Creative Intensive Processes

An approach to model creative work

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Abstract

Creativity – developing something new and useful – is a constant challenge in the working world. Work processes, services, or products must be sensibly adapted to changing times. To be able to analyze and, if necessary, adapt creativity in work processes, a precise understanding of these creative activities is necessary. Process modeling techniques are often used to capture business processes, represent them graphically and analyze them for adaptation possibilities. This has been very limited for creative work.

An accurate understanding of creative work is subject to the challenge that, on the one hand, it is usually very complex and iterative. On the other hand, it is at least partially unpredictable as new things emerge. How can the complexity of creative business processes be adequately addressed and simultaneously manageable? This dissertation attempts to answer this question by first developing a precise process understanding of creative work. In an interdisciplinary approach, the literature on the process description of creativity-intensive work is analyzed from the perspective of psychology, organizational studies, and business informatics.

In addition, a digital ethnographic study in the context of software development is used to analyze creative work. A model is developed based on which four elementary process components can be analyzed: **I**ntention of the creative activity, **C**reation to develop the new, **E**evaluation to assess its meaningfulness, and **P**lanning of the activities arising in the process – in short, the ICEP model.

These four process elements are then translated into the Knockledge Modeling Description Language (KMDL), which was developed to capture and represent knowledge-intensive business processes. The modeling extension based on the ICEP model enables creative business processes to be identified and specified without the need for extensive modeling of all process details. The modeling extension proposed here was developed using ethnographic data and then applied to other organizational process contexts. The modeling method was applied to other business contexts and evaluated by external parties as part of two expert studies.

The developed ICEP model provides an analytical framework for complex creative work processes. It can be comprehensively integrated into process models by transforming it into a modeling method, thus expanding the understanding of existing creative work in as-is process analyses.

Zusammenfassung

Kreativität – etwas Neues und Nützliches zu entwickeln – ist eine ständige Herausforderung in der Arbeitswelt. Arbeitsabläufe, Dienstleistungen oder Produkte müssen sinnvoll an den Wandel der Zeit angepasst werden. Um die Kreativität in Arbeitsprozessen analysieren und gegebenenfalls anpassen zu können, ist ein genaues Verständnis dieser kreativen Aktivitäten notwendig. Prozessmodellierungstechniken werden häufig eingesetzt, um Geschäftsprozesse zu erfassen, grafisch darzustellen und auf Anpassungsmöglichkeiten zu analysieren. Dies ist für kreative Arbeit nur sehr begrenzt möglich.

Ein genaues Verständnis der kreativen Arbeit unterliegt der Herausforderung, dass sie zum einen in der Regel sehr komplex und iterativ ist. Andererseits ist sie zumindest teilweise unvorhersehbar, da immer wieder Neues entsteht. Wie lässt sich die Komplexität kreativer Geschäftsprozesse adäquat adressieren und gleichzeitig handhabbar machen? Diese Dissertation versucht, diese Frage zu beantworten, indem sie zunächst ein präzises Prozessverständnis kreativer Arbeit entwickelt. In einem interdisziplinären Ansatz wird die Literatur zur Prozessbeschreibung kreativitätsintensiver Arbeit aus der Perspektive der Psychologie, der Organisationswissenschaft und der Wirtschaftsinformatik analysiert.

Darüber hinaus wird eine digital-ethnographische Studie im Kontext der Softwareentwicklung zur Analyse kreativer Arbeit herangezogen. Es wird ein Modell entwickelt, auf dessen Basis vier elementare Prozesskomponenten identifiziert werden können: **I**ntention der kreativen Tätigkeit, **C**reation zur Entwicklung des Neuen, **E**valuation zur Beurteilung der Sinnhaftigkeit und **P**lanung der im Prozess anfallenden Aktivitäten - kurz: das ICEP-Modell.

Diese vier Prozesselemente werden dann in die Knockledge Modeling Description Language (KMDL) übersetzt, die zur Erfassung und Darstellung wissensintensiver Geschäftsprozesse entwickelt wurde. Die Modellierungserweiterung auf der Grundlage des ICEP-Modells ermöglicht es, kreative Geschäftsprozesse zu identifizieren und zu spezifizieren, ohne dass eine umfangreiche Modellierung aller Prozessdetails erforderlich ist. Die hier vorgeschlagene Modellierungserweiterung wurde anhand ethnographischer Daten entwickelt und anschließend auf andere organisatorische Prozesskontexte angewendet. Die Modellierungsmethode wurde auf andere Geschäftskontexte angewandt und im Rahmen von zwei Expertenstudien von Modellierern evaluiert.

Das entwickelte ICEP-Modell bietet einen analytischen Rahmen für komplexe kreative Arbeitsprozesse. Es kann durch die Umwandlung in eine Modellierungsmethode umfassend in Prozessmodelle integriert werden und erweitert so das Verständnis für bestehende kreative Arbeit in Ist-Prozess-Analysen.

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List of abbreviations

ARIS	Architecture of Integrated Information Systems
BPM	business process management
BPMN	Business Process Model and Notation
CEO	Chief Executive Officer
CiP	creative intensive process
CMMN	Case Management Model and Notation
CSS	creative support systems
DCM	Dynamic Componential Model
EPC	Event-driven Process Chain
ER	Entity Relationship
GOM	Guidelines of Modeling
GPO-WM	Business process oriented knowledge management
ICEP	Intention, Creation, Evaluation, Planning
IS	Information Systems
ITU	intention to use
KiP	knowledge intensive processes
KMDL	Knowledge Modeling Description Language
PD	Prototype Development
PEOU	perceived ease of use
PO	PoV-Product Owner

PoC	Pockets of Creativity
PoV	proof-of-value
PU	perceived usefulness
RD	routine dynamics
SPA	social pedagogical assistance
SPO	Senior Product Owner
TAM	Technology Acceptance Model
UML	Unified Modeling Language
USP	Unique Selling Point
YAWL	Yet Another Workflow Language
4-P	person, process, product, press
7PMG	seven Process Modeling Guidelines

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Creativity is understandable, but no less admirable for that.

Simon (1988)

1. Introduction

Creative thinking fuels progress and adequate advancement as the prerequisite for innovation development. In times of rapid technological, cultural, and societal changes, creativity is becoming increasingly important (Karwowski & Soszynski, 2008) and is valued by managers, politicians, employees, and scholars alike (Archibugi, Filippetti, & Frenz, 2013). Indeed, managers consider innovations as one of the key determinants of business success (Barsh, Capozzi, & Davidson, 2008).

With this importance to the business world, the management of innovation has been studied from many angles, and in part, this is also true for creativity. Creative thinking and performance are mainly studied from a psychological, individual-centered perspective, which focuses on its development, innate dispositions, training methods, and personality trait associations, to name a few. However, creative performance – like any performance – unfolds under specific situational *processual* circumstances. Such a process focus is present in the literature, but as the following chapter will show, comparatively underrepresented.

The need to foster creativity is taken for granted, and it is assumed that more creativity is helpful for organizational development and overall success (Mould, 2018). However, measures for improvement and change require a fundamental understanding of what needs to change. This requires, on the one hand, an understanding of creativity and, on the other hand, an understanding of where and how to find it in the processes.

Business processes are best analyzed using business process management (BPM) methods. Research and practice have developed BPM into a discipline that has proven to drive the competitiveness of organizations (Hammer, 2004), as it is concerned with the design, implementation, and monitoring of efficient and effective business processes. To achieve that, visualization tools are used to represent the process flow. Such business process modeling techniques are increasingly used for human-centered process aspects but especially lack methods to visualize agile processes, just like creative ones. In 2015, BPM was ascribed to a new role: to foster the management of creative processes and support the development of new products and potential innovations (vom Brocke & Schmiedel, 2015). However, only one explicit approach which aims to capture and model creative processes could be found so far (Karow & Reul, 2012).

Research on creativity and BPM is extensive. Much is known about creative work, and many specified BPM methods and modeling tools exist. However, the research streams underlying those efforts are still rather less combined. ”Extant BPM models and methods focus on structured and standardizable processes. However, knowledge-intensive and dynamic business processes tend to be neglected.” (vom Brocke & Schmiedel, 2015, p.10). From a practitioner’s perspective, especially those human-centered, knowledge-intensive processes are complex and difficult to manage. This emphasizes the need for easy methods to better capture and comprehend these processes’ complexity. In particular, a conscious approach to individual creative processes and the associated conducive working conditions is needed. This dissertation attempts to combine both worlds of research – creativity and process modeling – and thereby offer new possibilities for modeling creative work. Doing so provides methods for detecting and understanding creative process features, which can be further used for process improvements.

1.1 Motivation

Creative work is characterized as developing something new and useful, for example, solving a problem, developing a concept, or seeking possible applications. Since it is uncertain what and how exactly can be done to solve the issue – it has never been done before – one approaches a potential solution iteratively, partly in a try-and-error manner. From a process perspective, the result is a complex, looped process – at least from retrospective process flow analysis. Prospectively, such a process can only be predicted in a very abstract way.

Capturing and modeling socio-technical systems is a complex task. This is due to the inherent complexity of the original system to be modeled and the subjective perspective that process actors have on the overall system. The modeling of a business process is done based on recognizable process patterns. In the case of creative work, such recognition is easily lost, as creative work requires actors to deviate from prior process runs to account for the new. This requires the modeler to abstract the creative work, leading to oversimplified modeling approaches. Information about the work done within this abstracted task gets lost, like the number of iterations done or mandatory sub-processes. Alternatively, the modeler could add all single process instances, potentially resulting in an overly detailed, complex model.

The challenge in this dissertation is to abstract creative processes enough so they are generalized but add specifics to enhance the information about the creative work in the process models. This dilemma of modeled process granularity requires a proper modeling method. Specifically, how the ”black-boxing” of creative work (Cohendet, Llerena, & Simon, 2014) vs. modeling all the specific details and process iterations creative work typically expresses can best be balanced.

1.2 Goal of this thesis

This thesis aims to link knowledge about creativity with formal business process analysis. In detail, characteristics of creative business processes are integrated into a business process modeling language. Creativity here is mainly studied from psychological research basis on creative performance, in combination with organizational studies on creative business processes. Supplemented by my research results, findings from these research areas will expand modeling methods for representing creative business processes.

More specifically, I aim to improve process discovery and analysis of creative work as described in the business process management life cycle (Dumas, La Rosa, Mendling, & Reijers, 2013). By specifying model representations for creativity, the gap between model and reality can potentially be minimized (Schmidt & Nurcan, 2008). The goal of this work is to gain a better and more accurate understanding of where and how creative work is performed within an organizational process landscape by being able to represent creative process specifics in process models. This knowledge, in turn, is the first step toward potentially improving creative work.

The purpose of this research is primarily to find a suitable way to model creative business processes. In doing so, a model to capture the basics of creative work was developed. Aiming for a modeling method for creative work, the literature review, combined with an ethnographic analysis of creative work performances, led to the development of the *Intention, Creation, Evaluation, Planning (ICEP)* model. ICEP can be used by practitioners to manage creative work also beyond the usage of modeling methods.

My basic research approach is an interdisciplinary one. By combining different scientific fields - psychology, organizational sciences, and business informatics - these different research perspectives broaden the overall understanding of the universal phenomenon of creative work. In this sense, by using ethnographic methods to collect and analyze data on creative work, I also support the interdisciplinary application and understanding of this method, which is mainly used and appreciated in organizational research.

1.3 Research questions

As outlined above: I follow the basic assumption that a precise process understanding leads to better process performance and aids potential process adjustment. To understand a business process, its best modeled. To model a creative process, the dilemma of granularity must be overcome, which poses the main problem addressed in this work:

Research problem *How can creative business processes be specified to be still manageable?*

To approach the aim to model creative work concisely, the characteristics and specific features of a creative intensive process (CiP) need to be understood. First, creative performance at work is analyzed from a general point of view to achieve a concise conceptualization of CiPs. Then the focus is set on the precise modeling goal:

Research question 1: *What are the characteristics of CiPs to be modeled?*

Along with this main question, several sub-questions partly resulted from the ongoing literature search, as well as through the interaction with practitioners from the field engaging in creative work:

- What is specific about creative work?
- How can CiPs be defined?

- When is a process a creative one?
- What are the core aspects of occupational creative work?

The analysis of creative performance using the case of rapid prototype design led to the ICEP model. It aims to defy the complexity of creative performance by defining four core aspects. The ICEP model serves as a concise, descriptive tool for creative work. Based on that, the actual goal of proposing a modeling method is addressed:

Research question 2: *How can CiPs effectively be visualized using a modeling notation language?*

This main research question also comes with more specific questions, some of which arose during the examination of the main question and which require a thorough analysis:

- What modeling methods exist to represent creative work?
- Which language is best suited to represent creative work?
- How can the ICEP model be best incorporated into a modeling language?
- How can the modeling extensions be applied to process data from creative work?
- How are the modeling extensions for creative work perceived by modeling experts?

In the following work, answering these research questions, I take a pragmatist philosophical stance. I am confident that my research is wrong in accurately capturing *reality*. Still, the way the following research is conducted, analyzed, and interpreted represents my best attempt at an approximation to what I call reality.

> ”And really that is the pragmatist position: every hypothesis, every theory is nothing more than a construction, it is something we are

saying, it is an argument we are constructing, it is a belief that we have. And we know we are wrong. This is the key to fallibilism of pragmatism, that every time we make a construction, we know it's imperfect, so it is not the end all right answer, and we know it is wrong in some way, but it is an assertion." (Berente & Recker, 2022, 35:25)

1.4 Thesis structure

There is no unified, accepted standard approach on how to advance a modeling language (cf. Czech, Moser, and Pichler 2020). Exploiting this circumstance, in this thesis, I propose how the presented fundamental dilemma of modeling creative work processes can be analyzed in an interdisciplinary way. Due to the positioning of the concept of creativity at the center of this work, the basics of modeling will be treated later. My understanding is that the object of consideration must first be comprehensively analyzed and understood before it can be practically integrated into methods such as process modeling.

To answer the first research question, several research steps are performed. First, the literature in the field of creativity is analyzed. A comprehensive understanding of this complex concept is needed to develop concrete proposals for modeling (Chapter 2). Second, the specifics of CiP are analyzed from a broader perspective. As the focus lies on business processes, literature from Organizational Science adds specifics to the occupational settings of creative work (Chapter 3). The understanding of how creative work unfolds in practice is enhanced through an ethnographic study in the field of rapid prototype design, which led to the development of the ICEP model. Based on this, the requirements for modeling creative work are specified (Chapter 4).

The second research question, the modeling of CiP, is also addressed in several working steps. First, the literature on modeling methods is reviewed for ways to represent creativity. Based on the definition of CiP, a metamodel is derived to represent all relevant creative work features. This is then used to define modeling extensions, using Knowledge Modeling Description Language (KMDL) (Chapter 5). These modeling extensions are applied to three different business process contexts. Through two expert studies, the developed method was applied and evaluated in depth and with general applicability, leading to further improvements (Chapter 6). In the final chapter, the results are discussed, along with limitations and further implications (Chapter 7). Figure 1.1 shows an overview of the thesis structure.

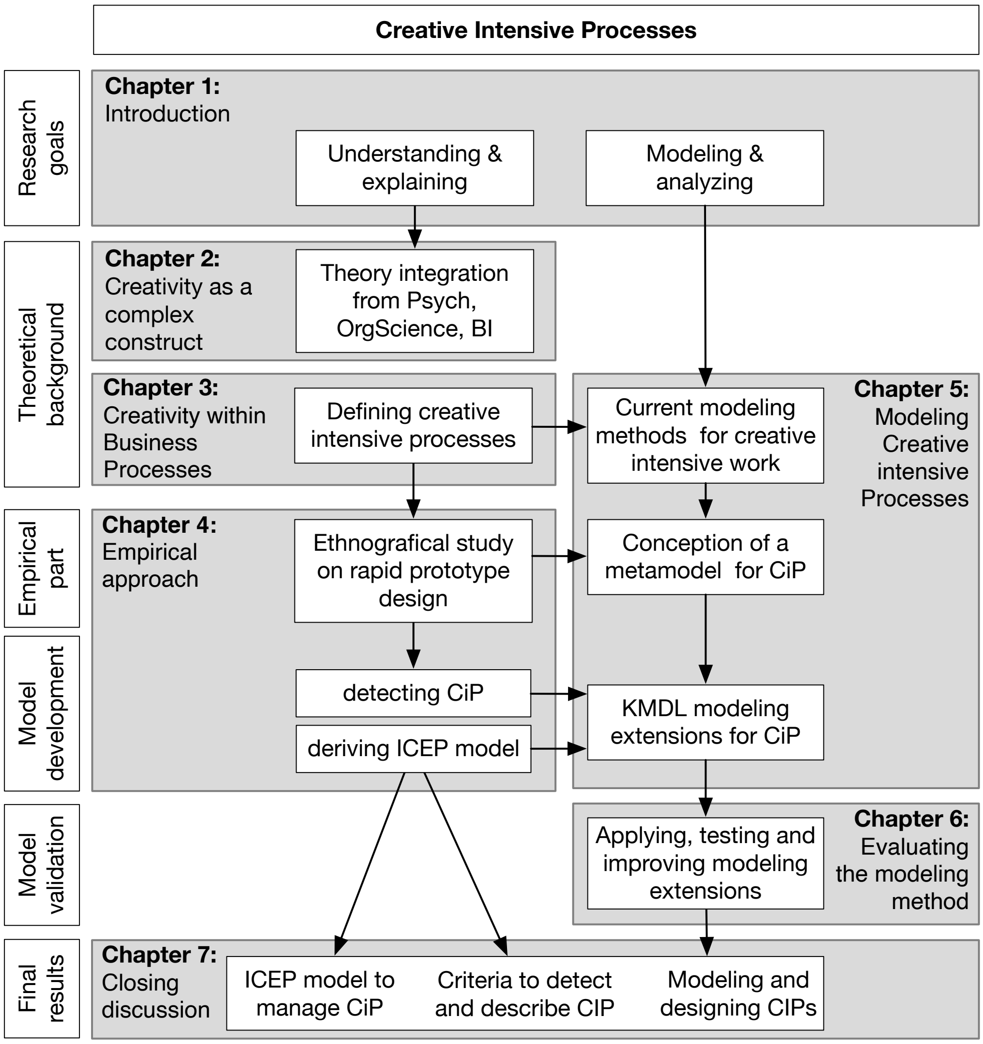


Figure 1.1: Overview of the thesis structure

While creativity is an easy concept to understand, it is difficult to define.

Green and Kaufman (2015)

2. Creativity as a complex construct

It would have been easy to explain *creativity* a hundred years ago. First, almost no one would have raised the issue of understanding creativity, as it was barely used. As an example taken from the Google Ngram Viewer for word counts from English books published after 1800, the term *creativity* did not occur much in written form before 1930[1]. It was the common understanding that *creare* (lat. for 'produce', 'to make') refers to divine creation *ex nihilo* and was thus used solely in the context of god or god-like geniuses (Tatarkiewicz, 1980). The humanization of the term *creativity* happened right after the second world war. Rather slowly, the god-like association with the term morphed into an understanding of innate human power. "Only gradually and fitfully did a specifically human sense of agency creep into the meaning of 'create'" (Pope, 2005, p. 38).

The spark of the scientific concept of *creativity* as we know it today came from the intelligence-researcher John P. Guilford as he expressed the need for the psychological community to explicitly look into the phenomenon of *creativity* (Guilford, 1950). Since then, the term and the concept have seen continued and ever-growing usage and development. So far so, today, the word is so overly present that its content is almost hollowed out. We all want to be more creative, as promised – especially in western societies – to benefit significantly from the creative spark in private and occupational matters (Mould, 2018).

[1] https://books.google.com/ngrams

The following chapter presents the current conceptual understanding of creativity from the relevant angles in this work's context. First, the concept is defined, and its breadth and complexity are briefly presented. In particular, the person, process, product, press (4-P) concept has proven helpful in explaining creativity as a whole, which will be shortly presented. Followed by the three perspectives I focus on in this work: Psychology, Organizational Science, and Business Informatics.

