

A Conceptual Framework for Information Retrieval in Pockets of Creativity

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Abstract: Creativity as the prerequisite for innovation is a core competitive factor in contemporary organizations. When creativity happens this involves creative persons who produce creative products in a process of imagination. We introduce the concept of Pockets of Creativity for those sections of a business process where creativity occurs. These sections are characterised by a high demand for flexibility and knowledge of the involved creative persons. In Pockets of Creativity previous knowledge is retrieved, transformed and combined into new procedures or artefacts – in short – innovations. Naturally, this raises the question of how Pockets of Creativity can be supported by Information Technology. Informed by the Cognitive Network Model by Santanen et al. and the work of Amabile and others, in this paper we introduce a conceptual framework for information retrieval that suggests creative persons to access relevant information through a multi-perspective, hierarchical view. Thus, people's differing worldviews and approaches to creative-thinking are considered. At the same time, such an approach can provide stimuli to invoke the discovery of entry points to areas of a person's cognitive network that have not been considered before. Through this, people may be able to think imaginatively and to combine seemingly different concepts to truly creative and innovative products. We suggest to consider the process as a whole as knowledge is created, retrieved, transferred and applied within business processes.

1 Introduction

Creativity as the prerequisite for innovation¹ is an important competitive factor for contemporary organizations [Pr03, SBD00]. Core processes are often characterized by

¹ The understanding of innovation underlying this research is that of innovation as applied creativity.

the existence of creative tasks within these processes. Processes that contain creative tasks differ from conventional business processes in many respects: They have a low level of repeatability, typically are high value-add processes, involve creative persons, have an extremely high demand for flexibility and are consequently characterized by particular risks. Typical examples are processes in game production, visual effects production, research and development or design. Knowledge is an important factor as there is a very close relationship between a person's knowledge and a person's capability of being creative [Am98, We99].

Based on the awareness that business processes often contain both creative and non-creative sections, we introduce the concept of Pockets of Creativity (PoC) as a means to identify creative parts of business processes. None-creative parts of a business process are often well-structured and easy to predict whereas creative parts have a high demand for flexibility and are hard to predict.

Consequently, this raises the question of how these Pockets of Creativity can be supported. As indicated, knowledge plays a prominent role: Creative persons (or creative individuals) "combine their knowledge in novel ways or invent new knowledge that is useful to some field" [Sh00]. A detailed discussion of whether previous knowledge is relevant to creative capability can be found in [We99] who concludes that reasons why particular persons come up with specific innovations can be found by "determining the knowledge that the creative thinker brings to the situation". Based on the awareness that (a) knowledge is the basis for creativity and that (b) information technology can assist creative individuals in storing and locating relevant knowledge, we introduce a framework for information retrieval to support Pockets of Creativity within business processes.

The approach to information retrieval we propose is based on a multi-perspective, hierarchical view on knowledge. It has been particularly informed by the Cognitive Network Model of Creativity [SBD00] that suggests that cognitive networks of knowledge are formed in response to stimuli. Consequently, the proposed approach offers multiple views on a knowledge base, thus, providing creative persons with external stimuli from multiple contexts that may lead to new entry points into a person's cognitive network. At the same time, providing diverse perspectives on a knowledge base accounts for the fact that creative individuals come from diverse backgrounds and, therefore, approach specific creative tasks from miscellaneous perspectives [DDB98, Fr99, MMG02].

Besides, we consider the work of Amabile who states that there are three components of creativity [Am98]. These are *expertise*, *creative-thinking skills* and *motivation*. With the approach we suggest, the first two are targeted: Whereas expertise "encompasses everything that a person knows and can do in the broad domain of his or her work", creative thinking refers to "how people approach problems and solutions – their capacity to put existing ideas together in new combinations." Thus, we suggest targeting both the "what" and the "how": First, a knowledge base is made accessible to broaden creative people's expertise. Second, it is sought that the multi-perspective, hierarchical way to access this knowledge base can support people to approach problems from different directions. This is in accordance to Amabile's claim that creativity can be enhanced when problems are turned upside down and knowledge from seemingly disparate fields is combined.

