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Matthias Voigt

European Research Center for Information Systems (ERCIS), University of Münster, Germany, matthias.voigt@ercis.uni-muenster.de

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Abstract:

Organizations depend on the creative potential of their members to continuously develop innovative solutions. Groups commonly approach creative processes using collaborative IT. However, current design of information systems does not cater to the business processes representing the context in which groups operate. Creativity-intensive processes are a conceptualization of business processes that involve creativity. Voigt, Bergener, and Becker (2013) developed an explanatory design theory for information systems supporting creativity-intensive processes. The core component of the design theory is an information system architecture for creativity-intensive process support systems (CPSS). This paper evaluates the utility of the CPSS architecture to comprehensively support creativity-intensive processes. Three exploratory cross-industry focus groups, in which the architecture instantiation CreativeFlow was demonstrated, suggest that the features of CreativeFlow and the underlying architectural concepts are useful in supporting practitioners' processes, especially for the support of creative group processes. However, three modifications to the CPSS architecture emerge: increased freedom for choosing individuals responsible for group tasks, differentiated authorization for creating and assigning creative group tasks, and advanced communication support for initiation of standard workflows. The evaluation further contributes recommendations for tool features and four research issues to advance system design of tools supporting creativity in business processes. The study provides insights for future information system evaluations in Design Science Research on Information Systems.

Keywords: creativity-intensive process, creative group process, information system architecture, artifact evaluation

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I. INTRODUCTION

Creativity in organizations is important for the development and improvement of products and services [Santanen, Briggs and de Vreede, 2004]. Creative processes are predominantly approached in groups [Paulus, 2000] that increasingly work geographically distributed and asynchronously. For that reason, groups make use of collaborative information systems (e.g., Groupware, computer mediated communication) [Shneiderman, 2007]. The predominant goal of these information systems is to maximize the creative performance of the group. However, the group processes are embedded in organizational business processes, which are partially supported by separate process-aware information systems (e.g., enterprise resource planning systems and customer relationship management systems). The goal of these information systems is to maximize business process efficiency. Both types of information systems are tailored to foster either creative performance (in teams) or efficient business processes [Avital and Te'eni, 2009]. Integration of both information systems is not provided.

Business processes often involve creative (group) processes. As such, they consist of both unstructured (group) sub-processes, which exhibit a high intensity of creativity, and structured sub-processes, performing routine procedures of low originality. These business processes are referred to as the *creativity-intensive process* [Karow, 2010; Seidel, 2009]. The next step is to integrate information systems for the comprehensive support of creativity-intensive processes. However, a particular challenge arises for tool design: The goals of both processes are conflicting. On the one hand, having enough time for developing new ideas, behavioral freedom to do so, and risk taking have proved to have a positive impact on the realization of the creative potential of the employees in an organization [Ekvall, 1996]. On the other hand, efficiency in business processes is ensured by process standardization with minimized deviance, process control, and risk minimization [e.g., Harrington, 1991]. Against that backdrop, information systems that support creativity-intensive processes have to balance creative performance and business process efficiency. This issue is addressed in a explanatory design theory for creativity-intensive process support systems (CPSS) [Voigt, Bergener and Becker, 2013]. The main component of the design theory describes an information system (IS) architecture for CPSS that, when implemented, caters to both the support of structured processes and creative group processes.

The topic of creativity support has been subject to computer-supported collaborative work (CSCW) experiments since the 1980s [Fjermestad and Hiltz, 1998]: Creative tasks (generating ideas, brainstorming) account for about 40 percent of the total of approximately 200 experimental investigations that have been conducted. In more recent studies, CPSS have been evaluated, for example, for supporting individual idea generation and evaluation [Massetti, 1996] and for supporting knowledge re-use for idea development in groups [Cheung, Chau and Au, 2008]. The results are ambiguous in that only single aspects of the creative performance (i.e., idea quantity and idea quality) are increased, while other aspects are not affected or even decreased. Most experiments take the tool design as a matter of fact, while specific support for business processes that include creative group processes are disregarded.

This paper evaluates the CPSS architecture in its contribution to designing systems that *comprehensively* support creativity-intensive processes—that is, systems that balance creative performance *and* process efficiency. The unique focus of this paper is the evaluation of IT support for business processes that involve creativity. The support of individual creativity is considered as a side aspect only [Müller-Wienbergen, Müller, Seidel and Becker, 2011]. Expert interviews in exploratory cross-industry focus groups [Tremblay, Hevner and Berndt, 2010] investigate the perceived utility of the tool CreativeFlow, which is an instantiation of the CPSS architecture. Single aspects of the architecture have already been evaluated in a laboratory group experiment [Voigt et al., 2013]. With the current qualitative evaluation, the aim is to evaluate the overall architecture, leading to the following research question:

> RQ: *Does the CPSS architecture provide for a tool design that is useful for comprehensively supporting creativity-intensive processes?*

The paper contributes empirical evidence for the usefulness of the CPSS architecture and recommendations for tool features from the interview data, which will guide purposeful implementations of the architecture. The findings are reflected to identify implications for the body of knowledge on Design Science Research on Information Systems (DSRIS), specifically for evaluations of design theories by means of instantiations. Four key issues are identified, which have to be considered in future design-oriented research on CPSS: the context-specificity of CPSS design, the value of CPSS in larger organizations, the degree of structure in creativity-intensive processes, and the development of refined instantiations of the CPSS architecture.

The paper is structured as follows: Section II outlines the architecture for CPSS. Section III presents the architecture instantiation CreativeFlow. The research design and methodology are introduced in Sections IV and Section V present the evaluation results. A conclusion, implications and limitations are indicated in Section VI.

II. PREMISES AND MORPHOLOGY OF THE CPSS ARCHITECTURE

The following discussion presents the CPSS architecture, indicating the theoretical concepts underlying the architecture, the architecture's design principles (DPs), and the associated architectural framework (morphology) [Voigt et al., 2013].

Theoretical Premises of the CPSS Architecture

The organizational model of creativity [Woodman, Sawyer and Griffin, 1993] allows us to position the theoretical concepts that are at the basis of CPSS architecture (Figure 1):

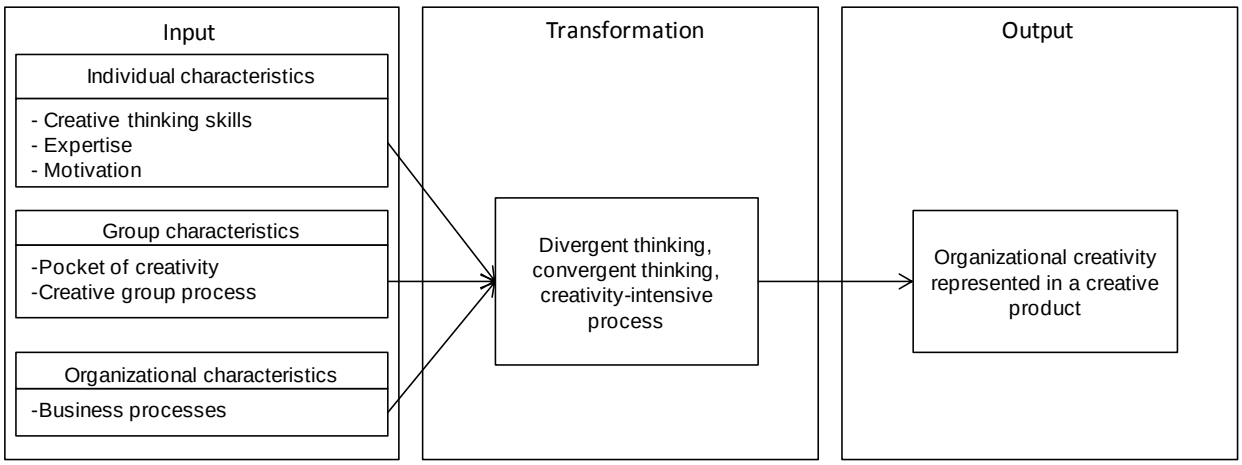

Figure 1. Theoretical Concepts Employed in the CPSS Architecture [Woodman et al., 1993]

Individual characteristics. An individual's abilities determine the creative potential of the creative process. Amabile [1996] framed these abilities as *components of creativity*, comprising *expertise* (knowledge in a given expert area), *creative thinking skills* ("capacity to put existing ideas together in new combinations" [Amabile, 1996, p. 79]), and *motivation* (the passion to develop solutions for the given problem). These abilities determine the potential performance of individuals in two elementary creative cognitive processes (transformation): *Divergent thinking* is the cognitive process that facilitates the generation of a large number of ideas (fluency) that are unique and unusual (originality) and are of different kinds (flexibility) [Guilford, 1967]. In contrast, *convergent thinking* is a process in which ideas are critically reflected to better understand their consequences and to select the most promising ones [Briggs, de Vreede and Nunamaker, 2003]. Expertise in the field where creativity should yield new ideas is important for convergence, since it allows for the critical reflection of whether an idea may work or not. Cropley [2006] emphasizes that both cognitive processes, divergence and convergence, are important to generate "effective novelty"—that is, to generate ideas that are both novel *and* useful.

