Comprehensive Support for Creativity-Intensive Processes

An Explanatory Information System Design Theory

Creativity-intensive processes require both process structure and creative freedom. We propose an explanatory information system design theory, addressing these contradictory properties. The core component of the design theory is an information system architecture, consisting of design principles and architectural models. Instantiations of the information system architecture are supposed to facilitate increased process efficiency and creative performance. We present the instantiation CreativeFlow, combining workflow support for structured processes and groupware support for creative group processes. We evaluate the groupware in a laboratory group experiment, assessing idea quantity and idea novelty, feasibility, relevance, and specificity. Ideas developed with the groupware are more specific, while no tool support led to more feasible ideas.

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1 Introduction

Business Process Management (BPM) focuses on optimizing processes through standardization and automation (Davenport 1993). However, there is increasing interest in those unique processes that generate business value by anticipating or reacting to changing market demands (Marjanovic 2008). These processes, which are at the core of many organizations' success, include those that lead to new products and services, those that facilitate organizational change, and those that develop innovative problem solutions which generate competitive advantage (Cooper 2000; vom Brocke et al. 2011). Creativity is essential to innovation, as "all innovation begins with creative ideas" (Amabile et al. 1996, pp. 1154 f.). Innovations are the successful implementations of creative ideas.

We define creativity as a (group) process by which novel and useful ideas are developed (Amabile et al. 1996; Sternberg and Lubart 1995). The ideas are transformed into innovation concepts, business processes, physical products, and services. What do groups need in order to be creative? One common answer is freedom, that is, no predefined work procedures, no short-term deadlines, no slashed budgets (Ekvall 1996; Jarman 2004). However, business processes – even the creative process – must be effective and efficient (Davenport 1993; Hammer 1990); customer needs have to be met with high quality (achieved with process standardization), on time, and with limited resources, often by imposing process structure. The contradictory properties – process structure and process freedom – of business processes that involve creativity must be addressed concurrently. The construct of *Creativity Intensive Processes* (*CIPs*) (Seidel 2009) provides insights into how to approach this challenge.

We contribute to the body of knowledge in design-oriented research on IT support for creativity by proposing a design theory for systems to support CIPs. The core component of the design theory is an IS architecture made up of design principles that specify *what* is to

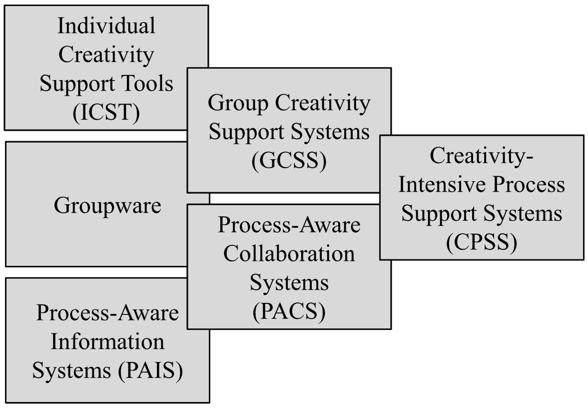


Fig. 1 Literature-based derivation of the CPSS architecture

be implemented and architectural models that provide guidance on *how* to implement it. In business engineering and business and information systems engineering (BISE), which address design science research and behavioral research (Winter and Baskerville 2010), BPM has a long tradition as the starting point for the design of IT systems (Ferstl and Sinz 1995; Harmon 2007; Österle 1995). Taking business processes as the point of departure for the definition of IT requirements ensures that IT systems align with business strategy, that is, that system follows strategy and not the reverse.

The goal of the systems that will implement the proposed architecture is to support CIPs comprehensively, that is to address the polarity of process structure and freedom. Moreover, system support must be adequate, that is, it must be useful in the sense that it positively impacts both business process efficiency (e.g., measured in process turnover, employed resources) (Davenport 1993) and creative performance (e.g., the number, originality, and workability of ideas) (Dean et al. 2006). Hence, we formulate the research question: *What is an adequate design of an IS architecture for systems that comprehensively support CIPs?*

This article is structured as follows: In the next section, we present the body of knowledge of information systems relating to *Creativity-Intensive Process Support Systems* (*CPSS*). Section 3 describes our research design and methodology. Section 4 addresses the theoretical constructs from BPM theory, creativity research, and collaboration engineering that are the bases for the definition of the IS architecture and its expository instantiation, CreativeFlow, presented in Sect. 5. A sub-portion of the IS architecture and CreativeFlow is evaluated in Sect. 6, and the results of this evaluation and of the overall architecture is discussed in Sect. 7. Finally, we draw conclusions and indicate limitations and a research outlook in Sect. 8.

2 Related Work

To position our IS architecture for CPSS, we refer to the body of knowledge on information systems for creativity support from various areas of research. **Figure 1** provides an overview of the relationships among these research areas, the overlapping research streams, and the derivation of the architecture of CPSS.

Individual Creativity Support Tools (*ICSTs*). The goal of ICSTs is "to make people more creative more often, enabling them to successfully cope with a wider variety of challenges and even straddle domains" (Shneiderman 2002, p. 116). Numerous design theories have been proposed to guide the development of individual-level creativity-support tools (see Voigt et al. 2012 for an overview). ICSTs can be categorized in terms of their support of either generative or convergent processes, where tools that support the generative (or divergent) phases focus on supporting idea generation (e.g., Paulus and Yang 2000), and tools that support the convergent phases focus on the evaluation and selection of ideas (Massetti 1996). Müller-Wienbergen et al. (2011) propose a design theory for systems that support both divergent and convergent thinking. ICSTs support the creative work of individuals, but in an organizational context, creative tasks such as new product development are often tackled in groups. These group processes are frequently supported by groupware.

Groupware: Georgakopoulos (2004, p. 10) describes groupware as tools "to perform ad hoc, optional, and group activities [that] allow people to manage such shared resources (e.g., permit specific users to create such artifacts, view them, manipulate them, check their status, etc.)." Groupware should support groups but also give them the flexibility they need (Nunamaker 1989), that is, an unstructured way to communicate, collaborate, and work toward a common goal. The common goal and the shared task can vary, also whether it is creative or non-creative, and must be supported accordingly. However, groupware per se is not tailored to the requirements of creative processes in groups. Support of such processes relies on the combination of ICSTs and group creativity support systems.

Group Creativity Support Systems (*GCSSs*): The combination of ICST and groupware, that is, the combination of properties of individual creativity support and collaboration, is the GCSS system type (Duncan and Paradice 1992). In the last twenty years, the research area of groupware has been expanded by creativity research. A plethora of design theories have been proposed to guide the development of GCSS (e.g., Hilliges et al. 2007; Nunamaker et al. 1996), and Bostrom and Nagasundaram (1998) provide an overview of empirical studies that concern groupware and creativity. However, GCSS alone cannot support creative groups in an organizational context; for the comprehensive support of CIPs, process-aware information systems have to be taken into account as well.

Process-Aware Information Systems (*PAISs*): PAISs provide functionality for automated process control. According to Dumas et al. (2005, p. 7), a PAIS is "a software system that manages and executes operational processes involving people, applications, and/or information sources on the basis of process models." Unlike groupware, which is highly oriented to human interaction and which supports ad-hoc processes, PAISs support structured, predetermined automated processes. Workflow Management Systems (WfMS) are one example of a PAIS. For the support of unstructured processes, several attempts have been made to broaden workflow applicability. Late Modeling (Sadiq et al. 2001) and Case Handling (van der Aalst et al. 2005) are well-known approaches to deferring process design to process execution or to replacing the control flow paradigm of sequential executions of activities to a data-centered perspective. The combination of properties of PAIS and groupware results in the process-aware collaboration type of system.

Process-Aware Collaboration Systems (*PACSs*): Deokar et al. (2004), developed a framework for distributed organizational processes that intertwine individual and group tasks. The framework integrates the concept of ThinkLets for collaboration engineering (Briggs et al. 2001) and case-based reasoning for workflow design. Deokar et al. (2004) focus on structuring group tasks based on the collaborative process patterns and supporting the information flow between group and individual activities. Schuster et al. (2000) propose a Collaboration Management Model that consists of a core model comprised of an abstract notion of processes, activities, and resources, and extensions in support of coordination, services, and awareness. Dustdar (2004) describes the development of a PACS for virtual teams to support asynchronous collaboration. The system supports both predefined and ad-hoc processes, focuses on collaborative work on shared documents in virtual teams, and provides a shared process view to enhance the process awareness of all team members. Another, less rigid process support approach is Collaborative Project Management Software (Romano et al. 2002), which combines project work, processes, and collaboration. Although those approaches deal with the support of both structured and unstructured processes in group work, they do no support creativity. The CPSS system type combines GCSS and PACS for the process-aware support of CIPs.

Creativity-Intensive Process Support Systems (*CPSSs*): Seidel et al. (2007) propose a framework for flexible process support that classifies existing approaches to process modeling and supports the introduction of IT support in CIPs based on the level of structure and the intensity of creativity. It is assumed that predefined processes are best supported by a WfMS, while unstructured, creative processes are best supported by groupware that focuses on coordination between people. For the support of predefined processes in a creative environment, Ouyang et al. (2008) propose a WfMS for the collection and automatic generation of reports during film production, integration of support for both structured and unstructured processes remains challenging. According to Georgakopoulos (2004, p. 22), most "groupware products assume that they are the main collaboration infrastructure and it is difficult to integrate them as components in another system (e.g., a WfMS [...])." Along this line, Tagg (2003) promotes the integration of workflow techniques with ad-hoc collaboration tools in order to provide for integrated business improvement tools. We address this challenge by developing a design theory for comprehensive CIP support.

