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A Conceptual Framework for Information Retrieval to Support Creativity in Business Processes

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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 that cannot be fully anticipated and predescribed. We introduce the concept of pockets of creativity for those sections of a business process where creativity occurs. These sections are characterized 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 artifacts – in short – innovations. Naturally, this raises the question of how pockets of creativity can be supported by information technology. Information retrieval is part of an organizations knowledge processes concerned with the representation, storage, organization, searching and finding of organizational knowledge. Informed by case studies we have conducted with organizations from the Creative Industries and drawing from existing theory, in this paper we introduce a conceptual framework for information retrieval that enables creative persons to access relevant information through a multi-perspective, hierarchical view. Such an approach both appropriately considers different ways of creative thinking and provides stimuli to a person's cognitive network fostering her creativity and thus the development of truly innovative products.

Keywords: Information Retrieval, Business Process Management, Creativity, Creativity-intensive Process

1 INTRODUCTION AND RESEARCH PROBLEM

Creativity as the prerequisite for innovation is an important competitive factor for contemporary organizations (Santanen et al., 2000). Core processes are often characterized by 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 (Seidel et al., 2007). Typical examples are processes in game production, visual effects production, research and development or design. Knowledge is an important factor as a person's knowledge is the foundation for the capability of being creative (Amabile, 1998; Weisberg, 1999).

Based on the awareness that business processes often contain both creative and non-creative sections, we introduce the concept of p*ockets 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" (Shneiderman, 2000). Weisberg, for example, discusses whether previous knowledge is relevant to creative capability and concludes that one reason why particular persons come up with specific innovations can be found by "determining the knowledge that the creative thinker brings to the situation" (Weisberg, 1999).

Storing and locating relevant knowledge can effectively be assisted by means of information technology (Shneiderman, 2000). Against this background, in this paper we introduce a framework for information retrieval to support pockets of creativity within business processes. Alongside of the processes of knowledge creation, knowledge transfer and knowledge application, information retrieval is part of the four core knowledge management processes occurring in an organization (Holzner and Marx, 1979; Pentland, 1995). Information retrieval is the process concerned with the representation, storage, organization, searching and finding of organizational knowledge (Alavi and Leidner, 2001; Ingwersen, 1992). Understanding an organization as an integrated system of knowledge types and processes (Spender, 1996), we believe that it is important to consider the business process as a whole. Consequently, our framework depicts the relationship between pockets of creativity and business processes. Only a process-wide view enables to understand the relationship between knowledge creation, knowledge retrieval, knowledge transfer and knowledge application in the context of generating creative outcomes.

We first identify requirements to the framework that have been derived based on (a) existing theory and (b) case study evidence. Our approach particularly draws from the knowledge-based theory of the firm (Nonaka, 1994; Spender, 1996) and the Cognitive Network Model (Santanen et al., 2000). We then introduce the framework and show how it can be applied in a real-world scenario. To do so, we take a process from our case studies and demonstrate the applicability of the framework by highlighting how an information retrieval system designed accordingly may support the actors who are in charge of creative tasks. This can be seen as an approach to evaluation as Hevner et al. refer to scenarios as means for descriptive evaluation of design artifacts (Hevner et al., 2004).

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.

2 IDENTIFIYING REQUIREMENTS FROM EXISTING THEORY AND CASE STUDIES

2.1 Relevant Theory

The knowledge-based theory of the firm (Cole, 1998; Nonaka, 1994; Spender, 1996) has evolved over the last decade extending the resource-based theory of the firm initially developed by Penrose (Penrose, 1959). It postulates that knowledge and its offspring, innovation, have a grave impact on organizational competitive success (Cole, 1998) if not constituting the only source of lasting competitive advantage (Kogut and Zander, 1992; Nonaka, 1991; Prahaled and Hamel, 1990; Spender, 1996). Thus, the creation and management of knowledge has to be in the very focus of any organizational endeavor. In this context, the knowledge-based theory of the firm conceives an organization as a system of knowledge types and processes. There are four types of knowledge characterized by their classification of being either tacit or explicit and of being related to either an individual or the whole organization (Spender, 1996).