Group characteristics. The theoretical concepts *pockets of creativity* and *creative group processes* allow considering creativity on a group level. Group work is indispensable in organizational contexts [Shneiderman, 2007]. Both pockets of creativity and creative group processes provide an understanding of creative processes in groups. Pockets of creativity are defined as "[…] those sections within creativity-intensive processes that are particularly characterized by the involvement of creativity" [Seidel, Müller-Wienbergen and Rosen, 2010, p.420]. Pockets of creativity are accomplished in collaborative efforts in groups, which encompass numerous creative activities requiring coordination. Case study findings from the film and visual effects industry provide insights on the nature of pockets of creativity [Seidel et al., 2010]. It was found that pockets of creativity expose uncertainties, or "unknowns," with respect to the creative product, process, and resources employed: Characteristics of a creative product may not be known in advance; the required process steps and number of iterations of a pocket of creativity may not be specified before their execution; planning of resources is cumbersome; and resource requirements may vary during the execution of a pocket of creativity. However, it is conceded that "it is not the case that nothing is known about the product, the process, and the required resources. Even though there is a certain degree of unpredictability, pockets of creativity underlie certain constraints" [Seidel et al., 2010, p. 422]. The constraints, or "knowns," again refer to the

product requirements, process, and resources: Creative products have to be purposeful and thus fulfill basic requirements, such as a movie that has to meet a specific target audience; the creative process includes some mandatory process steps or mandatory sequences (i.e., most movie production projects undergo a strict sequence of project phases [Karow, 2010]); and most creative activity is restricted by mandatory resources and by the availability of resources. For a movie production, a director is indispensable; however, budget and time restriction limit the choice of the director.

Internal process dynamics remain unclear in the concept of pockets of creativity. *Collaboration pattern* [Briggs et al., 2003] conceptualize the following six process dynamics as creative processes accomplished in groups—that is, as creative group processes: *Inspire* is the process of group members to mutually stimulate new associations and ideas. *Collect* is the process of gathering and sharing ideas among the group members. *Create* is the process of individually producing and documenting ideas and then collectively refining them. *Organize* is the process of relating ideas in order to reduce the complexity of the idea space and to foster a common understanding of ideas in the group. *Evaluate* is the process of assessing the value of ideas to fulfill the goal of the creative group process. *Select* is the process of negotiating and deciding on which ideas shall be selected for further elaboration and implementation. Sequences of creative group processes are reflected in the *micro-process* [Marjanovic, 2008]. The sequence of creative group processes is commonly undetermined prior to its execution. Thus, the sequence must not be restricted.

Organizational characteristics. Organizational characteristics are predominantly reflected in the paradigm of *business processes*. A business process is defined as a series of activities that need to be carried out in order to collectively realize an organizational objective. It is also defined as a set of conditions that determine the order of the activities [vom Brocke et al., 2011].

Transformation. The *creativity-intensive process* – the transformation of inputs into outputs – conceptualizes the creative process under the paradigm of business processes. Creativity-intensive processes are business processes where creativity plays an important role but is of varying intensity throughout the process [Seidel, 2009]. Insights into the structure of the creativity-intensive process can be obtained when the process is decomposed on various levels [Seidel et al., 2010]. Creativity-intensive processes consist of both structured sub-processes and unstructured, creative sub-processes, conceptualized as pockets of creativity. Starting from a blackbox perspective on a creativity-intensive process (e.g., movie production), several sub-processes (e.g., movie idea development, script development, production) can be identified on a first level of decomposition. The sum of these sub-processes and their sequencing represent the *macro-process* of a creativity-intensive process. The sub-processes can further be refined on a second level of decomposition [Seidel et al., 2010]: Pockets of creativity may again be decomposed to structured and unstructured, creative parts (e.g., script development contains creative writing sub-processes and structured review sub-processes). The process sequencing in pockets of creativity is described in the micro-process.

Output. The creative transformational processes yield the output of a *creative product,* which represents the sum of creative effort in an organization. The creative product allows us to assess organizational creativity: Based on a consensual definition of creativity [Amabile, 1982], a “product or response is creative to the extent that appropriate observers independently agree it is creative” (p. 1001). In that sense, creativity is regarded as the subjective, creative quality of products resulting from a creative process. Assessment criteria for creative quality comprise product novelty, relevance, specificity, and feasibility [Besemer and O’Quin, 1986; Dean, Hender, Rodgers and Santanen, 2006]. In contrast to this output-oriented perspective on creativity assessments, creativity tests for individuals take a distinct perspective: The Torrance Tests of Creative Thinking [Torrance, 1962] and the Creative Personality Scale [Gough, 1979] are measurement instruments to assess the personality-related *creative potential* of individuals. Creative performance, which should be positively affected by an appropriate CPSS design, is the realized creative potential of organizations reflected in the creative quality of the creative product.

In the following, the CPSS architecture is demonstrated, referring the theoretical concepts defined above.

Morphology of the CPSS Architecture

The CPSS architecture consists of *four design principles* (DP), which are illustrated by an *architectural framework* (Figure 2) [Voigt et al., 2013]. Each design principle refers to a sub-portion of the framework.

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

In the CPSS architecture, structured sub-processes are eligible to be controlled by *process-aware information systems*. In contrast, the creativity in pockets of creativity must not be restricted by automated process control. *Groupware* is a suitable class of information systems to support pockets of creativity, since it allows freedom of

process structure in group collaboration, while constraints on group work may be defined. The transition between structured sub-processes and pockets of creativity is realized in control flows and data flows predefined by the *macro-process* of the creativity-intensive process in the CPSS architecture (see Figure 2). Since the macro-process is structured, it can as well be supported by the process-aware information system.

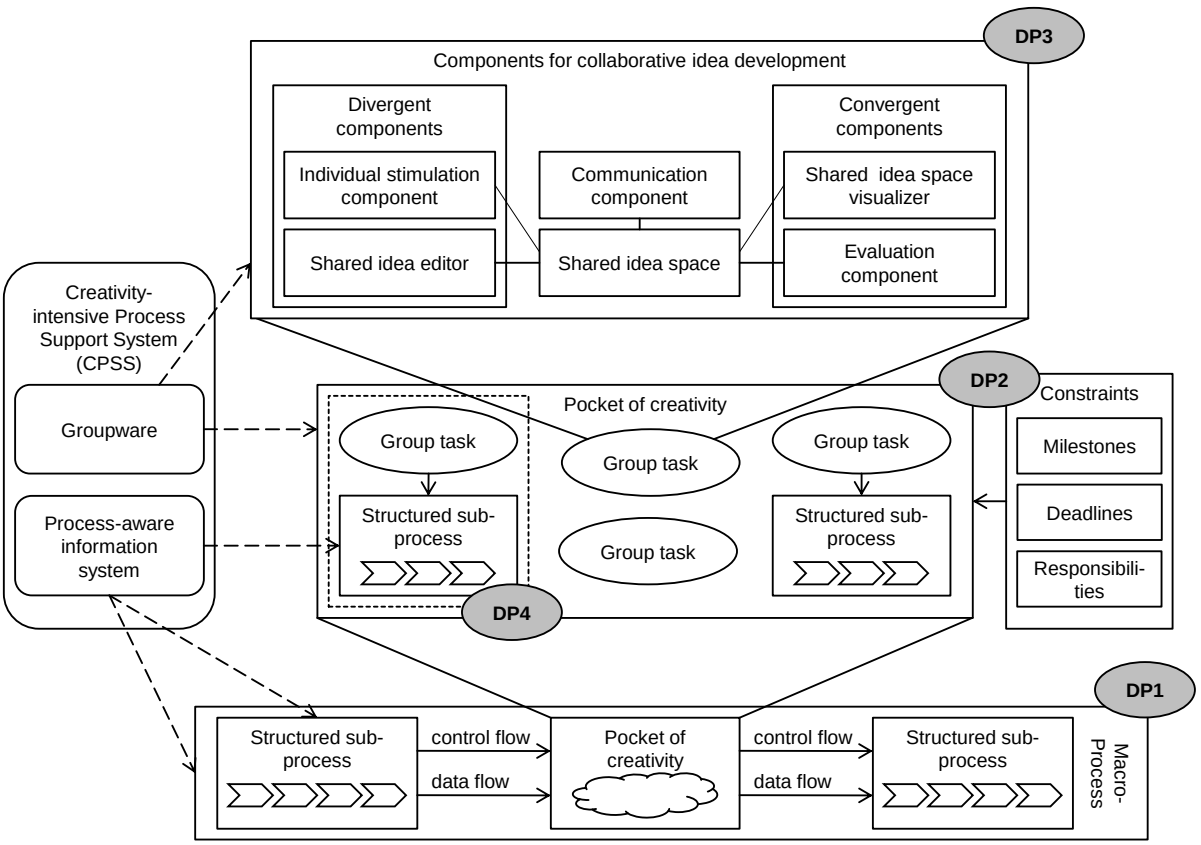

Figure 2. Architectural Framework of CPSS

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

The architectural concept of *group tasks* operationalizes pockets of creativity in smaller work packages. Group tasks are in line with the theoretical concepts of creativity-intensive processes and pockets of creativity, which per definition can be decomposed along multiple levels. Drawn from project management approaches, pockets of creativity may be considered as projects, and thus be decomposed to a work breakdown structure (WBS) [PMI, 2004] of group tasks. The assignment of group members to group tasks facilitates coordinated execution of a pocket of creativity. The constraints to pockets of creativity are translated into architectural concepts of the CPSS architecture: Product constraints are transformed to milestones, defining expected intermediate products developed within different group tasks and thus pockets of creativity. Process constraints are reflected by deadlines, which provide for a natural sequence of group task within a pocket of creativity. Resource constraints are transformed into responsibilities for the group tasks, in that creative personnel may be assigned as group members to the group task.