3 Research Design and Methodology

3.1 Development of an Explanatory Design Theory

We develop a design theory with the core component of an integrated information system architecture for systems that comprehensively support CIPs. The theory is intended for design and action in that it "gives explicit prescriptions (e.g., methods, techniques, principles of form and function) for constructing an artifact" (Gregor 2006, p. 620). Information system design theories help "provide theory-driven design guidelines and prescriptions for IS design, and the generation of hypotheses that are testable" (Walls et al. 2004, p. 54). Our focus is on the design object, which is an information system architecture for systems that support CIPs comprehensively. Therefore, the design theory is explanatory in that it "prescribes principles that relate requirements to an incomplete description of an object" (Baskerville and Pries-Heje 2010, p. 273). In the next section we illustrate our research process and introduce our evaluation design.

3.2 Applied Design Research Process

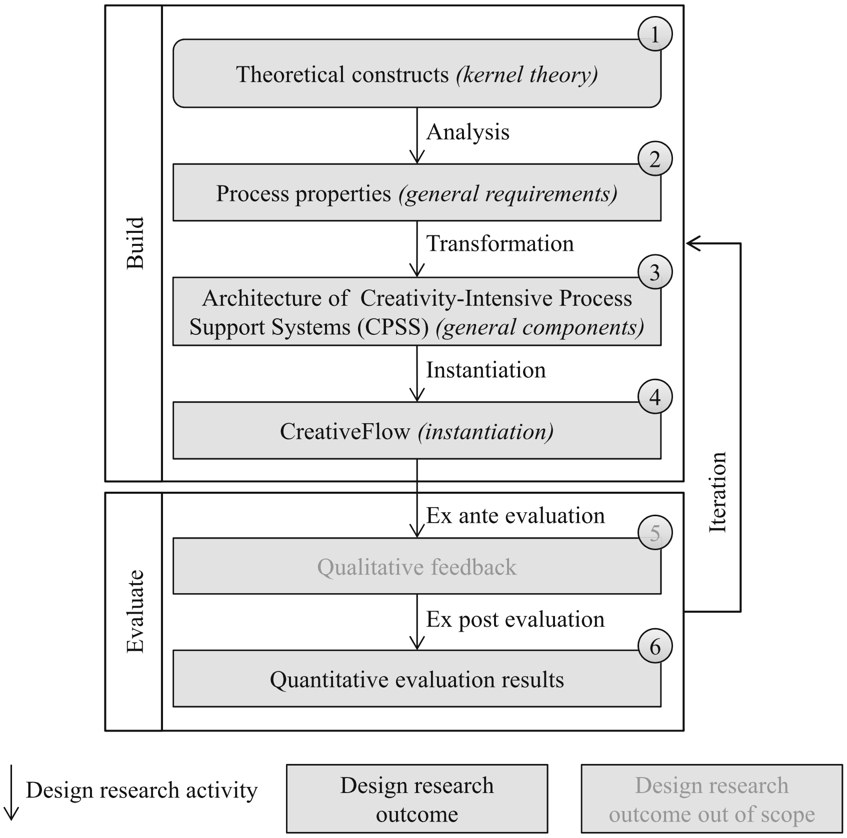
Our research process consists of two core activities: theory and artifact *building* and *evaluation* (March and Smith 1995; Peffers et al. 2007; Simon 1996) (see **Fig. 2**). Design decisions should continuously be informed by results of ongoing evaluation.

Build: Design theory building is concerned with the definition of a set of distinct theory components (Baskerville and Pries-Heje 2010; Gregor and Jones 2007; Walls et al. 1992) that provide "a framework around which [developers of IS design theories can] articulate their contributions to readers and scholarly consumers in a common agreed-upon language that [is] recognizable and repeatable" (Walls et al. 2004, p. 55). As the first component, we describe the theoretical constructs from BPM theory, creativity research, and collaboration engineering (**Fig. 2**, Design research outcome 1), which represent our kernel theory (Walls et al. 1992) or justification knowledge (Gregor and Jones 2007).

The theoretical constructs define process properties that have to be replicated and supported by a system that comprehensively supports CIPs. These process properties form the basis of the definition of our information system architecture's *general requirements* (Baskerville and Pries-Heje 2010) (**Fig. 2**, Design research outcome 2). We then define the design principles "governing the design of a system (i.e., specifying and implementing its features)" (Markus et al. 2002, p. 182). The design principles are "command variables," the actions required to change objects in order to achieve a desired future situation (Simon 1996, p. 28). The principles are supplemented by architectural models and standard information system types. All elements together define the architecture of CPSS, representing the general components (Baskerville and Pries-Heje 2010) of our design theory (**Fig. 2**, Design research outcome 3). We then present CreativeFlow as an (expository) instantiation (Gregor and Jones 2007; March and Smith 1995) of these components (**Fig. 2**, Design research outcome 4). As an instantiated artifact, CreativeFlow can "assist with the communication of the design principles in a theory" (Gregor and Jones 2007, p. 329). We also use CreativeFlow to evaluate the underlying information system architecture.

Evaluate: Artifact and theory evaluation is a core element in design science research (Hevner et al. 2004; March and Smith 1995; Venable et al. 2012), and design artifact evaluation and design theory

Fig. 2 CPSS design research process



evaluation are closely related. According to Venable et al. (2012, p. 425), "when an artifact is evaluated for its utility in achieving its purpose, one is also evaluating a design theory that the design artifact has utility to achieve that purpose." Using prototype instantiations as artifacts for evaluating design theories is a common approach to design theory verification and refinement (Brohman et al. 2009; Ngai et al. 2009), so we use our instantiation CreativeFlow as a "vehicle" with which we evaluate our design theory.

The purpose of CreativeFlow and its underlying architecture is to support CIPs comprehensively. In 2011 we conducted a qualitative ex ante evaluation (Becker et al. 2011b) (**Fig. 2**, Design research outcome 5) in which "the artifact is evaluated on the basis of its design specifications alone" (Pries-Heje et al. 2008, p. 2) and the appropriateness of the design principles was generally approved. Improvements were proposed mainly towards more restrictiveness in managing participation in the group process and for distinct system features (see Sect. 5, Design Principle 2).

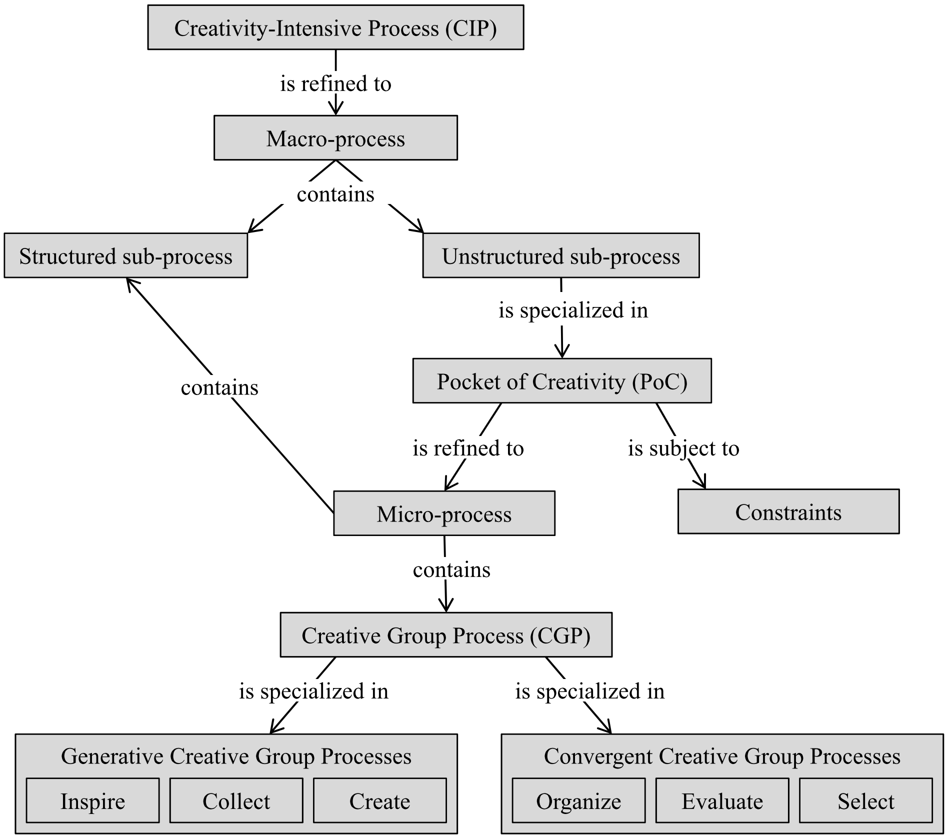
In the present paper we present the quantitative evaluation results of the CPSS architecture (**Fig. 2**, Design research outcome 6). Venable et al. (2012) provide guidance in the selection of both a design science research evaluation strategy and an evaluation method. We opt for an ex post evaluation (**Fig. 2**, Design research outcome 6), that is, the evaluation of an instantiated artifact (CreativeFlow) in an artificial evaluation setting, a controlled environment (Pries-Heje et al. 2008). We chose the artificial setting since we wanted to control the experimental variables, and considerable cost and time limitations applied. However, the setting and task of our experiment was reasonably realistic (Sect. 3.3). We chose ex post evaluation because a qualitative ex ante evaluation of a basic version of the architecture has already been conducted in the context of a case study in the German television industry (Becker et al. 2011a, 2011b) (**Fig. 2**, Design research outcome 5) and because feedback from our ex ante evaluation allowed us to develop a mature prototype that could be applied in an experimental task setting in our current evaluation setting. In line with these strategic decisions for our artifact evaluation, we chose a laboratory group experiment as evaluation methodology (Venable et al. 2012).