As Nonaka states, “new knowledge always begins with the individual” (Nonaka, 1991). It is the interaction of explicit and tacit knowledge on the individual level which forms the critical step in the organizational knowledge creation process (Nonaka, 1991). In this respect the difference of data and meaning bears relevance. Explicit knowledge storage systems provide organization-wide access to organizational knowledge necessary to fuel the knowledge creation process. But they merely hold data, they do not contain meaning (Spender, 1996). Explicit knowledge is not passively received by individuals. They actively interpret and fit it to their mental models and beliefs; they impose meaning on it (Nonaka, 1991). Thus, both a firm’s explicit knowledge base and the provision of means for fostering the meaningful transformation of explicit into tacit knowledge are critical elements in the organizational knowledge creating process (Cole, 1998; Nonaka, 1991; Spender, 1996).

In a similar manner Shneiderman highlights the important role of knowledge in being creative (Shneiderman, 2000). He introduces a framework based on a set of foundational beliefs of which the first one is that “New Knowledge is Built on Previous Knowledge” (Shneiderman, 2000). He also discusses the critical role of appropriate tool support for this phase. As Shneiderman points out, “locating the relevant knowledge can be difficult, costly, and time consuming, but computing technology […] can be helpful” (Shneiderman, 2000). Dwelling deeper on the phenomenon of creativity, Amabile states that there are three components of creativity (Amabile, 1998). These are *expertise*, *creative-thinking skills* and *motivation*. Whereas expertise “encompasses everything that a person knows and can do in the broad domain of his or her work” (Amabile, 1998), creative thinking refers to “how people approach problems and solutions – their capacity to put existing ideas together in new combinations.” (Amabile, 1998) A creative person’s expertise may effectively be broadened by information retrieval approaches. Providing effective means of access to the organizational memory extends a creative person’s knowledge by the organization’s explicit knowledge base. In this context an effective approach to information retrieval has to consider that creative individuals come from diverse backgrounds and, therefore, approach specific creative tasks from miscellaneous perspectives (Davenport et al., 1998; Markus et al., 2002). Thus, diverse means of knowledge access have to be provided to be effective for every stakeholder. To address an individual’s creative-thinking skills, stimuli can be provided. This insight is supported by the Cognitive Network Model of Creativity (Santanen et al., 2000) as well as other theories such as Information Processing Theory that points out the relevance of external stimuli (Miller, 1956). The Cognitive Network Model suggests that creativity is a function of the distance between the areas of an individual’s cognitive network which have been activated and combined to form a solution. External stimuli provide entry points into one’s cognitive network and may lead to the exploration of an individual’s knowledge network she may not have reached of her own (Santanen et al., 2000).

Thus, existent theory supports that means of information retrieval are crucial to organizational competitive success in general and the ability of being creative in particular. These means provide

access to organizational knowledge fueling the strategically important knowledge creation process. Furthermore, they can broaden an individual's expertise and creative-thinking skills and, thus, foster creativity. To fulfill these purposes, an approach to information retrieval has to consider the diverse perspectives that various creative individuals hold in fulfilling their creative tasks. Moreover, external stimuli can be provided to inspire the creative exploration of one's cognitive network.

2.2 Case Studies

As indicated earlier, besides consulting existent theory, the framework construction has been informed by findings we have made within exploratory case studies. The purpose of these case studies has been the investigation of the phenomenon of creativity from a business process management perspective. The case study organizations from the Creative Industries employ what can be referred to as creativity-intensive processes. That is, their core processes or primary activities target the creation of creative products. Creative products are characterized by novelty and purposefulness (Amabile, 1998; Firestien, 1993). Thus, case study organizations were chosen, where "the process of interest is 'transparently observable'" (Eisenhardt, 1989).