> *DP3: A CPSS must support the divergent 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.*

Six components for collaborative idea development provide support for the six creative group processes (see Figure 1). Each of the components facilitates specific creative group processes: Components for the divergent group processes (divergent components) support divergent thinking. Gathering and sharing of ideas (collect) is supported

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by the component *shared idea space*. It is the central database from which ideas can be stored and retrieved. The production and documentation of ideas (create) is supported by a *shared idea editor*. The development of simple idea descriptions may be supported by a simple text editor. However, more specific definitions of ideas require more complex editors such as sketching tools or tools for graphical modeling. The reciprocal inspiration of group members to generate novel ideas (inspire) is facilitated by both the shared idea space and the idea editor. Both components allow the sharing of ideas and build on those ideas, so that new ideas emerge as combinations and advancements of what is already there. The *communication component* shall facilitate synchronous (e.g., instant messaging and video conference) and asynchronous (e.g., forum and e-mail) communication, dependent on the process phase (inspire). As a non-group process-specific option, an extra component may be provided to support *individual stimulation* of ideas (inspire).

Convergent components for convergent group processes are required to support convergent thinking: A *shared idea space visualizer* helps to organize and reduce the complexity of the ideas that have been generated and collected (organize). Ideas may be clustered and related to each other. In consequence, simple, scattered ideas are integrated into idea categories. The group assessment of ideas (evaluate) is supported by an *evaluation component*. Ideas may be assessed qualitatively (e.g., comments) or quantitatively (e.g., grades, points). The selection of ideas for further elaboration (select) is supported by means of rich communication, facilitated by the communication component. Accordingly, the communication component supports divergent as well as convergent group processes. The shared idea space is the component where the ideas are "administered." It is the central component, which integrates all other components (Figure 1). According to the micro-process, the sequence of the creative group processes is commonly not predefined. In consequence, each component must always be employable by each group member.

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

Efficiency of pockets of creativity is enhanced if creative sub-processes are separated from non-creative, structured sub-processes, and if the structured sub-processes are supported by means of process enhancement. In order to maximize the time available to the group for accomplishing creative group processes within a group task (e.g., for accomplishing the creative sub-processes), structured sub-processes are outsourced to individuals outside the group, again taking advantage of the process-aware information system. In consequence, efficiency is increased by both task routing (outsourcing via process-aware information system) and task specialization (creative vs. non-creative tasks). Once the structured sub-process is completed, the results are reported back to the group task from which it has been issued.

The next section presents CreativeFlow, an instantiation of the CPSS architecture.

III. THE INSTANTIATION OF CREATIVEFLOW

Features of CreativeFlow

CreativeFlow consists of two systems: a workflow system and a groupware system. A *workflow system* allows the execution of pre-defined workflows representing business processes that involve creativity (creativity-intensive processes) (e.g., production of a movie) (Figure 3). A *groupware system* is invoked by the workflow system if creative tasks (pockets of creativity) occur in the workflow (Figure 4 and Figure 5). The groupware system supports creative group work (creative group processes). It comprises an electronic brainstorming tool for generating and evaluating ideas in groups (e.g., for the plot of the movie). The system includes an inspiration component, stimulating new ideas on the basis of a web 2.0 mash-up component. The component allows us to search randomly for digital resources (photos, videos, texts) in different web 2.0 services like Flickr and YouTube (Figure 5) (e.g., to inspire for movie props). The generated ideas may be associated with the digital resources and shared with group members.

As demanded in DP1, distinctive system support is needed for structured sub-processes (process-aware information system) and pockets of creativity (groupware). The process-aware information system is implemented by a commercial workflow management system[1] (*workflow system)* (Figure 3). Data and control flow in the macro-process is implemented in that pockets of creativity and structured sub-processes are automatically initiated, automatically assigned to a responsible person, and in that files are automatically routed through the workflow. Regarding the support of pockets of creativity, existent groupware fails to fulfill the requirements of DP3 comprehensively. For this reason, we have chosen to implement the system for supporting pockets of creativity by

[1] The workflow system IQ Optimize was provided by the software vendor IQ-optimize Software AG.

ourselves (*groupware system)* (Figure 4 and Figure 5). Distinct user interfaces for both systems are provided. Technically, the workflow systems and groupware system are integrated via a web service interface.

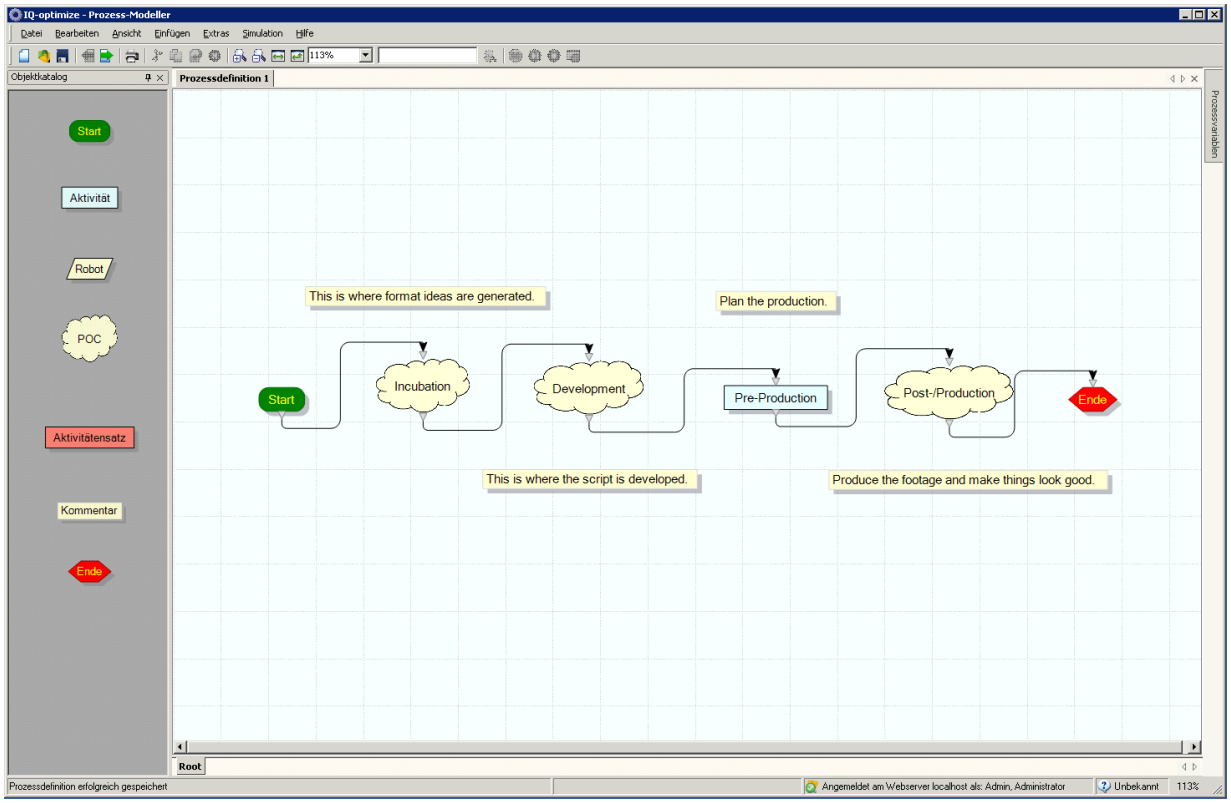

Figure 3. Screenshot of the Workflow System of CreativeFlow

As to DP2, group members can create *group tasks* within a pocket of creativity (see Figure 4, list in the left pane) to create a work breakdown structure. The groupware implements the construct pocket of creativity as a container for group tasks. Milestones are (implicitly) defined for the pocket of creativity by choosing an appropriate description of the new pocket of creativity. *Deadlines* may be defined, which then are controlled by the workflow system. Responsibilities can be defined by *assigning users* of the groupware to the group task. All tasks are visible to all users, as is the members' status of participation in the group task (invited, participating, and not participating). Each user can freely decide to join or decline a group task. This is possible regardless of any assignments that have been made by the task creator during the creation of a group task.