In the next section, we address the scope, design, and procedure of our experiment.

3.3 Ex Post Evaluation in a Laboratory Group Experiment

Scope of Evaluation: Our instantiation CreativeFlow consists of a PAIS and a GCSS, and our evaluation refers to a subportion of the CPSS architecture, that is the GCSS. We hypothesize that this system has a positive impact on the creative performance of groups (Sect. 7.1). The sub-portion of the CPSS architecture that supports the structured processes is out of the scope of our evaluation. We chose this focus for several reasons: First, we expect support for groups' creative performance to be of interest to organizations when they are opting for tool support (in contrast to process efficiency, which is already well understood). Second, the GCSS evaluation is more feasible (group laboratory experiment) than the evaluation of CreativeFlow as a whole, as the GCSS can be evaluated in an artificial, "closed world" group setting in a manageable amount of time. Evaluations of the overall system CreativeFlow, on the other hand, would imply field experiments that require longitudinal ap-

Fig. 3 Concept map of theoretical constructs



plication of the tool in real CIPs and go beyond the scope of our design theory development.

Experiment design and procedure: We conducted the laboratory group experiment with a class of twelve undergraduate students in media and communication management in the context of a course in television format development, such as television daily "soap operas," game shows, or reality shows. (The term format is often used synonymously with genre, but formats are subject to licensing requirements on the international market.) The groups' task was to develop ideas collectively for a new television show. Since the students were all from the same degree program and course, we assumed they had comparable expertise for completing the task. In real-world television format development, it is common for the customer, that is, the television broadcasting network, to define a target audience and television programming slot for the format, so we asked the students to develop ideas for a prime-time (8:15 p.m.) show format for a private broadcaster with a target audience of young adults and young families.

Before the actual experiment, the students were split into two groups of six students each, and CreativeFlow was presented to both groups. In order not to influence or disturb each other, the groups then went to separate rooms to develop their ideas. For both groups, the experiment session was split into two phases: a 45-minute initial phase to brainstorm new format ideas suing Osborn's (1957) rules for brainstorming, that is, omitting criticism and sharing and building on the ideas of others, and a 15-minute phase to choose and refine the most promising ideas. One group (the tool group) used the GCSS of CreativeFlow, and the other (the no-tool group) used paper and pencil to write down ideas. Both groups had facilitators who familiarized them with the basic rules of the workshop and observed their activities. After the workshop, four active, experienced professionals from the television industry (two senior producers, one junior producer, and one director) assessed the ideas. Our evaluation research model and the results are presented in Sect. 6.1.

The next section addresses our design activities. We introduce the theoretical constructs that are essential for the design of an architecture that comprehensively supports CIPs.

4 Theoretical Constructs

The central theoretical constructs for the design of our architecture are the Creativity-Intensive Process (CIP), the Pocket of Creativity (PoC), and the Creative Group Process (CGP). **Figure 3** provides a comprehensive overview of all constructs and their relationships in a concept map (Novak and Cañas 2008).

4.1 Creativity-Intensive Process (CIP)

A business process is defined as a series of activities that need to be carried out in order to realize collectively an organizational objective and a set of conditions that determine the order of the activities (vom Brocke et al. 2011). CIPs are specific business processes in which creativity plays a crucial role but varies in intensity throughout the process (Seidel 2009). One example of these processes is the development of software applications. Creative IT requirements development could be improved by allowing for uncertainty, but traditional IT theory suggests that a high degree of structure in IT development projects increases the chances of project success (Cooper 2000). As such, the CIP for developing software applications is subject to both uncertainty and

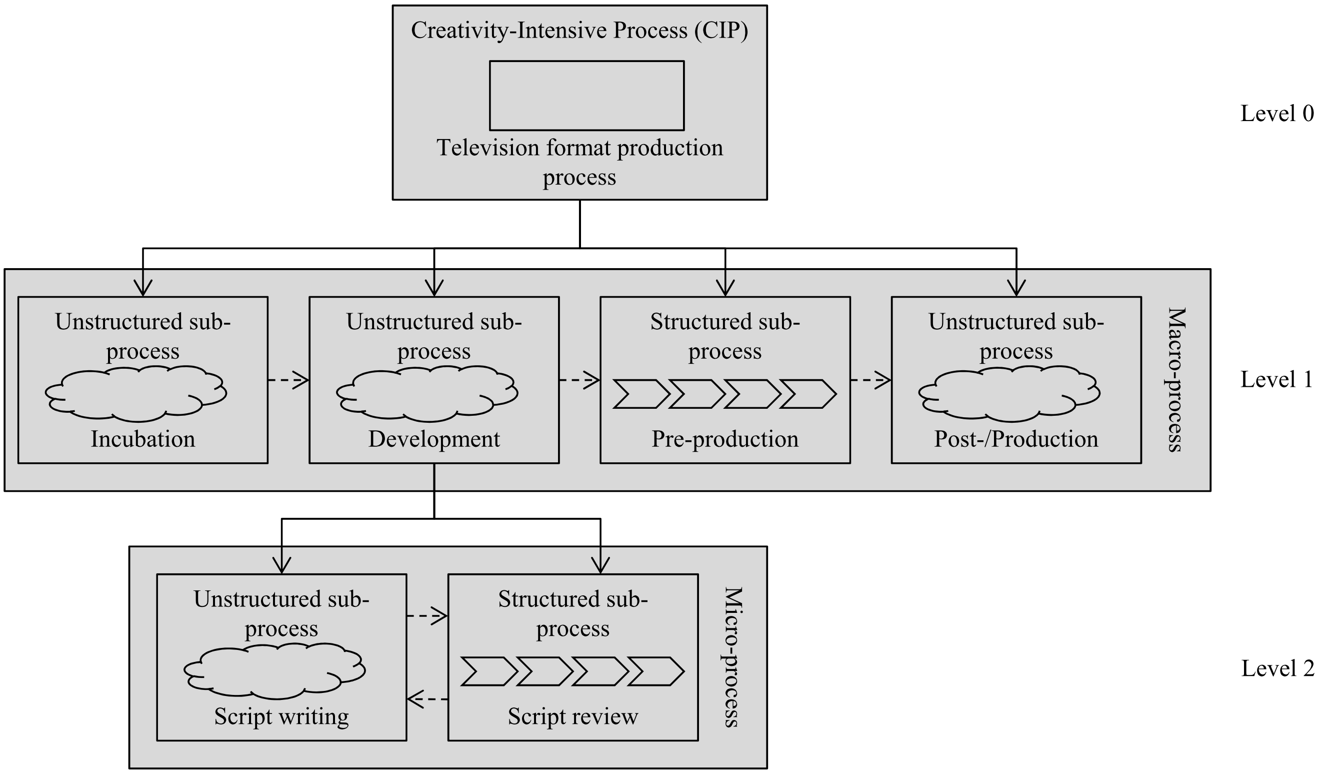


Fig. 4 Hierarchical decomposition of the CIP (Seidel et al. 2010)

structure. Another example with similar findings is the visual production process in the television and movie industries in Australia (Seidel 2009) and Germany (Becker et al. 2011a, 2011b; Karow 2010), which is structured for project management processes while distinctive sub-processes are prone to uncertainties with regard to process structure. Business process analysis in the consulting industry resulted in similar findings for consulting processes (Bergener et al. 2012). To illustrate the theoretical construct of CIPs with respect to its degree of structure, we use the example of production processes for television formats (**Fig. 4**).

Insights into the structure of the CIP are possible when it is hierarchically decomposed into its components (Seidel et al. 2010). **Figure 4** depicts the example CIP of the television format production process. On Level 0, the process is illustrated as a single black box. On Level 1, three unstructured sub-processes (illustrated as clouds) and one structured sub-process (illustrated as value chain) are identified as components of the CIP: The process starts with the incubation of television format ideas, followed by a concretion of those ideas to a format script (development). Pre-production is concerned with planning the shooting. The process then flows into the production of the format, shooting, and post-production of the footage, cutting and modifying the footage until the format is ready to be broadcasted. At this abstract level of decomposition, structure is identified both within the sub-processes (pre-production) and in the flow between the sub-processes (**Fig. 4**, dotted arrows), as these sub-processes produce intermediary products for the next sub-processes. We define the macro-process as the top-level process refinement of the CIP (Level 1), describing the sequence of structured and unstructured sub-processes. Unstructured processes can be further decomposed on Level 2. In our example, the unstructured sub-process development is decomposed into the sub-process script writing and script review. Script writing itself is a creative, unstructured sub-process, whereas intermediary reviews by a "head writer" follow a structured procedure. Accordingly, even those sub-processes on Level 1 that were considered to be an arbitrary sequence of activities turn out to contain unstructured and structured sub-processes on Level 2.

Interdependencies between the sub-processes on Level 2 result in sequencing those sub-processes. We refer to this process as the micro-processes of the CIP (**Fig. 4**, Level 2), which occur on each decomposition level, subordinated to the macro-process. In our example, the sub-processes of script writing and script review evolve in a "ping-pong" manner; several iterations are performed until the final script version is delivered. The micro-process is less pre-determined than the macro-process (Marjanovic 2008), as unforeseen sub-processes may occur, the sequence of the sub-processes may be undetermined, and the number of iterations performed may not be known.