Within exploratory case studies unstructured and semi-structured interviews, process modeling and analysis and document analysis have been used as means of data collection. Interview partners have been domain experts from the creative industries, particularly managers, creative workers and teaching professionals (Table 1). Main topics of the interviews have been processes that lead to the creation of creative products.

Organization	Approx. Number of Employees	Main Areas	Interview Partners within Exploratory Case Studies	Analyzed Processes
Case Study Organization I	Approx. 120	Post Production: Visual Effects Production	CEO, CTO, Head of 3D, Technical Directors, Compositors, Lighter, Coordinator	Visual Effects Production, Quality Assurance, etc.
Case Study Organization II	Approx. 150	Post Production, TV Commercials	Management, Head of Technical Engineering, Technical Directors, Visual Effects Specialist, Colourist	Visual Effects Production, Post-Production (Offline Editing etc.), Quality Assurance, Operational Support, etc.
Case Study Organization III	40 employees, 100 full-time postgraduate students, 5000 students attending short courses	Teaching Film Making	Director, Head of Editing, Producer, Post Production Supervisor	Post-Production Processes (Offline Editing, Sound Editing etc.)

Table 1: Case Study Organizations and Interview Partners

The role of knowledge for carrying out creative tasks has been repeatedly highlighted and discussed. Particularly, the need for an approach to efficiently store and retrieve previously developed creative assets has been expressed by different interview partners such as technical directors, producers and creative directors. Here, we present key findings pertaining to the role of knowledge along with some exemplary case study evidence:

- ***Knowledge is required to carry out creative tasks***. To support creative tasks, the case study organizations in the Creative Industries store explicit knowledge (such as documentation of processes) in Wikis. For example, to carry out a task such as compositing in 2D animation (a process that has been analyzed), a creative person needs extensive tool know-how as well as creative knowledge on how a scene should be lighted etc. Often, the same process/procedure is documented multiple times as there are no sufficient means for knowledge retrieval.
- ***In many cases, carrying out creative tasks is putting together previously designed artifacts.*** As a Creative Director in a post-production and animation house has put it, "everything you draw on, everything I draw on in my creativity comes from somewhere. So it's already been created

somewhere". Assets are stored in (knowledge) asset management systems. As with the documentation of procedures, often it is tough to locate knowledge in the base since text search is the only means of navigation. Regularly, this leads to the re-development of already existing artifacts.

- ***Creative tasks often start with some reference to previously created artifacts.*** Thus, entry-points into the pool of relevant artifacts are needed. Or, as stated by a design coordinator, "so that you have at least a reference that you can at least start from before you then have to cast your net wider".
- ***Multiple perspectives onto the knowledge base are required.*** Throughout the interviews it has been repeatedly expressed that different people have different perceptions on what an artifact should look like and different strategies to creative thinking. They need different entry points for information retrieval to effectively apply existing knowledge.
- ***References to what is possible are needed throughout the process.*** This is necessary to exemplify what is possible and what could be done. This is particularly relevant for an unobstructed communication with the customer. A design coordinator said "… if I say 'an aero plane' to you, you'll think of probably an aero plane that is completely different to what I am thinking of. So you really need that visual reference to show someone what exactly you are thinking …"

2.3 Framework Requirements

Based on existent theory and case-study findings we have identified requirements/themes to an approach to information retrieval to support creative tasks. Table 2 provides an overview of the requirements along with evidence and references these originate from.