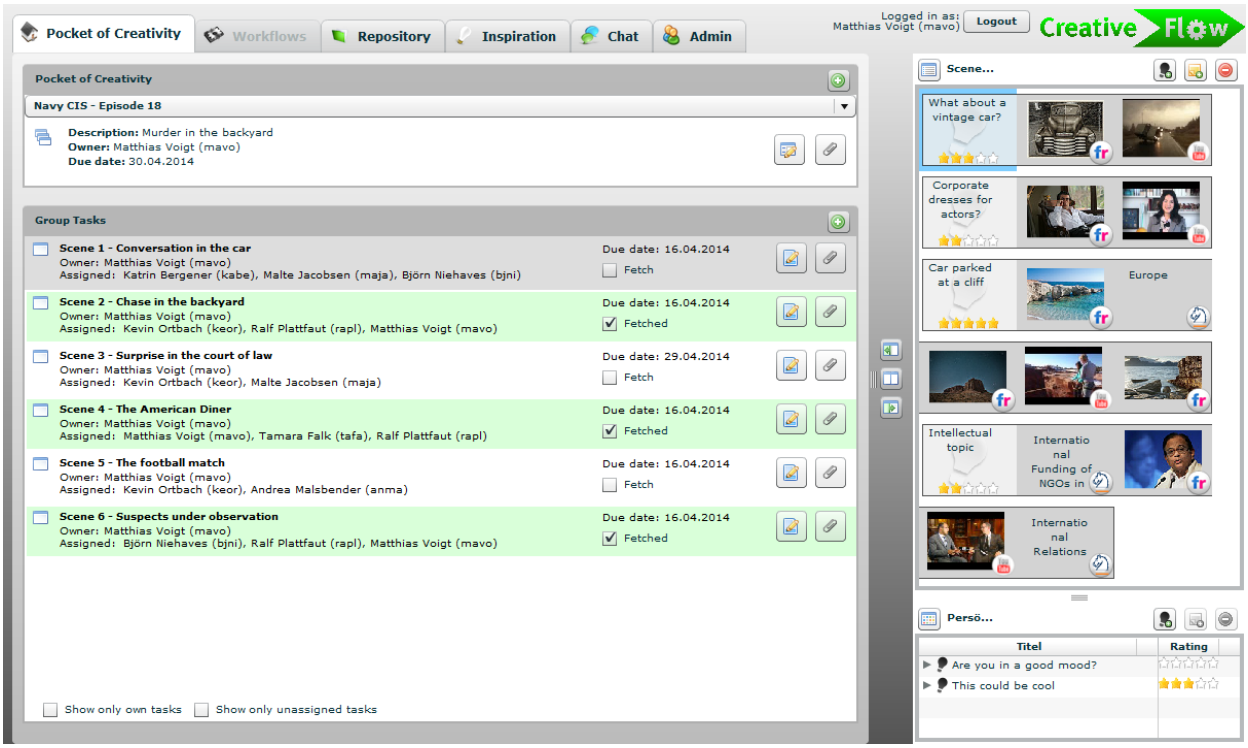

Figure 4. Screenshot of the "Pocket of Creativity" Tab of the CreativeFlow Groupware System

DP 3 stipulates the implementation of the components for collaborative idea development. In CreativeFlow, the first component for individual inspiration is implemented in two ways: first, an *information retrieval component*[2] stores multimedia content from past projects and helps to structure this data within an ontology—that is, a multi-tree structure of topical categories. The system generates stimulation of single group members in proposing data from remote categories in the ontology [Müller-Wienbergen et al., 2011]. Second, individual inspiration is supported by a *web 2.0 mash-up component* (Figure 5), allowing simultaneous full text search in different web 2.0 services. Search results are digital resources (photos, videos, texts) that inspire new ideas. The shared idea space is implemented in form of the *watch list* (Figure 4 and Figure 5, right pane). Each group task is associated with exactly one watch list. It allows group members to share ideas and to drop digital resources (photos, video, audio files, etc.) retrieved in the information retrieval component and web 2.0 mash-up component. The digital resources can be linked to the ideas. Ideas and resources in the watch list are shared by all group members of the group task associated with the watch list. The shared-idea editor is implemented as a *rich-text editor,* allowing the description of ideas and commenting upon ideas. The implementation of a shared-idea space visualizer (third architectural component) is a graphical representation of the ideas and resources in the watch list. So far, ideas and associated resources are visualized as an *unordered list* of idea items and associated thumbnails of digital resources (Figure 4 and Figure 5, right pane). The communication component is implemented as an *online chat*. For idea evaluations, the best ideas can be selected in a process of personal discussions of group members. The evaluation component is implemented implicitly by the online chat.

[2] The component was out of scope of the evaluation. It is based on a different design theory for systems supporting convergent and divergent thinking. For a detailed discussion see Müller-Wienbergen et al., 2011.

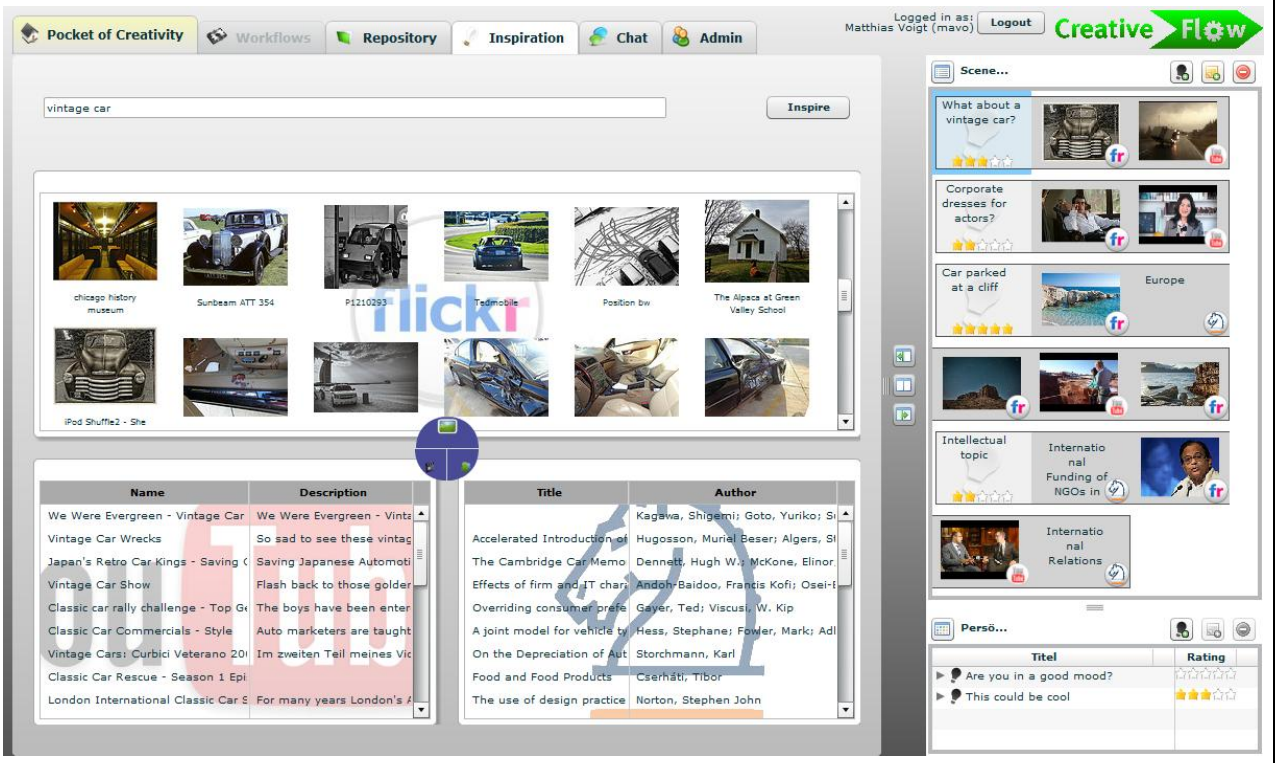

Figure 5. Screenshot of the "Inspiration" Tab of the CreativeFlow Groupware System

As to DP 4, structured sub-processes also occur within pockets of creativity. To meet this circumstance, *standard workflows* can be predefined in the workflow system. They may then be triggered from within the groupware, more specifically from a group task. The workflow is then executed by a user of the workflow system (Figure 3), allowing "creative roles" to focus exclusively on the creative group processes. Once the workflow is completed, a notification is sent back to the groupware along with the output of the workflow.

Comparison to Other Creativity-Support Systems

The distinct approach of CreativeFlow in supporting creative processes is illustrated with a comparison to two other creativity support systems: MUSE and IdeaStream.