The next section focuses on the unstructured sub-processes within CIPs.

4.2 Pockets of Creativity (PoC)

Unstructured, creative sub-processes have been conceptualized as PoCs (**Fig. 3**), which are defined as "those sections within creativity-intensive processes that are particularly characterized by the involvement of creativity" (Seidel et al. 2010, p. 420). PoCs expose uncertainties with respect to the outcome of the process, that is, the creative product, the process itself, and the resources needed to perform the process. As counterparts to these "unknowns," constraints limit the variances in product, process,

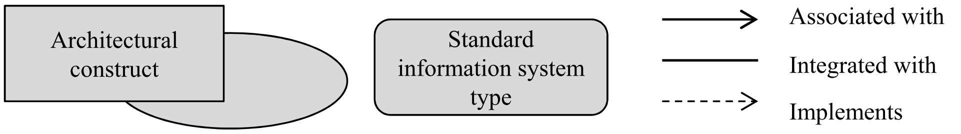


Fig. 5 Explanation for architectural models of the CPSS architecture

and resources in several ways (**Fig. 3**). Three types of constraints are distinguished: First, new products are bound to specific product requirements; in the case of a television format, the broadcasting network defines, for example, a target audience, a basic feature type (action, drama, etc.), and a cast. Second, PoCs are not entirely free of process structure, as the micro-process, the process-oriented refinement of a PoC (**Fig. 3**), defines basic process constraints and thus partly reveals its inner process dynamics as sequences of structured and unstructured sub-processes. Third, some resources are obligatory for the execution of PoCs while others are limited; for example, a director is central to the success of a television movie, but costly special effects that have been planned may not be realizable given the limited financial resources.

Thus far, we have identified the structural components in CIPs; isolated the unstructured, creative sub-processes conceptualized as PoCs; and specified appending constraints. However, the process dynamics taking place inside the PoCs remain unclear. This issue is subject to the next section.

4.3 Creative Group Process (CGP)

PoCs are predominantly approached in the CGP. To explain the CGP, we start with the conceptualization of the creative process in general as consisting of two phases (Lonergan et al. 2004): the generative phase, where high quantities of novel and diverse ideas are created (Guilford 1968), and the convergent phase, where ideas undergo a critical, reflective process (Lonergan et al. 2004). The generative phase is associated with divergent thinking by individuals, where novelty is generated by unconventional combinations of remote associations (Cropley 2006). The convergent phase is associated with convergent thinking, in which individuals build on existing knowledge to derive the single best answer (Cropley 2006). Creative processes evolve in generative and convergent phases, which alternate in numbers of cycles of iteration unknown prior to the execution of the process (Brophy 1998). For a more differentiated view of the phases of the CGP, we draw on a partially modified set of collaboration patterns, or group processes (Briggs et al. 2003). Based on the general creative process, we distinguish two kinds of group processes: generative group processes and convergent group processes. Generative group processes consist of three sub-processes: inspire, the process by which group members mutually stimulate one another to come up with new associations and ideas; collect, the process of gathering and sharing ideas among the members; and create, the process of producing, documenting, and refining ideas. The convergent group processes also consist of three sub-processes: organize, the process of relating ideas in order to reduce their complexity and come to a common understanding of ideas; evaluate, the process of assessing the value of ideas; and select, the process of negotiating and selecting ideas for elaboration.

The characteristics of CIPs and related processes are the general requirements (Baskerville and Pries-Heje 2010) for the design of CPSS:

1. CIPs consist of both unstructured sub-processes and structured sub-processes.
2. The macro-process is the top-level process refinement of the CIP that describes the sequence of structured and unstructured sub-processes.
3. PoCs are unstructured sub-processes that are characterized by the involvement of creativity and that are subject to product, process, and resource constraints.
4. The micro-process defines the basic process constraints of a PoC, revealing its inner process dynamics as iterations of structured and unstructured sub-processes that are at least partly unknown before execution.
5. CGPs, realizations of PoCs in groups, are specialized in generative group processes (inspire, collect, and create) and convergent group processes (organize, evaluate, and select).

The next section draws on the identified theoretical constructs to define an IS architecture for tools that are capable of comprehensively supporting CIPs.

5 Information System Architecture for Creativity-intensive Process Support System (CPSS)

We develop an information system architecture for CPSS as the basis for purposeful design of systems that support CIPs. The architecture is made up of design principles that specify *what* is to be implemented and architectural models (**Figs. 6, 7, 8, 9, 10**) that provide a guide to *how* to implement the design principles. Further, the architectural models indicate standard information system types for implementing architectural constructs.

The notation of the architectural models is explained in **Fig. 5**. The models refer to architectural constructs, which we derive from the theoretical constructs. We have two shapes for the architectural constructs: group tasks are illustrated as ellipse, all other constructs as rectangles. We hereby want to emphasize that group tasks are in the middle of a continuum of structure (represented by a rectangle) and freedom (represented as cloud in **Fig. 4**). The models further refer to standard information system types that support the technical implementation of the architectural constructs. Constructs and information system types are interrelated with three types of relationships: associative, integrative, and implemented. As an additional source of information for the architecture design, we refer to a preliminary version of the architecture and its qualitative evaluation results (Becker et al. 2011b).

5.1 CPSS Architecture

The distinct properties of the macro-process and the structured sub-processes (both of predictable structure and subject to automation) as well as the properties of PoCs (realized in CGPs that are reliant on human intervention) require distinctive system support (**Fig. 6**). The macro-process and the structured sub-processes, both of which we transform

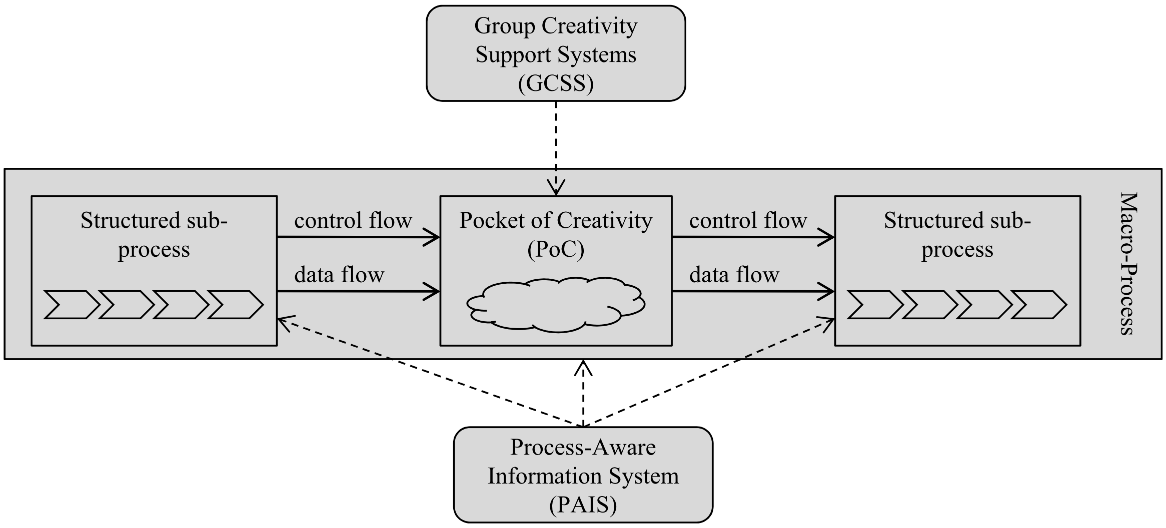


Fig. 6 CPSS support for the macro-process

from theoretical into architectural constructs, can be supported by an automated process control system that controls the process execution, assigns single tasks of the process to task performers, and manages the resources involved in the process. PAISs are suitable for this purpose (Sect. 2) while PoCs, which are performed as CGPs, are not to be straight-jacketed by automated process control. This argument is in line with the properties of the micro-process (partly undetermined prior to its execution). The aim of IT support for PoCs is to ensure creative freedom. PoCs are also transformed into an architectural construct; like the constraints pertaining to the theoretical construct, milestones (product constraints), deadlines (process constraints), and responsibilities (resource constraint) have to be defined. GCSS is a suitable type of information systems to support PoCs, because it allows freedom of process structure in group collaboration while controlling the constraints.

Moreover, the PAIS integrates with the GCSS by in invoking structured subprocesses and PoCs (supported by the GCSS) in accordance with the proceeding macro-process. Control flow and data flow in the macro-process are facilitated by the PAIS. We subsume the requirements in a first design principle (DP):

DP1: *A CPSS must implement distinctive system support for structured processes and PoCs. The integration of both systems is facilitated by supporting the macro-process.*

Two properties of PoCs challenge their operationalization: PoCs might be complex (e.g., writing a television movie script), making the coordination of all group members cumbersome, and PoCs are subject to product, process, and resource constraints that have to be controlled in order to ensure the CGP's goal orientation. The architectural construct group task copes with both challenges by breaking PoCs down into smaller work packages, reducing complexity (Globerson 1994) and by assigning group tasks to group members, thereby building "subgroups" within a PoC that contribute to the completion of a PoC in a coordinated way. Preliminary evaluation of the construct of group tasks and participation in the group tasks reveals that the right to join and decline participation in a group task and the right to define responsibilities in a group task should be configurable in accordance with the nature of the tasks (Becker et al. 2011b). To ensure that group tasks are aligned with the goals of a PoC, we introduce the architectural constructs of task milestones, task deadlines, and task responsibilities. Group tasks have to be implemented in the GCSS. The decomposition of PoCs is subsumed in the second design principle.