#	Requirement	Description	Evidence / Reference
R1	Support of multiple perspectives/ multiple entry points for information retrieval	Knowledge elements have to be accessible from multiple perspectives. Information seekers have different worldviews and, thus, different approaches to creative thinking.	**Literature/Theory:** (Davenport et al., 1998; Markus et al., 2002): Diverse backgrounds require different perspectives **Case Study Evidence:** Throughout the interviews it has been repeatedly expressed that different people have different perceptions on what an artifact should look like and different strategies to creative thinking.
R2	Process-wide perspective	Knowledge is created, stored, retrieved, transferred and applied throughout an organization's processes. Thus, an approach to information retrieval to support creative tasks has to be integrated with the organization's processes in that actors (creative persons) carrying out tasks get appropriate access to the organizational knowledge base.	**Literature/Theory:** (Alavi and Leidner, 2001): Four types of integrated knowledge processes: creation, storage/retrieval, transfer, application **Case Study Evidence:** Artifacts are created, stored, retrieved, transferred and altered (applied) throughout creativity-intensive processes. Examples are Visual Effects Production, Post-Production, etc.
R3	Explication of tacit knowledge	Particularly with creative workers, tacit knowledge is prevalent. Thus, a challenge is to be seen in how tacit knowledge can be explicated and made available within the organization's knowledge base that it becomes part of the organization's explicit knowledge. An approach to information retrieval may support creative people in relating their tacit knowledge to already existing explicit knowledge and, thus, facilitate the transfer of tacit into explicit knowledge.	**Literature/Theory:** (Nonaka, 1991): The explication of personal knowledge to make it available for testing and use by the company as a whole is the central activity of every knowledge-creating company. **Case Study Evidence:** Often organizations loose knowledge when creative persons leave that organization. Furthermore, creative projects heavily depend on references to previously designed artifacts. The problem has been recognized and it is sought to implement knowledge-related systems that simultaneously support knowledge storage and retrieval.
R4	Appropriate internalization of explicit knowledge	Means for fostering the meaningful transformation of explicit into tacit knowledge need to be provided.	**Literature/Theory:** (Nonaka, 1991; Spender, 1996): Explicit knowledge is not passively received by individuals. They actively interpret and fit it to their mental models and beliefs.

R5	Providing stimuli	It is sought that external stimuli from multiple contexts may lead to new entry points into a person's cognitive network and, thus, facilitate creativity. In an organizational context it is necessary that not only stimuli are provided to creative persons but also to the customer to show them possible solutions and to facilitate communication.	**Literature/Theory:** (Amabile, 1998), (Santanen et al., 2000): To a large extent creativity is to depart from status quo, to turn things upside down. Santanen et al. introduce the Cognitive Network Model, suggesting that cognitive networks of knowledge are formed in response to stimuli. **Case Study Evidence:** Creative persons as well as customers need reference points that provide stimuli that open new entry points into a person's cognitive network. A design coordinator, for example, stated that in the beginning you need "at least a reference that you can at least start from before you then have to cast your net wider …"

Table 2: Framework Requirements

Based on these requirements in the following we introduce a framework for information retrieval to support creative tasks within business processes.

3 CONCEPTUAL FRAMEWORK

3.1 Framework Construction

3.1.1 Creativity-intensive Processes 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 c*reativity-intensive process* (CIP) and *pockets of creativity*. 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" (Becker and Kahn, 2003).

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" (May, 1959). 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" (DeGraff and Lawrence, 2002). Similarly Sternberg and Lubart, who write that creativity "is the ability to produce work that is both novel […] and appropriate […]" (Sternberg and Lubart, 1999). In accordance to this, Amabile claims that "in business, originality isn't enough. To be creative, and idea must also be appropriate – useful and actionable."(Amabile, 1998) Rhodes (Rhodes, 1961) 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 (Fawcett and Downs, 1986; Gregor, 2006). 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* (Brown, 1989). 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 (Firestien, 1993; O'Quin and Besemer, 1989).

The four aspects introduced by Rhodes (and extended by (Isaksen, 1987)) are utilized to define the notion of the *creativity-intensive process* (CIP). The *creative product* (Firestien, 1993) 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* (Brown, 1989; Guilford, 1967; Osborn, 1957). 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, 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" (Firestien, 1993)).

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 p*ocket 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.