2.1 An approach to define creativity

Creativity can be broadly defined as the ability to produce something new and useful (Runco & Jaeger, 2012). This represents the concept's core, like the common divisor most researchers agree upon. First and foremost, a creative act results in the emergence of *something*, which corresponds to the aspect of *new*. Focusing solely on the *new* aspect, it soon becomes apparent that this alone is not enough. Creating something new for the sake of being different or acting in nonconformity would not necessarily result in something we would consider as *creative*. What is created needs to be in some way or the other *useful*, in terms of effective or relevant to some degree (Cropley, 2011). Both aspects leave some room for questions and debates, like ”New for whom?” or ”Effective or relevant to what degree?”. Especially in pseudo-scientific literature, one can often find the notion that creative ideas arise from a blank slate, defining *new* in absolute terms. However, a closer look at even highly creative and seemingly *new* ideas shows that there is always a linkage in some form to already existing ideas, concepts, or knowledge. Thus, the *new* aspect of creativity should be understood as a unique combination of existing knowledge, appearing to us as new (e.g., Johnson 2011).

Concerning the *useful* aspect, a strong dependency on societal and individual interpretation becomes apparent. What constitutes usefulness is solely in the eye of the beholder. Thus, there is no ”objective” understanding of *creativity*, as a core aspect of its definition is solely subjective. Recurring debates about ”art or garbage" in abstract art scenes illustrate this quite nicely. The theories developed to explain creativity address some of the ambiguous concepts presented in the following section.

The most prominent definitions aim at a more holistic approach than the sole focus on the creation of *something new and useful*:

> Creativity is the interaction among *aptitude, process, and environment* by which an individual or group produces a *perceptible product* that is both *novel and useful* as defined within a *social context.* (Plucker, 2004, p.90, emphasis in original)

Here, the embedding of the individual's work in the ecological and social context becomes clear. This is one way of appreciating the subjectivity of work as something creative by including it in the assessment of the environment. Another way is to precisely define creativity within such an environment, such as the art or design industry, to capture specific contexts (Puryear & Lamb, 2020).

2.2 Capturing the creativity's complexity

Over the last seven decades of active creativity research, numerous attempts have been made to structure and cluster the diverse concepts of creativity. Many researchers looked into the phenomena of *creativity*, so a huge research body with various, partly conflicting, theories about the mechanisms and explanations of creative work emerged. Kaufman and Sternberg (2019) distinguished between ten theoretical approaches most common in the literature: *Developmental*, *Psychometric*, *Economic*, *Stage and Componential Process*, *Cognitive*, *Problem-Solving and Expertise-Based*, *Problem Finding*, *Evolutionary*, *Typological*, and *Systems.* Those cannot be understood as completely distinct from each other. Instead, the goal is to promote an understanding of the various perspectives and approaches related to the concept of creativity. The first, *Developmental* theories aim to explain where this individual cognitive capacity comes from and how it changes over the lifespan.

Psychometric theories focus on assessment issues of creativity and thus are applied in most other theory categories. Here, particular focus is put on different aspects of the concept and how to measure those (e.g., convergent vs. divergent thinking, see Section 2.4.1 on page 24). In contrast, *Economic* theories put creativity in a more extensive social context, in which individual creative behavior is seen as dependent on macro-social and economic pressures.

Stage and Componential Process theories address the complexity of creativity by assigning certain divisions for the process (which is often seen as a recursive, iterative stage-like process), the output-level (like small, everyday like creative output, called little-c vs. great world-changing creative endeavors, called Big-C), and preconditions of a creative person to act creatively successfully (as an integration of several individual competencies, emotions, and motivation).

Cognitive theories focus on individual differences in cognitive mechanisms involved in creative acts. Such mechanisms can be of a relatively broad focus, like attention and memory capacities, or creativity-specific, like remote associations or divergent thinking. Related to that are *Problem-Solving and Expertise-Based* theories as those focus on cognitive strategies to find and elaborate on a creative problem, mainly focusing on expertise as a means of addressing complex creative problem domains.

Problem Finding theories developed as a counterbalance to the mere problem-solving-focused theories. Here, it is argued that the discovery of a creative and complex problem should be considered a crucial part of the creative process. The individual's abilities vary similarly to those for solving problems.

Evolutionary theories compare to the Darwinian model, as ideas get generated blindly (usually subconsciously) and selected based on criteria of potential success. Only the most promising ideas will then be transformed into products. This approach mimics the principles of the Darwinian random combination and success-based selection of traits.

Typological theories aim to find crucial differences between individual creators systematically. This allows for a broad understanding of important influences, like specific preferences in thinking or approaching creative problems. However, such theories show typical signs of oversimplification and mostly ignore the multi-faced nature of the creativity concept. This is why the theories shifted to continuous dimensions instead of categories.

Last, *Systems* theories perceive creativity as a complex phenomenon in which several components and aspects beyond the mere cognitive and individual focus must be integrated. Especially aspects of the (social) system surrounding the creative individual are considered, which enriches but complicates any empirical endeavors. One prominent holistic approach, which could be considered an example of a systems theory, is the 4-P model of creativity (Rhodes, 1961), which is described in greater detail below.

2.3 The 4-P model of creativity

Creativity is argued to be fully represented by the four main perspectives *Person*, *Process*, *Product*, and *Press*. These can be used to differentiate the actor (person) from the act (process), the result (product), and the influencing environment (press, cf. Figure 2.1). Such a distinction is also mirrored within the definition by Plucker (2004) cited above (cf. page 11) and is used to clarify which angle is taken to look at the multidimensional concept of creativity.

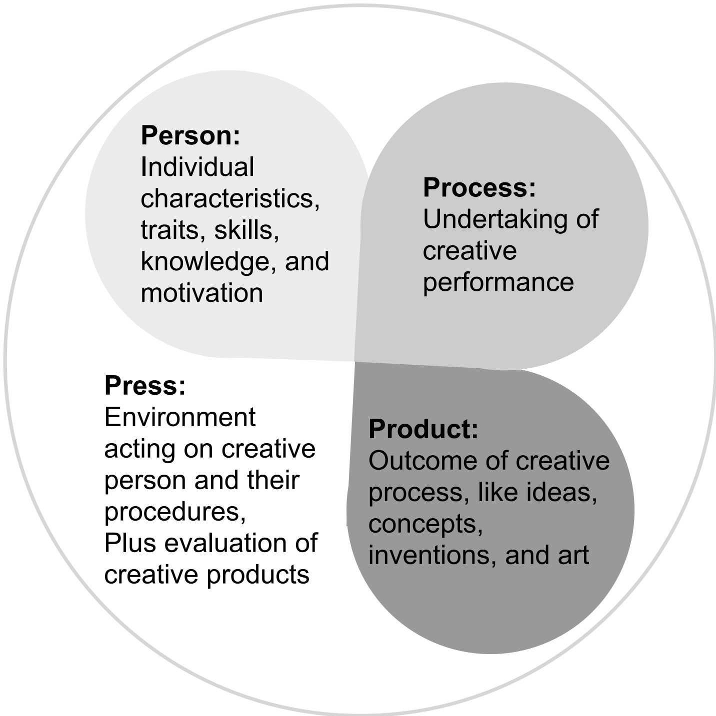


Figure 2.1: Overview of the 4-P-model of creativity

2.3.1 Person

Taking the *person*-perspective, the individual actor with its traits, habits, attitudes, personal beliefs, cognitive competencies, and behavior is focused on. This is the perspective typically taken from Psychology, in which relational analyses are performed to understand better the dependencies between creative abilities and other individual factors. The focus is on questions about the heritage of creative abilities and their connection with intelligence and personality. Also of interest are the relations between creative abilities and more flexible individual aspects, like self-beliefs, habits, and behavior.

To get a general idea about such relations, meta-analyses are performed to aggregate and accumulate prior analyses of individual conceptual relationships. Da Costa and colleagues (2015) went a step further by conducting a second-order meta-analysis of personal factors of creativity. They compared the results of up to seven meta-analyses about the relationship of creativity with intelligence, personality factors like openness, creative self-beliefs, motivation, and individual characteristics like education and gender. Their results revealed the strongest relations between creative abilities with divergent thinking (mean effect combining several studies, $\bar{r} = .27$), openness to experience ($\bar{r} = .22$), creative personality ($\bar{r} = .21$), intrinsic motivation ($\bar{r} = .20$), positive affect ($\bar{r} = .19$), intelligence ($\bar{r} = .17$), self-efficacy ($\bar{r} = .13$) and extraversion ($\bar{r} = .12$). This is in line with several other analyses not part of this second-order-meta-analysis.

Divergent thinking

As for divergent thinking, the general ability to think diversely and broadly could be perceived as the core competence associated with creativity. Indeed, da Costa's analyses showed the strongest relation with it. However, it is far from being synonymous with creativity, as the mean effect size of $\bar{r} = .27$ shows (da Costa et al., 2015). Instead, it should be seen as an indicator of the potential to think creatively (Runco, Kim, Runco, & Pritzker, 2011). One reason why divergent thinking is often perceived as synonymous with creative thinking might be that an overwhelming amount of studies about creativity rely on divergent thinking tests. The most commonly used test represents divergent thinking directly (the Alternate Uses Test, Christensen, Guilford, Merrifield, and Wilson 1960) or integrates association tasks as a significant part of the test (e.g., the Torrence Test of Creative Thinking, Torrance 1972). Thus, most papers claiming to analyze a relationship between creativity and an associated concept analyze divergent thinking with this concept. Our knowledge about creativity is greatly narrowed to one aspect of one way to think creatively.

Openness for new experiences

Openness to new experiences is another constant positive predictor of creativity. As one of the big-five facets to fully describe an individual's personality, openness describes a person's motivation and preference to surround oneself with new experiences, places, and people. It captures a person's thirst and interest for unknown and possibly challenging situations (Graham et al., 2020). This is relevant in two ways for creativity: seeking new experiences enhances the chances to learn more and from more diverse fields, which should facilitate creative thinking, as more broad associations from diverse knowledge domains are possible. Such a preference for new experiences would also positively affect a person's motivation to deal with creative problems, as these often represent a new experience in themselves. Other personality factors seem to be important in relation to creativity only in the context of certain domains. For example, creative scientists show higher conscientiousness scores than creative artists (Feist, 1998).

Self-evaluations

Other important, influential personal attributes besides personality aspects come from self-evaluations. In the case of creative behavior, the individual's performance is highly dependent on motivational aspects. This might seem trivial, as most behavior depends highly on the individual's motivation to act or not. Taking the example of intelligence, it becomes apparent that certain aspects of ourselves cannot be changed by motivation alone: even if I would like to score very high on intelligence tests, I could not improve my test scores much for the better, as I am limited to my cognitive abilities (I could, however, worsen my performance when I am lacking the motivation to perform well). In the case of creativity, it could be shown that individuals improve significantly once they set their minds to performing well. This is covered by the concept of *self-efficacy beliefs* from Bandura (1993), which refers to the individual's belief about their ability to perform in specific situations. This influences what individuals try to accomplish, how they approach a task, with the effort they seem to need. It thus does not reflect the competence itself, but the mere belief about it (Lemons, 2010).

Similarly, but conceptually different, is the *creative personality*, capturing the individual's perceived importance of creative abilities and traits for themselves. This, again does not reflect the actual abilities or the creative potential. Instead, it describes the ascribed importance of being creative. The working mechanisms of self-efficacy beliefs and the creative personality are deeply linked to intrinsic motivation. Once a person sees himself as creative and assumes to be competent to solve a task, the motivation to approach and put effort into solving this task should be high. Amabile's Componential Theory (2012) constitutes three aspects within a person influencing the creative process: domain-relevant skills (intelligence, expertise, and talent), creativity-relevant processes (cognitive style for broad associations, and personality qualities in relation to creativity) and task-motivation. The latter is a synonym for intrinsic motivation, leading to engagement in a task because it is perceived as interesting, challenging, and satisfying. An additional aspect that acts on motivation is mood and affect. Generally, a positive mood is positively associated with creative performances. However, it turns out that negative feelings can also positively channel creative thinking, as long as those feelings are activating, like anger or frustration (Baas, De Dreu, & Nijstad, 2008).

Intelligence

The relation of intelligence with creative abilities is a topic of ongoing debate. Da Costa's (2015) second-order meta-analysis of personal factors of creativity showed only weak relations with intelligence, and other studies show even no relation with creativity (e.g., Furnham, Batey, Anand, and Manfield 2008). Following the Componential Theory, intelligence is a factor acting on domain-relevant skills, which are needed to have cognitive ”material” as the basis for creative associations.

Higher levels of intelligence would benefit the acquisition of new information and a quicker processing speed for any cognitive task. This would be less impactful in practice, as creative tasks are not typically time-dependent. Some data shows a possible positive relation up to a certain degree of intelligence, indicating that a reasonable degree of intelligence is a minimum requirement for creativity (as for any cognitive endeavor). However, higher levels of intelligence do not improve creative performances (Batey & Furnham, 2006).

Section summary

Overall, individual factors explain a surprisingly small part of the variation of individual differences in creative performances. In the example of the second-order meta-analysis from da Costa et al. (2015), only 2% of the variance in creative behavior was explained by those individual factors looked upon. Situational factors of the environment, role, and group affiliation proof to be better predictors than individual differences, as humans tend to adapt their behavior to situational claims (Baird, Le, & Lucas, 2006). This underlines the importance of the influence of the environment.

2.3.2 Press

Under *press*, the influence of the environment on the individual's creative performance is focused upon. Multiple ways exist in which the environment influences individuals' intentions and behavior. As social beings, we always depend on our social system, composed of other human beings and their complex interactions (Fiske, 2018). Most famously, this notion is addressed by a systems theory of Mihaly Csikszentmihalyi, who considered the integrative perspective of the individual within a social space necessary to understand creative behavior. He studied the lives of many highly creative and inventive individuals in his work to understand where their creative force comes from (Csikszentmihalyi, 1996). By focusing on individuals, he understood that no individual performance could make sense without a thorough understanding of the individual's environment. The social interactions lead to the individual's success factors: their style of upbringing, their education, their peer influences, political conditions, and many more major and minor influences from the macro-and micro-social environment of the actor.

There are mainly two forces coming from the social environment. First, it nudges the actor with topics and possible creative problems it might care about, and second, it evaluates the individual's creative efforts and gives feedback. Thus, the social environment dramatically impacts the individual's motivation to act and stay motivated based on the ascribed success (or no success) of creative achievements. The key is "that any attribution of creativity must be relative, grounded only in social agreement" (Csikszentmihalyi, 2014, p.49).

The object of assessment is always a kind of *product*, another central perspective on creativity. Although Csikszentmihalyi and colleagues pushed this view in the late 90s, the psychological research community focused on the individual aspects of creativity covered under the *person* part. Vlad Glăveanu revived the social-system view by explicitly calling for a broader socio-cultural perspective on the creativity concept (Glăveanu et al., 2019). In his manifesto, creativity is, among others, defined as a culturally mediated action that stands in constant relation to other humans. Even if an actor works alone on a creative problem, their behavior, thoughts, and ideas are hugely influenced by others' prior work and depend on others' final judgment.

2.3.3 Product

The *product* perspective of creativity focuses on the tangible result of a creative process. It refers to what is created by the actor and what is judged by the social environment. Products can take many forms, like inventions, designs, literature, paintings, or patents. Even an idea spoken out or written down is a product in the broader sense.

Evaluating the product

As shown in the previous section, the creative product is the central element judgments are based on. A concrete result can be seen, assessed, and evaluated. An estimation regarding an individual's creative abilities is often made backward-facing. If a product is considered creative, the process that led to it must have been creative, and the main actors involved must possess some creative abilities. Thus, the judgment of a person's creative abilities relies on their ability to develop a product. Most (individual) creative assessments are based on this implicit assumption. Like the most common association test, Alternate Uses Test, (Christensen et al., 1960), creative abilities are referred to a person's creative output in the test situation.

Similarly, in the business world, employees are judged based on their past creative behavior in the form of successful project implementations, patents, or grants they acquired. This might seem plausible, as it is the most common practice and the most natural and logical way to conclude about individual abilities. However, it equals potential with behavior. This is problematic in at least two ways: first, it falls short of valuing the situational and motivational influence on creative performance. When we apply a creative test, we know that the person is more or less able to perform the assessment tasks in the specific assessment situation. We do not know how the performance would change when the type or topic of assessment changes, the situational pressure, or the individual mental condition of the person on another test day. As our understanding of the complexity of the creativity concept grows, it becomes harder to justify the application of oversimplifying creativity assessments (e.g., Cseh and Jeffries 2019). There are certainly contexts in which such assessments are valid, especially if their limiting nature is considered and reflected upon.

In such settings, when selling ideas is not the primary goal, e.g., in education, creative products should be perceived in their entire version, including forms of ideas, fantasies, and acted-out situational expressiveness. Positive feedback on such behavior can improve the personal belief system toward individual creative capacities, which can be seen as a product of creative performances.

Creative products as innovations

The second issue arising from equaling creative potential with outcome measures is the assumed conceptual proximity with innovation. Creativity and innovation are related but far from synonyms (Amabile, 1988). Whereas creativity is about the generation of ideas, innovation is about executing the idea and transforming it into a business success. When creativity is primarily seen in results, especially in the business world, innovations can easily be mistaken as such. Scholars and companies, however, do benefit from separating those two concepts: creativity is subjective, fuzzy, and complex, whereas innovations based on good ideas can be thoroughly planned, their potential success calculated, and possibly implemented without any further need for creative thinking. This also means that the creative and the innovation process require different skills: innovation is a considerable amount about the grid, planning skills, risk-taking, and logical thinking, whereas creativity is at its core concerned with divergent thinking in the form of broad associations.

Section summary

The *product*-perspective focused on the output generated through the creative process performed by an actor. Ultimately, the product will be used to judge *something* as creative in terms of its newness and usefulness. However, a sole or extended focus on the product falls short of capturing the creativity concept's complexity.

2.3.4 Process

The fourth aspect, the process perspective, looks at the creative act. Here, the focus is on generating ideas or solving a creative problem. As mentioned above, the act can hardly be separated from the actor or the developed result. However, the emphasis is on the performative aspects rather than the person's skills or the result achieved.

Before discussing all the variations and facets of the creative process, it is worth asking how and when the creative process is initiated in the first place. Any motivation to show a specific behavior is either a self-determined choice or triggered externally (Deci & Ryan, 2012). Either way, the basis for behavioral engagement comes from the perceived gap between the present state and a future goal state (Unsworth, 2001). This is often referred to as the "problem", for which the creative process shall bring a solution. However, a creative process does not require a precise problem formulation to be triggered, as the process itself can be applied to find a suitable problem (Abdulla, Paek, Cramond, & Runco, 2020).

Since the present work primarily focuses on the process aspect of creative performance, details about its conceptual understanding will be discussed in the following sections. Here, understanding how it relates to the other P 's is of interest. By taking the process perspective, the historical assumption that ideas magically appear to the actor is questioned, and instead, models of path sequences emerge (e.g., Botella and Lubart 2019). The creative act is aimed to be understood under time aspects, as it unfolds over micro-time spans of seconds (as for an idea popping up, e.g., Barlow 2001) up to more specific time spans like life-times as in analyses of artists or inventors (e.g., Csikszentmihalyi 1996). Broadly, the creative act is characterized by apparently contradicting forces: focusing on the problem whereas needing a distant perspective for remote associations found for the solution. They are accumulating many ideas versus picking the best-fitting one, being open to diverse topics and activities versus mastering specific skills, or critically thinking about creative problems vs. taking distance to let room for subconscious processing.

In the following section, the question of how exactly creative performances unfold is focused upon by combining several perspectives to address the multi-facet phenomena of creative performance at work.

2.4 The creative process: generating ideas

When addressing creative processes in an organizational context, primarily three streams of research are most appealing to focus on (cf. Figure 2.2). First, as previously explained, the actor is challenging to separate from the act. Thus, a psychological perspective serves with its individual-focused theories for explanations on an entity level. Further, as the broader concept of creativity is historically most broadly analyzed and conceptualized from a psychological perspective, it provides rich information on the general understanding of the concept (as the previous chapter displayed). The creative processes are embedded to create a contextual understanding of the specific work environments, and the research will be approached from an organizational science perspective. Here, several classical research streams are combined, like Sociology, Organizational Psychology, and Economics, to mention a few. Especially the concept of *organizational routines* proves to be useful as it is one conceptual way to explain how most work in organizations is done (cf. Section 3.3 on page 59). A Business Informatics perspective complements these approaches. Here, tools are developed to analyze and ideally adjust business processes for the better. This entails a rather pragmatic approach to analyzing business processes within organizations, which has hugely beneficial implications for the feasibility of research outcomes.