It is important to consider the business process as a whole instead of taking an isolated view on Pockets of Creativity: Only a process-wide view enables to understand the relationship between knowledge creation, knowledge transfer and knowledge application. As stated in the related literature, organisations can be seen as knowledge systems that consist of four types of knowledge processes. These are creation, storage/retrieval, transfer and application [AL01, HM79, Pe95]. Pockets of Creativity are sections within business processes where such knowledge processes occur: Existing knowledge is retrieved, transferred and combined (and, thus, applied) to create new knowledge. This new knowledge becomes manifest in procedures and artifacts that are characterized by novelty – in short innovations – and that are stored in a knowledge database.

This work is relevant to both academia and practice: First, we introduce a conceptual framework that establishes a link between creativity, business processes (via the concept of ‘Pockets of Creativity’) and knowledge processes. It can serve as an analytical and descriptive framework that can inform future research. Second, the framework provides a starting point for the development of new or the adaptation of existing information systems artifacts to support creativity as parts of business processes.

The remainder of this paper is structured as follows. The next section provides a brief overview of relevant related work and further justifies this research. We then elaborate on the concept of ‘Pockets of Creativity’ and establish a link with business processes. A conceptual framework to information retrieval is introduced and the relationship to business processes and ‘Pockets of Creativity’ is depicted. We further provide an example case that illustrates how the framework can be utilized to inform the design of information systems in practice. The paper concludes with a summary and an outlook to our future research agenda. We particularly discuss how the introduced approach can be evaluated.

2 Related Work

Business Process Management (BPM) has been defined as “a structured, coherent and consistent way of understanding, documenting, modeling, analyzing, simulating, executing, measuring and continuously changing end-to-end business processes and all involved resources in light of their contribution to business improvement” [Qu06]. BPM has been deployed in many organizations throughout different industries [APM99, Sc96]. Over the last years the notion of the Knowledge-intensive Process has developed [ESR99, Py06]. This is of particular interest to this research as there is a close relationship between creativity and knowledge [Am98, CV05, Gu69, We99]. Guilford, for example, highlights the “role of information” and the “role of previous experience” [Gu69]. The concept of the Knowledge-intensive Process is mainly concerned with the role of people, the knowledge workers, and their interaction within processes. One key point is that Knowledge-intensive Processes demand for flexibility.

As indicated, we aim to identify creative sections within business processes that we refer to as ‘Pockets of Creativity’. This has lead to the question of how these Pockets of Creativity can be supported by Information Technology. In the related literature many approaches to support creativity can be found [KN03, MRG04, WN06]. For example, Shneiderman has developed a research agenda that lists aspects such as searching and

browsing digital libraries, thinking by free associations, exploring solutions, composing artifacts and performances [Sh98]. Kristensson and Norlander refer to group communication support systems, since efficient communication between parties involved in the creative processes are crucial to success [KN03]. Regarding the role of group communication systems to support creativity compare also [DVN90, Nu91]. Wierzbicki and Nakamori present “a review of the needs and possibilities of constructing diverse types of dedicated Creative Environments (information technology systems for supporting creativity) for knowledge and, in particular, technology creation” [WN06]. Their concept of the Creative Environment is defined as “an informational technology system (software and hardware artifacts) to support selected processes of knowledge and technology creation following the principles of systemic integration [...]” [WN06]. They further identify several types of needed Creative Environments based on the intensity of research that has been done in the particular areas. These are web knowledge acquisition, debating, experiment design and support, virtual laboratories, road-mapping for scientific research, brainstorming, gaming for creativity support, electronic and distant teaching and learning, innovation in modern and small enterprises. The role of knowledge to support creativity has also been highlighted by Shneiderman who introduces a framework based on a set of foundational beliefs of which the first one is that “New Knowledge is Built on Previous Knowledge” [Sh00]. He also discusses the critical role of appropriate tool support for this phase. Examples are digital libraries, search services, dynamic queries, information visualization, and multimedia search. As Shneiderman points out, “locating the relevant knowledge can be difficult, costly, and time consuming, but computing technology [...] can be helpful” [Sh00].

Based on the awareness that knowledge and the retrieval of relevant information are crucial to a person’s capability of being creative as well as the fact that there is still a lack of convincing approaches to information retrieval for supporting creative tasks, we introduce a conceptual framework that may inform the design of information systems to support what we refer to as Pockets of Creativity. As indicated earlier, the approach is informed by the Cognitive Network Model [SBD00] and the work of Amabile [Am98] and others who identify knowledge and creative-thinking skills as important components of creativity and imagination.