3.1.2 An Information Retrieval Approach to Support Creativity

Information needs emerge in problem solving situations, such as creative problem solving (Osborn, 1957). Explicit knowledge is applied to extend the problem solver's tacit knowledge appropriately for coping with a novel situation (Nonaka, 1991). 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. (Brelage, 2006)

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 needs (requirements **R3** and **R4**). (Furnas and Zacks, 1994)

Explicit knowledge 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 (Mey, 1982). The meaning of the explicit knowledge depends on the complex and highly personal tacit background of its user (Polanyi, 1975; Spender, 1996). 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 (Ingwersen, 1992). Against this background, a single hierarchy is not sufficient to provide appropriate navigation means for diverse potential information seekers in various contexts (Furnas and Zacks, 1994). Due to the individual nature of every information retrieval process navigation structures have to reflect the diverse perspectives on explicit knowledge by providing alternative navigation paths for alternative users (Brelage, 2006). When hierarchies are favored as appropriate navigation means, consequently, a choice of hierarchical refinement structures has to be offered. In this regard, Furnas and Zack propose the concept of multi-trees which refers to a set of overlapping hierarchical navigation structures (Furnas and Zacks, 1994). 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 (Markus et al., 2002) (requirements **R1** and **R4**).

Aside from the provision of multi-perspective views at the explicit knowledge available, multi-trees also facilitate the creative exploration of available tacit knowledge. In the sense of the Cognitive Network Model (Santanen et al., 2000) the evaluation of the diverse perspectives on the same knowledge artifacts may provide external stimuli. 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, the indication of various affiliations of a navigation node may trigger the discovery of entry points to areas of a person's cognitive network that have not been considered before (requirement **R5**).

Multiple navigation hierarchies do not merely provide appropriate guidance for creative individuals in problem solving situations, in contexts which are hard to predict and dynamic in nature. They also offer expressive means to precisely specify information needs evolving during the information retrieval process. 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) (Pendse and Creeth, 1995) is applied to navigate through comprehensive sets of structured data (requirement **R1**).

Consequently we argue that supporting information retrieval by means of navigation which provide hierarchical refinement structures and reflect multiple perspectives may offer appropriate access to explicit knowledge in creative problem solving situations. They both provide guidance for the stepwise explication of information needs and powerful means for their precise specification. Furthermore, the navigation structure proposed furthers the creation of new knowledge by providing external stimuli exposing new entry points to a person's cognitive network.

3.1.3 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. That is, as demanded by requirement **R2**, we integrate an approach to information retrieval with what we refer to as creativity-intensive processes. 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 within creativity-intensive processes.