MUSE is a creativity support system that focuses on the support of individuals in divergent and convergent thinking [Müller, Debortoli, and Seidel, 2013]. Divergent thinking is fostered by the provision of stimuli in the form of knowledge items. The stimuli are retrieved either from external sources or from a knowledge base internal to the system. Convergence is fostered by categorizing and filtering knowledge items. IdeaStream facilitates creativity techniques, for both individuals and groups, fostering divergence and convergence [Forster, 2009]. Individual as well as collaborative creativity techniques for divergence and convergence may be combined in an overall creative process, which then is controlled by the system. In comparison, CreativeFlow supports creative group processes for collaborative divergence and convergence and embeds creative group processes in the overall creativity-intensive process (business process support). Thus, besides supporting creativity on an individual and group level, CreativeFlow additionally supports creativity on an organizational level.

Table 1: Scope of Evaluation					
Tool	**Individual support**		**Group Support**		**Business Process Support**
	Divergence	**Convergence**	**Divergence**	**Convergence**	
MUSE	Presentation of knowledge-related stimuli	Categorization and filtering of knowledge items			
IdeaStream	Individual and collective creativity techniques facilitated and arranged in accordance with a predefined overall creative process.				
CreativeFlow	Individual stimulation with media content (web mash-up)	Idea assessment with idea rating (star voting)	Mutual inspiration by sharing ideas (watch list)	Discussion of ideas (chat)	Control of structured sub-processes for the creativity-intensive process (process-aware information system)

The next section indicates the research design and methodology for evaluating the CPSS architecture.

IV. RESEARCH DESIGN AND METHODOLOGY

There is consensus in DSRIS that evaluation of design theories and artifacts is an essential step of the design research process [Hevner, March, Park and Ram, 2004; Kuechler and Vaishnavi, 2008; March and Smith, 1995; Peffers, Tuunanen, Rothenberger and Chatterjee, 2007]. Hevner [2007] identified three cycles in design science research that involve distinct forms of evaluation: Within the *relevance cycle*, requirements for the artifact are extracted from the field and then, in turn, the artifact is evaluated in the field against those requirements. In the *design cycle*, artifact design takes place in iterative cycles of artifact construction and artifact evaluation. In contrast to field evaluations in the relevance cycle, design evaluations are performed in controlled environments. "[Artifacts] must be rigorously and thoroughly tested in laboratory and experimental situations before releasing the artifact into field testing […]." Within the *rigor cycle*, design is grounded in the existent knowledge base, and evaluation results are generalized and fed back to the knowledge base.

Table 2: Scope of Evaluation	
Aspect	**Description**
Design research process stage	Evaluation within the design cycle [Hevner, 2007]; second design iteration
Approach of evaluation	Evaluation of the CPSS architecture via its instantiation**,** CreativeFlow
Research methodology	Exploratory Focus Groups (EFGs) [Tremblay et al., 2010], tool presentation
Evaluation criterion	Utility; that is, the degree to which CreativeFlow comprehensively supports creativity-intensive processes
Evaluated objects	The CPSS architecture via its instantiation, CreativeFlow

Against that backdrop, the evaluation of the artifact CreativeFlow is presented as part of the design cycle in a controlled environment (Table 2). The approach of evaluation is the assessment of the CPSS architecture via its instantiation CreativeFlow. "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" [Venable, Pries-Heje and Baskerville, 2012, p. 425]. The research methodology of exploratory focus groups (EFGs) is applied, specifically serving the evaluation purpose of artifact improvement: "For the evaluation of an artifact design, exploratory focus groups (EFGs) study the artifact to propose improvements in the design" [Tremblay et al., 2010, p. 121]. A focus group is defined as a moderated discussion in groups of people discussing a subject under the supervision of a moderator [Stewart, Shamdasani and Rook, 2007]. The evaluation criterion is utility—that is, the degree to which CreativeFlow achieves its purpose to support creativity-intensive processes comprehensively (see Table 2). The success in doing so can be measured with both process efficiency and creative performance. As prestage of a field evaluation, the utility of CreativeFlow is assessed qualitatively. No quantitative data is collected on efficiency and creative performance. However, indications for operationalizing both measures are given in Section VI. Evaluation objects are the CPSS architecture and its instantiation CreativeFlow.

We presented a single case study evaluation of CreativeFlow and the CPSS architecture as part of a first design iteration [Becker, Breuker, Heide and Voigt, 2011]. The present paper also incorporates evaluation data from this first evaluation in more depth, and triangulates with evaluation data of the second design iteration, conducted with a modified and extended version of CreativeFlow and the CPSS architecture [Voigt et al., 2013] (Section 4). The

extended version includes support for creative group processes, structured sub-processes in creative group processes, and refers to standard IS types.

Table 3: Focus Group Organizations

#	Industry	Size of Organizations	# Interviewees, Organizational Roles	Length
A	TV production	20 permanents, 150 freelancers	Four: executive producer, production manager, managing screenplay author, head of the postproduction	3.5 h
B	TV production	40 permanents, 200 freelancers	Three: director of development and formats, development editor, promotional editor	2.5 h
C	Tool machine engineering	370 permanents	Five: director for research and development, head of design engineering, three design engineers	4 h

The following describes steps for conducting focus groups and analyzing the results [Tremblay et al., 2010]. We identified a *sample frame*, applying three criteria to select the organizations for the focus groups: (1) the organizations had to perform business processes in which novel as well as useful products (TV formats, machinery engineering drafts) are created on a regular basis. (2) Digital resources had to be of high importance in the business processes, increasing the application value of CreativeFlow. (3) The development of the creative products had to be a collaborative effort, requiring a division of labor. Table 3 summarizes the three selected Organizations A, B, and C, their size, the number and organizational roles of interviewees, and the time elapsed for the focus groups.

We we developed a questioning route, which determines how to proceed in the evaluation. On that basis, we conducted face-to-face evaluation interviews with the interviewee groups, using a semi-structured, open-question questionnaire, which was open to all interviewees during the evaluation (slide presentation). The interview questions were organized according to the design principles implemented in CreativeFlow. We demonstrated CreativeFlow in a live demo, using exemplary creativity-intensive processes that we developed on the basis of priorly conducted telephone interviews with each organization. Every focus group was facilitated by one moderator, who participated in the design of the CPSS architecture and CreativeFlow. The moderator was presenting the tool and asking the questions. She or he was supported by one industry expert who prevented potential misconceptions, being familiarized with the industry specific vocabulary (e.g., for clarification of roles of employees in the organization, for clarification of stages in the design process). Data in the form of interview minutes was collected by the moderator and domain expert and by at least one additional person, who was also responsible for recording the interviews. Equally to the moderator, the industry expert participated in the design of CreativeFlow and the CPSS architecture in order to have an adequate background for interpreting the interview feedback. The data was analyzed and interpreted. The central interview results had been discussed by all interviewers immediately after the focus groups. The moderator integrated the results of those discussions with all data collected, including minutes and interview recordings. She or he analyzed the data and compiled a result data set, which was then again discussed by all interviewees.

CreativeFlow was presented to all focus groups in a live demo. Demonstrations of tool components were followed by questions regarding these components. We asked for the utility, advantages, and disadvantages of design choices and of concrete tool features. We also asked the interviewees for possible improvements for the CPSS architecture and the functionality of CreativeFlow in order to address potential aspects and features, so far disregarded in the design. The feedback of the interviews on CreativeFlow is interpreted against the background of the underlying CPSS architecture. Three kinds of conclusions are drawn: First, if a feature of CreativeFlow is considered useful by the experts, it is concluded that the underlying CPSS design principle is valid. Second, if CreativeFlow needs modifications to meet the specific application context of the interviewees, concepts of the underlying CPSS architecture may persist or may need modifications, depending on the severity of modifications. Third, if features are perceived as superfluous or even contra-productive by the interviewees, CPSS elements need to be modified or excluded.

The next section presents the results and discussion of the focus group interviews. The interviewees' feedback is presented for each design principle, referring to the respective features of CreativeFlow. The feedback is discussed against the backdrop of the design principle and the underlying theoretical construct.

V. EVALUATION RESULTS AND DISCUSSION

Distinctive Support for Structured Sub-Processes and Pockets of Creativity

To verify the validity of design principle 1 (DP1), the first topic of the focus group interviews was the feature of CreativeFlow to support structured sub-processes and pockets of creativity distinctively. In addition, appropriateness of the integration of both process types within the macro-process had to be verified. To address both issues, we asked the interviewees to provide feedback on three potential advantages residing from the tool design: (1) routing of digital results, (2) no sub-processes are forgotten, and (3) automatic control of responsibilities. We specifically asked the following question: "*What is the importance of these advantages in your business context?"*

Routing of digital artifacts. The head of post-production in Organization A stated that the feature for routing of digital creative products is not fully applicable to his tasks. The major part of visual material used in post-production—the rough cut—often is in analogue and not in digital format. Many activities in the post-production are manual. In consequence, only meta-data (e.g., location, status) may prove appropriate to be routed through CreativeFlow. The experts of Organization C emphasized the necessity to store digital artifacts (CAD files) in a central repository in order to allow for version control. Routing of digital artifacts shall thus be restricted to forwarding links to centrally stored artifacts. The visual editor in Organization B considered the routing of artifacts most important of all potential advantages. She stated that effective TV format development depends on the ubiquitous availability of all relevant intermediate results. While the applicability of information systems for the routing of work results is limited to digital artifacts, the feedback of the interviewees can be interpreted as support for the utility of data flow support, as proposed by the CPSS architecture. In turn, the underlying theoretical concept of the macro-process, which is the origin of the necessity of control flow and data flow, is supported.