Those three compartments are also found within the definition by Plucker (2004) cited above: "Creativity is the interaction among aptitude, process, and environ-

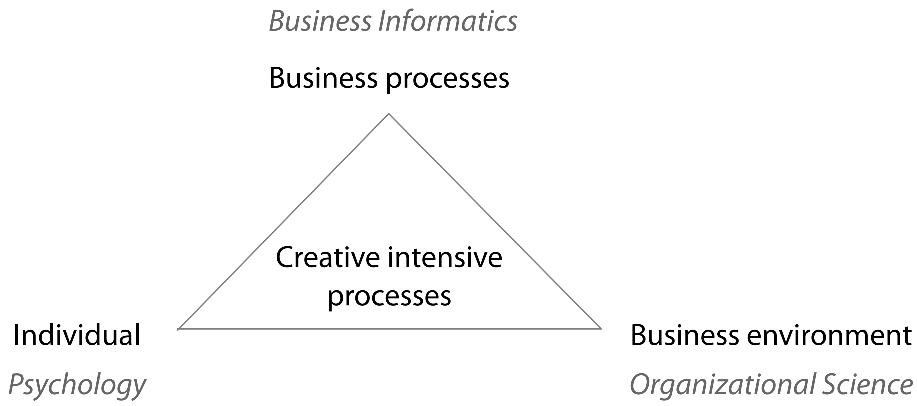


Figure 2.2: Theoretical background to conceptualize creative intensive processes

ment" (p.90). Although they were presented as separate approaches, all three disciplines show a high level of connection, especially as the tendency for interdisciplinary research is growing over time (Wang, Thijs, & Glänzel, 2015). The distinctions exist especially in terms of a different kind of focus taken on the phenomena of creative efforts at work, as well as a (usually implicit) diverse understanding of important influences and perspectives (Fuller et al., 2013). By combining those three approaches, an attempt to define and conceptualize *creative intensive processes* (CiPs) will be made. The following subsections focus on the central question of "How is creative work done?".

2.4.1 Taking the psychological perspective

From Psychology, two related but distinguishable research streams emerged. First, process models developed that address the overall enactments of creative work as a set of activities typically performed to achieve creative output. In addition, other process models address the cognitive mechanisms of an individual coming up with a new idea. Thus, there are processual models from a behavioral perspective and models addressing cognitive mechanisms.

Wallas's 4-stage model

The most prominent (behavioral) process model comes from Wallas, who described four stages of the creative process in the mid-1920s (Wallas, 1926). He based his work on introspective evidence from the mathematician Poincaré, who described his journey working on his mathematical discoveries in a journal. In those essays, he wrote how his work formed as a process of conscious elaboration on existing problems, followed by unconscious time in which he did not actively engage with the problems. Then, some insight emerged when he expected it the least. He would then work on those ideas and finalize a proper solution.

Wallas transformed those reports into a scheme of four stages that should reflect any creative endeavor (cf. Figure 2.3). First, the *preparation* phase: any creative problem, big or small, needs to be based on professional knowledge about the nature of the problem. Finding solutions for mathematical problems requires a deep understanding of mathematics. Designing a new work of art requires knowledge about the materials and techniques used. Through professional education, study programs, and specific job experience, this elaboration phase can take years. It could, however, take only a short amount of time, depending on the nature of the creative problem.

Most creative problems are relatively complex, and a satisfying solution is not accessible through mere thinking and learning. Instead, it requires a so far unknown, or at least for the actor, an uncommon combination of knowledge. Thus, the preparation phase rarely leads to a satisfying solution for the creative problem. Instead, somehow contradictory ideas on addressing the problems can best be reached when not actively engaging with the problem. As ideas are developing, this phase is called *incubation*. This phase is ended by an *illumination*, in which an idea appears.

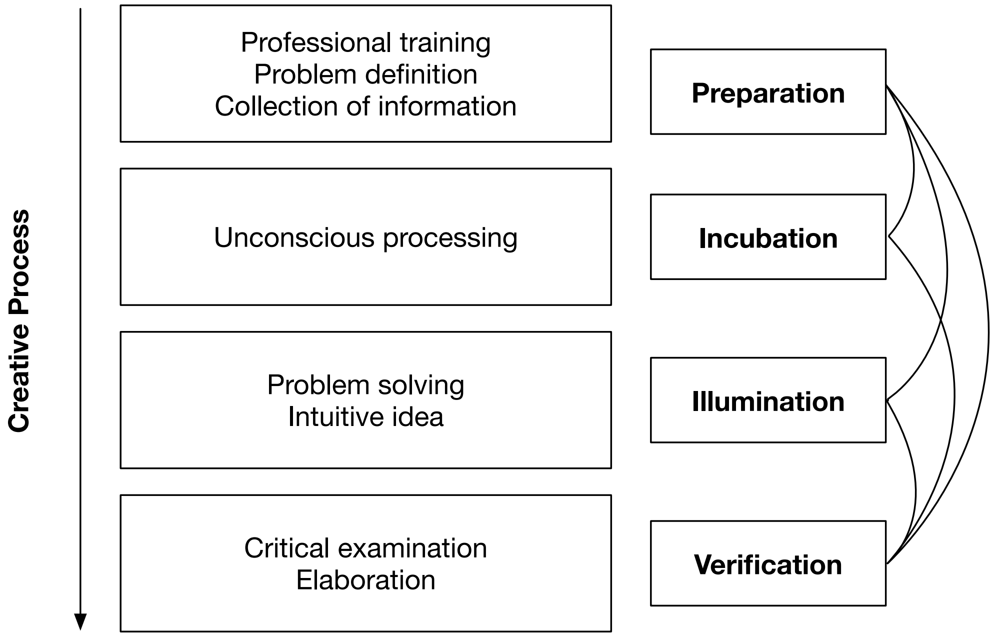


Figure 2.3: Four-stage process according to Wallas, 1926

Often, ideas pop up when one does expect the least, which is commonly referred to as the rule of the ”3-B’s” (bus, bed, bath) has emerged (Michalko, 2010). In those places, we are expected to perform highly routinized everyday tasks that allow us to incubate. We can not fully concentrate on a problem as we perform another task, but that task would not need our full attention. The brain will have more capacity for unconscious thoughts, like connecting broad associations. Those three B’s are exemplary, as many other activities work similarly. The idea behind it is that ”nothing should interfere with the free working of the unconscious or partially conscious processes of the mind” (Wallas, 1926, p.87). This mechanism can also be found within descriptions of daily work routines from highly creative individuals, for example, examined by Csikszentmihalyi (1996). Often those people reported dynamic scheduling of some relaxation activities into their daily routines, like taking walks, naps, playing instruments, or playing games.

Ideas could pop up, as explained, or emerge rather slowly (Sadler-Smith, 2015). A clear-cut does not separate the subconscious from the conscious. Instead, the sub-conscious should be understood as on a continuum with the conscious, with many forms of fringe consciousness in between (e.g., Bear, Connors, and Paradiso 2020). As the conceptualization of the mind is rather complex (e.g., Wilson 2004), a more profound analysis is not within the scope of this work. What is important is the broad distinction between consciously controllable thought processes vs. those that are out of our conscious reach. For creative work, the switch between those two cognitive modes appears central to achieving satisfying creative results (e.g., Csikszentmihalyi and Sawyer 2014).

Focusing again on Wallas's 4-stage model, the last phase is *verification*, as ideas need to be evaluated on their value. Some ideas only make sense initially, but a crucial analysis reveals some weaknesses. Plus, some initial ideas might only solve one aspect of the problem, but others must be worked on further. This will all be done during the *verification* phase, in which the idea is critically examined. Here, the creative process might (in parts) be repeated as the idea does not hold up to the set criteria.

Even in the 1930s, those four stages were found to be highly interrelated and iteratively performed in practice. For example, Patrick (1937) studied artists and found those four stages occur for most artistic processes, although some stages seem to occur more often and some even overlap. For example, preparation and incubation co-occurred, as artists would engage with the problem, get distracted, and engage with similar problems. Her work enforced the idea of the generalizability of the creative process, as artists from all expertise levels and most diverse domains reported similar working patterns.

Alternative stage-models

The following research was not solely based on Wallas's process model. Instead, a vast amount of similar yet distinguishable models emerged. Howard and colleagues (2008) created an overview of the creative process models up until 2001. They claim that those process models can be sorted into a scheme of four components: an analysis phase, a generation phase, an evaluation phase, and finally, a communication/implementation phase. Not all models do provide an element in all those four phases. For example, Guilford (1957) established the distinction between divergent (broadly, free-associative) thinking vs. convergent (straightforward, directed) thinking, which can be interpreted as a form of generation vs. evaluation phase.

Similarly, Wallas's four stages also fit into three phases: preparation as a form of the analysis phase, incubation and illumination as a form of the generation phase, and verification as a form of the evaluation phase. Wallas did not specifically include a phase for implementation. One could argue that such an explication of the idea implementation would tap into the conceptualization of an innovation process, which is to be separated from the creative process.

Botella and colleagues (2018) did similar analyses comparing prominent models of creative processes from the literature up until 2016. Their results show a similar diverse picture of the literature, with most models proposing four to five stages of the creative process and vary hugely in their conceptualization. Especially around the phase which Wallas called *illumination*, the literature shows the most diverse approaches in the presentation of how to develop a new idea. It ranges from *ideation*, *transformation*, *idea production*, *problem construction*, *development*, *(idea) generation*, and *sketching* to *insight*.

A focus on creative sub-processes

Studying the creative process literature, it becomes apparent that there is no agreement about conceptualizing the creative process. As research showed that sub-processes could co-occur and be performed in a fast-switching iterative manner (e.g., Botella and Lubart 2019), the notion of a fixed temporal relation between phases could hardly hold up. Thus, parallel to the growing number of diverse stage models emerging, a body of literature was established that focused on sub-processes within creative work instead. Such sub-processes studied were, for example *problem-finding*, *problem formulation*, *problem redefinition*, *divergent thinking* and *remote associations*, *synthesis* and *combination of information*, *emotional resonance*, *feature mapping*, and even *random or chance-based processes* (cf. Lubart 2001). The basic proposition is that most of such sub-processes are relevant for most kinds of creative work being done but that no sequence can be assumed. Although it seems logical to start a creative process with a clear problem definition, it is also highly possible that within the process, one has to re-enter the problem-definition phase to redefine or adjust the problem at hand. Similarly, once creative ideas emerge and are evaluated in some way, one can fall back into the preparation phase (again), as the idea does not seem fit and further information about the problem at hand need to be searched for (Botella & Lubart, 2019).

Creative vs. non-creative processes

As no straightforward process could be described so far, the question emerges of how a creative process differs from a non-creative process (cf. Lubart 2001). The previous literature did not seem to find a clear answer to that. Three theoretical assumptions could be pursued. First, creative vs. non-creative processes could differ in *kind*, meaning that basic features would exist for the creative process, which are not relevant for non-creative processes - or vice-versa. Second, both process types could differ in *quality*, meaning that both entail the same or similar sub-processes but how those are performed, with the amount of effort, motivation, and skill explains the difference between creative and non-creative processes. Third, it could be assumed that there is no creative process at all, meaning that nothing within the process is, per see, responsible for creativity. This does not assume that creativity does not exist, as products could still be judged as creative, only that nothing could be detected to differentiate a creative from a non-creative one.

Especially the latter approach seems quite extreme, as a huge research body exists with evidence for creativity-specific sub-processes. The first approach, finding difference(s) in *kind*, is also difficult to defend, as nothing uniquely creative within the process could be found so far. However, researchers have looked into it for about 100 years. Even core sub-processes like divergent thinking are *per se* not exclusive to creativity, as, for example, improvisation also relies heavily on it (e.g., Lewis and Lovatt 2013). Thus, the second approach needs further consideration: creative processes differ from non-creative processes in their performance and quality. This idea is in line with the previously explained finding of new creative ideas that are never new but appears new to us as the underlying associations are far the opposite of obvious. Thus, not the association per se is responsible for the judgment of creativity, but the quality of such an association.

A creative process would be not so much about *what* is done, but *how* it is done. To illustrate this difference, looking at chess might be helpful. Chess follows a clear and somewhat limited set of rules to be played. Although all chess players follow the same rules and thus perform the same type of processes, they differ significantly in their ability to master the game. What differentiates a novice from a Grandmaster is not a different performance but the quality of such performances. The better one can predict possible future steps in the game, the higher the chance of mastering the game.

Defining a creative process

Assuming the quality and characteristics of a process are crucial to defining a creative process, it is of interest what those could be. Mumford and colleagues (1991) proposed four ways to find answers for that as they compared creative with non-creative processes:

- Creative processes include more ill-defined problems.
- Within the creative process, new and useful ideas need to be generated based on divergent and convergent thinking.
- Creative processes involve repeated switches between divergent and convergent thinking.
- Within the creative process, existing knowledge is combined or reorganized.

A creative process would start with the demand for a new solution as an ill-defined problem or task that needs to be addressed. If the problem were known, the process to solve it would also be standardized. Further, to achieve a proper solution for such ill-defined problems, a ”shifting process between generative and evaluative modes of thought” (Sowden, Pringle, & Gabora, 2015, p.1) is needed. When ideas are generated, existing knowledge is recombined through divergent thinking. The fitness of those ideas is evaluated by convergent thinking. As most ill-defined problems are complex, the dyad of divergent vs. convergent thinking must be repeated several times until a proper solution emerges.

Creative cognitive processes

The antagonistic thought processes of divergent and convergent thinking appear crucial for understanding the creative process. Both can be further explained through a focus on human cognitive processes. The Dual Process Model of cognition (Evans, 2008; Stanovich, 1999) describes a fundamental distinction between two types of thinking styles humans seem to use. These models distinguish between ”type 1” (rapid, automatic, associative processes) and ”type 2” (conscious, structured, evaluated processes) thinking processes. Most famously, Daniel Kahnemann (2017) used this model to explain differences in decision-making. His basic assumption is that rational thought, based on ”type 2” processes, can lead to valuable, well-elaborated decisions, which we often prefer as we seem to have control over them. As the ”type 1” process feels less controllable, we tend to trust it less often. However, as most complex decisions would need the consideration of a vast amount of information, it soon overloads our rational and cognitive capacity, and decisions based on the ”type 1” process are much more valuable. Here, subconsciously, much more information can be integrated and associated with forming a ”proper” decision.

The ”type 1” vs. ”type 2” model has also been applied to the creativity concept (Sowden et al., 2015). For the creative process, the ”type 1” process corresponds to divergent thinking, whereas the ”type 2” process equals convergent thinking (O’Connor, Gardiner, & Watson, 2016). As the ”type 1” process is mainly subconscious and more challenging to predict and influence, it benefits from incubation time. This is where the foundation for the incubation phase in Wallas’s model comes from. The switch between ”type 1” and ”type 2” processes succeeds better when time is added in which the focus is drawn away from the problem at hand. As we have almost no control over the ”type 1” process, we need to make time to increase the chance for the subconscious to come up with associations.

Dual pathway model

The distinction between antagonistic processes to achieve potentially creative outcomes can also be found in the Dual Pathway to Creativity Model (Nijstad, Dreu, Rietzschel, & Baas, 2010). Here, creative work is understood as the interdependence of systematic and focused thinking (persistence pathway) with defocused, holistic thinking (flexibility pathway). This is a synonym for the prior ”type 1” vs. ”type 2” argumentation. However, it broadens the scope from the mere cognitive processes of divergent vs. convergent thinking to a whole set of associated cognitive patterns. The persistence pathway is characterized by the effortful exploration of ideas and hard work to generate problem solutions. On the contrary, the flexibility path is characterized by reduced latent inhibition and flexible switching between categories, resulting in more distant associations. A constant switch between both modes would then characterize creative efforts.

Section summary

When we look at the creative process from a psychological – cognitive as well as behavioral – perspective, the process unfolds as a collection of possible sub-processes performed by highly motivated, encouraged, and skilled individuals. It seems that the configuration and characteristics of sub-processes are decisive for a process to be considered *creative*, compared to creative-specific kinds of sub-processes. Especially a proper repeated switch between directed and free-associative cognitive processes appears crucial to successfully developing ideas for open-ended problems. This, overall, illustrates the complexity in the definition and recognition of creative processes.

2.4.2 Taking the organizational perspective

Organizational scholars are mainly interested in creativity in the form of innovation. Taking the publication rate as a proxy for research interest, overall *innovation* is roughly five times more often addressed in an organizational paper compared to *creativity*[2]. Whereas papers covering creativity mainly come from Psychology, Cognitive Science, and Education, innovation is mainly covered in Management, Medical and Health Sciences, and Economics. Thus when trying to understand how creativity is covered from an organizational perspective, one should start looking at innovation concepts.

[2]The comparison was made based on keywords in abstract and title, using the Dimension database, which tracks publications online, cf. Digital-Science 2020

Creativity as a part of innovation

Creativity and innovation are by no means synonyms. ”Research into creativity has typically examined the stage of idea generation, whereas innovation studies have commonly also included the latter phase of idea implementation” (Anderson, Potočnik, & Zhou, 2014, p.1297). As discussed above, also *creativity* is sometimes conceptualized as including steps of implementation (cf. Howard et al. 2008). However, the focus differs: creativity is about the generation of ideas, whereas innovation is about the implementation of ideas.

Within the vast amount of innovation-connected research papers, similar complex examples of the conceptualization of the innovation process can be found, as explained above for creativity. Eveleens (2010) compared essential innovation process models and came up with 12 models, starting from 1962 till 2008.

These models propose similar processes subdivided into comparable sub-stages for the creative stage models. What is striking is that all models propose that *idea production* (some do not even go as far as referring to ”scoping” and ”searching”) is the first stage of the innovation process (usually from around seven stages). The stages following are about testing and implementing the idea, as well as marketing and learnings from the process. Thus, only one stage is explicitly dealing with the creative process. This is, at its core, plausible, as these models address *innovation*, which is mainly focused on aspects of implementation, testing, risk aversion, and monetization.

It further shows that these innovation process models and the linked literature are of little help as we seek to understand exactly how new ideas emerge. For example, the most famous books addressing innovation (Davila, Epstein, and Shelton 2012, Skarzynski and Gibson 2008, Trott 2008) do not cover mechanisms of idea generation, divergent thinking, or cognitive associations. Ford stated back in 1996 that ”one would expect innovation researchers and creativity researchers to be working hand in hand to solve the mysteries surrounding these complex events. However, these intimately related concepts have been studied primarily by inhabitants of divergent disciplinary worlds" (p.1112). As much as creativity scholars neglect aspects of idea implementation, innovation scholars neglect the emergence of new ideas.

Interactionist model of organizational creativity

Some scholars focus specifically on creative thinking within the organizational context. Especially an interactionist perspective on the creative concept proved helpful in understanding how the individual creative process unfolds within the work environment. Here, creativity emerges as an interaction between the individual, the team, and the organizational level (Woodman, Sawyer, & Griffin, 1993). "Individual creativity is a function of antecedent conditions, cognitive styles and abilities, personality, motivational factors, and knowledge" (p.301). The group or team in which the individual works serves as the immediate social influence on the individual (as the individual is part of the team, it also influences the team). Individual behavior is a part of the team's creative process. This is not simply the sum of the individual's work, as it includes group-specific characteristics and processes, and the composition of the team members matter. Figure 2.4 shows the Interactionist Model. The arrows indicate the directions of action.

The *individual* within Woodman's model 1993 is strikingly similar to Amabile's componential model of individual creative behavior (Amabile, 1988). Woodman explicitly adds *antecedents* and *personality* as an important influence on the individual, which is difficult to support based on the body of knowledge discussed above concerning personality aspects and creativity (cf. Section 2.3.1 on page 14).

