlights the importance of management of organizational processes related to tacit knowledge, which emerges essentially from processes of social and discursive interaction involving organizational actors.

SECTION 4: BEST PRACTICES

In this section we present three examples of best practice on how to use technology to promote creativity and innovation. The first one presents the use of digital storytelling in primary schools classrooms, the second one deals with the use of technology as a creative management tool at the BBC. The last chapter describes a b-learning case in a Higher Education Institution.

Chapter 13, *Exploring Alternative Assessments to Support Digital Storytelling for Creative Thinking in Primary School Classrooms*, by Lee Yong Tay, Siew Khiaw Lim and Cher Ping Lim, documents the use of digital storytelling as a teaching approach to facilitate the learning of creative thinking among students (aged 7 and 8) in a primary school setting. A constructive teaching approach is adopted to allow students to create their own digital stories based on an authentic experience and expression of their thoughts. The focus of this chapter is to show how a shift from traditional classroom assessment to more flexible, alternative assessment format facilitates higher level thought processes (e.g., creative thinking) and range of skills. Several issues and challenges related to the use of alternative assessment in digital storytelling are explored and discussed. Findings suggest that digital storytelling may be effectively used as an approach to foster creative thinking. The authors also suggest that refinements to the assessment process are needed to make it more formative in nature.

Chapter 14, *Creative Management, Technology and the BBC*, by Nicholas Nicoli, argues that the past decade has witnessed increased attempts by managers, scholars and policy-makers to stimulate the creativity of organisations. The practice of stimulating organisational creativity has led to a paradigm shift known as creative management, the focus of which is to use these practices to achieve competitive advantages. Such creative stimulation can come in a variety of forms. These include identifying and influencing environmental conditions that can increase the chances of creating new and significant products or services. In order to stimulate creativity, current creative management literature proposes the use of technology as a disseminator of knowledge and ideas. This chapter offers a literature review of creative management and technology use for creativity. It next introduces a case study of how technology is used as a creative management tool at the BBC. The findings of the study indicate that although the BBC's yearly revenues are under sustained pressure, the organisation has invested heavily in technology in order to maintain its high creative standing. In conclusion, supported by the findings of the case study, this chapter corroborates and further advocates the use of technology as a significant component of creative management practices.

Chapter 15, *Sustainable Blended-Learning in HEI: Developing and Implementing Multi-Level Interventions*, by Paula Peres, Sandra Ribeiro, Célia Tavares, Luciana Oliveira and Manuel Silva, aims to demonstrate how PAOL - Unit for Innovation in Education, a project from ISCAP - School of Accounting and Administration of Oporto - Institute Polytechnic of Oporto, Portugal - prompted new educational initiatives and new learning scenarios at a Higher Education Institution. Furthermore, authors intend to demonstrate PAOL's lines of intervention through an extensive analysis based on the 6 years of experience that this unit has in the educational technology field; a project that began small but that, due to the force of innovation, has progressively conquered new adepts. Therefore the unit described in this chapter relates all these factors, as a whole, capable of attaining changes that influence mentalities and methodologies, overcoming cultural and technical barriers. This case study can serve as a catalyst, potentiating the creation of new multi-faceted projects in the scope of Web technologies in higher education teaching-learning processes.

SECTION 5: CONCLUSION

It is very difficult to foresee the future. Anyway, we decided to present here a perspective of two authors on how the future will look in the field of creativity.

Chapter 16, *The Opportunities and Challenges of Technology Driven Creative Collaborations*, by Diego E. Uribe Larach and John F. Cabra, elaborates on some trends that will govern creativity and innovation. Authors argue that the onset of the 21st century is marked by deep psychological and sociological transformations affecting every scale of human endeavour, ranging from individual to crowd behaviour. Deep and central to these transformations is the penetration of digital communication and computer technology into modern day life. Above all, this new and evolving technological landscape has opened exciting new possibilities to drive creative behaviour, organizational creativity and innovation through computer-mediated interactions. Such opportunities are met with equal challenges that need to be addressed in order to harness the full potential of massively distributed creative collaborations. This chapter will elaborate on the underlying trends that give rise to these opportunities and challenges and to what extent these trends will govern creativity and innovation in areas of organizational life such as business, education, science and design in the next 10 to 30 years.

A final word just to say that we hope that the reader enjoys reading this book as much as we enjoyed preparing it.

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