3 A Framework of Creativity-intensive Processes

3.1 Creativity-intensive Process and Pockets of Creativity

At the outset, we point out the relationship between the phenomenon of creativity and what is known as a business process in the Information Systems discipline. This leads to the concepts of the *Creativity-intensive Process* (CIP) and *Pockets of Creativity* [Se06]. A business process has been defined as “a completely closed, timely and logical sequence of activities which are required to work on a process-oriented business object” [BK03].

Most definitions of creativity concur in that something ‘new’ is at the core of creativity. May, for example, defined creativity in 1959 as “the process of bringing something new into birth” [Ma59]. Later definitions further state that creativity is *purposeful* or *useful*.

For example, DeGraff and Lawrence defined creativity as “a purposeful activity (or set of activities) that produces valuable products, services, processes, or ideas that are better or new” [DL02]. Similarly Sternberg and Lubart, who write that creativity “is the ability to produce work that is both novel [...] and appropriate [...]” [SL99]. In accordance to this, Amabile claims that “in business, originality isn’t enough. To be creative, an idea must also be appropriate – useful and actionable.” [Am98] Rhodes [Rh61] tried to unify the many different definitions of creativity by introducing a framework that can be regarded to as analytic and descriptive theory that provides clear definitions of basic constructs [FD86, Gr06]. His framework is based on the assessment of 56 definitions and clusters these around four aspects: the *creative product*, the *creative process*, the *creative person* and the *creative environment* [Br89]. The awareness that something new is at the heart of creativity becomes manifest in the creative product: The so-called Creative Product Semantic Scale (CPSS) can be used to determine whether a product is creative – and the first dimension of CPSS is that of novelty [Fi93, OB89].

The four aspects introduced by Rhodes (and extended by [Is87]) are utilized to define the notion of the Creativity-intensive Process (CIP). The *creative product* [Fi93] corresponds to the business object in a business process that is characterized by novelty. *Creative persons* are actors within a business process. The activities within a business process are *creative processes* [Br89, Gu69, Os57]. Based on the definition of business processes as a logical sequence of activities, creative processes as parts of business processes are referred to as *creative tasks*. The *creative environment* is constituted by the business environment including resources, application systems, external systems, risks etc. (it has to be mentioned, that according to Firestien the creative environment is the target audience, meaning that creative products “are introduced to environments [...] and subsequently change those environments” [Fi93]).

Creative tasks, creative persons, creative products as well as other relevant factors of the creative environment such as risk and knowledge are subsumed under the term *Pocket of Creativity*. A CIP is either a single Pocket of Creativity that cannot be further broken down or a business process that contains at least one Pocket of Creativity. The relationship between the different introduced concepts is also depicted in Figure 1.

3.2 An Information Retrieval Approach to Support Creativity

Shneiderman points out that new knowledge is developed on the basis of previously existing knowledge. The relevant knowledge in innovative processes comprises of the participants’ understanding of the domain of interest, her mental maps, beliefs, paradigms, and viewpoints (tacit knowledge) as well as articulated or codified knowledge (explicit knowledge) provided by secondary sources [Sh00]. Thus, in addition to their personal tacit knowledge creative persons have to acquire supplementary explicit knowledge which may also be referred to as information [AL01, No91].

Information retrieval being part of an organization’s knowledge management processes [HM79, Pe95] is concerned with the representation, storage, organization, searching, and finding of organizational information [AL01, In92] in order to meet information needs. Information needs emerge in problem solving situations, such as creative problem solving [Os57]. The information perceived as relevant by an information seeker is

mediated by her world-view which represents a system of individual categories or concepts leading every process of human cognition [Me82]. Thus, information retrieval is about aligning the cognitive structures of system designers, information providers, and system users in order to provide appropriate means for satisfying information needs [In92].