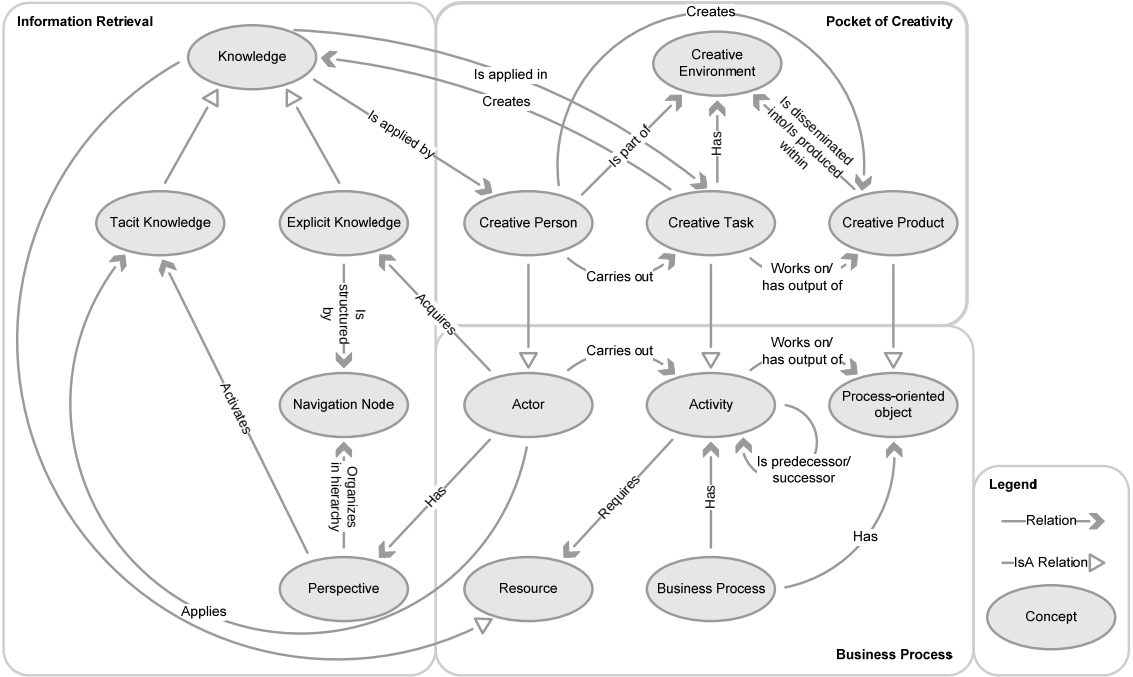

Figure 1: Conceptual Framework of Creativity-intensive Processes and Information Retrieval

Figure 1 represents a graphical illustration of the 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 and may activate tacit knowledge she has not considered before.

3.2 Example Scenario and Evaluation

As Hevner et al. state, an artifact "is complete and effective when it satisfies the requirements and constraints of the problem it was meant to solve." (Hevner et al., 2004) In our case, the problem to be solved is the support of what we have defined as pockets of creativity as parts of creativity-intensive processes by the means of information retrieval to positively influence product quality. We first introduce an exemplary scenario from our case studies to show that it is possible to construct "detailed scenarios around the artifact to demonstrate its utility." (Hevner et al., 2004) The construction of such scenarios can be seen as descriptive evaluation. As to our understanding substantial evaluation requires the implementation of the proposed framework by means of an IT system in an organizational context, we then discuss a proposition and suggest possible metrics for testing the artifact.

Figure 2 provides an extract from the process *look development*. Look development is a core process in the development of visual effects where the appearance of an artifact is designed. Creative Persons within the process have access to a knowledge base that is structured by means of multiple hierarchies. One actor carries out a task called *texture painting*. A texture refers to the attributes that affect appearance and color of a surface. For this creative task the actor needs both technical knowledge (how to use a set of software tools) and creative knowledge (what do I need to know when creating a surface). The according knowledge can be made available through the knowledge base and accessed via navigation paths that start with entry points such as "creative knowledge" and "tool guidelines". Besides, our creative person can browse the knowledge base and search for textures that have been created in similar and different situations before. Let's say, our designer wants to create a cat. Consequently, she might browse the knowledge base starting from perspective **P2** which represents *textures for animals*. When retrieving an artifact linked to node **A**, she realizes that this artifact is also part of another perspective **P1** that represents *components for moving assets*. This perspective may offer her associations such as textures for humans, planes, ships, or dinosaurs 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 she saw in a particular production. All she remembers is the name of the animation movie's director. To satisfy the client's wish, our designer may refine her search by consulting an additional perspective which hierarchically structures the *textures by directors*. In combining the navigation node clustering textures for animals and the one containing all artifacts developed for the specific director, she gets an impression of the texture style her client is looking for. Eventually, the knowledge base is populated with the new artifact (assigned to node **B** in Figure 2).

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.