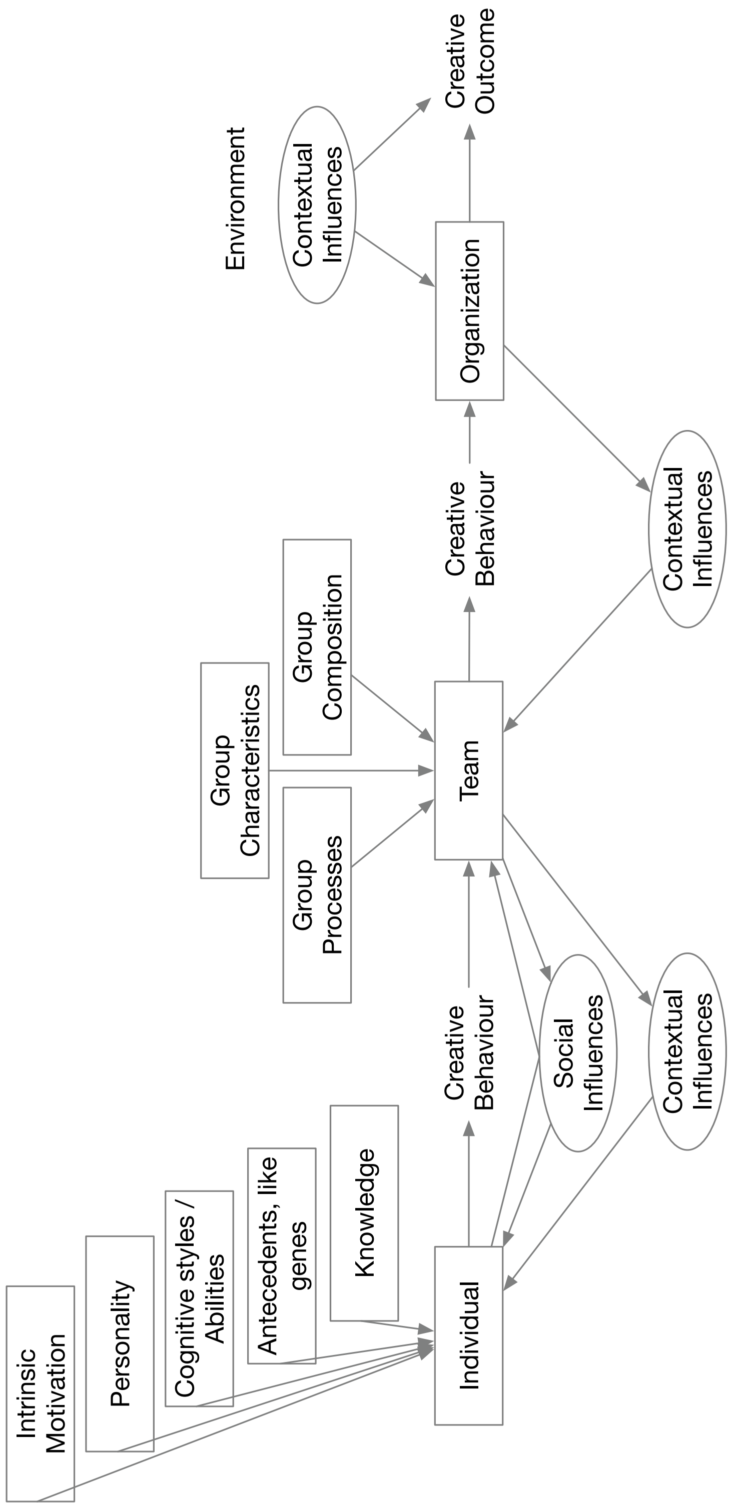


Figure 2.4: Interactionist Model of Organizational Creativity; own representation according to Woodman (1993)

Further, Woodman proposes important influences on and from the team working on creative problems. The composition of team members has a huge influence on their creative output, with more diverse teams showing tremendous creative potential (cultural diversity: Stahl, Mäkelä, Zander, and Maznevski 2010, cognitive diversity: Shin, Kim, Lee, and Bian 2012). Further, different cultural influences are beneficial as long as an essential work ethic and mutual understanding of the project goal exists (Stahl et al., 2010).

Although diversity in knowledge and expertise benefits the ideation process, teamwork might be perceived as more difficult and less joyful for individuals when working with colleagues from diverse disciplines (Kurtzberg, 2005). This leads to the matter of climate, which serves as a proxy for the sense-making of the individual, as it influences the shared understanding of how work is to be approached, what needs to be done, and what is valued in what way precisely (Anderson & West, 1998).

Woodman's model (1993) falls short of explaining the organizational level. It is understood as the mean through which creative outcome is realized under specific contextual influences. Such influences come from culture, policy-making, resource allocation, reward systems, and leadership understanding. Thus, the organization provides an environment where the teams and individuals feel supported or hindered in their creative endeavors. Woodman coined the term *creative situation*, which "is defined as the total of social and environmental (contextual) influences on creative behavior" (p.310). Individual and group creative behavior is embedded in such a creative situation. Factors that support creative work can be differentiated in terms of strategy (a clear vision and purpose of work), structure (which allows for flexibility and individual freedom in terms of autonomy and decision-making, as well as cooperation between teams and organizational units), support mechanisms (reward and recognition, resource availability of time, information and creative people) and open communication throughout the organization (Martins & Terblanche, 2003).

Overall, Woodman's (1993) model demonstrates the need to integrate the perspectives of the individual, the team, and the organization to understand how creative outcomes occur in the organizational context. From a process perspective, the model explains what components and aspects are relevant to a successful creative process. It does little to explain *how* the process unfolds. Amabile addressed this gap when she added an organizational perspective (Amabile & Pratt, 2016) to her component model of individual creativity (1988).

The Dynamic Componentional Model of creativity and innovation

The componential model (cf. section 2.3.1 on page 17) captures the individual components relevant to the creative process: domain-relevant skills, creativity-relevant processes, and task motivation. Group characteristics extend this model: norms, processes, and contextual influences at the team and organizational levels (Amabile & Pratt, 2016). In the extended model, Dynamic Componential Model (DCM), a distinction is made between individual and group creativity and organizational innovation. For individual creativity and organizational innovation, three main components are distinguished: Task motivation, creativity-relevant processes, task-relevant skills for creativity and innovation motivation, resources in the task area, and skills in innovation management for innovation. Both levels influence each other, as the organizational environment influences individual and group creativity, and individual and group creativity leads to organizational innovation. These components are then related to the proposed process stages for individual creativity and organizational innovation. The stages are comparable for creativity and innovation, although they are associated with different individual and group behaviors (cf. Figure 2.5).

As explained above, the organization serves as the environment in which individual and group processes are embedded. Thus, the organizations create this kind of environment by 1. setting an agenda (often implicitly through their overall goals set by leaders) and 2. by setting a stage in the form of goals and resources made available. The rules for meeting and communicating are set here in the physical workplace. Within this context, individuals and groups generate ideas (stage 3). Those ideas are then tested and implemented (stage 4), which could lead to the assessment of success, failure, or progress. The individual and group level is relevant whenever new ideas are needed within the organizational innovation process (predominant in stage 3). Here, individual(s) first need a mental representation of the task at hand through external and internal sources (stage 1). Then, following the classical individual creative process of Wallas (1926), a broad and deep understanding of the problem is needed, so further information is acquired (stage 2). On this basis, ideas and possibly products are generated (stage 3), which can then be evaluated based on the criteria set for the task (stage 4). Again, such evaluation can result in success, failure, or progress.

	Stage 1	**Stage 2**	**Stage 3**	**Stage 4**	**Stage 5**
Organizational Innovation	Agenda setting	Stage setting	Producing ideas	Testing and implementing ideas	Outcome assessment
Individual / Group Creativity	Task Presentation	Prepa-ration	Idea generation	Idea validation	Outcome assessment

Figure 2.5: The process stages of the Dynamic Componential Model (DCM) of creativity and innovation; own representation according to Amabile and Pratt (2016)

Although the process steps are proposed in straight order, their dynamic relations are stressed in feedback loops. The process does not need to end when an evaluation is made in the ”last” step, instead falls back to another level for both positive and negative evaluations. In the case of a positive one, this feeling of success and mastery – often combined with positive emotions of joy – should increase the individual’s intrinsic motivation for such activities. Rewards like recognition from the organization can facilitate this effect. In case of a negative evaluation, new -

better-fitting - solutions are needed, which is why the problem at hand needs to be revised. Holding up the motivation to keep working in the face of experiences setbacks is not trivial; however crucial for the creative process (Tahirsylaj, 2012). Plus, the evaluation often does not come in clear terms of success vs. failure. Instead, a not-yet, fully satisfying idea can be essential for overall progress. To perceive such progress is critical for the motivation to keep going in the creative process (Amabile & Kramer, 2011a).

Section summary

The literature review from the perspective of organizational research on how creative work processes occur primarily provided two models: the Interactionist Model and the DCM. These focus on the interaction between the individual, other associated organizational (team) members, and organizational constraints. These models are, therefore, complex. Although the proposed stage-like model of the creative and innovative process of the DCM aims to reflect procedural processes, it lacks a concrete procedural understanding of a temporal process. Most creative and innovative work has much more complex, interactive, and dynamic forms than such a model could capture (e.g., Botella and Lubart 2019). Nevertheless, it supports understanding the general mechanisms relevant to potentially successful creative work in organizations: As an organization creates the environmental conditions and boundaries for any work, its expectations, goals, leadership implementation, and resource allocation define the basis for individual and group creative behavior.

2.4.3 Taking the business informatics perspective

From the point of view of business informatics, it is primarily a matter of recognizing economic processes in organizations, representing their flows, and adapting them. Concerning creativity, its main focus is on how business processes can be managed without suppressing creative efforts within companies (Becker, 2012). Because managing processes involves regulations and often optimizations to achieve and increase efficiency, it can limit the actor's freedom of action (Sushil, 2016). As discussed in the previous section, individual freedom of choice is essential to the creative process. This presents a particular challenge for the process planning of creative work.

Business process management perspective

One approach to analyzing and managing the processes within organizations comes from business process management (BPM). As one of the biggest challenges for companies is to deal with today's complexity and constant change, BPM can help to analyze the current processes and dependencies within their workflows and improve them to increase effectiveness and efficiency (Wirtz, 2019). The main objectives of BPM are thus process organization, control, and optimization. If this is transferred to the context of creative work, a dilemma arises between the urge to increase the efficiency of processes and the need for free space for creative work. In the context of BPM, creative tasks are usually perceived as a black box whose execution is fuzzy, complex, and challenging to predict (Seidel, Rosemann, & Becker, 2008). However, with the help of BPM, appropriate resource allocation at the task and process level can be considered to enable creative freedom, foster creativity, manage the associated risks, and maintain control over the creative process (Seidel and Rosemann 2008, more in section 3.2 on page 57).

When planning and designing processes, the need for flexibility can be addressed with two approaches: Flexibility by design vs. underspecification (Bider & Jalali, 2016). This differentiates precisely planned flexible parts of a process from placeholders where the person performing the process might deviate from the process. A common approach to planning flexibility is based on the agility concept (Conboy, 2009). Based on the Agile Manifesto from software development (Fowler & Highsmith, 2001), agile principles have been applied to classical BPM approaches to reconcile the conflicting needs of structure vs. freedom (Becker, Bergener, Schwehm, & Voigt, 2011).

Following the concept of agility, the main idea is to incorporate more flexibility into processes, set up iterative process cycles with production and evaluation rounds, and train people to evaluate ideas after the idea generation phase. This approach could address some needs in creative work, especially the iterative play between divergent and convergent thinking (cf. section 2.4.1 on page 24). Agile process methods, however, are not synonymous with creative process methods. The agility concept focuses primarily on complex project work in certain areas, first and foremost (software) product management (e.g., Martins and Zacarias 2017; Meyer 2018).

Pockets of Creativity

One approach to opening the black box of creative work within BPM is the concept of PoC (Seidel, Muller-Wienbergen, and Rosemann 2010). Film and cinema production processes were used to analyze the compatibility of stable and flexible process aspects. Creative work is rarely completely unspecific and random. When a process is broken down into individual tasks, the combination of creative and non-creative parts becomes clear. Thus, a process labeled ”creative” at a higher level can be more accurately described and planned when broken down into sub-processes. The parts that cannot be broken down further and contain creative work are referred to as Pockets of Creativity (PoC).

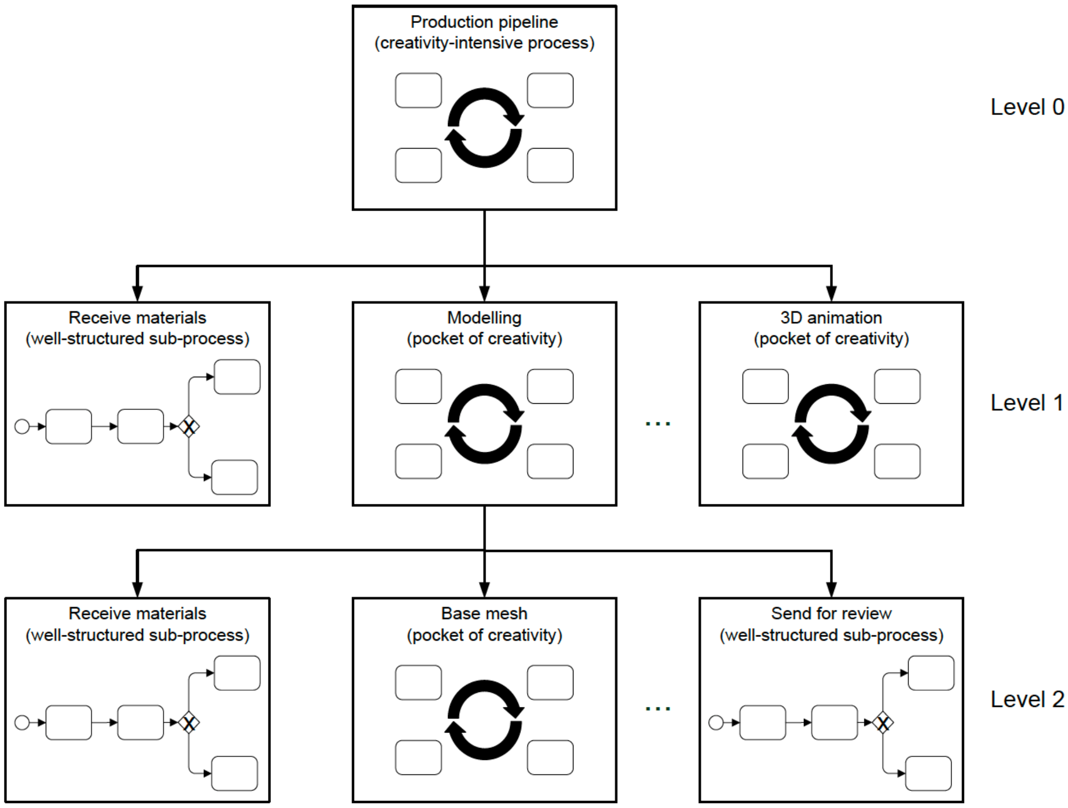


Figure 2.6: Example from Visual Effects Production showing Pockets of Creativity (PoC), from Seidel, Muller-Wienbergen, and Rosemann 2010, p.421

In Figure 2.6, an example from TV production shows a creative process with PoC. Three levels of analysis are distinguished. The entire production process is considered creative. This process can be divided into several sub-processes, some of which are creative but not all. For example, modeling contains creative aspects, but when broken down further (level 2), it contains creative and non-creative aspects. They are characterized by uncertainty about the exact flow of the process (visualized with a circle), the resources needed, such as time, money, and people involved, and the final product or outcome. In addition, such PoCs are subject to certain constraints embedded in the overall process, organizational influences, standards, and expectations of the product, the equipment provided, and the people involved. Such an approach to the core creative elements within a process helps to know where creative efforts are needed and desired, where caution is needed in risk assessment, and where creativity can best be encouraged within set boundaries (Eaglestone, Ford, Brown, & Moore, 2007). Knowing where creativity is vital in organizational processes also allows IT support to be allocated appropriately (Seidel, 2012).

Creative support systems

Another branch of research in business informatics related to creativity aims to understand how individuals and groups can benefit from creativity-supporting software tools and techniques (Muller & Ulrich, 2013). A direct focus on process, in terms of how best to perform the creative act, is less considered in these analyses. Instead, the software is developed and tested to support ideation, teamwork, knowledge management systems, actual product development, and testing of the idea or product (Seidel, 2012; Voigt, 2014; Voigt, Bergener, & Becker, 2013).

Olszak (2018) distinguishes between different forms of creative support systems (CSS), all of which aim to support different aspects of the creative process, such as communication, idea generation, and idea selection. CSS can support individual and group work. Overall, organizational creativity support systems are intensely concerned with information resources and motivating actors to use them, which creates conceptual proximity to knowledge-intensive processes (Gronau & Weber, 2004). Since creative endeavors rely heavily on the actor's knowledge and creative problems, tend to be complex, deep knowledge is required to create and develop new *and* useful ideas in particular (Seidel, 2011). The CSS aims to help workers acquire knowledge, including strategies to rely more heavily on internal company knowledge and increase competitive advantage (Muller & Ulrich, 2013).

Knowledge intensive processes

In classic BPM approaches, processes are differentiated on many aspects, one of which is the knowledge intensity required to execute the process (more in Section 3.1 on page 55). Business processes can be knowledge-intensive, such as product development or strategic planning. The flow of such processes is more difficult to predict, many parallel processes are possible, and documentation about the exact process flow is often sparse. Since task complexity is high, specialists with implicit knowledge about how to approach such complex tasks are needed (Gronau, Müller, & Korf, 2005). Eppler and colleagues (1999) incorporate the need for innovation into the concept of knowledge intensive processes (KiP). On the other side of the spectrum, routine processes require less specific knowledge and are much more standardized and straightforward in their approach. Such processes include, for example, incoming mail procedures or accounting (Hall, Park, Song, & Cody, 2010).

Creative intensive processes

The aspect of creativity extended the differentiation of knowledge intensity of processes. Seidel (2011) adds creative intensive process (CiP) as another group of complex processes, focusing on the uncertainty and risk associated with creativity. "A CiP is either a single creative activity that cannot be further subdivided or a business process that contains at least one creative activity" (Seidel, 2007, p.3). Very complex, knowledge-intensive processes, as defined by Harmon (2010), contain the potential for creative work but do not necessarily have to be creative. For CiP, the main goal is to solve complex problems in novel and valuable ways.

In combination with PoC, CiP are further characterized by a complex interaction of tasks and between process levels. Essentially, four levels are distinguished: 1. the overall process, 2. sub-processes in which the interaction between the actors involved is of particular importance, 3. the creative task or creative act, which is characterized above all by its iterativity of tasks, 4. an interdependence between the various actors involved, which is characterized by a high need for communication and interaction between the actors and beyond the task levels. In particular, CiP are characterized by their dependence on creativity, complexity, and interdependence of the actors involved, as well as the interconnectedness of multiple organizational units (Seidel, 2011). This approach is closely related to DCM (cf. section 2.4.2 on page 33), which explains the three perspectives important for the interactive work of creativity in organizations: the individual, the group, and the organization.

Section summary

The study of creativity from a business information systems perspective roughly presents a bifurcated picture: one approach is loosely contained in the research area of flexibility, agility, and ways to increase an organization's ability to deal with life's complexity (e.g., Martins and Zacarias 2017; Meyer 2018; Sushil 2016). In the other stream, PoC and CiP are conceptualized as a knowledge-intensive business process type but lack a broader connection within research. Thus, studies that support (or reject) the theory or provide further examples of its application are scarce (e.g., Voigt et al. 2013). This again emphasizes the need for an interdisciplinary approach around research findings from fields other than information systems to better understand the creative work process.

2.4.4 What constitutes a creative intensive process

Based on the literature summarized in the previous sections, explanations of what constitutes a creative intensive process in organizations can be gathered, and theoretical approaches from several fields can be combined. It becomes clear that creative work has a high degree of complexity and variability, and a clear definition of specific characteristics is not possible. Instead, factors that influence the creative process are identified based on the literature. The direct positive or negative influence on the course of the creative process depends on the individual case (cf. Amabile 1998).

In Figure 2.7, an attempt was made to describe creative processes' influencing factors and main mechanisms. This model aggregates and combines core statements from the literature and sorts relevant principles on creative processes in organizational contexts. To order the complexity of organizational work, the distinction between the individual, group, and organization is used (cf. section 33 on page 33 and, e.g., Borghini 2005; Seidel 2011). I will first explain the characteristics that contribute to each level and then explain the main working mechanisms of the creative process.