However, information seekers in creative environments who are faced with innovative tasks often do not know what kind of information they actually search for. Their vague information needs evolve and are refined during the information retrieval process constantly. Therefore, creative individuals are often unable to state explicit search queries which effectively satisfy their information needs. Here, navigation structures representing pre-defined search queries may aid the information seeker by providing guidance through the cognitive process of information retrieval and leading the search into the right direction. [Br06]

Hierarchies provide a common structure applied for navigation purpose. They offer intuitive representation for the notions of abstraction and aggregation. That is, they provide a multilevel disjoint categorization of the world which guides an individual along a stepwise refinement process to satisfy her information need. [FZ94]

However, given a set of information objects one single hierarchy is not sufficient to provide appropriate navigation means for diverse potential information seekers in various contexts [FZ94]. As mentioned above, human information processing is mediated by an individual's world-view which is not only specific for every individual but also varies during one information retrieval process. Thus, information retrieval structures have to reflect these diverse perspectives on information by providing alternative navigation paths leading to the same piece of information [Br06]. When hierarchies are favored as appropriate navigation means, consequently, a choice of hierarchical refinement structures has to be offered to the information seeker. Furnas and Zack proposed the concept of multi-trees which refers to a set of overlapping hierarchical navigation structures [FZ94]. The need for flexible and multi-perspective information retrieval means is even more prevalent in the field of creative processes. The group of professionals taking part in a process is often very heterogeneous concerning the way of approaching a creative task and also varies from process execution to process execution [MMG02].

Aside from the provision of multi-perspective views at the information available, multi-trees also facilitate the creative exploration of available tacit knowledge. As suggested by the Cognitive Network Model of Creativity [SBD00], external stimuli trigger the discovery of entry points to areas of a person's cognitive network that have not been considered before. Due to the overlapping structure of multi-trees a navigation node may be part of several alternative hierarchies representing different views at the same aspect. Therefore, an indication of various affiliations of a navigation node may evoke novel insights into a problem at hand. Folksonomies represent a current example of overlapping navigation structures which may be applied in the aforesaid manner. They comprise categorization structures evolved from the Web 2.0 phenomenon of social book marking or tagging. Here, the categorization of contents is not provided up-front but evolves from the continuous annotation of information artifacts with so called tags by a system's users. [Mc06] Tags may be understood as a representation of the mental models of their initiators. The evaluation of the diverse perspectives on the same

information may provide stimuli in the sense of the Cognitive Network Model of Creativity as mentioned above.

In addition to their appropriateness for guiding creative individuals through problem solving situations in contexts which are hard to predict and dynamic in nature, multiple navigation hierarchies do also offer powerful means for precisely expressing information needs. As every hierarchical navigation structure classifies information from a different angle the simultaneous refinement of information requirements along multiple hierarchies facilitates the effective translation of information needs into search queries. A similar approach is known from the area of business intelligence. Here the concept of online analytical processing (OLAP) [PC95] is applied to navigate through comprehensive sets of structured data. In contrast to the OLAP approach the idea presented here aids a search process on an unknown set of information.

3.3 Conceptual Framework of Creativity-intensive Processes and Information Retrieval

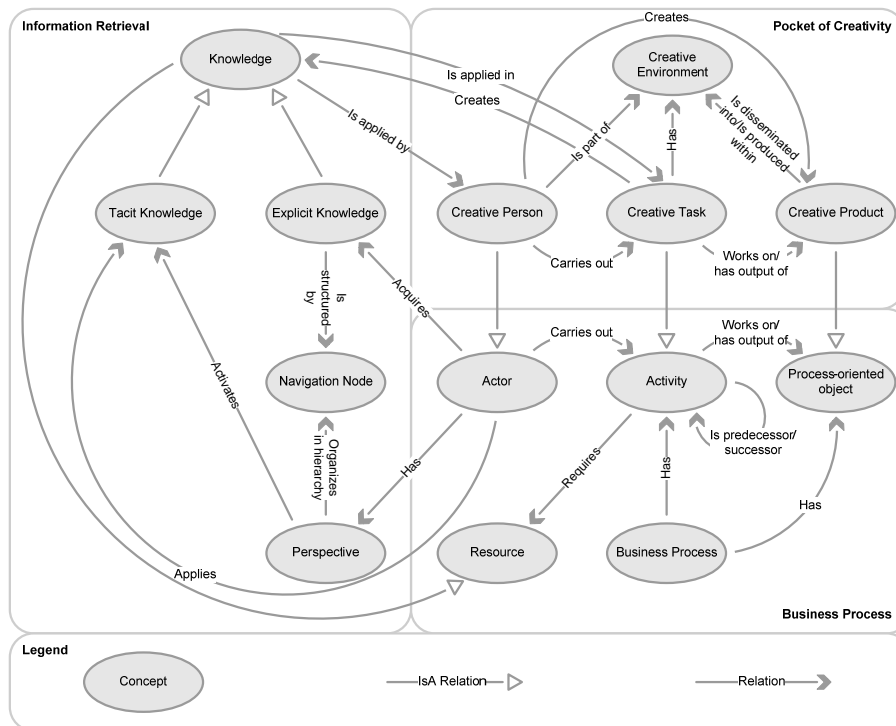


Figure 1: Conceptual Framework of Creativity-intensive Processes and Information Retrieval

