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Creativity support systems: A systematic mapping study

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ABSTRACT

As part of the innovation process, creativity has become a critical dimension for organizations that wish to maintain their competitiveness. In order to foster the creativity potential within organizations, processes and systems need to be designed and integrated so that all stakeholders can participate in a coordinated and timely fashion, and despite the various dispersion levels that may separate them. Although many tools are already available on the market or being tested, a significant gap still exists between those products and the creativity process that they are supposed to support. To truly respond to the need for creativity in a distributed environment, it is suggested that the entire process be re-examined and understood so that future Creativity Support Systems can fulfil real needs. This paper is a systematic mapping study of the literature on existing digital tools dedicated to creativity. A thorough examination of over 49 digital tools is carried out, providing the action channel for emerging Creativity Support Systems that would better support collaboration diversity throughout the creative process.

1. Introduction

In today's globalized competitive context, organizations need to maintain their competitiveness by regularly generating new ideas, new products or services, and new processes. Globalization also requires remote collaboration and extensive use of digital devices, as creativity is becoming a collective process. From the perspective of the innovation process, numerous factors influence the generation of value and novelty for a company. A trend that confirms and combines innovation and remote collaboration is the increase in open innovation strategies and associated platforms (i.e. OpenIdeo,[1] Dell IdeaStorm,[2] etc.). This article focuses on digital systems that support creativity during conceptual design and innovative initiatives and, more specifically, innovation approaches that involve teams, such as creative workshops.

Designing an entire system that supports creativity integrated into the entire innovation process is a complex problem that involves different research fields. (Ardaiz-Villanueva, Nicuesa-Chacón, Brene-Artazcoz, Sanz de Acedo Lizarraga, & Sanz de Acedo Baquedano, 2011) identified four separate groups of studies, each of which has a different underlying goal: (1) to determine how creativity is associated with personal characteristics (personality traits, cognitive ability); (2) to examine the cognitive and social processes that are involved in creativity; (3) to foster ideational creativity by means of computer tools; and (4) to identify the environmental factors that nurture or inhibit creativity. The challenge is to gather these different

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[1] OpenIdeo: https://openideo.com/.
[2] Dell Idea Storm: http://www.ideastorm.com/.

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approaches to create satisfying digital tools. In other words, foster the creativity by means of computer tools by considering individual characteristics, the social interaction processes involved in creativity, and the environmental factors that influence the individual and social fields and thus creativity.

In this paper, we investigate how currently available digital tools dedicated to creativity are supporting it. Investigating these systems requires consideration of the social and cognitive process of creativity, social interaction through the collaborative mode, and the environmental factors as the technological means and the creative techniques applied. This investigation was done through a systematic mapping study defined as a "broad review of [. . .] in a specific topic area that aims to identify what evidence is available on the topic" (Kitchenham & Charters, 2007). Ultimately, the aim is to describe the actual "progress" concerning the support of creativity through digital tools and address the area to explore for future research in the field. The present work does not pretend to evaluate the efficiency of the systems to facilitate creativity, but rather is focused on the functionalities communicated by the authors reviewed.

As a starting point, in the coming section we will develop several concepts such as creativity, innovation, creative process, and creative support system and set the point of view of this work. In Section 3, the applied methodology for this mapping study will be described. Section 4 will then present the main results of the study. To conclude the result of the study, we will discuss confirmation of the fact that the domain of the digital systems dedicated to creativity is incomplete as suggested by (Bonnardel & Zenasni, 2010; Shneiderman, 2007).

2. Overview on creativity and some associated concepts

Several concepts were introduced in the previous section, most of them requiring further explanation and positioning to understand the assumptions underlying the systematic mapping study in this article.

2.1. Innovation vs. design vs. creativity

Innovation, defined as the acceptance and widespread use of a new product, process, or service, conveys the notion of success and of perceived value from various economic actors (e.g. customers), as well as differentiation from existing solutions (Tidd & Bessant, 2009). It is also considered as a process (e.g. search-select-strategy-implementation) and as a necessary mind set to produce novelty. From the perspective of innovation *as a process,* it is quite common for creativity to be considered as a component of innovation (Tidd & Bessant, 2009; Damanpour & Aravind, 2012; Boly, 2008).

Like innovation, *creativity* can be seen from different perspectives: some authors would describe it as a mindset, others as a process, and some as a result. Several definitions have been proposed in the literature. In a problem-solving context, the most common definition of creativity is the ability to achieve a new and adapted production of concepts (Lubart, 2003), or the ability to produce something original and appropriate to a context (Howard, Culley, & Dekoninck, 2008). In other words, creativity is a balance between concept novelty and usefulness (Puccio & Cabra, 2012) or appropriateness (Zeng, Proctor, & Salvendy, 2011; Howard et al., 2008) that is achieved by using existing knowledge (Ogot & Okudan, 2007).

These definitions of creativity have a lot in common with the concept of *designing* a solution. In this case, there are three relevant interpretations of 'design': design as a tangible outcome (Von Stamm, 2008), design as a creative activity (Von Stamm, 2008; Warr & O'Neill, 2005), and design as a process of transforming information into outcomes (Von Stamm, 2008). The third definition, which is the most commonly used according to Von Stamm, can be defined as a "conscious decision-making process by which information (an idea) is transformed into an outcome, be it tangible (product) or intangible (service)." (Von Stamm, 2008, p. 17). Von Stamm also suggests that creativity takes place within the design process. From this perspective, design *as a process* can be divided into three different types: *conceptual design,* in which concepts are generated to fulfil an objective; *embodiment design,* which is the structured development of the selected concept; and *detailed design,* which precisely defines every individual element of the outcome (Von Stamm, 2008). Thus, it appears that conceptual design concerns the generation of ideas/concepts, while embodiment design and detailed design concern creativity in the generation of new technical solutions.

In many cases, the distinction between innovation, conceptual design and creativity is blurred for the benefit of an overall process. For example, (Von Stamm, 2008) argues that innovation is composed of the creativity process plus the (successful) implementation of the idea in the form of a product, process or service. On the other hand, other authors consider implementation to be part of the creativity process. This view suggests that the innovation and design processes do overlap. Based on the authors' experience concerning creative session facilitation, implementation will be considered as the stakeholders' concern and not as part of the creative process. However, a link will be made between conceptual design and creativity. As highlighted by Howard et al. (2008) review, there is a slight difference in the scopes and the concepts considered, but design remains a creative process which is generally applied to domain-specific problems (e.g. engineering).

2.2. Influencing factors

Beyond the issue of defining creativity, multiple directions have been proposed to scientifically investigate the creativity domain. There are several perspectives for understanding the phenomenon of creativity. Creativity can be broken down into six main strands (Long, 2014): process, product, person, place, persuasion, and potential. Another structure for breaking down and understanding creativity comprises three different levels (Mumford, 2012): individual, collective (team), and