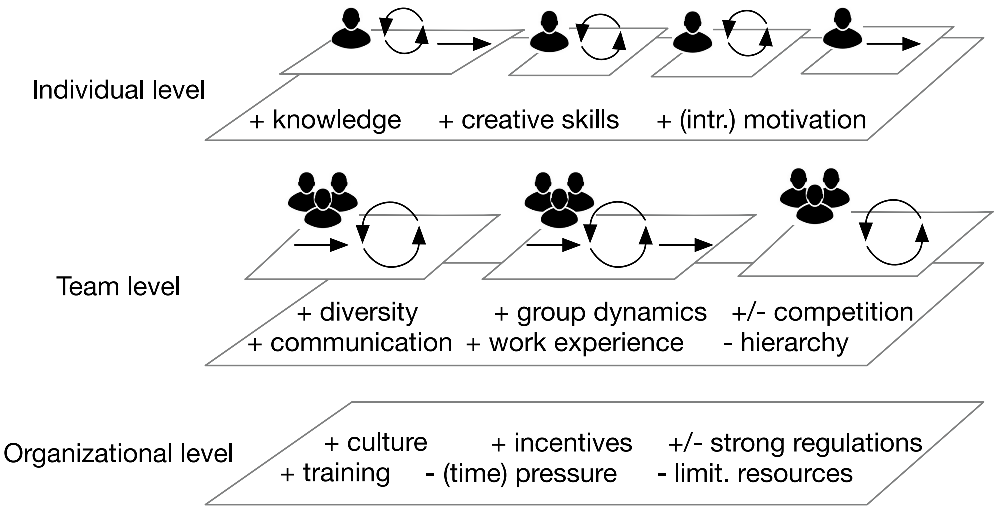


Figure 2.7: Contributing factors on the creative process differentiated for the three organizational levels, own representation

The organizational level

The organizational level is a foundation, a kind of framework in which all work takes place. Specific goals, the existing culture and norms, and the resources allocated to specific projects and departments influence all the work done in the organization. In the case of creativity, the influencing factors are many, and their interactions are complex. For example, organizational culture affects the extent to which employees have the need, support, and freedom to engage in creative activity (Ali Taha, Sirkova, & Ferencova, 2016). Idea generation is likely to thrive when there is sufficient freedom and support for creative and promising ideas, playfulness and humor are a natural part of the workday, and when employees are given clear goals and challenges to apply their creativity skills (Ekvall, 1996).

As for training creative skills, research reviews have repeatedly shown that they can be trained, (Ma, 2006; Scott, Leritz, & Mumford, 2004a, 2004b; Valgeirsdottir & Onarheim, 2017). Based on a custom meta-analysis that included 84 studies and 332 effect sizes on creative performance measures, the overall results showed that approximately 70% of the individuals in the training condition performed better creatively than the average individual in the comparison condition. A comparison between students and professionals showed no difference in their ability to improve their creative performance. This speaks to the trainability of creative skills beyond the typical student age (Haase, Hanel, & Gronau, 2023).

Incentives are another way to support creative efforts in the workplace. Based on the fact that intrinsic motivation particularly motivates people to work on complex problems (Amabile & Kramer, 2011b), incentives work best when they are not based on money. Instead, recognition, praise, and allocation of resources for further work can motivate employees (Azoulay, Zivin, & Manso, 2011; Toubia, 2006).

Limited resources, e.g., too little time, information, and pressure to create something extraordinary, usually prevent creative flow (Acar, Tarakci, & van Knippenberg, 2019). Similarly, strong regulations limit the realm in which creative work is possible, often limiting motivation to engage and actual opportunities to find new ways (Acar et al., 2019). However, constraints and limitations can also foster creative endeavors under certain conditions, as they create the need for creative solutions and limit the realm of possibilities, which is often too overwhelming to engage in (Cromwell, Amabile, & Harvey, 2018). The constraints aspect is thus a matter of looking closely to adapt it to the specific case of each organization (Rosso, 2014).

The team level

The organizational level forms the basis for individual work. As explained in the section 2.4.2, the team level is a combination of individuals and their prerequisites as well as a team- and group-specific characteristics. In particular, a diverse team with different knowledge and skills is advantageous for working out creative problems together. In addition, teams accustomed to working together have an orderly work dynamic, and common approaches are more effective overall (Moirano, Sánchez, & Štěpánek, 2020; Stevens & Campion, 1994). Effective communication among team members in creative work is essential to manage the complexity of the work (Dittrich, Guérard, & Seidl, 2016; Malmelin & Virta, 2015). Hierarchy within a team often impedes creative flow, especially when it is rigid and strictly enforced (Romme, 1996; Ye, Tung, Li, & Zhu, 2020). In addition, stress within the team negatively affects its efficiency, for example, through direct evaluation (Byron, Khazanchi, & Nazarian, 2010; L. Chen, Wadei, Bai, & Liu, 2020). In contrast, competition within the group, especially if it is more playful, can increase performance motivation (Eisenberg & Thompson, 2011).

Teamwork is effective only as long as employees work with each other and not against each other (Frankel, Leonard, & Denham, 2006). Therefore, image work, like impression management toward managers, inhibits creative team performance because it diverts individual efforts from the actual work (Byron et al., 2010; Liu et al., 2022).

The individual level

At the individual level, as explained in detail in the 2.4.1 section, three aspects are critical to creative work: knowledge of the problem at hand, creative ability, and motivation to engage with the problem (Amabile, 2012). These aspects are inherent in individuals and affect their creative performance and engagement within creative team performances.

These previously explained factors create the conditions and influence the creative process on a team and individual level. However, they do not explain how the creative process is performed. An important finding from the analysis of how creative work is performed at the performative level is the decomposability of the creative process into sub-processes and individual units that are creative or not (cf. PoC, section 2.4.3 on page 41). The PoC approach emphasized the dichotomous nature of creative problems that contain creative and non-creative work. Transferring this to the distinction between individual and team levels, teamwork involves an interplay between creative and non-creative parts of the process (in Figure 2.7 on page 47, circular arrows signal the iterativity of creative parts of the process, while single straight arrows signal non-creative process parts). Sub-processes may or may not contain creative elements, depending on the nature of the topic or problem being worked on.

Individually, a person may work on creative or non-creative tasks or a combination of both. This depends on the nature of the problem at hand. The main mechanisms within the circular arrows of creative tasks are the iteration of divergent vs. convergent thought processes (cf. section 2.4.1 on page 24). Since new ideas must be generated, tested, adapted, and extended to meet the creative's requirements, the exact action pattern emerges only during process execution. Therefore, it is unknown how often and how long the cycle is repeated until the judgment of a "final" solution is made.

Importance of process flexibility

The creative process flows require the repetition of opposites, such as divergent and convergent thinking, ideation and testing, associative thinking, and critical thinking. They also involve changes between process steps and repeating process circles and loops. Overall, this requires flexibility. Following the logic of PoCs, a process perspective on creative work can help to know when and under what conditions creative tasks will be performed, but exactly how, with how many iteration loops, resources, effort, and time requirements are less likely to be predictable in advance. Traditionally, process planning and modeling have aimed at standardization and predictability of workflows. This goal can also be aimed at creative work, but by definition, it cannot be achieved. Creative work involves a lot of improvisation, trial, and error and contains subjective assessments of situations. Against this background, it is a particular challenge to analyze the possibilities of planning and predictability of creative work.

The term CiP was coined in analogy to KiP. They have conceptual similarities since both describe complex, little standardized work processes in which knowledge and flexibility are of central importance (cf. Eppler et al. 1999; Gronau et al. 2005; Seidel 2011). For CiP, the focus on the aspect of "novelty" requires further specification, namely that "processes that can be categorized as creativity-intensive share the property of uncertainty with respect to outcome" (Seidel, 2009, S.84). When a process is creative, *intensive* is even less specified. The PoC conceptualizes each creative process and thus quantifies less the amount of creativity required. Again, by analogy with KiPs, a differentiation could be made that prescribes the degree of creativity required from weak to strong (Eppler et al., 1999). Such a differentiation based on case studies from practice is still pending.

Section summary

The previous sections aimed to find evidence in the literature to support the conceptualization of creative work in organizations. Although the volume of literature, theories, and approaches is considerable, the accumulated knowledge about the actual performance of creative work is limited to a thorough understanding of the key influencing factors. Accordingly, Muller and Ulrich (2013) also draw a somewhat sobering conclusion in their review of the representation of creativity within Information Systems (IS) research: "the research field lacks maturity compared to the literature on innovation in IS." (p.185). Since this statement, the conceptual understanding regarding the creative process has not been significantly developed.

In order to broaden the understanding of the processual routines of creative ventures, literature outside the previous discourse of business information systems was also considered. The concept of organizational routines analyzes the repeated performance of organizational process flows with a focus on the actors involved in the process (Howard-Grenville, Rerup, Langley, & Tsoukas, 2016). Routines are one way to analyze the way most work is done in organizations (cf. Pentland 2005). The focus on process dynamics applied here, as well as actors' practices of action that evolve over time (cf. Wenzel, Danner-Schröder, and Spee 2021), is consistent with the characteristics of the creative process.

2.5 Chapter summary

In this chapter, the basics of the creativity concept are presented from the perspective of psychology, organizational, and business informatics.

Models explaining creative work in the workplace focus on the interrelationship between the individual, other associated organizational (team) members, and organizational constraints. As a result, these models are complex. Although the proposed stage-like model of the creative and innovative process aims to reflect procedural processes, they are hardly tenable in practice. Most creative and innovative work has much more complex, interactive, and dynamic forms than such a model could capture (e.g., Botella and Lubart 2019). Nevertheless, it supports understanding the general mechanisms relevant to potentially successful creative work in organizations: As an organization creates the environmental conditions and boundaries for the work done, its expectations, goals, leadership implementation, and resource allocation define the basis for individual and group creative behavior. How and with what results from such creative work comes about depends on a complex interaction between individual competencies, knowledge, and the ability and motivation of individuals to work with others within the given organizational environment.

The study of creativity from an information systems perspective presents a dichotomous picture: one approach is loosely embedded in the research area of flexibility, agility, and ways to increase an organization's ability to deal with life's complexity (e.g., Martins and Zacarias 2017; Meyer 2018; Sushil 2016). As for the explanatory power of creativity, this stream of research relatively rarely digs into the black box of creativity. In the other stream, the conceptualization of PoC and CiP as a business process type lacks a broad connection to the research community. Thus, there are few studies that support (or reject) the theory or provide further examples of its application (e.g., Voigt et al. 2013). This seems surprising, especially since creativity is considered an important asset for organizations to gain competitive advantage, especially in a fast-paced and crisis-ridden world like ours.

We do not 'have' a body; rather, we 'are' bodily.

M. Heidegger, in Aho (2010)

3. Creativity within business processes

This chapter aims to provide a deeper understanding of the actual performance of creative business processes. The previous chapter dealt with the phenomenon of creativity and explained descriptive approaches to creative business processes. This chapter focuses on how creative behavior is performed within business processes.

The chapter starts with the basics of business processes, followed by an integrating look at creative work. As presented in the previous chapter (especially in section 2.4.4), creativity does not play a major role in the classical business process management literature. For this reason, related constructs were sought and the concept of organizational routines was identified as a promising field of research analyzing how (creative) work is done in different workplaces. The literature on the concept of organizational routines was analyzed in terms of detailed accounts of creativity, and based on this, differences in conceptual understanding are discussed. This chapter begins with an introduction to business processes and ends with a consolidation of the routine concept with business processes.

3.1 Defining business processes

A process can be defined as the transformation of a set of predefined inputs (such as actions, methods, and operations) into predefined outputs. In comparison, a business process refers to such an input transformation that creates value for customers and supports the goals of the business (Krogstie, 2016).

Processes may be part of a broader process system and may include one or more levels of sub-processes. Business processes are therefore typically represented in levels. The smallest unit of a business process is an activity that cannot be meaningfully broken down into smaller process components. All types of activities performed within the enterprise are accumulated at higher business process levels, which include the core activities of the enterprise and activities related to suppliers and customers (Laguna & Marklund, 2018).

Business processes can be differentiated according to various aspects, such as task complexity, goal orientation, use of resources, and knowledge intensity, to name but a few. Based on such differences, a rough classification can be made into three process types, which differ primarily in the degree of process complexity (Dumas, La Rosa, Mendling, & Reijers, 2018; Krogstie, 2016). Type 1 is characterized by non-standardized work with high task complexity, high knowledge intensity, and a low degree of process documentation and process control. The main goal of such processes is to optimize the process outcome (cf. 3.1). Examples would be product innovation or strategic management. In marked contrast to this are type 3 processes, which are characterized by a high degree of standardization, low task complexity, low knowledge intensity, and a high degree of process documentation and process control. Examples include the delivery of products or the provision of services. Type 2 processes describe tasks that have a medium level on all these dimensions, with some aspects of complex and fully standardized sub-tasks.

This differentiation into process types shows a distinction and juxtaposition of knowledge-intensive tasks with standardized tasks. Along with that, different understandings of how detailed a process can be analyzed come along: complex, non-standardized processes including high levels of tacit knowledge can be documented on high levels only, whereas highly standardized mundane tasks, containing mostly

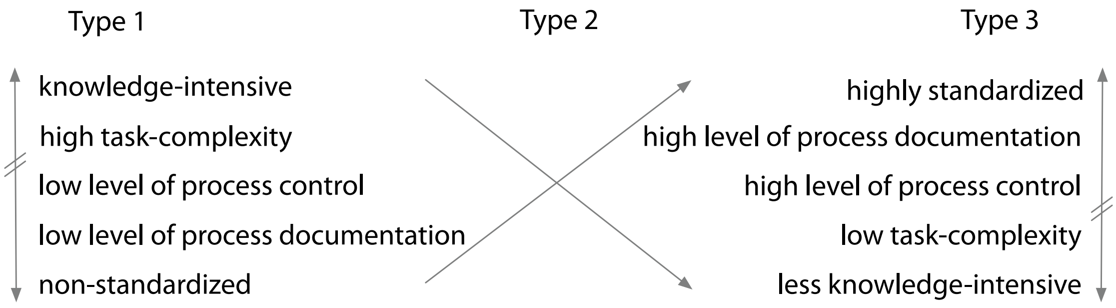


Figure 3.1: Comparing types of business processes

explicit knowledge and are mainly performed on sequential flows, can be documented and standardized in detail (Dumas et al., 2018). In the following section, when introducing the routine concept, I will show how this traditional distinction of process types is problematic with the current understanding of routine dynamics.

3.2 Creative work within business processes

A central goal of business process research is the documentation and adaptation of business processes in order to improve them with regard to various goals such as efficiency, economy, and knowledge sharing (Hammer, 2015). Business process management is the active planning and improvement of business processes, as already presented in section 2.4.3. The essential goal is to design efficient and effective business processes, which means that a ”process does the right things in the right way” (Laguna & Marklund, 2018, S.10). To achieve this goal of process improvement, a diverse set of methods and software has been developed to capture and analyze the diversity of business processes in practice (Recker & Mendling, 2016).

Since BPM is concerned with documenting and adapting business processes, the perspective taken tends to be mechanistic. This is true even though early work (e.g., Davenport, 1993) brought a shift from the basic description of tasks and processes to the inclusion of aspects of the actor. These relate to the interaction between human actors and the increased integration of knowledge and individual factors essential to process performance. Even when actors are included in process studies, this does not do justice to the complexity of sociotechnical systems (Lindsay, Downs, & Lunn, 2003). This is particularly problematic when considering creative business processes, as they depend heavily on actor participation in the process (Sonenshein, 2016).

Creative work within business processes has so far mainly been considered under two different process aspects: on the one hand, the knowledge intensity required to develop something new and useful (Castellano, Davidson, & Khelladi, 2017; Eppler et al., 1999), and on the other hand, the uncertainty associated with a creative process, captured by the Pockets of Creativity (PoC) principle (Seidel, Müller-Wienbergen, and Becker 2010, cf. 41 section on 41). Both describe features of a ”typical” creative process, but less about how the actual execution of such a process takes place. Since both research directions follow the narrative of business process management (BPM), the descriptions of creative work are also relatively static.

In contrast to descriptive research approaches, such as BPM, routine research, especially the routine dynamics (RD) approach, follows an explanatory research approach (Feldman, 2016). Both focus on the same subject matter, namely the establishment, enactment, and evolution of business processes, but with different conceptual underpinnings (Deken and Sele 2021; in the context of digital innovation, see Mendling, Pentland, and Recker 2020). ”A core insight from research on routine dynamics is the close connection among routines, practices and process” (Howard-Grenville et al., 2016, p.506). Routines and practices provide a conceptual framework for analyzing the dynamic interactions between individuals and process (Fortwengel, Schüßler, & Sydow, 2017), discussed in more detail below.

3.3 Routine Dynamics as a frame to analyze creativity within business processes

Organizational routines were first understood and analyzed as entities for studying organizations (Feldman, 2016). As such, they were understood as synonymous with inflexible processes and a common reason for stagnation in organizations (March & Simon, 1958). Beginning in 2000 (cf. Feldman 2000; Leana 2000), various methods and theories were introduced into studying routines, particularly through the increased use of ethnographic research approaches to capture their complexity and emergence over time. This made it possible to analyze the relationship between actions and patterns, and an understanding of the inertial complexity of routines (Feldman, 2016) emerged. In particular, the dynamics of stability and change of routines over time and in dynamic environments is the focus of current routine research (Feldman & Pentland, 2003; Feldman, Pentland, D'Adderio, & Lazaric, 2016; Goh & Pentland, 2019; Pentland, Peng Liu, Kremser, & Hærem, 2020).

At the core of routine studies, a debate began about the "never-changing vs. ever-changing" nature of organizational environments. (Pentland, Hærem, & Hillison, 2011). One perspective emphasizes the stability aspects of a routine, assuming that routines remain stable as long as external forces drive change. This is best captured by Winter's approach to routines (1964), as he defines routines as a "pattern of behavior that is followed repeatedly, but is subject to change if conditions change" (p.263). The other perspective is that of constant change, which emphasizes the actions of those who perform and constantly adapt routines. Here, it is argued that change in routines can also be caused by endogenous forces of the actors performing the routine.

The debate and argumentation about stability and change within routines are very similar to creative achievements in the corporate context. Here, too, the dynamic between stable and plannable business processes and the goal of always creating something new and useful must be aligned.

3.3.1 Defining organizational routines

Organizational routines are defined as ”repetitive, recognizable patterns of interdependent actions, carried out by multiple actors” (Feldman & Pentland, 2003, p.93). Compared to individual routines, which describe recurring behaviors of individuals (also referred to as habits,Wood and Rünger 2016), organizational routines describe recurring work processes involving multiple individuals. A work process can be called an organizational routine (for readability, I use the term *routine* hereafter) if it involves a clear path of steps that repeat in a recognizably similar manner over time. As such, routines are applied to most work in the workplace (Becker, 2004). Routines are so common because the repetition of work procedures is helpful for cognitive efficiency and reducing task complexity. Another important aspect of routines is that organizational norms are established through performance. Thus, they help reduce conflict about how work should be done and create stability and a subjective sense of control and security for those who perform the routines (Feldman & Pentland, 2003).

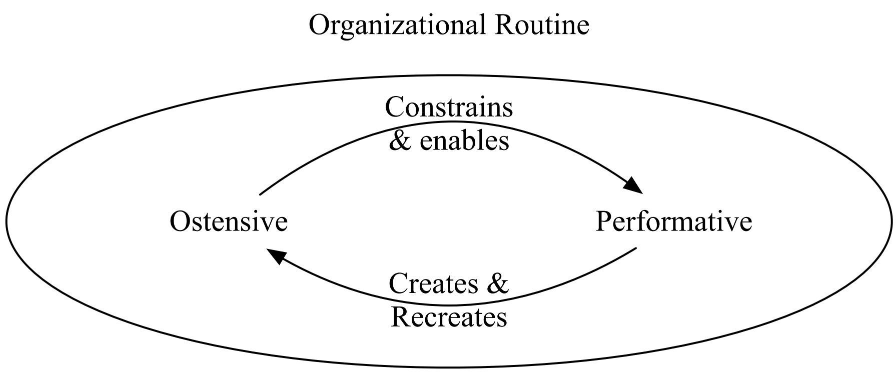


Figure 3.2: Model of organizational routines, based on Pentland and Feldman (2008)

At its core, a routine entails structure and agency's duality. The first describes the abstract pattern of the routine, the *know-that*, which is referred to as the *ostensive aspect* (cf. Figure 3.2). It creates and shapes the understanding of the routine as a process that unfolds over time. The knowledge about the process is often tacit and becomes only apparent by performing the routine itself. The ostensive aspect of a routine serves three goals for the actors' performance: first, it guides the workers' behavior; second, it can account for the behavior by setting a bigger picture and third, it can help make sense of a bigger set of activities by ordering them. Thus, the ostensive aspects create a frame for the task to perform, by guiding the *what*, *how*, and *why*.

The other aspect of routines, the performative or "textitknow-how" perspective, describes the actual execution of the routine. Here, certain individuals perform certain actions at certain times (Pentland, 2003). The focus of this perspective is on the individual agency of the actor performing the routine, as he has the freedom to follow or deviate from the ostensive understanding of the routine.