No sub-processes are forgotten. *"Forgetting important things"* within creativity-intensive processes was deemed to be one of the biggest challenges for all focus groups. The executive producer in Organization A acts as an "inspirer" for his creative teams. He generates creative impulses and asks his creative staff to follow up on and concretize the ideas. However, due to high workloads, the advancement of ideas is often disregarded. Hence, he considered the explicit definition and control of sub-processes to be the most important potential advantages of workflows. This argument was supported by Organization C. The director of development and formats of Organization B added that the importance arises from the complexity of TV format production processes, which in the theoretical understanding of creativity-intensive processes represents the macro-process and the sum of all sub-processes. However, interviewees of all three organizations deemed the absence of process structure in all creative processes the major challenge for the introduction of workflows. For Organization C this mainly manifests in the fact that the different machine development projects differ significantly from each other. Against the backdrop of the CPSS architecture, the question arises whether the workflow system of CreativeFlow is the right choice for implementing the process-aware information system—the system supporting structured sub-processes. Still, distinctive support of structured processes, as defined in DP1, is supported by the evaluation data.

Automatic control of responsibilities. Personal dialogue for discussing and communicating task responsibilities was deemed important to assure the motivation of the team members. According to Organization C, the "automated assignment of responsibilities is contra productive to creativity." For Organization B, the assignment of experts is a selection process that requires intimate knowledge of the team members' competencies. This was deemed to be hardly automatable. Again, the question arises whether the approach of workflows is appropriate as implementation of the process-aware information system for the given context. For the CPSS architecture, the importance of the issue of task assignment for facilitating its timely execution can be interpreted as support for the concept of the macro-process.

Conclusion. The assessment of each feature is shown in Table 4. The improvements proposed by the interviewees could be satisfied with a modified implementation of the CPSS architecture. DP1, per se, was not considered inappropriate and can be maintained as implementation basis. However, in the case of offline material, routing of digital results is restricted to routing of meta-data. To address the overall absence of automatically controllable process structure in the organizations' creativity-intensive processes, and the necessity to assign task responsibilities manually in accordance with the given task, alternative implementations of the process-aware information system with less rigidity in process control should be considered. One candidate could be project management systems, which provide for a general structuring of creativity-intensive processes in process phases (macro-process), but leave process control and task assignment up to the system user. First open discussions in the focus group in Organization C were supportive to project management systems.

Table 4: Assessment of Design Principle 1 and its Implementation			
Feature	**Assessment**	**Conclusion**	**CPSS Architecture**
Routing of digital results	Useful	• In case of offline material, provide meta-data (e.g., location, status) • Store results in a central repository and provide links to results only	• Support for data flow • Support for macro-process
No sub-processes are forgotten	Useful	• Provide for alternative implementations of the process-aware information system (e.g., project management system)	• Choice of process-aware information system implementation is important • Support for creativity-intensive processes
Automatic control of responsibilities	Contra productive	• Exclude feature	• Choice of process-aware information system implementation is important • Support for the macro-process

Decomposition in Group Tasks

The next questions relates to DP2—the decomposition of pockets of creativity to group tasks, as supported by the groupware system. A peculiarity of CreativeFlow is that group tasks may be created and joined freely by all group members. This design choice arose from the goal of guaranteeing a maximum of freedom in creative group processes. Against that background, we asked the interviewees the following question: *"Is it appropriate to decompose the creative group process in group tasks? Is the free creation and participation in group tasks appropriate?"*

Decomposition in group tasks. In Organization A, the interviewees deemed the practice of decomposing pockets of creativity in group tasks as matter of course. Equally, for Organization C, task assignment in projects was common practice. In Organization B, the explicit definition of group tasks was considered to be a good means for not forgetting anything in the creative process. However, the risk may occur that the decomposition leads to a multitude of small group tasks, which could be hard to handle. Against the backdrop of the CPSS architecture, the feedback can be interpreted as support for the concept of group tasks and the decomposition of creativity-intensive processes and pockets of creativity along multiple levels.

Deadline control for group tasks. The director of research and development in Organization C stated that deadline control is an important issue in tool machinery engineering. The overall engineering process has to be kept in sight. This argument was supported by the development editor of Organization B, referring to the TV format development process. However, the director of research and development of Organization C stated that creative group work should not focus merely on deadlines. Time pressure may lead to forgetting valuable ideas and restrict the group's creativity in general. Time management has to be flexible: *"There is no creativity at the push of a button",* so the director. With respect to the CPSS architecture, the feedback supports the necessity of deadlines for group tasks and thus the support of process constraints in pockets of creativity.

Authorization in group task management. Rights and duties of group members for group tasks were part of lilvely discussions in all focus groups. The general topic of these discussions was the role of authorization for group tasks creation and participation. For free group task creation in CreativeFlow, the promotional editor in Organization B stated: *"This kind of liberal working style does not work for creative group work."* Only one group member, the group manager, should be allowed to create group tasks. The group manager has to oversee all group tasks and make sure that the number of group tasks remains manageable. In Organization A, free participation in group tasks was deemed to be appropriate for group work. However, declining participation in group tasks was considered to be a potential source of affront. As a solution, the interviewees proposed to modify CreativeFlow in a way that reasons for declining group task participation can be formulated and communicated with the tool. For Organization C, group task participation was not matter of choice but was obligatory. This feedback reveals a shortcoming of the CPSS architecture, since authorization for group task creation and participation is not considered to an appropriate extent.

Conclusion. The evaluation results of DP2 are shown in Table 5. Group tasks decomposition is an adequate design principle. However, the amount group tasks of a pocket of creativity has to be kept manageable. The necessity to

consider issues of authorization for group task creation and participation requires explicit design guidance. Authorization depends on the specifics of the creativity-intensive processes in each organization. Thus, group task creation and participation rights shall be configurable. For increased utility of implementations of the CPSS architecture, DP2 has to be extended:

DP2: A CPSS must implement the construct of group tasks as a decomposition of pockets of creativity. Group tasks define work packages with milestones, deadlines, and task responsibilities. Differentiated user rights for the creation of or participation in group tasks shall be definable.

Table 5: Assessment of Design Principle 2 and its Implementation

Feature	Assessment	Conclusion	CPSS Architecture
Decomposition in group tasks	Useful	• Retain feature and keep amount of tasks manageable	• Support for group tasks, creativity-intensive processes, and pocket of creativity decomposition
Deadline control for group tasks	Useful	• Retain feature and refine with modifiable deadlines	• Support for deadlines for group tasks and for process constraints in pockets of creativity
Group task authorizations	Newly Proposed	• Extend DP2 for user right management	• Incompleteness of CPSS architecture

Distinctive Support for Creative Group Processes

As a second aspect for the support of pockets of creativity, DP3 instructs to provide support for divergent and convergent group processes. The design principle is implemented in the groupware system in CreativeFlow, providing features to develop collaboratively (divergent) and evaluate (convergent) ideas in groups. The features are implementations of the CPSS component for collaborative idea development. We asked the following question: *"Are the CreativeFlow groupware system features appropriate to support your creative group processes?"*

Inspiration. For Organization B, specifically the *web 2.0 mash-up component* was an attractive feature for individual inspiration. The promotional editor stated that web 2.0 sources such as Youtube or Flickr already are an especially important source of inspiration in her daily work practice. The integration of several web 2.0 services in one application could simplify the search process. The component was also perceived useful by the managing screenplay author in Organization A. The development of (movie / TV serial) stories does not start on the green field, but is rather inspired by what has already been produced. Organization C echoed this statement. The development of machinery components could be inspired by videos from the engineering field, such as videos about production technology for the construction of milling machines. This feedback supports the individual inspiration component of the CPSS architecture and the underlying collaboration pattern "inspire."

Shared idea space / idea space visualizer. The *watch list* as implementation of the shared idea space and its visualization was affirmed to be a handy tool for sharing ideas in groups in all three focus groups. However, several improvements have been proposed by the interviewees. These improvements predominantly address the shared idea space visualizer, in its current version implemented as an *unordered list* of ideas and digital resources. Structuring of ideas and associated digital resources was deemed insufficiently supported. Organizations A and B recommended the implementation of tree structures or mind maps. Throughout the focus group session, a revolving issue for Organization C was the archiving of ideas for later retrieval and reuse in other projects. *"Idea retrieval for all ideas that have been developed in the past would be very helpful to assure knowledge exchange along several generations [of employees],"* stated the director for research and development. In sum, the feature improvements are directed towards advanced visualization and grouping of ideas. This feedback can be interpreted as emphasis for the importance of the share idea space and idea space visualizer within the CPSS architecture.