DP2: *A CPSS must implement the construct of group tasks as a decomposition of PoCs. Group tasks define work packages with milestones, deadlines, and responsibilities.*

The CGPs in a PoC are performed in the context of a group task. Both the generative and convergent group processes have to be supported by the GCSS. Components for the generative group processes are generative components, while components for the convergent group processes are convergent components, and all components together build the components for collaborative idea development (**Fig. 8**). The generative component shared idea space supports the gathering and sharing of rough ideas (collect), which are to be stored for several working sessions to allow for long-lasting processes of idea generation.

The production and documentation of more concrete ideas (create) is supported by a shared idea editor. The type of media that can be generated with the editor (text, sketches, audio, and video) and the feature set provided to modify the media determine the ideas' level of detail. The reciprocal inspiration of group members to generate novel ideas (inspire) is facilitated by the shared idea space and the shared idea editor. Further, the communication component supports idea generation by facilitating group communication (e.g., with instant messaging, with a forum). As a non-group process-specific option, an extra component may be provided to support individual stimulation of ideas. (See the discussion on ICST in Sect. 2) The convergent components include a shared idea space visualizer that helps to organize and reduce the complexity of the ideas that have been generated and collected (organize). Relationships between ideas (is-a, is-part-of, freely chosen semantics) can be visualized in hierarchical structures (tree structures, unordered collections) or network structures (mind maps, concept maps).

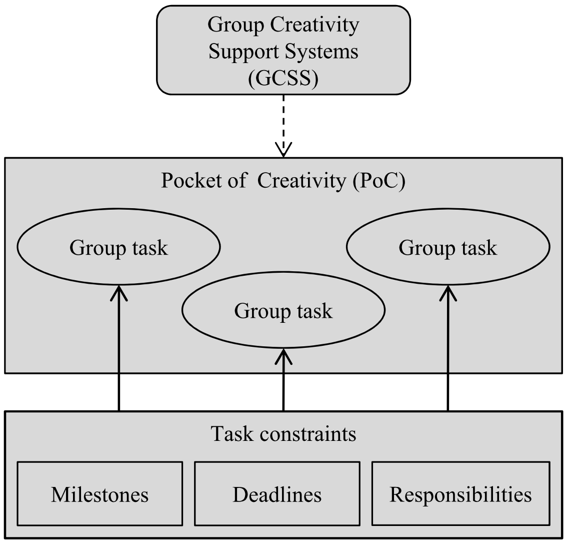


Fig. 7 Decomposition of PoCs to group tasks

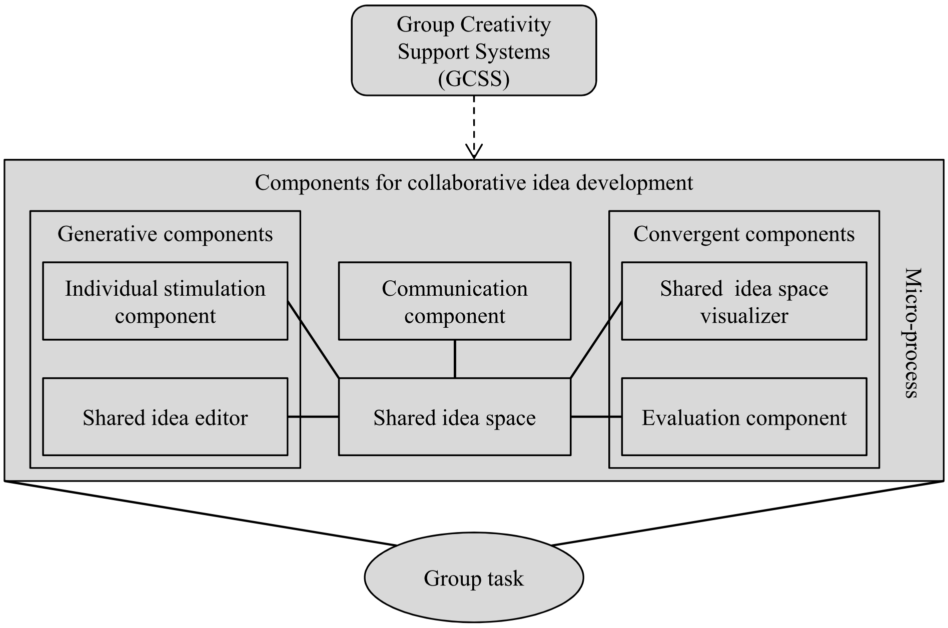


Fig. 8 The components for collaborative idea development

The group assessment of ideas (evaluate) should be supported by an evaluation component that allows for both quantitative (rating scores, priority ranking, etc.) and qualitative (commenting on ideas) evaluation. Finally, the selection of ideas for further elaboration (select) should be supported by rich communication through using the communication component, also provided idea generation. Therefore, the communication component has a hybrid role in that it supports both generative and convergent group processes. Since the shared idea space is the component where the ideas are "administered," it is the central component that integrates all other components (**Fig. 8**).

The sequencing of the CGP, that is, the sequence in which the components for collaborative idea development are employed, is reflected in the micro-process. Since the sequence is not entirely determined prior to its execution, it must not be restricted. In other words, each component must always be employable by each group member.

DP3: *A CPSS must support the generative and convergent group processes by implementing the components for collaborative idea development. The micro-process must be supported by allowing permanent employment of all components.*

The hierarchical decomposition of CIPs revealed that PoCs may encompass structured sub-processes (**Fig. 4**, Level 2). As a reflection of that property of PoCs in the IS architecture, it should be possible to trigger the architectural construct of structured sub-processes from within a group task (**Fig. 9**). These structured sub-processes are then executed in the PAIS, outside the GCSS in order to maximize the time available for group members to contribute to the CGP in the GCSS. After the structured sub-processes are completed, results are returned to the GCSS, or to the group task respectively.

DP4: *A CPSS must facilitate the outsourcing of structured sub-processes from a PoC. The sub-processes must be associated with the group tasks.*