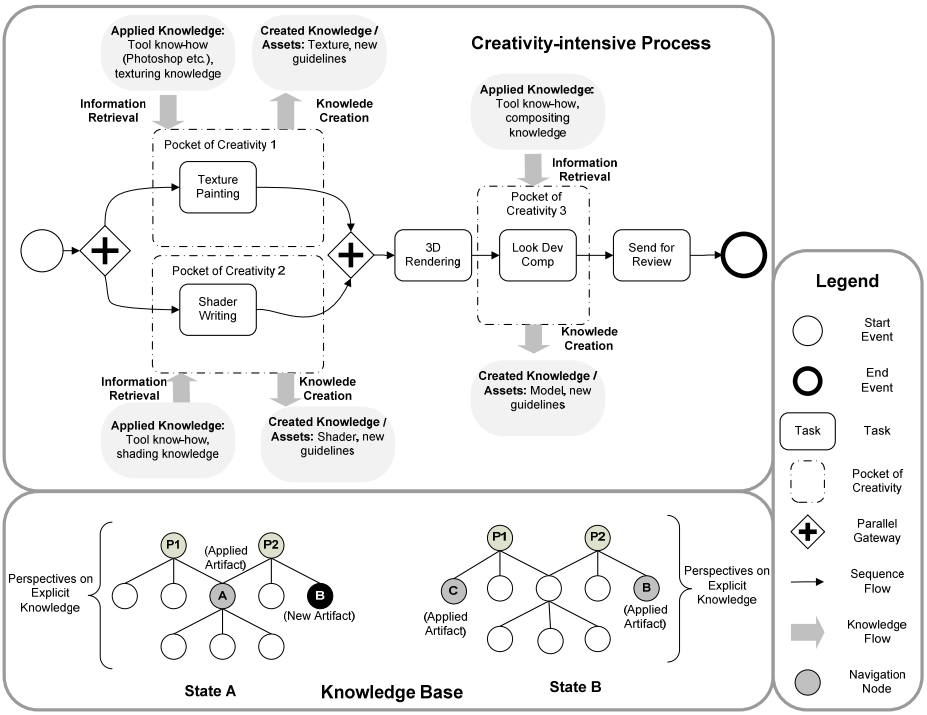

Figure 2: Example Process with Pockets of Creativity

In parallel to that task the so-called *shader writing* is carried out. This is another creative task where an artifact is produced that is stored in the knowledge base, too. Once both tasks are completed, the artifacts go to a so-called render-farm where they are rendered. Rendering is a mathematical calculation done by a computer to produce a smoother output – this is a non-creative task. This task is then followed by the *compositing*. Compositing means to combine multiple layers to create a single image. Texture and shader are input to this task (as well as some other artifacts which due to space limitations we omit here). That is, the creative person carrying out this task has to retrieve the already created artifacts from the knowledge base (in the example artifacts assigned to nodes **B** and **C**). Thus, knowledge (in form of an object) that has been created earlier in the creativity-intensive process is now retrieved and then applied.

To effectively support the execution of creativity-intensive processes different perspectives should be provided for different roles involved. For instance, within a process for visual effects 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.

As indicated, in-depth evaluation of the framework requires its practical application, that is, prototypical implementation and application in real-world scenarios. To further our research into this direction we first have to evaluate whether there are existing IT artifacts which by themselves or in combination match the requirements proposed by our framework. Otherwise, evaluation needs for the development of a prototypical information retrieval system. Second, appropriate measures have to be identified. In our case, we may evaluate creative performance (Massetti, 1996) in dependence on the application of a multi-perspective, hierarchical approach to information retrieval. 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." (Firestien, 1993) O'Quin and Besemer have developed a scale that allows to test whether a product is 'creative' (O'Quin and Besemer, 1989). 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.

4 CONCLUSION, LIMITATIONS AND OUTLOOK

Based on the awareness that knowledge is the basis for creativity and that information technology can assist creative individuals in storing and locating relevant knowledge, this paper introduced a framework for information retrieval to support pockets of creativity within business processes. The framework construction has been informed by existing theory and findings we have made in case studies with organizations from the creative industries.

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. Thus, in addition to the evaluation of creative performance, an empirical study also has to assess the information retrieval system in terms of perceived usefulness (Davis, 1989) in creative problem solving situations.

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 be integrated with other approaches/models to creativity support via the concept of pockets of creativity.

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