Both aspects, the ostensive and the performative, are closely related, as can be seen in Figure 3.2: the ostensive aspect specifies the path for a particular behavior to be executed, while the performative maintains or modifies the routine through repeated adaptation, thus constantly updating the ostensive aspect. Interestingly, the routine is only *actual* once it has been executed. This fact should clarify the quote mentioned at the beginning: a routine is not a stable entity, as a thing, but exists only through its performance. Even the stabilizing aspect, the ostensive, exists only as a mental concept. Routines serve as a theoretical basis to represent cognitive structures about work, on the one hand, and actual (repeated) performance, on the other (Feldman, 2000). And as such, both aspects are necessary and sufficient to create a repeated pattern of action (Feldman & Pentland, 2003).

Creative work is a fundamental and pervasive aspect of human behavior and thus of organizational work (Zhou & Hoever, 2014). Therefore, creativity is expected to play a dominant role within routinized work. To understand the potential of creativity within routines, I first analyze flexibility within work processes, which is the basis for all creative behavior. As stated in the 2.4.3 section, only with a certain degree of flexibility in a process can potentially creative work be done. By comparison, a completely rigid routine would provide no room for creative deviation. Flexibility, defined as the ability to change and adapt to changing circumstances, is not synonymous with creativity. However, by examining flexibility as a property of routines, a foundation for potentially creative work can be developed on which to base my further work.

3.3.2 Flexibility within organizational routines

A "given routine, within a given organization, has the inherent, endogenous capacity to generate and retain novel patterns of action" (Feldman & Pentland, 2003, p.112). Because actors can use their agency to adapt routines, the inherent flexibility of routines is utilized. Such adaptation can address situational changes and lead to more stable work performance (Farjoun, 2010). Thus, a routine may involve a set of potential behaviors that all aim at the same outcome but can be adapted situationally to achieve the best possible routine outcome (Yi, Knudsen, & Becker, 2016). It can be argued that repetition is a complex process in which situational aspects, artifacts, and facilitators interact to create something new but similar to the original process (Aroles & McLean, 2016).

Lillrank (2003) distinguishes between standard, routine, non-routine, and even chaotic processes. This distinction appears to be less a categorical distinction than a gradual one. A process is a nonroutine work when both the process and the outcome are uncertain in advance and task completion is the primary goal. The conceptual evolution of routines, including different patterns, has such a high degree of flexibility that it becomes more difficult to distinguish routine work from non-routine work. It is in this flexibility that creative work is found.

3.3.3 Representative review on creativity within routines

Since many occupations involve repetitive creative work-as evidenced by the demand for constantly new outcomes-such organizational routines must incorporate creative work in some way (Cohendet & Simon, 2016). The development of routine *dynamics* research has led to an increase in scholarly work addressing creative and innovation-related topics (cf. Deken and Sele 2021). However, despite the conceptual development of RD, ”we still lack important insights into the inner workings of such routines because many scholars have treated innovation routines as stable entities” (p.3). There is considerable divergence in the conceptual representation of creative work within routines in the literature, which forms the basis for the following review.

A representative literature review was conducted to present the discussion and arguments raised in the literature to understand how creative work is represented in routines. The report follows the PRISMA guidelines (Page et al., 2020).

Paper collection process

The literature search began and focused on the major journals of routine research: Organization Science, Organization Studies, Academy of Management Journal, and Academy of Management Review. Using Google Scholar, publications in these journals were searched using the keywords ”routine” paired with ”creative” and ”innovative.” A total of 1193 hits were found for ”creative” and 1948 for ”innovative.” Based on the title and abstract, 41 papers were selected for further review. The literature search was expanded by forward searching (using Google Scholar) and backward searching (based on citations from the 41 selected articles), resulting in 18 additional articles. After reading the full papers, 21 papers were selected.

The main criteria for inclusion were the theoretical basis in routine discourse and specific information about creativity. In the tables in Appendix A on page 275, I provide an overview of these papers and their main characteristics.

Data collection process

Regarding the data collection process, the papers were first read thoroughly and the main points were extracted. With the information selected, a conventional content analytic approach was applied to categorize the central perspective on the relationship between routine and creative action for each paper (following the inductive content analytic approach, cf. Mayring 2010; Selvi 2019). A particular focus was on attributed routinization, the definition of creative work, individual agency, environmental influences, and the possible influence of artifacts, e.g., technology. The main goal was to understand the authors' conceptualization of the relationship between creativity and routine work and the representation of creativity within routines.

Data aggregation

After inductive content analysis, different forms of the relationship between creativity and routines could be found for the studies adopting a duality perspective. Following Farjoun (2010), who argues for a duality perspective for change and stability, the creativity-routine works were sorted into two main categories: Dualism vs. Duality. A dualistic approach assumes two irreducible dimensions, e.g., creative OR routine work. Duality assumes two integrated dimensions, e.g., creative AND routinized work.

The relation between creative and routinized work is differently conceptualized in the literature, depending on which aspect of the other resides in each case. Table 3.1 summarizes these five different conceptual perspectives:

1. Independence: creative work extends routinized work
2. Routinized work is an element within creative work: an overall fuzzy creative work process contains some routinized elements
3. Routine and creativity in balance: an exact balance of both aspects is required for a successful process run
4. Routinized work is an element within creative work: routine replication entails some change and deviation when replicated, which entails room for creative work
5. Creative routines: some routines constantly lead to creative output

3.3.4 Synthesizing current perspectives on routinized creative work

Dualism: creativity extends routines

The assumption that creative and routine behavior is in some sense distinct and incompatible still holds. Ford (1996) argues that creative and habitual actions compete with each other. Because habitual actions are usually perceived as safe and easy, they are preferred. Creative behavior is perceived as riskier, especially in a business setting. Therefore, routine behavior will always be chosen unless it is clearly undesirable and creative behavior is required. From Ford's perspective, creative work competes with routine behavior and can only be done in its place. This creates an understanding that creative work is exclusive, outside of routine work, and occurs only when explicitly required.

Lillrank (2003) further argues that creative work outside routines is always necessary. Since both the process and the product are unknown in advance, creative work is required to find a way and a suitable solution. Thus, Obstfeld (2012) coins the term "creative project" for creative work beyond routines in which new ways of working are tried out. Whenever there is not (yet) an established repertoire of past practices that indicate what to do next, work is done outside of routines.

Table 3.1: Differentiation of theoretical assumptions regarding creative and routinized work

	Definition	**Demarcation**	**Studies**
Dualism			
C extends R	creative work can only be done outside or beyond routine work	to achieve C, R cannot be applied	Bucher, 2016 Ford, 1996 Hargadon, 2006 Obstfeld, 2012
Duality			
R inherent in C	when working creatively, some routinized aspects are applied	all C include R	Becker, 2009 Cardinal, 2001 Fortwengel, 2017
R and C in balance	routinized and creative aspects of a process need to be balanced to work successfully	C- and R-elements need to be properly balanced	Gilson, 2005 Lombardo, 2014 Malmelin, 2015 Ortman, 2018 Rosso, 2014 Sele, 2016
C inherent in R	all R include potential of C	change and deviation, thus potentially cr. work, is inherent within R	Aroles, 2016 D'Adderio, 2014 Deken, 2014 Lillrank, 2003
Creative routines	cr. work can be seen as a R in itself	R can lead to constant C	Cohendet, 2016 Goh, 2019 Sonenshein, 2016

Notes. C = creativity, cr. = creative, R = Routine/s.

Creative projects describe unfolding paths of action by anticipating or responding to emergent means and ends. Such behavior is characterized by high uncertainty and reactivity in situ. Because no clear action path is established, a creative project's ostensive aspect is indeterminate. Thus, creative projects can begin an emerging routine as new patterns of action are found that, if repeated, can become established over time. Likewise, already established routines can be changed by working outside the routine, what Bucher and Langley (2016) calls "reflexive and experimental spaces."

The dualism of routine and creative work assumes an either/or perspective on repeated creative work in organizations. Since creative work is not predictable in advance, its performance is understood to lie outside routines. Creative performance can nevertheless be (positively) influenced by the standardization of work practices, as it guides the overall process of work and interaction in organizations. However, these aspects of routinization are seen here as explicitly not directly related to the creative act itself.

Duality: an integrative perspective on creativity and routines

The dual perspective includes creative and routine work processes. Different perspectives place creative or routine work in the foreground, and both routine and creative aspects can be found. The intensity of creative work also varies in the studies examined. All of the studies presented here present examples from practice in which creative and routinized work could be integrated somehow.

Routines are inherent to creativity. Routines support innovative work in two ways: they create stability as a prerequisite for work and they enable step-by-step exploration and use, leading to continuous improvement of creative products. Constraints, in one form or another, are an essential aspect of creative work (cf. section 2.4.4 on page 46). Constraints in the form of standardized work processes are described as conducive to the creative process because they guide group work in an otherwise over-complex space of possibilities (Acar et al., 2019). Thus, innovation repeatedly results from formalized, bureaucratized processes in organizations. From practical experience, Becker and Zirpoli (2009) have found that routinization and standardization of work processes can foster radical innovation. This may explain why the pharmaceutical industry, which has a high degree of formalization, control, and regulation, has a very high output of incremental and radical innovations in new drugs and medicines (Cardinal, 2001).

Especially in complex and challenging domains, a form of scientific rigor and a high degree of formalization enables the necessary incremental steps along the path to discovery. Although the creative process is about individuals making sense of complex, ambiguous information in time and space, the organizational support structure cannot be spontaneous and situational. Therefore, such structures, which serve as the foundation for any work, may take the form of routines that support creative endeavors (Fortwengel et al., 2017).

Routines and creativity in balance. When organizations provide the framework for the work, constraints, formalization, and routines are associated with it. Regarding creativity, the freedom needed in the process must be in proportion to these constraints. If there is too much focus on routines, creativity cannot flourish, while too much focus on creativity increases the risk of a chaotic or overwhelming complex process. In analyzing communication in an organizational context and its relationship to creativity, Malmelin and Virta (2015) found this dual nature of seemingly contradictory forces juxtaposed: static vs. dynamic, freedom vs. constraints, informal vs. formal. Constraints, on the one hand, limit the process and the outcome, but on the other hand, they can guide and limit the search for solutions (Lombardo & Kvålshaugen, 2014).

Routines are understood in the sense of agreed patterns of action, less in the sense of precise work processes (Sele & Grand, 2016). Employees can use their creative scope, especially through spontaneous face-to-face communication and individual encouragement. Such informal spaces are essential to creative work because they trigger broader content and allow for serendipity. Formalized aspects remain crucial for creative work to be done appropriately by elaborating and reviewing interaction. "Instead of considering paradoxical situations as contradictory, they can be seen as two coexisting streams of synergic action" (Malmelin & Virta, 2015, p.20). Above all, a balance between removing constraints to expand opportunities and introducing constraints to ensure control is needed. In teamwork, the role and importance of standardization as a means of ordering work is paramount in guiding creative group work (Gilson, Mathieu, Shalley, & Ruddy, 2005; Rosso, 2014).

In contrast to the first approach, where routines are seen as inherent to creativity, this approach sees both aspects of routine and creative work as equally important. For creativity to unfold, work in the organizational context must be structured and balanced.

Creativity inherent in routines. The repeated performance of a routine is never simply a copy of a process but an active, emergent, and thus potentially creative process of routine replication (Aroles & McLean, 2016). As briefly introduced at the beginning of the chapter, routine research has evolved toward this much more flexible and generative perspective following the paper by Feldman and Pentland (2003). RD theory (e.g., Feldman 2016) incorporates the potential for creative action into any routine replication. Because all routines are embedded in a dynamic environment, adjustments and improvements are necessary. Therefore, routines – which are still perceived as relatively stable patterns of behavior – can and do change over time as the social and material context can adapt (D'Adderio, 2014).

In this flexibility of routine replication lies the behavioral scope for deviant behavior and thus potentially creative output (Lillrank, 2003). Individual behavior could be considered creative, but the resulting product would be relatively incremental change and a low degree of creativity. What is potentially creative, however, is the process of routine adaptation. This theoretical approach does not focus on the actual development of a creative product through routines but extends the conceptual understanding of all routines to include creative aspects.

Creative work as routines. So far, the theoretical approaches presented have argued that there are some routinized aspects in creative work or that creativity is contained in routines. Some authors have shown that routines can also repeatedly lead to creative output. Analyzing behavioral traces within a game design process can be understood as a theoretical approach. Goh and Pentland (2019) focused on how paths and patterns are established and evolve in the group work of game design. In this study, the game development process was understood as a creative project loosely structured by these sprints.

Nevertheless, repeated actions could be found in the form of patterns that stabilized the totality of actions. Of particular importance is the finding that creative work elements were also routinized within a work process. Previously, it was argued that routinized aspects of work supported and guided creative work. Within a highly creative project, any task can become routine if it is successfully repeated over time. ”These findings thus provide evidence of stable, repetitive patterns of action even within the context of a creative project” (Goh & Pentland, 2019, p.1913).

The draping and appealing clothing presentation were explored as a creative process repeated daily by examining the work of retail salespeople. For these tasks, sales associates had only vague guidelines that left room for playfulness, experimentation, and redesign. Sonenshein (2016) argues a step further, finding that repeated creative acts improve creative output over time. He refers to creative implementation as a process of ”personalization” and ”depersonalization” in which the actor decides how to interact with the merchandising routine: whether to follow the guidance provided by the routine or to use the space for potential creative behavior. Compared to the first example, this study finds evidence of stable, repetitive action patterns within daily creative work. Previously, routines were considered beneficial to creativity only as they maintain cognitive energy or as routines guide work practices, leading to creative outcomes. By applying the concept of de/personalization, creative behavior becomes an individual choice not to act like routines.

Similarly, another ethnographic study from the field of game design supports the notion of creative routines as an example of significant creative achievement: Cohendet and Simon (2016) followed a game design team at Ubisoft as they dealt with a creative crisis. Facing some rejection of their work by higher management, the team needed to develop new work practices to increase their overall success. The team's management pursued a two-pronged strategy: enhancing the individual's creative freedom as part of the overall work routine and routinizing engaging and entertaining activities to evaluate the team's ideas, which had previously been done unofficially by the team. Overall, the study showed that these interventions had a positive impact on employees' internal motivation by giving them more freedom to explore initial ideas while also giving them greater responsibility as a team for evaluating their ideas early in the process. This "freedom" granted early in the game development process allowed for greater creativity than the previous stage-gate model. In addition, this adaptation of the ideation process increased individual effort as their expertise was more valued, and they received early feedback.

The leadership of this game development team at Ubisoft established a new (better) routine by deliberately disrupting, splitting, and recombining aspects from different routines. This change may have been successful because it stayed close to what employees used to do and was designed to increase motivation and engagement. From a routine perspective, the obvious aspect of the routine remained relatively similar and only nuances were added, making the transition easier. Although the paper focuses on workers' behavior - their ability to act - the actual change in routine occurred through the adjustment of work routines under the direction of the manager. This top-down approach differs from the individual creative agency within a routine discussed earlier. Here, a routine adaptation that allows for greater creative freedom comes about through structural adaptation from the outside and not solely through an individual agency within routines. This demonstrates that creative work is done within a set of routines that are performed repeatedly and yet leave room for not just incremental but significant creative output.

Limitations of the literature review

As with any method, there are some limitations to the literature review conducted here. Since the selection of papers represents a current debate within the scientific community dealing with the representation of creativity in routines, it cannot be excluded that relevant papers are missing. Therefore, the results of this analysis are focused and bound to the perspective of routine research.

Since it is common in routine research to conduct ethnographic analyses, almost all study results rely on the same method. Ethnography allows the analysis of complex situated actions, which makes it a very suitable tool for routine analyses. However, this method entails a high degree of subjectivity, as researchers must determine their own system for observation, data analysis, and interpretation (Dittrich, 2021). Because researchers observe processes in the field, they are often obvious to study participants, which may influence their behavior. Therefore, the method may influence the processes being studied, especially when analyzed over shorter periods of time (Paradis & Sutkin, 2017).

The review encountered some issues that could not be further analyzed because only a minority of the primary papers discussed the topic: the distinction between process vs. process outcome is rarely made explicit (as a positive exception, cf. Farjoun 2010), but seems to be relevant to the general understanding of creative input to change the process vs. creative input to create a (creative) outcome. Nor is there an explicit distinction between the different forms of individual agency. On the one hand, the agency can consist of choosing which (part of) the routine to perform (cf. traces the concept of Goh and Pentland 2019), as well as some degree of freedom within the routine (e.g., Sonenshein's, 2016, conceptualization of (de)personalization with a routine task).

Finally, change and dynamics of and within routines are mostly viewed positively. However, some studies point to negative consequences of even incremental routine changes and adaptations, as the actors involved and the routines associated with them can become confused and unbalanced (Tate, Campbell-Meier, & Sudfelt, 2018). Such potentially detrimental and harmful effects receive somewhat less attention, which may represent a black spot in the RD research landscape.

3.3.5 Review summary

The RD perspective on creative work focuses on the different ways in which creative performance is realized in the workplace. Following the review, different accounts of creativity within routines can be derived from the literature. Some of these views are complementary, while some are more contrary to each other.

The dualistic view, which sees creative work as beyond routinization, contrasts with the dualistic view, which incorporates creative performance into routines. For the latter, creative work is possible within the constant repetition of routines, endogenous changes based on the actor's ability to deviate from routines, and explicit routine parts that require repeated creative performances.

Figure 3.3 summarizes the forms of creative work discussed above in terms of the degree of routinization. Typically, lower levels of creativity are found in routine replication (Aroles & McLean, 2016; D'Adderio, 2014) and in spontaneous ad hoc processes (Dustdar, Hoffmann, & van der Aalst, 2005). Higher levels of creativity emerge either through creative routines (Cohendet & Simon, 2016; Goh & Pentland,

2019) or, when the process flow is not predictable in advance, through creative projects (Obstfeld, 2012). This differentiation spans creative work from low to high process standardization. This holds an important insight for the BPM context: highly creative work is found within standardized processes, which in principle, can be well captured and modeled. In the following section, further implications for the modeling goal of creative work are discussed in detail.

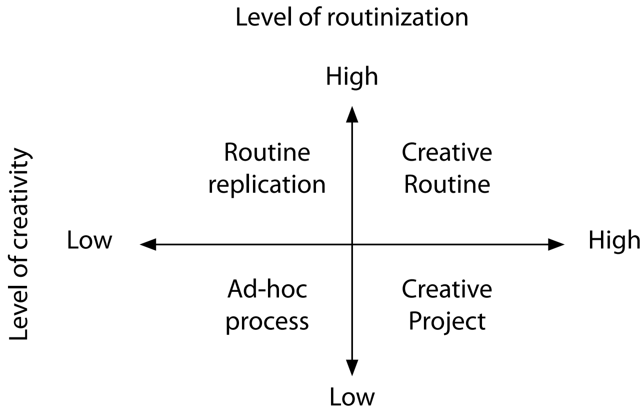


Figure 3.3: Differentiating four process types based on the level of creative output about the routinization of the process

3.4 Conclusions for the BPM context

The theoretical representations of creative work within routines have multiple implications for the handling and management of creative work. Previously, the conceptual differentiation of creative work within routines was discussed. I will further elaborate on the differentiation and implications, focusing on the visualization and potential management of creative work. From this, I derive propositions about creative work processes that will be incorporated into modeling extensions in Chapter 5.

3.4.1 Differentiating the degree of creative work

The cases of creative work discussed in the literature presented differ in the extent of creativity expressed in the processes carried out. To some extent, this is related to how ”creative work” is defined: One strand of research sees creative work as possible only outside of routine work, as it would require a significant degree of process flexibility that expands the routine definition. The attitude is that creative work of significance can only be done in ”creative projects” where the work processes are not predictable in advance (Obstfeld, 2012). This assumption lacks the possibility of a priori process representation and planning. Indeed, in some business ventures, such a high degree of unpredictability may be possible if the process and outcome are *very* vague in advance. Such work outside routines is always considered creative. However, because organizations need to be efficient, most work is repeated in some form and performed according to predetermined patterns (Becker, 2004). As mentioned earlier, standardized processes can lead directly to new and useful results −ergo, creative ones (Goh & Pentland, 2019). This counters the classic process typology that distinguishes non-standardized from standardized processes based on knowledge intensity. The RD studies of creative work demonstrate that processes can be both highly standardized and highly knowledge intensive. This provides the basis for a modeling approach to creative work:

Proposition 1: Creative work can be modeled properly with business process notations.