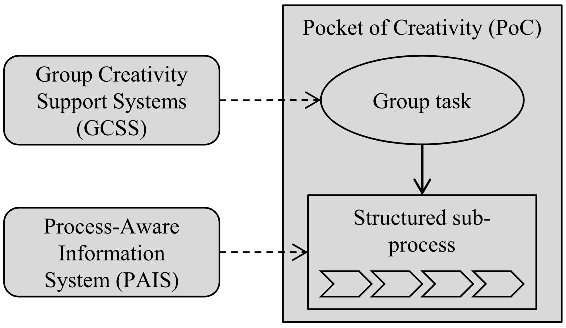


Fig. 9 Structured sub-processes in group tasks

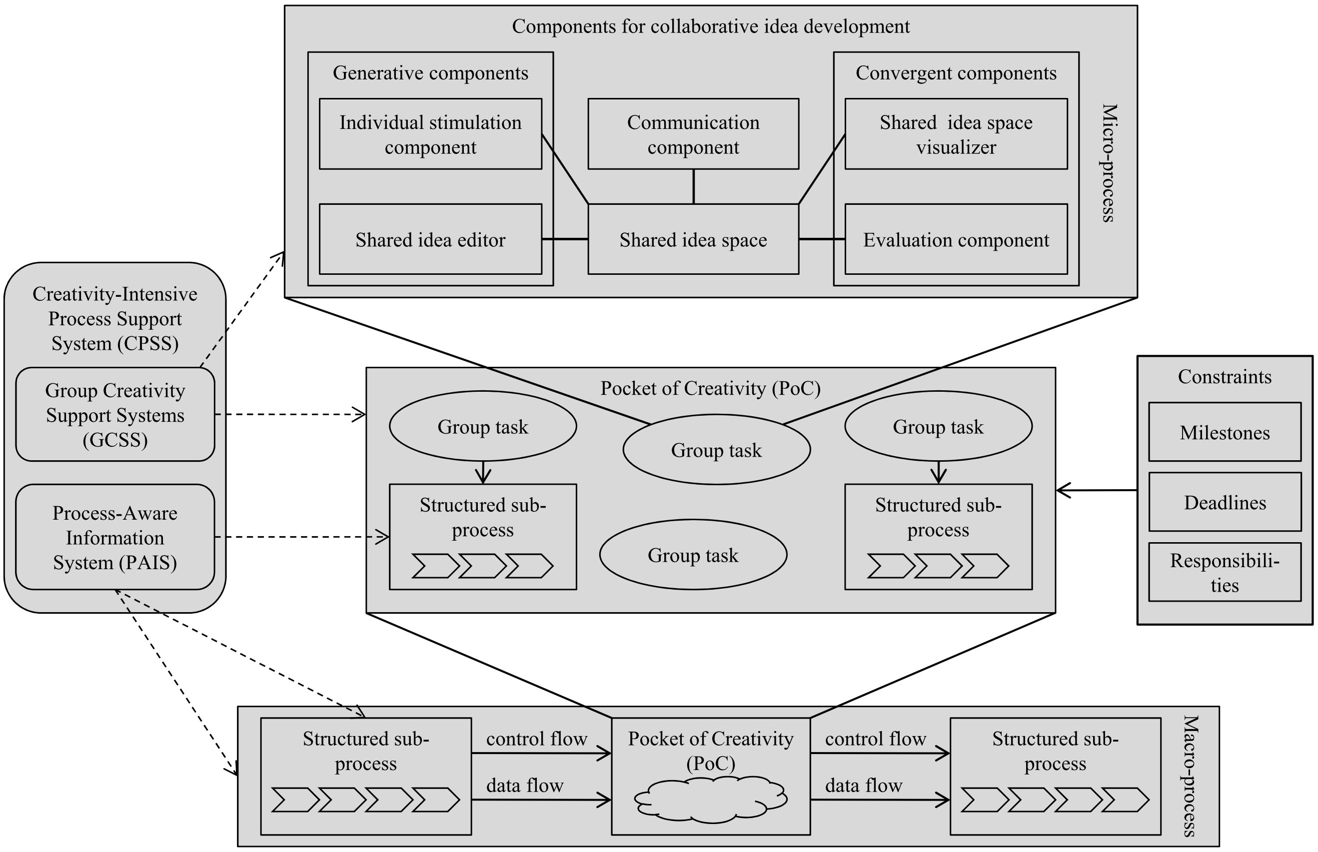


Fig. 10 Overview of the CPSS architecture

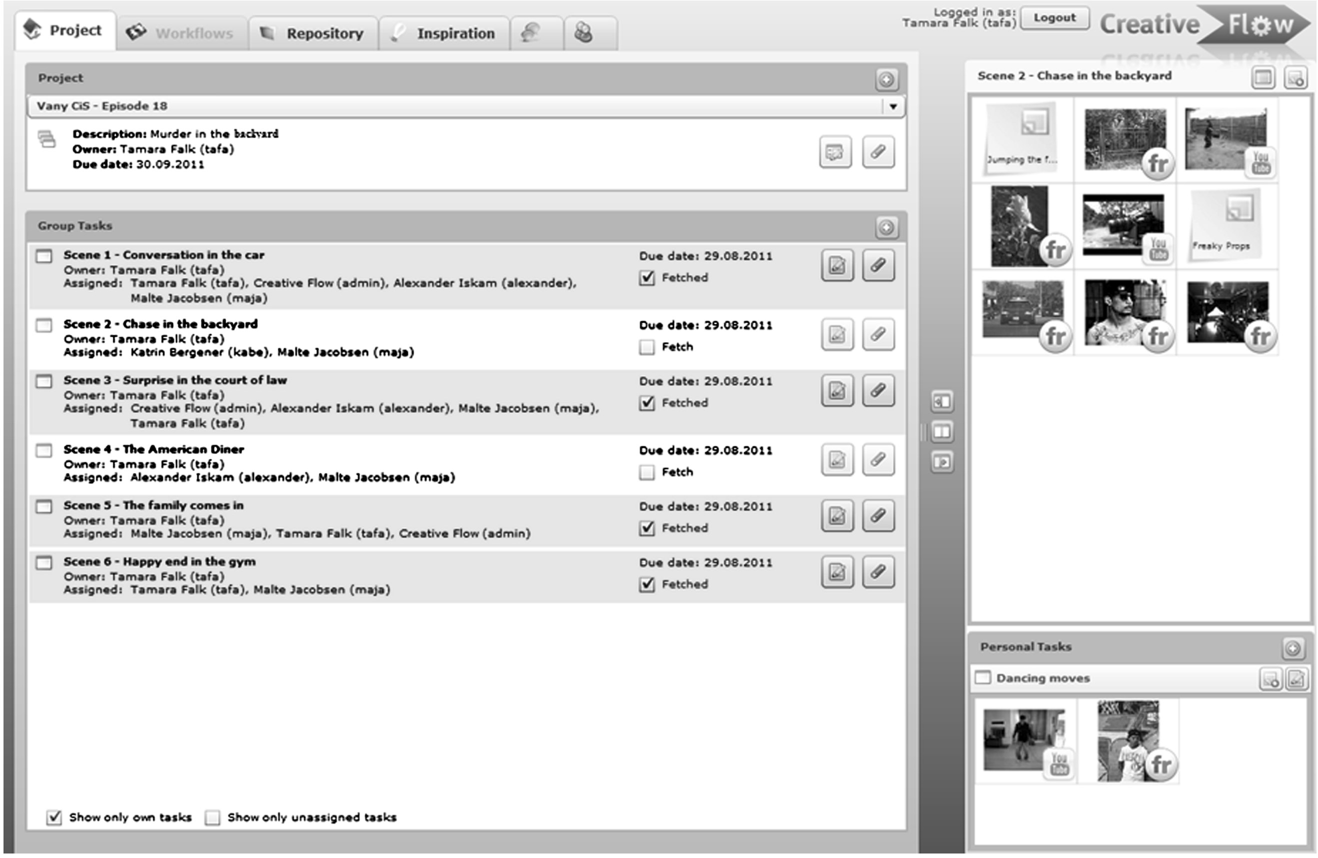
The architectural models for each design principle in the CPSS architecture are subsumed in an integrated architectural model (**Fig. 10**). PoCs in the macro-process (**Fig. 6**) are decomposed into group tasks, prone to constraints (**Fig. 7**), and associated structured sub-processes (**Fig. 9**). Group tasks are then associated with the components for collaborative idea development (**Fig. 8**).

We implemented the CPSS architecture in the research prototype CreativeFlow, an expository instantiation that we use to evaluate the CPSS architecture and thus our design theory. The next section introduces CreativeFlow.

5.2 Expository Instantiation

CreativeFlow implements the CPSS architecture as specified in the design principles and architectural models. CreativeFlow consists of a WfMS, which supports the execution of the overall CIP (structured as macro-process) and the structured sub-processes, and a GCSS, which supports unstructured, creative sub-processes. Modeled as process schema, the macro-process and the structured sub-processes are controlled automatically by the WfMS, invoking process activities and assigning these activities to users and applications. In the unstructured, creative processes, groups are able to develop and share ideas in a text editor and enrich them with the help of digital resources like documents, pictures, and videos. The resources may be obtained from an integrated, proprietary knowledge base (supported by the information retrieval component) or from the internet (supported by the web 2.0 mashup component). The GCSS is automatically invoked by the WfMS if unstructured, creative sub-processes occur in the macro-process.

As DP1 and the corresponding architectural model require, structured sub-processes and PoCs need distinctive system support. As PAIS we chose the WfMS, to which we refer as the workflow



Description: Murder in the backyard
Owner: Tamara Falk (tafa)
Due date: 30.09.2011

☐ **Scene 1 - Conversation in the car**
Owner: Tamara Falk (tafa)
Assigned: Tamara Falk (tafa), Creative Flow (admin), Alexander Iskam (alexander), Malte Jacobsen (maja)
Due date: 29.08.2011
☑ Fetched

☐ **Scene 2 - Chase in the backyard**
Owner: Tamara Falk (tafa)
Assigned: Katrin Bergener (kabe), Malte Jacobsen (maja)
Due date: 29.08.2011
☐ Fetch

☐ **Scene 3 - Surprise in the court of law**
Owner: Tamara Falk (tafa)
Assigned: Creative Flow (admin), Alexander Iskam (alexander), Malte Jacobsen (maja), Tamara Falk (tafa)
Due date: 29.08.2011
☑ Fetched

☐ **Scene 4 - The American Diner**
Owner: Tamara Falk (tafa)
Assigned: Alexander Iskam (alexander), Malte Jacobsen (maja)
Due date: 29.08.2011
☐ Fetch

☐ **Scene 5 - The family comes in**
Owner: Tamara Falk (tafa)
Assigned: Malte Jacobsen (maja), Tamara Falk (tafa), Creative Flow (admin)
Due date: 29.08.2011
☑ Fetched

☐ **Scene 6 - Happy end in the gym**
Owner: Tamara Falk (tafa)
Assigned: Tamara Falk (tafa), Malte Jacobsen (maja)
Due date: 29.08.2011
☑ Fetched

☑ Show only own tasks ☐ Show only unassigned tasks

Fig. 11 Screenshot of the GCSS of CreativeFlow

system of CreativeFlow. No standard system for the support of PoCs is available on the market that comprehensively fulfills the requirements of DP2, DP3 and the associated architectural models, so we chose to implement the system for PoC support in a proper prototype, the GCSS of CreativeFlow (**Fig. 11**).

As to DP2, the GCSS implements the two required architectural constructs that help to organize the CGP: The construct PoC is implemented as a container for group tasks (**Fig. 11**, "Project" pane), and group members can create group tasks within a PoC to create a work breakdown structure (**Fig. 11**, "Group Tasks" pane). The components for individual stimulation (DP3) are implemented through an information retrieval component (**Fig. 11**, tab "Repository"), which stores multimedia content from past projects and helps to structure this data within a multi-tree ontology of topical categories (Müller-Wienbergen et al. 2011). Individual inspiration is supported by a web 2.0 mash-up component (**Fig. 11**, tab "Inspiration") that allows simultaneous full text search in web 2.0 services, such as Flickr, YouTube and Twitter.

The shared idea space and the shared idea editor are implemented in the form of the watch list (**Fig. 11**, "Scene 2 – Chase in the backyard" pane) and a rich text editor. Each group task is associated with exactly one watch list, which is visible to all group task members. New ideas may be documented with the rich text editor and may then be shared with other group members by dropping them in the watch list. Digital resources retrieved in the information retrieval component or the web 2.0 mash-up component may also be dropped in the watch list to help illustrate the idea.