Based on the definitions of the Creativity-intensive Process and Pockets of Creativity, we now introduce a conceptual framework that depicts the relationship between creativity, business processes and the approach to information retrieval introduced above. It provides description of the relevant concepts and relations among these. Thus, it is intended to elucidate our notion of a Creativity-intensive process and its connection

to an information retrieval approach bearing on diverse, hierarchical navigation structures. In this respect the conceptual framework caters for a shared understanding being a premise for the development of information retrieval systems effectively supporting the accomplishment of creative tasks.

Figure 1 represents a graphical illustration of our framework. Besides elucidating relevant concepts and their interrelations Figure 1 additionally pictures a topical clustering of the concepts according to Business Process, Pocket of Creativity and Information Retrieval. Pockets of Creativity are subsets of business processes. Consequently, they are linked via three is-a relationships to resembling elements in the business process cluster: a creative person is an actor in a business process, a creative task is an activity that is part of a business process and the creative product is the process-oriented object in a business process. Creative tasks are carried out in a creative environment. Creative persons are part of this creative environment and creative products are created within and disseminated into the creative environment.

As indicated, a business process is a logical sequence of activities. Hence, every activity may be predecessor and/or successor of other activities. To carry out activities, resources are needed. One type of resource is knowledge. Knowledge can be divided into tacit and explicit knowledge. In addition to the application of her tacit knowledge an actor (who may be a creative person) may need to acquire additional explicit knowledge to successfully fulfill an activity at hand. Hierarchically ordered navigation nodes structure explicit knowledge and provide means for the stepwise refinement of an actor's information need. Multiple hierarchical navigation structures on the same information artifacts correspond to a diverse set of perspectives. Thus, this approach of information structuring serves a variety of ways to think and work as appropriate means for information retrieval. Besides providing guidance through the information retrieval process, the navigation structure explicates additional perspectives on the same knowledge which provides stimuli that may lead to new entry points in a person's cognitive network [SBD00] and may activate tacit knowledge she has not considered before.

4 Example Scenario

Figure 2 shows an exemplary business process that contains two pockets of creativity. Creative persons have access to a knowledge base that is structured by means of multiple hierarchies. An actor carrying out tasks in Pocket of Creativity 1 retrieves an artifact assigned to navigation node A from the knowledge base after navigation through the nodes of perspective P2. The creative tasks she is carrying out lead to the creation of a new artifact that is stored in the knowledge base and assigned to node B. The same artifact may be applied by another actor in Pocket of Creativity 2.

As indicated, the chosen structure for navigating the knowledge base serves two purposes: First, different individuals can utilize different perspectives to retrieve particular artifacts. At the same time, by taking different perspectives on that artifact, they can stimulate their cognitive network which may lead to new associations and, thus, to enhanced creativity. For example, when our actor in Pocket of Creativity 1 retrieves the artifact of node A she might see that there are other perspectives (in this case P1) on

that artifact, too. Consequently, the artifact can be seen in another context containing different associations.

Say the example process deals with the production of a visual effect for a movie production. Thus, the creative person may be an animator whose task is to produce an animated car. Consequently, she might browse the knowledge base for cars that have previously been designed which leads her to an artifact assigned to node A representing a car. She started her search from perspective P2 which represents 'Moving Assets'. When retrieving the artifact linked to node A, she realizes that this artifact is also part of another perspective P1 that represents 'Assets used in TV commercials'. This perspective may offer her associations such as sounds, buildings, other types of vehicles or people that may lead her to new associations that, in turn, lead to a more creative outcome. Moreover, her client may alter the product requirements by referring to a specific style of animation she saw in a different production. All she remembers is the name of the movie's director. To satisfy the client's wish, our animator may refine her search by consulting an additional perspective which hierarchically structures the created products by directors. In combining the navigation node clustering moving assets and the one containing all artifacts developed for the specific director, she gets an impression of the animation style her client is looking for.