Routine and non-routine work is not a matter of 0 or 1. ”The difference between standards, routines and nonroutines is relative.” (Lillrank, 2003, p.226). Even though Figure 3.3 shows the categories ”Creative Routines” and ”Creative Projects,” these are typical examples of a gradient from low to highly standardized creative work processes. If the questions ”What’s going on here?” and ”What do I do next?” cannot be answered, the work is more non-routine. ”Routines and creative projects can be distinguished by the extent to which the answers to these questions are well in hand as the action unfolds." (Obstfeld, 2012, p.1573).

Proposition 2: Creative work is characterized by uncertainty about the process sequence and the process outcome.

Creative work from endogenous deviation of a routine

In RD papers, individual action is given a special role to explain creative behavior in routines. Actors must use the freedom of the process to act creatively (Lillrank, 2003; Sonenshein, 2016). Thus, similar to knowledge intensive processes (KiP), who performs the creative intensive process (CiP) matters, as their knowledge, experience, and skills are important to the potential performance of the routine. Such individually encouraged routine adaptation does not require significant change to still be relevant to creative output. Sele and Grant (2016) were able to show that similar routine interactions can nevertheless lead to different routine outcomes that were considered creative. This suggests that incremental creative outcomes can result from even minor changes in routine performance.

Creative work as process variation by-design

Creativity can be conceptualized within routines that go beyond an individual's ability to potentially act creatively. Routines can be explicitly designed for variability in outcomes. Variation within some sub-process is required to successfully complete the defined process. Variation is defined here in comparison to previous runs of the same business process. This approach would allow for greater overall process flexibility, which could lead to high outcome creativity (Cohendet & Simon, 2016).

Proposition 3: Standardized processes may involve sub-processes that require deviation from previous process flows, which can lead to creative outputs.

3.4.2 Differentiating process levels

The RD perspective analyzes work from a temporal-sequential perspective as performative patterns over time. In contrast, the BPM perspective typically examines processes from a hierarchical perspective that differentiates process levels. The papers presented in the review discuss creativity within routines without the concept of process levels. Looking at the case studies discussed in these papers with an BPM framework, there is no doubt that processes were examined at different process levels. For example, Cohendt's case from the game industry was described as a higher-level stage-gate process that included various steps in game development. In contrast, Malmelin's study (2015) in the media industry focused on informal interaction within teamwork, which is a much lower process level and relates to specific activities.

Since the study found evidence of successful routinization of creative work for all process levels examined, it can be concluded that creative work is routinized at all process levels, including sub-process and activity levels. In the introduction to this chapter, I gave the definition of Type 1 processes as knowledge-intensive, complex work that can only be meaningfully analyzed at the higher process level (cf. Section 2.4.1 on page 32). Again, the analysis of creative routines shows the need to expand the definition. Complex, knowledge- and creativity-intensive work can be standardized to a high degree at all process levels.

Proposition 4: Creative work can be standardized on all process levels.

3.4.3 Differentiating process phases

The degree of flexibility required for a successful creative process depends on the phase through which such a process typically passes. The idea of a series of different phases has already been introduced in the context of the psychological perspective on creative work. To develop something new and useful, one typically needs to understand the problem, find solutions, and evaluate the best one. From a routine perspective, stronger routine deviations can be observed in the idea generation stages, while the evaluation processes may have a higher degree of standardized (Malmelin & Virta, 2015).

Proposition 5: The creative process can be distinguished into phases of ideation and evaluation.

3.4.4 Section summary

Several conclusions for the management of creative work can be drawn from the literature on RD and creative work. In this section, I have discussed the differentiation of the degree of creativity – from incremental to significant – that results from standardized creative work. Routine studies argue that creative work unfolds in routines in two main ways: through endogenous variation within a routine and through variation in the routine by design. Furthermore, analysis of creative work at all process levels shows a standardization of work routines that allows creativity to unfold. Different process phases show different needs for process flexibility. Sub-processes of idea generation generally require more process flexibility than evaluation processes, which are often more standardized.

3.5 Chapter summary

The goal of this chapter is to develop a deeper understanding of how creative behavior emerges in business processes. To this end, literature from the field of routine dynamics (RD) research was reviewed. The different conceptual perspectives are discussed, as well as the implications for the BPM perspective. Most importantly, the RD perspective provides great support for highly creative work within well-structured (routinized) processes. Furthermore, the RD perspective supports and extends insights from the BPM domain, such as the PoC principle and the basic idea of process phases for creative work. This provides a solid foundation for the following goal of creative business modeling.

Applying the results of RD research to the example of creative work from the BPM perspective, creative work is understood as standardized work that enables complex and knowledge- and creativity-intensive work. Routines are conceptualized as repetitive work patterns (Feldman et al., 2016) that enable a relatively high degree of process flexibility. The counterpart to routines in the BPM perspective are standardized work processes, which are usually defined as work processes with a high degree of automation.

Based on the assumptions about creative work in routines, I derived five theses about creative work that will later inform the development of modeling extensions for creative work. Because the RD literature covers a wide range of different work domains and topics, the theses are considered general to creative work in all domains. However, in-depth process studies are best conducted within a clearly defined process landscape. Therefore, in the following chapter, a detailed creative process is taken from practice and examined for its potential for managing creative work.

The Prime Directive is not just a set of rules; it is a philosophy...
and a very correct one.

JEAN-LUC PICARD, IN "SYMBIOSIS"

4. Empirical approach analyzing creative business processes

This chapter describes the case study conducted to collect data about concrete creative processes. My methodological approach aims at answering the first of the two main questions of this dissertation: what needs to be considered to capture the creative process fully? The prior two chapters built the theoretical foundation, which is now put into context in the form of this case study. I first introduce the methodology of ethnography, specifically digital ethnography. Then, the case study context, as well as the people involved, are presented. A detailed explanation of the data analysis process is provided, leading to the creative process's conceptual advancement. The analyses build the basis for the modeling extensions developed in the following chapter. This next chapter will address the second research question: how can creative intensive processes (CiPs) be visualized using a modeling notation language?

4.1 Research design

Ethnography was chosen as the primary method for collecting and analyzing detailed process information because it allows for "firsthand experience and exploration of a particular social or cultural setting based on (though not exclusively by) participant observation" (Atkinson, Coffey, Delamont, Lofland, & Lofland, 2001, p.4). Thus, ethnography is a holistic approach to analyzing the contextualization of the particular object of research (Fetterman, 2009). This method has its roots in anthropology, which is primarily concerned with the analysis of people, usually groups, focusing on their interactions and typical processes. This requires intensive access to the field and time-consuming observation of people and their activities. Overall, it is a subjective method that depends heavily on the researcher's perception of the data throughout the observation period (Neyland, 2007).

An ethnography aims to combine methods such as field observation with interviews and document analysis. Business processes that cannot be captured directly by information systems are often captured through interviews or workshops with process participants (Dumas et al., 2013). Such methods can lead to comprehensive process descriptions but are limited to the perceptual and verbalization capabilities of the participants. Further process observations by an outsider, such as a researcher, increase the objectivity of the process descriptions. "An ethnography attempts to be holistic—covering as much territory as possible about a culture, subculture, or program — but it necessarily falls far short of the whole" (Fetterman, 2009, p.11).

Ethnography is the most important method used in the context of routine dynamics (cf. Dittrich 2021). This method enables the analysis of individual patterns of action and their interdependence with the organizational environment. Zooming into the process reveals individual action, and zooming out reveals the coherence of organizational routines (Feldman & Pentland, 2003). Real-time observation of process steps can assess "a coherent, time-ordered sequence of actions or interactions in the workflow—steps in a process" can be assessed (Goh & Pentland, 2019, p.1901). This enables the association of *actual* activities with process patterns embedded in the specific setting (Grahle & Hibbert, 2020). Temporality is added to situational embedding, as the progression and change of activities can be perceived over time (Dittrich, 2021).

The ethnography took the special form of a *virtual ethnography*, which functions similarly in its main methods and guidelines, using digital media for observation. The observation is placed in the virtual room, as the work performed was mainly done virtually. However, it is necessary to critically question whether a virtual ethnography is useful for the specific case. Of particular relevance is the fit between the digital tools used for observation and the tools used by the people in the case (Neyland, 2007).

4.2 Methodical application of an ethnography

Ethnography as a method requires adaptation to the specific point of view that is the subject of analysis. Therefore, it is impossible to describe the precise steps to conduct an ethnography (Neyland, 2007). However, general guidelines should be considered to ensure the method's sound and valid application. These basic principles relate to data collection and analysis to ensure quality and richness.

4.2.1 Observation

The top priority is passive engagement in the field through observation. The main point here is to observe everything and consider everything potentially relevant. Thus, the object of analysis is best a new one since most things still seem unusual to the researcher and can be analyzed with fewer presuppositions. The researcher takes on the ”incompetent stranger” role and asks more profound questions about the activities observed (Neyland, 2007).

Two aspects are central to observation: First, a theoretical framework must guide the observation process. Because field observation allows for many angles and aspects to focus on, observing *everything* requires guidance from the research question(s) and a theoretical framework. Second, observation requires some degree of immersion in the field, but only with marginal involvement. Any interaction with the observed people could result in a change in the behavior being analyzed (Grahle & Hibbert, 2020). The researcher must constantly balance interaction through questions and interviews with the potential to alter the conduct of the process through such interaction.

To keep the quality of observation appropriately high, I communicated my study objectives only superficially at the beginning of the study. My observation took place digitally by attending team meetings and taking notes only. I asked content-related questions in separate conversations with participants so as not to disrupt the flow of the meetings. The interviews with the process participants were conducted after the projects were completed so that the reflection initiated in the process could not influence the work process.

4.2.2 Triangulation

Ethnography is a method in which data are collected from different sources. This is done to increase the data's richness and compensate for possible weaknesses of different data sources such as field observation, interviews, and document analysis. Another way to increase data richness is to aim for multiple sources of the same information. This primarily increases the validity of the extracted information. According to Fetterman (2009, p.95), that "works with any topic, in any setting, and on any level". In the organizational context, data richness could be achieved by including the management perspectives, workers, and potential users, or other connected third parties.

In the study, I aimed to achieve data richness by adding different sources: observation of teamwork, interviews with process participants, the management, and the collection of associated data like written documents, screenshots from online working tools, and written team communication.

4.2.3 Content analysis

A data-rich assessment technique like ethnography aims to find patterns in the masses of information gathered. When the data is reviewed, often over and over again, regularities and similarities can be found to answer the posed research questions (Fetterman, 2009). For that, the importance arises for coding software, to better keep track of data chunks and their potential similarities (Mayring, 2015). To manage and analyze the data accordingly, I used the software ATLAS.ti.

Pattern recognition and extracting insight into the data is a subjective process (Madden, 2017). However, there are guidelines and quality standards for such qualitative content analysis to follow (e.g. Mayring 2015). Classical quality criteria like reliability (the soundness of the data gathered) and validity (coherence and properness of the results) still hold for qualitative data. Both concern the data assessment, as well as the data analysis phases. Quality of an ethnographic is best assured when

- the subject studied allows for conclusions about the raised research question(s) (cf. following section);
- the data is assessed in coherent, structured, and exhaustive ways (cf. Section 4.5);
- the data analysis if performed based on clearly comprehensible categories, and rigorously performed across all kinds of data (cf. Section 4.6.2);
- the interpretation of results is based on repeated data-evaluation (cf. Section 4.7; Mayring 2010, 2015).

4.3 Study case

A case study was sought that addressed the possibility of observing highly creative work via digital media. Many companies were forced to move to digital working methods due to pandemic restrictions from 2020. However, these processes often did not work correctly when spontaneously transferred to the digital space (B. Wang, Liu, Qian, & Parker, 2021). To be able to analyze effective business processes, I looked for those companies that have always relied heavily on digital tools, assuming that their work would not have been affected as much by the pandemic restrictions. I assumed that such a high level of digitalization and creative work would be found in areas such as game and software development. Such an approach to finding a case study represents a form of purposeful sampling to ensure a strong and appropriate case for analyzing creative work (Flick, Kardorff, & Steinke, 2004).

The data evaluation approach I have chosen is one-sided, i.e. it analyzes a concrete process within an organizational environment (Neyland, 2007). The company – Ideas Engineering, Ideas for short – is part of one of the world's leading publishing companies, which includes traditional and digital media such as *Bild*, *Die Welt*, *Business Insider*, and *Politico*, as well as digital platforms such as *Idealo* and the career site *StepStone*, to name a few. I followed a team working for Ideas, which is part of Axel Springer *National Media & Tech*. It is a software development department whose main goal is to develop, test, and possibly implement new software for Axel Springer's wide-ranging services. Ideas focus on the development, testing, and possible implementation of new technological tools related to the publisher's (digital) services. The main activity is therefore software development. The staff are mostly professionals in the field of software development and rely heavily on digital tools to perform and coordinate their work. Their teams work entirely remotely, although they can use office space if they wish.

The work process I focus on in my analysis follows a clear, predefined meta-process with predefined phases and quality gates. This overarching process should be called Prototype Development (PD) (cf. Figure 4.1). The process begins with a general idea or vision for a new prototype that can be proposed by anyone in the company who has an idea for improving or inventing new technological tools. Over the course of several months, this idea is shaped and developed into a technical solution by a team of five developers with the support of two managers.

The PD consists of five main phases: the pitched idea, pitch preparation, pitch evaluation, prototype phase, and potential implementation. Between some of these steps (see vertical lines in Figure 4.1), the pitched idea is evaluated, leading to acceptance or rejection of further work on it. I followed two of these meta-processes over a period of five months, focusing on the prototyping phase, as this was the most intensive phase of work, with the most people working on the actual implementation of the idea.

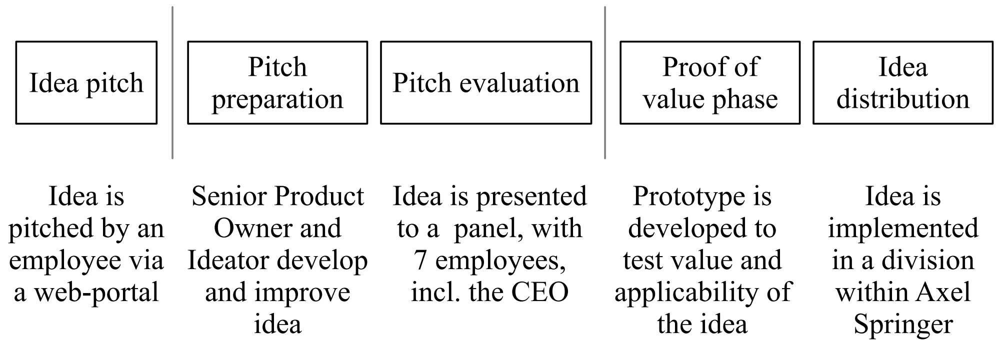


Figure 4.1: Overview of the process phases of the Prototype Development

4.3.1 Setting description

Since Idea's main goal is to further develop the software currently used in the media industry, their work habits are based on agile and lean principles. They mostly work in small teams, with a high degree of individual freedom and responsibility. The ideas they work on can come from all areas of the Axel Springer companies and can potentially be applied and further processed by any of them. Ideas employees, therefore, occasionally work directly with colleagues from other areas to jointly drive forward new technological ideas.

The team works entirely digitally, mainly supported by the Microsoft Teams software. The office in Berlin was available during my observation, but most employees worked from home. All meetings were therefore held digitally, so I could also participate virtually. The company's main language is German, but some colleagues are more familiar with English, so team meetings and chats were partly held in English. They communicated mainly via Microsoft Teams, which allows for both team and individual chats and video calls, as well as in person when they met in the office.

4.3.2 Participant description

Throughout the data collection process, I was in close contact with a key informant (following the logic of a narrative ethnography, Neyland 2007), the Senior Product Owner (SPO) of the overall PD process. Further, for the software-development phase, I closely monitored the work of the proof-of-value (PoV) team, which consists of five developers, plus the ideator and the PoV-Product Owner (PO). Figure 4.2 shows the simplified product development process with associated roles; Figure 4.3 shows an overview of the roles involved in the PD, which are explained below.

Senior-Product Owner (SPO): is responsible for the entire PD, which ranges from the submission of ideas to the marketing of the finished prototypes within the company. She promotes the concept of PD within Axel Springer so that employees submit new idea pitches. She first evaluates these pitches and then improves and refines with the idea provider. The goal is to create a concise pitch to ”sell” the idea to the panel. In case of a positive evaluation by the panel, she supports the transition of the idea to the PoV team. She also coordinates the pitched

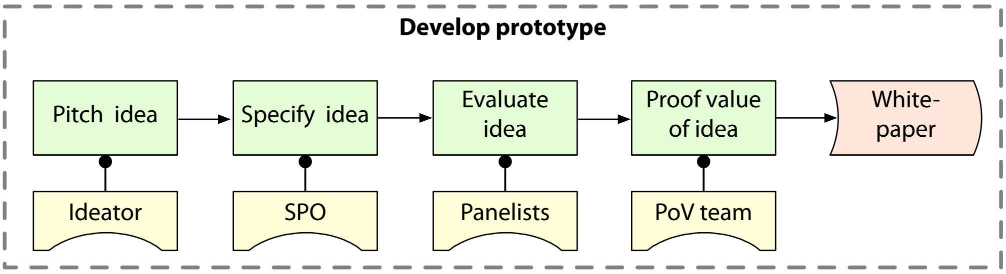


Figure 4.2: Overview of the Prototype Development process with associated roles, modeled using Knowledge Modeling Description Language (KMDL); Gronau 2012

ideas so the PoV team can work on each idea. In the PoV phase, she provides support and handles completing the white paper (including the full explanation and evaluation of the invented prototype). She also collaborates with colleagues from other departments to implement the prototypes when appropriate. From a meta-perspective, she also anticipates potential adjustments to the overall PD process by soliciting feedback from all stakeholders. As PoV team developers change after two to three PDs, she also coordinates the recruitment of new software developers.

Ideator: an employee of the Axel Springer companies who proposes an idea and seeks help in developing it further. The ideas may still be vague, as elaboration takes place during PD. The idea generator can come from a wide variety of areas and is not limited to positions in software development. Idea generators can also appear in teams if they have developed an idea together. The role of the ideator in the two cases I observed was performed quite differently depending on their professional backgrounds: In the first prototype, the idea giver was a software developer, which led to active participation in the prototype development process. In the second prototype, the idea generator had a design background and participated actively, but more with a design focus and with much less active management of the work progress.

Roles associated with the Prototype Development	**Explanation**
Senior Product Owner	Managing overall Prototype Development process, handling pitched ideas, distributing tested ideas
Ideator	Pitching an idea with the potential to advance the (technological) services provided by Axel Springer; potentially supporting the PoV-developing team
Panelist	Evaluating pitched ideas
PoV developing team member	Developing and testing a prototype based on the pitched idea
consisting of:	
PoV Product Owner	Managing the Proof-of-value phase, in which a prototype is developed; guiding group work, planning prototype testing
Software Developer	Specialized software developer in back-end or front-end design

Figure 4.3: Explanation of the roles associated with the Prototype Development

Panelist: Once two or more prepared idea pitches are received, the SPO convenes a panel meeting. The panel includes seven company employees –the panelists– from different departments selected based on their professional backgrounds and expertise and individual openness to potential innovations. The panel also consists of a general manager whose vote carries equal weight in evaluating the ideas. The ideator presents his/her pitch for three minutes, with additional time for questions. Only in the event of a positive evaluation will an idea be pursued.

Proof-of-value-team (PoV-team) member: the PoV-team consists of up to seven members: a PoV product owner (PO), two software developers, and up to four spare seats for developers and the Ideator from across the company. In the two prototypes I tracked, developers from Ideas and the Ideator filled three spare seats. The developers had different back-end and front-end design requirements to allow for a wide range of expertise on the team. They take the essence of the pitched idea and develop a prototype to test its value. Their main goal is to find a way to prove that the basic concept of the idea presented works, has some value to people, and can potentially be developed into a marketable product. The way they work, with what tools, frameworks, etc., is entirely up to them. The only goal is to find reasonable proof (or no proof) for the worth of a presented idea. The two software developers who are permanently part of the PoV team are more familiar with the operation and format of this concise and fast prototyping process than the substitute seat developers. This led them to take a more active role in leading and planning the prototype development.

Proof-of-Value Product Owner (PO): its task is to lead the PoV team, keep an eye on the development of the prototype, lead the tests and write the final whitepaper. The PO rotated between the two prototypes; in both cases, about 20% of the work time was dedicated to this task. This resulted in the PoV team being highly self-organized and having a high degree of freedom to coordinate the prototype's work and development. The PO was actively involved in the team as needed and was particularly active in leading regular meetings, such as the daily and weekly meetings, and coordinating prototype testing.