The implementation of a shared idea space visualizer is a graphical representation (thumbnails) of the ideas and resources in the watch list. The evaluation component and the communication component are implemented as an online chat where opinions about ideas can be communicated (qualitative evaluation) and the best ideas can be selected in a process of personal discussions among group members. In line with the micro-process, all GCSS features may be used at any time by all users. As to DP4 and the associated architectural model, structured sub-processes also occur within PoCs, and standard workflows can be pre-defined in the WfMS to cope with them. They may then be triggered from within the GCSS—more specifically, from a group task (**Fig. 11**, tab "Workflow").

The evaluation of the GCSS of CreativeFlow is presented in the next section.

6 GCSS Evaluation

The scope of our evaluation was the GCSS of CreativeFlow, so the results refer to the underlying sub-portion of the architecture described in DP2 (PoC and group task management) and DP3 (components for collaborative idea development) and the associated architectural models. After describing the research model in the next section, we present the results of the group experiment.

6.1 Research Model

We hypothesize a positive impact of the GCSS of CreativeFlow on the creative

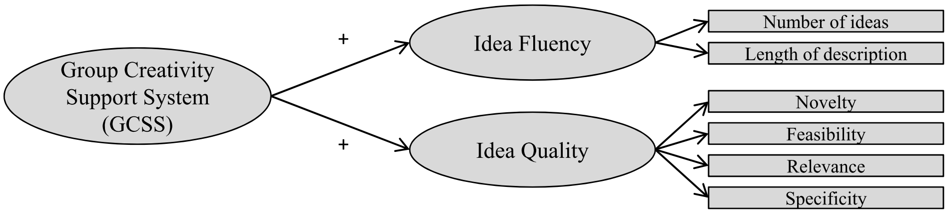


Fig. 12 Research model for GCSS Evaluation

Table 1 Mean value idea rating scores by raters

	Rater 1	Rater 2	Rater 3	Rater 4
Tool group				
Novelty	4.00 (0.82)	4.29 (1.11)	3.14 (0.90)	3.71 (0.76)
Feasibility	2.57 (0.79)	3.57 (1.62)	2.14 (0.38)	2.57 (0.53)
Relevance	3.29 (0.49)	4.57 (0.53)	4.29 (0.49)	3.14 (0.38)
Specificity	4.57 (0.53)	4.43 (0.98)	3.14 (0.69)	3.57 (0.98)
No-tool group				
Novelty	3.78 (1.28)	4.26 (1.14)	2.61 (1.16)	4.00 (1.00)
Feasibility	3.00 (1.21)	2.04 (1.07)	2.26 (0.54)	2.30 (0.88)
Relevance	3.78 (1.00)	4.22 (1.13)	4.39 (0.72)	3.57 (0.79)
Specificity	4.83 (0.39)	4.87 (0.46)	3.26 (0.62)	3.78 (0.74)

Standard deviations are in parents. 1 = very high; 5 = very low

performance of individuals who apply the system. Measuring creativity is challenging because of the complexity of the creativity concept. For example, Christiaans (2002, p. 41) states that "the core of the creativity concept cannot be formalized into an objective instrument." However, as a pragmatic approximation, creative performance is commonly assessed with respect to the output of the creative process, that is, the number and quality of the ideas generated (Reinig et al. 2007; Silva and Read 2010).

Several measurement instruments for idea quality have been developed that refine the quality of an idea to the quality dimensions of novelty, usefulness, feasibility, and specificity (Besemer and O'Quin 1986; Dean et al. 2006). As common measurement procedure, idea quality is assessed by experts with respect to these quality dimensions (Amabile 1982).

Studies on the impact of creativity support systems on creative performance assess the number of ideas, their quality, or both, in accordance with the focus of the study (Cheung et al. 2008; MacCrimmon and Wagner 1994; Massetti 1996). In line with recommendations for the dependent variable in research on CSS (Wierenga and Van Bruggen 1998), we assess creative performance in terms of both idea quantity and idea quality. Hence, our experiment was designed for two dependent variables (**Fig. 12**). First, we assess idea fluency (Guilford 1968), which is the number of ideas a group was able to develop in the allotted time. Then we assess the quality of the ideas by collecting expert feedback on the four dimensions of quality (Dean et al. 2006). The independent variable is GCSS support.

Idea fluency (Guilford 1968) is a manifest variable measured as the number of ideas, and the length of idea description, measured as the number of words. Idea quality, a latent variable, is measured with four items or quality dimensions: novelty, feasibility, relevance, and specificity. The novelty of an idea is the degree to which it is original. In our context, television show concepts are deemed as highly original if they have not been proposed before in the German television market. The feasibility of an idea in our experiment is the degree to which the television show can be realized with a reasonable amount of effort (e.g., with respect to necessary actors, props, special effects, etc.). Relevance refers to the degree to which the idea applies to the stated problem and contributes to its solution. In the context of our group task, a television show was relevant if it fulfilled the format requirements (airing in prime-time on a private television broadcasting network to a target audience of young adults and young families). An idea's specificity is the degree to which it is worked out in detail. An idea has a high degree of specificity if multiple aspects of the idea have been described as a specific television show concept (e.g., the personnel involved, whether it is a live show or a taped show, the rules of the game). Each quality criterion was assessed by our four domain experts on a five-point Likert scale.

To ensure the validity of our findings, we controlled for several factors in the experiment setup: With respect to the group process, both groups had to follow the identical session procedure (see Sect. 3.3), and the task (design of a television show format) was identical for both groups. We controlled for the expertise of the subjects for the given task by ensuring that all students were attending the same course in television format development. Finally, we controlled for the environment by having the groups' sessions take place in regular course classrooms. The results of our experiment are presented in the next section.

6.2 Results

The variable of idea fluency was assessed by counting the number of ideas and the number of words in the description for each idea. The tool group developed seven ideas, while the no-tool group developed 23 ideas. The average number of words in the idea descriptions in the tool group was 64 words, and that for the no-tool group was 19 words.

On average all raters deemed the specificity of ideas generated by the tool group as higher than those generated by the no-tool group (see **Table 1**). Three out of

Table 2 Overall mean value rating scores

	Novelty	Feasibility	Relevance	Specificity	Overall
Tool group	3.79 (0.96)	2.71 (1.05)	3.82 (0.77)	3.93 (0.98)	3.56 (0.42)
No-tool group	3.66 (1.29)	2.40 (1.01)	3.99 (0.97)	4.18 (0.89)	3.56 (0.35)
Student *t*-test	$t = 0.46, p = 0.64,$	$t = 1.42, p = 0.16,$	$t = -0.84, p = 0.40,$	$t = -1.30, p = 0.19,$	

Standard deviations are in parents. 1 = very high; 5 = very low

four raters (Raters 1, 3, and 4) assigned higher levels of relevance to the ideas of the tool group than to those of the no-tool group, and three out of four raters (Raters 1, 2, and 3) assessed the ideas of the no-tool group as more novel than the ideas of the tool group. For feasibility, two raters (Raters 1 and 3) deemed the ideas of the tool group to be more specific, whereas the other two raters were in favor of the ideas of the no-tool group.

We further calculated mean values for the four dimensions idea quality, integrating all raters' assessments (**Table 2**). Ideas of the no-tool group were rated more feasible than those of the tool group ($t = 1,42, p = 0,16$), while ideas of the tool group were rated more specific ($t = -1.30, p = 0,19$). Moreover, the ideas of the no?tool group were rated slightly more relevant than those of the tool group ($t = -0,84, p = 0,40$), while the novelty of ideas of the tool group was rated as slightly higher than those of the no-tool group ($t = 0,46, p = 0,64$). The differences of the mean values are not statistically significant. We further calculated an overall creative quality score, averaging all raters' results with respect to all quality dimensions. This overall score is 3.56 for both groups.

We discuss the results of our laboratory group experiment in the next section, relating them to the features of the GCSS of CreativeFlow and to DP2 and DP3.

7 Discussion

First we address the results of the evaluation of the GCSS of CreativeFlow and the underlying sub-portion of the architecture, referring to impacts on creative performance. Then we discuss the overall CPSS architecture.

7.1 Discussion of the GCSS Evaluation Results

Idea fluency: The group without tool support generated three times as many ideas (23) as the group with CreativeFlow (7), but the descriptions of many of the ideas from the no-tool group contained only a short sentence. Although the number of words does not necessarily indicate that an idea is or is not specific, the raters viewed the lack of detail in the no-tool group's idea descriptions as also being reflected in qualitative specificity. Therefore, we interpret the idea development of the no-tool group as a "sloppy" process in which the group members have emphasized quantity, rather than quality. The rater criticized: "Idea quantity can seldom compensate for a lack of idea quality."

Nonetheless, the overall rating score for idea quality (3.56) was identical for both groups. With reference to the dimensions of idea quality, the tool group produced ideas that were more specific, while the no-tool group produced ideas that were more feasible. From these observations we conclude that neither Creative Flow nor "offline" brainstorming is an absolutely superior choice if a large number of high-quality ideas is required. With reference to the research question, CreativeFlow is adequate if ideas have to be specific, while no tool support is adequate if ideas are to be feasible. Next, we interpret these findings with reference to tool design and the CPSS architecture design.

Specificity: As to the implementation of DP3 (components for collaborative idea development), we assume that the tool group generated ideas that were more specific because its members were able to enrich their ideas with digital resources from the web 2.0 mash-up component and the information retrieval component (individual stimulation component) and, thus, to explicate their ideas more precisely to other group members. Therefore, the tool-group members could easily understand each other's ideas and refine them using the watch list and the rich text editor (shared idea space and shared idea editor). As to the implementation of DP2 (group tasks), we assume that the tool helped the tool group organize the CGP by breaking down the complex task of developing an idea for a complete television show into several work packages, managed with group tasks (see **Fig. 6** for the architectural model). Thus, the tool group could focus on distinct "sub-ideas" and elaborate on them more effectively than the no-tool group could.