Shared idea editor / idea space. Organization C doubted that idea generation in machinery engineering would be sufficiently supported by textual descriptions, as it is the case in the *rich text editor* of CreativeFlow. Technical sketches are an important means to document ideas. Accordingly, it was proposed to extend CreativeFlow so that digital sketches could be added to the watch list or even created within CreativeFlow. CAD tools would have to be integrated in CreativeFlow. For Organization B, several issues arose regarding the idea creation and modification: First, the visual editor emphasized the importance of protecting intellectual property in the tool. To that end, she stated that authorship of ideas should be clearly indicated and traceable along the modification of ideas. Moreover, the right to modify and delete ideas should be exclusive to the author of the idea. Second, automatic versioning of ideas should support the tracing of modification of ideas. In that way, it should also be assured that original versions

of ideas could be restored. User rights management and idea versioning require modifications to the shared idea space. In sum, both the *rich-text editor*, as implementation of the shared idea editor, and the archiving of ideas in the shared idea space require richer functionality. With regards to the CPSS architecture, the numerous feature improvement propositions support the importance of the components.

Evaluation component. In CreativeFlow, the *online chat* facilitates collaborative, qualitative idea evaluation. This mode of evaluation was preferred over a quantitative evaluation by Organization B. However, as to Organizations A and B, it should be possible to associate comments in the chat with specific ideas and digital resources in the watch list. Similarly, Organization C deemed qualitative assessment of ideas *"at least equally important"* to the quantitative evaluation. The latter should be implemented with scale ratings to support the selection of ideas. Organizations B and C agreed that final decision making for the single best idea should likewise be supported by the tool. The director of development and formats in Organization B proposed a feature to prioritize ideas. However, the final decision should be up to the team manager: *"I don't want to pitch [an idea] of which I'm not totally convinced."* This refers to the issue of authorization for managing group tasks. CreativeFlow has to provide for both qualitative and quantitative idea assessment. The necessity of an evaluation component, as part of the CPSS architecture, could be confirmed.

Communication component. The interviewees of Organization C stated that the use of computer-mediated communication for group work is not part of their work practice. Face-to-face meetings were deemed inevitable and more effective than virtual ones. In cases of meetings with business units abroad, telephone conferences were the preferred mode of communication. Against that backdrop, the head of design engineering doubted that an online chat would be a "rich" enough communication medium. Moreover, he stated that the affinity to use electronic means of communication will be dependent on the age of the employees in the organization: *"The younger generations probably accustom to using online chats easily, whereas I can't imagine using it."* It was proposed that the communication component in CreativeFlow shall be supplemented with other communication applications such as Voice-over-IP. It may be assumed that the communication component of the groupware system will not replace personal communication. However, it may be seen as a complementary means of communication. In sum, the interviewees support the provision of virtual communication.

Conclusion. None of the groupware features of CreativeFlow was deemed superfluous or inappropriate. Moreover, the discussions didn't provide indications for missing components. All components for collaborative idea development in the CPSS architecture are useful for the support of creative group processes within creativity-intensive processes. However, the interviews indicated numerous propositions for feature implementation improvements, which are shown in Table 6.

Table 6: Assessment of Design Principle 3 and its Implementation

Feature	Assessment	Conclusion	CPSS Architecture
Individual inspiration	Useful	• Retain feature	• Support for individual inspiration component
Shared idea space / Idea space visualizer	Useful	• Add tree structures and mind maps • Allow for idea archiving and retrieval	• Support for shared idea space and idea space visualizer
Shared idea editor	Useful	• Upload of complex artifacts and integration of complex external resource creation tools • Allow for protection of intellectual property • Allow for version management of ideas	• Support for shared idea editor
Evaluation component	Useful	• Associate chat comments with ideas • Allow for scale rating of ideas • Allow prioritizing of ideas for decision making	• Support for evaluation component
Communication component	Useful	• Add further communication applications; e.g., Voice-over-IP	• Support for communication component

Initiation of Standard Workflows in CreativeFlow

The last part of the evaluation was on DP4—the initiation of structured sub-processes from group tasks. Since we implemented structured sub-process as workflows that can be initiated from within the groupware system, we asked the following question: *"Is it useful to support the initiation of workflows from within group tasks?"*

There was a general consensus in the focus groups that workflow control for structured sub-process would prove to be inadequate to support existing work practice. Organization A stated that there were very few structured sub-processes that occur frequently, as opposed to Organizations B and C, where those processes are quite common (e.g., ordering of video material, ordering of engineering parts for design prototyping). However, the structured sub-processes are handled spontaneously and in personal communication, due to the relatively small number of employees in both organizations. Moreover, Organizations A and C stated that some of the structured sub-processes require personal communication. *"In creative work, sometimes one facial expressions tells more than 1000 words,"* stated the director of development and formats of Organization B. Organization A stated that the effort for predefining and implementing workflows pays off only if they are used frequently. In that context, Organizations B and C agreed that control for structured sub-processes could pay off in larger, geographically distributed organizations.

Conclusion. Automated workflow control of structured sub-processes is inadequate for the focus group organizations (Table 7). However, the initiation of standard workflow could go along with computer-mediated communication features such as text messages, chat messages, or Voice-over-IP calls. In that way, the issuer of a workflow could discuss details of the inherent structured sub-processes with the personnel responsible for the workflow. This additional feature could increase the usefulness of standard workflow initiation. Moreover, the feedback of the interviewees suggests that workflow support could be especially useful in larger organizations. This should be subject to further focus group investigations. With regards to the underlying theory, the interviewees confirmed that pockets of creativity in their organizations included structured sub-processes.

Table 7: Assessment of Design Principle 4 and its Implementation

Feature	Assessment	Conclusion	CPSS Architecture
Structured sub-processes in group tasks	Inadequate in the given context	• Enrich initiation of workflows with computer-mediated communication features • Assess workflow eligibility for larger organizations	• No support for outsourcing of structured sub-processes (DP4) • Support for creativity-intensive processes and pocket of creativity decomposition

The next section concludes the CPSS architecture evaluation and indicates implications and limitations.

VI. CONCLUSIONS, IMPLICATIONS, AND LIMITATIONS

Conclusions for CPSS design. The focus group evaluation provided feedback on the utility of the features of CreativeFlow and thus the adequacy of the underlying elements of the CPSS architecture (design principles) to support creativity-intensive processes in general, and creative group processes in particular. The evaluation data shows that the design principles define a system architecture that, in general, comprehensively supports creativity-intensive processes. However, three key issues require modification of the CPSS architecture, modification of its implementation, and reflection of the underlying creativity-related theory:

First, the automatic control of responsibilities (DP1) was deemed contra-productive in the context of creativity-intensive processes. This feature, especially residing from workflow functionality, should be omitted in future system design. One possible solution could be to use less rigid project management systems. Second, the focus groups revealed the necessity of authority in the management of group tasks in the groupware component. Accordingly, DP2 was extended: Discussions in the focus groups indicated that there was no generic, correct configuration of user rights in the group process for creating and participating in group tasks. Rather, this decision is specific to the type of group task (e.g., group tasks involving discussions on the project budget might be more restrictive than tasks for idea brainstorming). DP2 was extended, in that *differentiated user rights for the creation of or participation in group tasks shall be definable.* Third, the initiation of structured sub-processes (workflows in CreativeFlow) from within group tasks was deemed inadequate in the given context of the focus group organizations, all being small and medium sized enterprises. However, the feedback of the interviewees suggests that extended computer-mediated communication support could increase the utility of this feature. Moreover, it was stated that initiation of structured

sub-processes could be more useful in larger organizations. The design principle is maintained, deferring its final assessment to other focus groups in larger organizations.

The CPSS architecture leaves a degree of freedom for its implementation, which may lead to information systems that do not fully satisfy the requirements of creativity-intensive processes (for a discussion of this issue see the next paragraph). Several recommendations for appropriate feature implementations are provided by the interviewees. In a nutshell, these features are the following: less restrictive support of structured processes (project management systems instead of workflow management systems), advanced knowledge visualization (tree structures, mind maps), advanced knowledge management (archiving, retrieval, versioning of information), more support in evaluation (scale rating, prioritizing of ideas), and advanced communication support (Voice-over-IP), both for group collaboration and for initiating structured sub-processes.