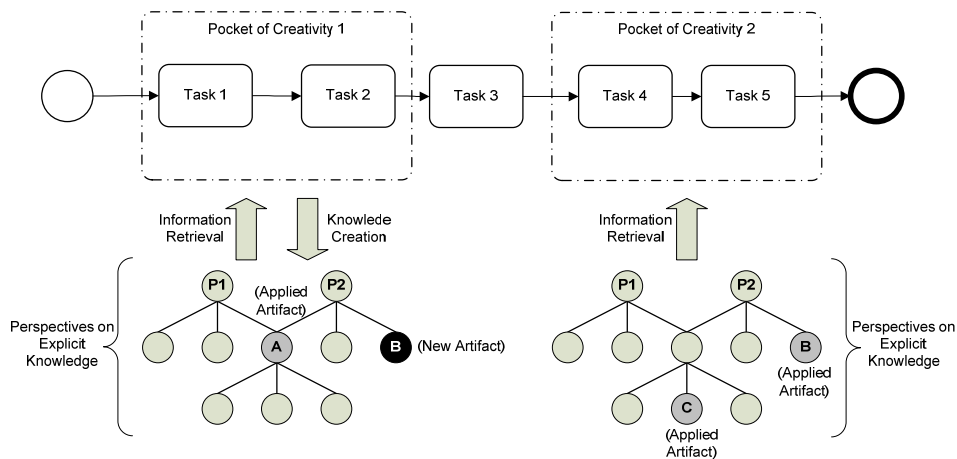


Figure 2: Example Process with two Pockets of Creativity

Consequently, the multi-perspective, hierarchical structure supported her in three ways: first, she found an artifact based on a navigation path that matched her worldview (starting with perspective P2). Second, the knowledge base provided additional perspectives on a particular asset that provided her with associations that could provide stimuli for her cognitive network. Third, by applying multiple perspectives simultaneously for navigation purpose she was able to precisely explicate her information need.

To effectively support the execution of Creativity-intensive Processes perspectives provided should be oriented at the different roles involved. For instance, within a process for visual effect development an animation artist certainly relies on different perspectives and entry points to a knowledge base than a sound editor. Thus, considering

the overall process and the diverse set of stakeholders involved allows pre-defining perspectives that may be useful for certain Pockets of Creativity.

5 Conclusion and Outlook

Based on the awareness that (a) knowledge is the basis for creativity and that (b) information technology can assist creative individuals in storing and locating relevant knowledge, in this paper we have introduced a framework for information retrieval to support Pockets of Creativity within business processes. This analytical and descriptive framework establishes a relationship between business processes, Pockets of Creativity and an approach to information retrieval.

Real evaluation of the framework requires its practical application. This leads to the question of what measures can be used. One possible way may be the evaluation of creative products as outputs of Creativity-intensive Processes. The proposition to be tested would be the following:

The usage of a multiple-perspective, hierarchical approach to information retrieval to support creative tasks leads to higher quality of the creative product.

Firestien states that “the evaluation [of a creative product] must occur on a number of levels; not with a single factor, or a single total effective criterion score.” [Fi93] O’Quin and Besemer have developed a scale that allows to test whether a product is ‘creative’ [OB89]. It is called the Creative Product Semantic Scale (CPSS) and consists of three dimensions. These are novelty, resolution and elaboration and synthesis. Particularly the first two dimensions (novelty and resolution) correspond to the understanding of creativity underlying this research that defines a product as being creative if it is original (novel) and if it is purposeful or appropriate. In addition to the product quality perspective it will be interesting to evaluate the impact of the proposed approach on the performance of the process as a whole by using measures such as time and costs.

As the vast amount of literature shows, knowledge management and information retrieval are just one means among many others that can potentially support creativity. Therefore, the introduced framework may integrate other approaches to creativity support via the concept of Pockets of Creativity. Examples are brainstorming and group communication systems. Besides, the existence of Pockets of Creativity within a business process has other implications, too: For example, creative outputs are often hard to predict and requirements to creative products are often not sufficiently specified. Consequently, these processes are linked to particular risks that need to be mitigated.

Throughout this work we have relied on the assumption that knowledge does positively correlate with the creative outputs of individuals or groups. Although this is strongly supported by literature, there needs to be a discussion of possible limitations. The main aspect is often seen in the danger of biasing creative people by providing knowledge and thus limiting their imagination.

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