Feasibility and Relevance: Assuming that the more specific ideas are also more feasible, we were surprised that the ideas the no-tool group generated were rated more feasible than those generated by the tool group. One possible explanation is that the tool inspires radical, ambitious ideas that may not be feasible, even though they are specific. This effect could be mitigated if the relative importance of critical idea reflection (convergent components) in Creative-Flow were more balanced with idea generation (generative components); currently, only the chat supports qualitative idea evaluation and idea selection. Advanced quantitative idea evaluation functionality like idea rating could contribute to this balance. The tool modification could also strengthen the positive impact of the GCSS support on the relevance of ideas, which were rated only moderately more relevant in the tool group. Moreover, the modification would contribute that CreativeFlow more directly reflects the CPSS architecture, proposing two components for both idea generation and convergence.

Novelty: The differences in the novelty of the two groups' ideas were only marginal (difference of 0.13 points in favor of no tool support). However, group feedback suggests that the restricted time for becoming familiar with CreativeFlow had a negative impact on the tool group's performance. A central take-away for future tool evaluations is to allow for more time for the tool group to get acquainted with CreativeFlow.

7.2 Discussion of the Overall CPSS Architecture

Structure and freedom: Our approach to developing a design theory that guides system design for CIP support is deductive in that we consistently address the theoretical constructs that capture the contradictory properties (process structure and process freedom) of CIPs in architectural constructs (Briggs 2006). The CPSS architecture is useful in CIPs' support since it is an isomorphic replication of the CIP properties: Structured sub-processes within the macro-process (DP1) and within PoCs (DP4) can be streamlined for process efficiency when implemented by a PAIS; CGPs are distinctively supported by group tasks (DP2) and the components for collaborative idea development (DP3), both of which are implemented in a GCSS to increase creative performance; and both sub-portions of the CPSS architecture are integrated via the macro-process. However, since we replicate theoretical constructs, the "quality" of the CPSS architecture depends on the validity of these theoretical constructs. We address this issue in our conclusion (Sect. 8).

Contextual dependencies: We expect that the contextual factors of organizations that perform CIPs impact on the choice of individual CPSS implementations. Larger organizations may choose WfMS (as implementation of the PAIS) for automated control of structured processes that span multiple departments, while smaller organizations in which most of the CIPs are handled in a spontaneous, non-standardized manner, might ask for less rigid process support. Therefore, an appropriate PAIS might be a Project Management System. Prior evaluation results from the television industry show an analogous situation for technology-acceptance issues (Becker et al. 2011b), where professionals in a smaller organization who worked with many freelancers expected difficulties in familiarizing and integrating those freelancers with rigid process-aware technologies. Hence, the implementation of the CPSS architecture in specific contexts requires a wide-ranging choice of technology. This argument is related to the subsequent discussion of the validity of design theory evaluations.

Validity of design theory evaluations: We employed CreativeFlow as a vehicle with which to evaluate the CPSS architecture because it can be tested in an experimental environment. However, the question to what extent CreativeFlow reflects the architecture remains. This issue, an internal validity criterion for design theory evaluations, is currently discussed in design science research (Küchler and Vaishnavi 2008; Niehaves et al. 2012). We take the stance that explanatory design theories have to explicate *what* is to be implemented and *in what way* (*how*) when specifying an information system. Thereby, the "semantic gap" between design theory and its instantiation can be bridged, easing the implementation of design theory and allowing for greater validity in theory evaluation. For that reason, our design theory consists of both design principles (*what*) and detailed architectural models (*how*). However, because of constant changes in technology, it is difficult to provide design guidance for concrete features, therefore implementations must be adjusted continuously in order to improve the tool's impact in the given context.

Experimental design: Our evaluation experiment design has several limitations: First, we focus on creative performance in terms of idea fluency (number of ideas) and idea quality (novelty, feasibility, relevance, specificity), while other experiments on the impact of creativity support systems raise additional data from the user's perspective, including software satisfaction (Massetti 1996), enjoyment of use, and ease of use (Elam and Mead 1990). Silva and Read (2010) propose a creativity metric that includes the user's enjoyment and learning in the creative process. User feedback may provide insights into the impact of GCSSs' human-computer-interface design on user satisfaction, which may, in turn, impact the user's creative performance. When describing an experiment with creativity support systems for idea generation and evaluation, Massetti (1996, p. 93) states that, because "low ratings on likability and usability did not appear to negatively affect performance, further study of the impact of [individual creativity support system] design on creative performance seems appropriate."

A second limitation is that the individual creative potential of our subjects may have influenced their creative performance in both the tool group and the no-tool group. Since personal creative potential depends on individual task expertise (Amabile 1998), we attempted to ensure that all subjects had about the same level of expertise for the given task by choosing graduate students in a course in television format development. However, future experiments should control for the creative potential of subjects by employing a creativity test like the Abbreviated Torrance Test for Adults (ATTA) (Johnson and Fishkin 1999) or the Creative Personality Scale (CPS) (Gough 1979).

Third, the external validity of our results is limited in that we conducted a singular experiment with a specific user group of undergraduate students in media and communication management. To increase the generalizability of our findings, further evaluations are needed that consider diverse groups of subjects, including professionals. In addition, the internal validity of our experiment is limited in that we had only twelve subjects. Future experiments should consider more groups and reduce the number of subjects in a group to three.

Fourth, our findings might be biased by the Hawthorne Effect, which states that subjects involved in experimental studies may behave differently, knowing that they are under observation, than they would otherwise (Cook 1962). We tried to minimize the effect by means of three measures: conducting the experiment in classrooms with which our subjects were familiar, which potentially contributed to natural behavior; controlling for numerous variables (i.e., identical task, group process, subject expertise) for the no-tool and the tool groups to create similar treatment conditions; and ensuring that all subjects in both groups were aware that they were part of an empirical investigation so that, if the subjects behaved unnaturally, they would have done so in both treatment groups.

8 Conclusion, Limitations, and Outlook

We presented an information system architecture that comprehensively supports CIPs and enclosed creative group processes (CGPs). A CIP is a business process that consists of unstructured, creative sub-processes and structured, routine sub-processes. A PoC is the conceptualization of an unstructured sub-process that is particularly characterized by creativity and adheres to several uncertainties and constraints with respect to the creative product, process, and required resources. PoCs are performed in CGPs consisting of generative processes (inspire, collect, create) and convergent processes (organize, evaluate, select), each of which must be supported.

Based on the theoretical constructs of CIP, PoC, and CGP, we derived architectural constructs and related them to existent information system types (PAIS and GCSS) that support the technical implementation of the constructs. This effort led to design principles and architectural models that represent the comprehensive architecture of a CPSS. Then we presented CreativeFlow as an expository instantiation of the architecture and evaluated the GCSS of CreativeFlow in a laboratory setting.

Results show that using CreativeFlow leads to ideas that are more specific, while using no tool support generated ideas that were more feasible. To increase the feasibility and relevance of ideas, the idea evaluation support in CreativeFlow, including support for quantitative evaluation, must be improved. The overall validity of our theory derives from a deductive development approach in which we transform theoretical constructs to architectural constructs.

Our research has several limitations that provide two primary opportunities for future research. First, we evaluated the GCSS of CreativeFlow and, thus, DP2 and DP3 and the corresponding architectural models of the CPSS architecture. An evaluation of the overall CreativeFlow system and the underlying architectural sub-portion, focusing on process efficiency, requires a longitudinal field application of the tool that covers CIPs of distinct industries. Moreover, the evaluation should be conducted in organizations in distinct contexts, such as, with respect to industry, organization size, and governance structure. Second, the appropriateness of our design theory depends heavily on the validity of the underlying theoretical constructs. Although numerous applications in a variety of industries have validated these constructs (Becker et al. 2011a; Bergener et al. 2012; Cooper 2000; Karow 2010; Seidel 2009), an extension of those studies is still necessary in order to increase their generalizability. To that end, the CPSS architecture can contribute meaningfully to further theory evaluation because it embodies the theoretical constructs, thereby easing their evaluation through applications of that architecture. In other words, such research would clarify the appropriateness of the theoretical constructs by clarifying the appropriateness of CreativeFlow and other instantiations of the CPSS architecture to come.

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Abstract

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Comprehensive Support for Creativity-Intensive Processes

An Explanatory Information System Design Theory

Creativity is an important precondition of innovation. However, the management of creativity-intensive processes (CIPs) is beyond the scope of standard methodologies for business process standardization and automation because of the contradictory properties of CIPs, which require both process structure and creative freedom. We develop an explanatory design theory based on theoretical constructs from BPM theory, creativity research, and collaboration engineering, with the core component of an integrated IS architecture that facilitates the design of systems providing comprehensive support for CIPs. Automated control of structured processes and support of idea development in groups increase process efficiency and creative performance. Evaluation of a sub-portion of an expository instantiation (CreativeFlow) of the architecture in a laboratory experiment suggests that working with CreativeFlow leads to ideas that are more specific, while working without the tool generates ideas that are more feasible. Further, idea evaluation support of CreativeFlow must be improved in order to increase ideas' feasibility and relevance. The validity of our theory is derived from a deductive development approach. We indicate limitations and further research.

Keywords: Explanatory design theory, Systems design, Business process management, Creativity, Creativity support systems, Groupware

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