Implications for research on CPSS. Four key issues for future research on CPSS emerge from the evaluation: First, we are left to consider that some system requirements reside from the specific context in which the CPSS shall be employed. Though the interview data showed recurring issues for the CPSS architecture and CreativeFlow in all three organizations, some issues are specific to the type of creativity-intensive processes in each organization (e.g., authorization for creating and for joining group tasks in the TV production in Organization B is considerably different from the rights management in tool machine engineering in Organization C). Second, the implementation of CPSS is adequate for larger groups and organizations. SMEs seem to have lower necessity for virtual teamwork in that they handle creativity-intensive processes in a much more ad-hoc and spontaneous way (as it was the case in all three organizations). Thus, efficiency gains—for example, facilitated by automation of structured processes and computer-mediated idea development—might occur especially in larger organizations. Third, besides the evaluation of the architecture for CPSS, there was a permanent struggle for the focus groups to identify structure in the proper creativity-intensive processes. The production manager of Organization A stated: *"In our business operations, we don't have process structure comparable with those in workflows. […] You will hardly be able to structure the processes in the TV industry. There are so many bypasses."* Further research should deal with the question of how structured and pre-determined creativity-intensive processes really are, and what exactly the different dimensions of process structure refer to (sequence of activities in the [macro-]process, responsibilities for activities, exact number of iterations, etc.). The interviewees were much more familiar (and "comfortable") with the notion of "projects" instead of "processes." How do projects relate to processes? The director for research and development in Organization C stated*: "Every project is one of a kind, so the structure of the processes within the project is known vaguely only."*

Fourth, all focus groups confirmed the utility of the groupware system of CreativeFlow, which is an implementation of the components for collaborative idea development of the CPSS architecture. There was support especially for the inspiration component: *"The web mash-up component is a really handy tool. I already use the internet for being inspired,"* stated the promotional editor of Organization B. This finding ties in with prior research, stipulating and affirming the utility of IT support for idea stimulation [Durand and VanHuss, 1992; Müller-Wienbergen et al., 2011; Santanen, Briggs and de Vreede, 2004]. Yet there is a need to refine the instantiation of the architecture, especially with regards to the shared idea editor and evaluation components of the CPSS architecture. To guide purposeful design of tools supporting creative group processes, interdisciplinary research is needed: At the intersection of law and IS, questions arise on the choice of appropriate mechanisms for the management of intellectual property (shared idea editor). Communication science and IS should further explore the issue of the appropriateness of qualitative and quantitative idea evaluation (evaluation component). In general, designers of tools for the support of creative group processes should consider the necessity for continuous and iterative design of ideas: *"The processes for idea and concept development do hardly ever terminate,"* stated the promotional editor of Organization B.

Implication for IS evaluations in DSRIS. The results of the focus group evaluation contribute to the current discussion in DSRIS on the relationship of design theories and its instantiations [e.g., Kuechler and Vaishnavi, 2012; Niehaves, Ortbach and Tavakoli, 2012]. Design theories are normative by nature [Walls, Widmeyer and El Sawy, 1992], in that they give "explicit descriptions […] for constructing and artifact [Gregor, 2006, p. 13]." These descriptions are formulated as design principles or meta-design, respectively [Walls et al., 1992], "governing the development or selection of system features [Markus, Majchrzak and Gasser, 2002, p. 186]."

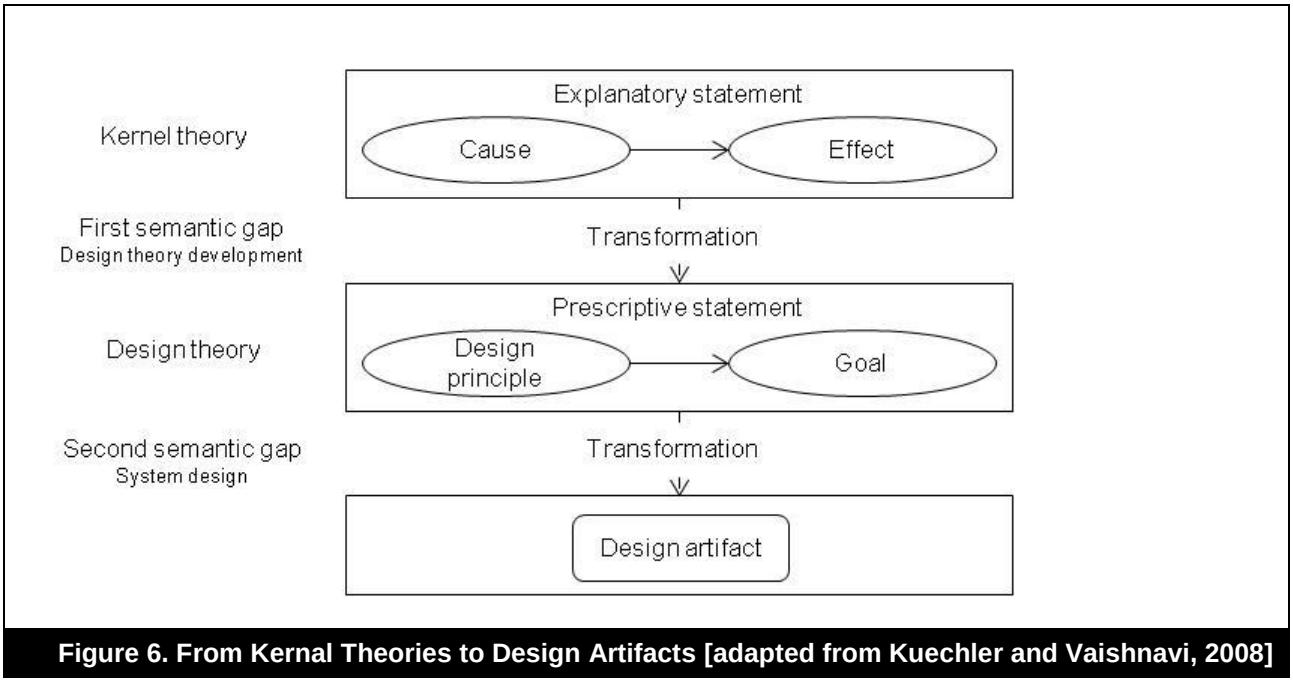

Figure 6. From Kernal Theories to Design Artifacts [adapted from Kuechler and Vaishnavi, 2008]

Design principles shall be based on kernel theories [Markus et al., 2002] or justificatory knowledge, respectively [Gregor and Jones, 2007]. Explanatory statements of cause and effect have to be transformed to prescriptive statements of design principles and goals (see Figure 6) [Kuechler and Vaishnavi, 2008]. This transition requires the bridging of a first semantic gap and is an important challenge in design theory development. The current evaluation reveals considerable challenges occurring in the bridging of the second semantic gap—that is, in the transition from the design theory to the design artifact (see Figure 6). This challenge is generally faced in system design. The evaluation shows that design principles that prove to *potentially* allow for the design of useful information systems still may (partially) fail to do so. The expert feedback on CreativeFlow indicates that this is due to inadequate implementation of the design principles, residing from a high degree of freedom for system designers in interpreting design principles. This inherent degree of freedom has been identified for other design theories as well [e.g., Voigt, Niehaves and Becker, 2012]. As the propositions of the interviewees for desired tool feature show, one possible answer to this challenge could be to integrate feature recommendations in the design theories. Similarly, Gregor and Jones [2007] define an expository instantiation of the design theory as an obligatory component of the design theory. In that way, design principles could be concretized in providing examples for their implementation.

Limitations and Outlook. The current evaluation has two limitations: First, the results of the focus groups depend on the way the tool is presented and how the moderators guide the interviews [Tremblay et al., 2010]. If the interviewees had applied CreativeFlow by themselves without guidance of a moderator, additional or slightly different results could have emerged. We controlled this potential bias by providing a possibly "authentic" impression of the tool with a live demo. Second, exploratory focus groups provide no evidence on the effective utility of CreativeFlow when applied in real-world scenarios. After implementing the design improvements in CreativeFlow, field evaluations within relevance cycles [Hevner, 2007] have to be conducted. For rigorous experimental evaluation, dependent variables (in line with the purpose of CPSS) and independent variables (represented by tool variations) have to be identified [Niehaves et al., 2012]: As to the beginning of the paper, dependent variables to be influenced by CPSS are creative performance [Dean et al., 2006] and business process efficiency (e.g., cycle time, process costs). The independent variables under consideration could be a type of IS to support creativity-intensive processes (e.g., CPSS, Groupware only, process-aware information system only, electronic brainstorming tool, and project management system) or the tool design specifics of CPSS (e.g., playfulness, comprehension, specialization) [Voigt et al., 2012]. The experiment could further cover a comparison of alternative implementations of the CPSS architecture. In that way, varying support of the architecture components could help to verify the contribution of the CPSS architecture to comprehensively support for creativity-intensive processes across multiple instantiations. Candidates for CPSS implementations could be commercial collaboration tools such as Microsoft Sharepoint[3] or the HYPE[4] innovation platform. Insights in the usefulness of these widely applied tools could provide organizations with decision support in the software selection process.

[3] cf. http://office.microsoft.com/en-us/sharepoint/
[4] cf. http://www.hypeinnovation.com/

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web can gain direct access to these linked references. Readers are warned, however, that:

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ABOUT THE AUTHOR

Matthias Voigt is an associated member of the European Research Center for Information Systems (ERCIS) and received his Ph.D. at the University of Münster, Germany. His dissertational thesis is on the development and evaluation of an information system architecture for supporting creativity-intensive processes. His research interests are business process management, creativity and innovation management, and information system architecture development. Matthias has published peer-reviewed articles in international journals such as the *Business & Information Systems Engineering (BISE) Journal* as well as in proceedings of international conferences (e.g., *AMCIS, ECIS, HICSS*). Since 2013, Matthias has been consultant for technology advisory services.

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