4.4 Prototype description

4.4.1 Prototype 1

I observed the work on the first prototype (Prot1) from July to September 2021. By then, the SPO and Ideator had already worked on the idea and it was approved by the panel. Prot1 is a website that makes it possible to find Axel Springer tech peers worldwide. It is used to connect developers from Axel Springer, share their expertise and find help with programming tasks.

The prototype is connected to GitHub, which is used by all the company's developers as a platform to collect all the code written by the developers. Prot1 takes all the code information from GitHub and creates individual developer profiles. These profiles collect information about the code and languages written and the developers' individual contact information. In addition, the Prot1 platform allows users to search and sort by different programming languages so that other developers with specific programming skills can be found and contacted.

When the idea of Prot1 was presented to the panel, the basic framework of this website had already been invented and created by the idea creator. There was still some room for the PoV team to add specific features and give the website a particular style to improve usability and user experience. Thus, the scope of what was to be invented in the PoV phase was already clear and predetermined.

4.4.2 Prototype 2

The panel approved the second prototype (Prot2) in August 2021, and the PoV team worked on it from late September through November. The ideator came up with the idea for Prot2 when difficulties arose working from a different time zone than most other team members. The pitch is based on the idea that we can focus differently on work tasks depending on our circadian rhythms. People show differences in when they are most efficient and able to concentrate best, depending on their individual sleep-wake rhythms (cf. Minors and Waterhouse 2013). However, we rarely consider such effects when planning our (working) day. The original idea of Prot2 is a calendar extension whose main function is to implement information about the user's circadian rhythm to match specific types of meetings to the user's energy curve.

When this initial idea was presented to the PoV team, it was further developed to include information about the physical location of their teammates for team members sharing one calendar. During the PoV phase, a chatbot was added to communicate possible tweaks to the calendar to the user, include more specifications on the typical concentration curve, and improve the work-life balance of users.

4.5 Data collection and sources

The data collection process began in June 2021 with regular meetings with the SPO as the primary informant. The majority of the data was collected in two PoV phases from July to November 2021. All meetings took place online through their Microsoft Teams account. Interviews with team members were conducted via Zoom and recorded for further transcription.

Notes were taken for all sessions with key statements from all participants. I also noted the time of day, the team members present, and any anomalies in the group members' interactions. When notes were collected live during a session, they were reread, improved, and missing information was added within a period of about 24 hours.

Additionally, there was access to the PoV team chat, where the team shared brief information and links. These were not recorded, as it was explicitly a "safe" space for individual exchanges. However, it was noted when important prototyping decisions were communicated there. Meetings that I could not attend live were audio recorded by a member of the PoV team. Notes were also taken on these recordings.

In addition to observing the actual teamwork, I followed the SPO's work in weekly meetings, in addition to meetings she held with other stakeholders to manage the overall PD process. This helped gather more information on other prototypes that had not yet been approved by the panel, as well as previous prototypes and how they were being promoted by other departments for further work. Overall, I was able to gather process knowledge from all process phases of PD, with a focus on two prototypes during the PoV phases.

Most of the data were collected based on team meetings, followed by interviews and in-process documents, especially the pitches and final white papers. There are five types of group sessions: SPO meetings as one-on-one meetings with myself and the SPO; PD meta-meetings coordinated by the SPO with colleagues to coordinate and improve the overall PD process; PoV team meetings to plan and work on the prototype; daily PoV team meetings to coordinate their workday; and weekly PoV team meetings to plan their weekly sprints and review their progress, cf. Figure 4.4.

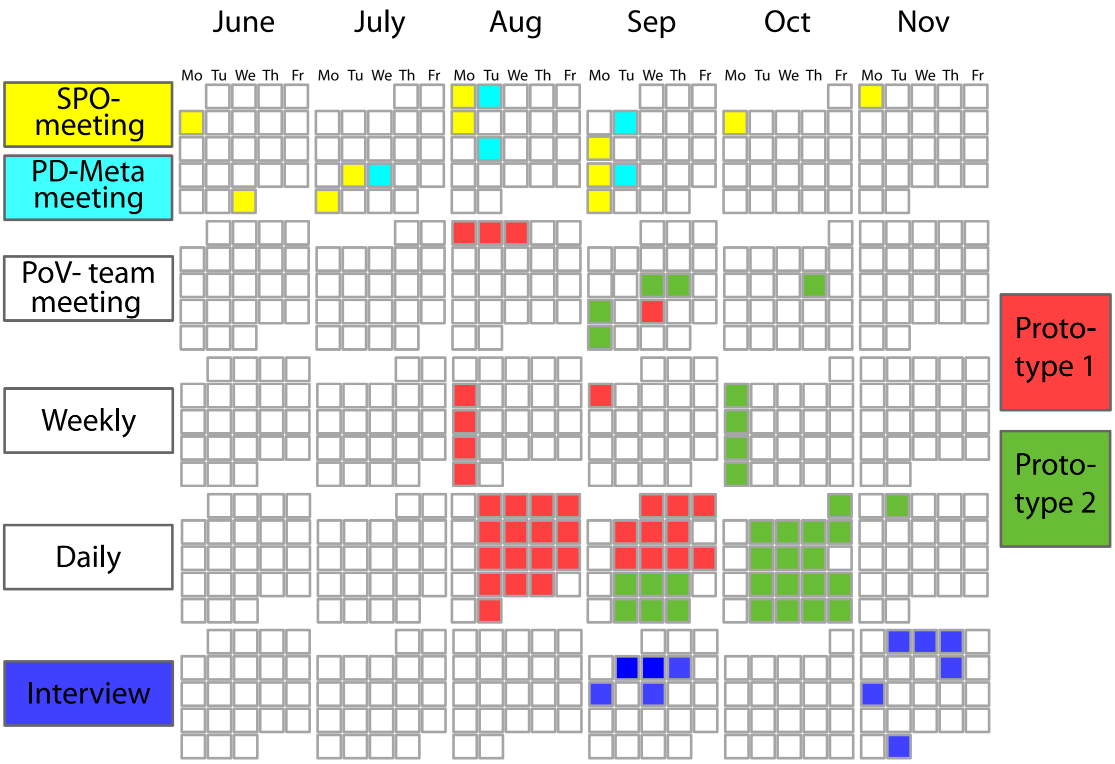


Figure 4.4: Overview of the type and time data was assessed

Group meetings

SPO-meetings. At the beginning of my ethnographic study, I had weekly meetings with the SPO in which she explained the PD process and the progress of the pitches and prototypes to date. As the study progressed, these meetings were changed from a weekly to a bi-weekly schedule as there were fewer topics to discuss, but I still had the opportunity to clarify some issues I encountered during my observations. The SPO is a key informant, having invented and implemented the PD process in collaboration with colleagues and actively managing ongoing PD calls. During these SPO meetings, I gathered all the knowledge about the PD process and kept track of other prototypes that were still in the pre-pitch phase or already completed and distributed to other departments. I also gathered important background knowledge for the PoV phases I attended. I had a total of eleven such meetings, each lasting about an hour.

PD-meta-meetings. Every other week, the SPO invites a former SPO to discuss the current status of pitches and prototypes. The PD was originally invented and installed by two SPOs, one of whom supports the PD in the form of these meta-meetings, which are about planning and adapting the PD and transferring the prototypes to the departments. Their focus is, therefore, more on using and implementing the finished prototypes in other areas of Axel Springer. These meta-meetings aimed to find the right support for different topics related to the PD, with a special focus on new pitches and the use of the finished prototypes. I participated in five of these meetings, which is about 2.5 hours.

PoV-team meetings. Once a positively evaluated pitch enters the PoV phase, the team meets to start working. Especially in the first week, there were several spontaneous meetings with the idea generator and the team to get everyone involved in the idea and to find a good framework for the final prototype. These meetings have a more spontaneous character, as they are scheduled according to the team's needs to coordinate and discuss the idea as a whole and to plan basics like the software to be used. Once such basic issues are resolved, the team moves to a more regular structure of daily and weekly meetings. I participated in nine such meetings for both prototypes, each lasting about 1 hour.

Weeklies. On Mondays, the PoV team met for a longer group session to discuss the progress of the previous week and plan for the week ahead. Again, this meeting format does not follow a strict Scrum methodology but includes aspects of a retrospective (what was accomplished?), a retrospective (how are we doing as a team? how do I feel about our work?), and planning (what do we want to accomplish next?, cf. Schwaber and Sutherland 2011). These meetings are supported by an Agile Coach, who moderates these meetings with the help of the digital visualization tool Mural. All team members are equal in these meetings, and there is explicit room for personal sensitivities and criticism. The meetings begin with a check-in, where everyone indicates their overall satisfaction with the project on a scale of 0-10. This opens up the space to discuss potential problems. Then there is a brief documentation of what the prototype has achieved, what has been learned, and what open issues remain. Added to this are the individual wants and needs, which the team often sorted and ranked by the urgency to create the current week's to-dos. Each meeting lasted about 45 minutes and served as a substitute for the Monday daily. I participated in five weeklies for Prototype 1, and four weeklies for Prototype 2.

Dailies. During the PoV phase, the PoV team meets for about 15 minutes daily. This meeting format is based on the Scrum method, where tasks are scheduled and planned within a 24-hour framework. So the team meets at a specific time to review the progress of the last 24 hours and plan the tasks for the next 24 hours (cf. Schwaber and Sutherland 2011). Since the team consists of seven people (PO, ideator, and five developers), about 2 minutes are allotted for each person to give a brief report. These meetings are also used to ask for help with more complex tasks and to offer help to others if someone is behind on their tasks. Since the team did not strictly follow Scrum rules, these meetings also loosely followed the principle of everyone reporting for only two minutes. Often the meetings were used to discuss and clarify general technical issues.

All PoV team tasks are coordinated and documented on a Kanban board. A Kanban board is used to visualize group tasks to achieve a lean and just-in-time software development process (Corona & Pani, 2013). Tasks are represented on the board as tickets and stories (for more complex tasks). Collaborators can be assigned to them, and the flow of progress can be visualized through ”to do”, ”in progress”, ”under review” and ”done” steps. Dailies were used to update the Kanban board and keep track of tasks and their urgency. I participated in 26 dailies for Prototype 1, and 23 dailies for Prototype 2.

Interviews

After the completion of each PoV phase, I scheduled one-hour interview appointments with each PoV phase employee, resulting in a total of 13 interviews collected. The main goal of these interviews was to provide a structured reflection on the individually perceived creative work processes during the PoV phase. The interviews were semi-structured, with a predetermined collection of questions and topics that I adjusted as the interviews progressed. The questionnaire can be found in Appendix B, on page 282.

My pre-planned questions differed slightly depending on the role of the interviewee. For those with prior experience from other PoVs, I asked about comparisons throughout the PD process and what led to potential differences or process adjustments. I also asked about their pitch process and how they were explicitly involved in the PD process for the ideators. For the POs, I inquired about their management approach and possible efforts to foster creativity in group work.

All interviews were recorded, which the interviewees agreed to before the interview. These recordings were transcribed using the services of *amberscript*, an online tool that creates automatic AI-based transcripts. I manually enhanced these transcripts to correct the colloquial and technical terms used.

Documents

There are mainly two types of documents collected during the PD process: official PD documents for the pitches and whitepapers and screenshots that capture the work process with the online tools used during the PD process, such as the Kanban board and the mural boards used for the weeklies and their ideation processes. These screenshots are used to track the progress of the prototype development. The pitch and white paper represent the beginning and end points of the prototype, respectively. Overall, the documents represent a way to triangulate the data to increase the richness of the data.

4.6 Data analysis

Data were collected from field notes from virtual (team) meetings, audio transcripts, interview transcripts, and digital documents. Data analysis was performed in three steps: first, the check of coherence and completeness; second, the analysis of all explicit information about the processes unfolding; and third, the analysis of patterns concerning the creative process.

For data coherence, all sessions and interview transcripts were recorded in a separate file in ATLAS. After all the data were analyzed, the transcripts were read and improved for readability and comprehensibility. In particular, I added background information for aspects that involved technical details discussed in planning documents or daily newspapers.

4.6.1 Process analysis

Based on the SPO meetings, interviews, and observations, I gathered detailed information about the prototype development process. The specific process I observed is part of the company's idea management process. It aims to create the opportunity to work on ideas outside the daily work of Axel Springer's individual brands and divisions. Any employee of the company can propose an idea via a web portal. This idea then goes through a predefined meta-process, the PD. This process aims to test the value of the idea, its feasibility, and its application potential by developing and testing a software prototype (cf. Figure 4.5). Thus, this process is inherently creative, as new services and software tools are developed within a predefined process landscape.

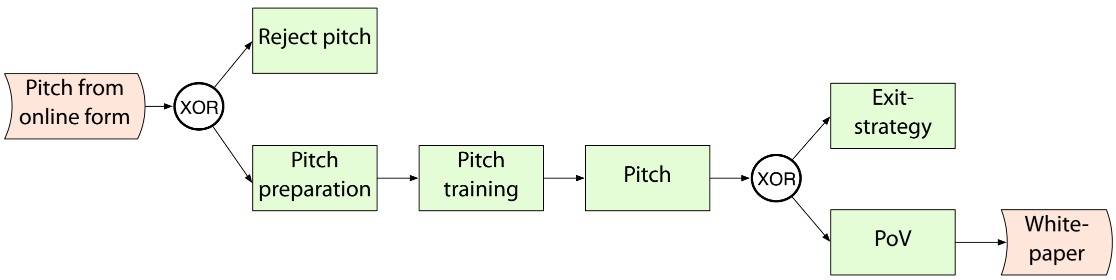


Figure 4.5: Overall Prototype Development process, modeled using KMDL (Gronau, 2012)

The Prototype Development Process

The process begins with a person from the Axel Springer company proposing an idea on the website and answering general questions about the idea, where it comes from, what it is about, and what it should solve or address. The SPO then contacts the idea provider and works on the idea. She focuses on understanding the idea in detail, its potential value, and its feasibility in the context of the PD. The SPO may reject or refocus an idea if it does not have the potential to be positively

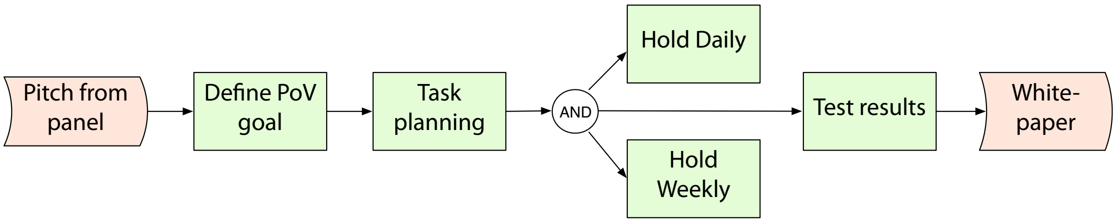


Figure 4.6: Proof-of-value process, modeled using KMDL (Gronau, 2012)

evaluated later. In reformulating and improving the idea with the idea generator, the SPO may bring in developers from the PoV team to review technical feasibility issues. Together, they evaluate and sharpen the idea, sometimes realigning it.

The idea generator then prepares to sell the idea in a pitch within about three minutes. The pitch takes place in person in front of seven people. Only one member of top management explicitly belongs to this panel, while the others cover different areas of the company. The emphasis in the composition of this panel is on a broad knowledge base and a positive attitude toward innovation. This panel has the opportunity to ask questions of the idea generator to fully understand the potential of the idea. The panel rates the pitch on a scale of 1-10, with 1 representing no prospects and 10 representing an extremely positive rating. At least 50% of the possible points are required for an overall positive evaluation of the pitch. In this case, the idea enters the PoV phase (cf. Figure 4.6). Otherwise, the idea is discarded or other alternatives for working with the idea are found.

The Proof-of-value phase

In the PoV phase, the PoV team looks for ways to develop some testable tools. Often, the originally proposed idea needs to be narrowed down. The idea presented is usually a larger vision, such as a business venture. However, during the PoV phase, only a smaller aspect of the idea can be implemented and tested. The PoV phase lasts 4-5 weeks and is used to write a white paper describing the prototype and presenting the test results. On this basis, further action can be assessed. In case of a promising result, the SPO tries to find support in other departments or related companies to exploit this idea. This exploitation aspect of the PoVs is discussed in the PD meta-meetings, as there is not yet a clear path and best practice for the optimal implementation of the tested ideas.

The PoV team consists of six software developers (developers) and possibly the idea creator. The team is supported by a product owner (PO) who is responsible for the success of the PoV to be delivered.

During the first week, they work to identify the main starting point, which leads to several team meetings where they brainstorm and discuss possible hypotheses. They write down their intermediate goals and related issues in the form of tickets (Kanban style; Corona and Pani 2013). Once they have determined the main goal they want to focus on, they create a technical roadmap.

During those four to five weeks, they have daily meetings led by the PO where they briefly - 15 minutes is the goal - update each other, ask for support, and coordinate tickets. Often the meetings have lasted longer as they get bogged down in technical discussions. They also meet every Monday for about 45 minutes for the Weekly. Coordinated by an Agile coach, they reflect on the previous week's progress, how the teamwork works, and their following goals.

In addition to daily and weekly meetings, team members meet as needed to share ideas and provide (technical) support. Often, such meetings are scheduled during daily work. The meetings sometimes take place in the office, but mainly via virtual calls using the Teams software. In addition, the PoV team had a common chat where some topics were discussed even if they concerned the whole team. This chat was also used for private and informal exchanges within the team. The team works according to the pull principle: they work separately or in pairs, but if they need feedback or support, they get it immediately from their colleagues.

The first week is special because several team meetings are scheduled to brainstorm and formulate a precise goal for the PoV. The first prototype was more characterized by the developers getting into the existing code and methods already developed before the PoV phase. This phase was also about finding a feasible goal for the PoV and agreeing on what features should be added. For the second prototype, the first week was filled with research on circadian rhythms and possible similar features on the market. At the beginning of the second week, they used the week to agree on a set of features they wanted to develop (and then adjust in the following weeks).

The following weeks are characterized by technical implementation, fixing bugs, solving coding problems, and sometimes brainstorming on specific aspects of the prototype's functionality. Because the software to be used is new to some team members, sometimes even to the entire team, the feasibility of these tools often cannot be well predicted. This sometimes results in additional tasks and work on the code taking longer than originally planned. Such problems are usually discussed in regular meetings, and the team agrees on course corrections.

Testing the work done is critical to both the progress of prototype development and the final evaluation of the work. Testing can mean presenting the developed tool to potential users and letting them evaluate it. Based on this, the team knows what works and what needs to be revised and can even realign the plan in case of a negative evaluation. Testing was supposed to begin in the second week but was not executed until later in both prototypes. This was partly because they felt they did not have enough material to present to the testers. Therefore, testing for both prototypes was conducted in the fourth week, which allowed for a proper evaluation of the developed tool but did not allow for further adjustments based on the test results.

The end of the PoV phase is defined as a fixed end day, but in practice, it was fluid because some tests and the information gathering for the whitepaper took place directly afterward. For the white paper, the PO and the team write a text describing the goal of the PoV, their approach, their findings and experience with the tests, and a conclusion and recommendation. The white paper is intended to serve as a decision-making basis for other departments at Axel Springer that want to adopt the idea and develop it further. The preparation of the white paper takes about one to two weeks and will be adapted in format and style by the SPO. x

4.6.2 Analyzing the features of the creative process

The main goal of the following process analyses is to find patterns in creative work that can be transferred to a modeling language. The analysis was essentially done in four phases, cf. Figure 4.7:

1. creativity-intensive processes were identified in the collected data
2. creative process theory was applied to identify process patterns
3. a fixed set of process aspects were defined, representing the creative work (cf. Bingham and Witkowsky 2021)
4. the defined aspects of the creative process were used as code and applied to the collected data

This mixed-methods approach was chosen to unify existing theoretical models with the specific requirements of the modeling objective. Originally, I intended to use a deductive approach by basing the data analysis on process descriptions for creative work from the theory (Fereday & Muir-Cochrane, 2006). However, this revealed a discrepancy between the theory and the data collected (cf. Phase 2). This created the need for an inductive approach to generate better-fitting process descriptions for creative work (cf. Schutt 2018).

Even though the data collection is based on two PD process runs, the analysis of these is combined in the following. The topics worked on are different, and so are

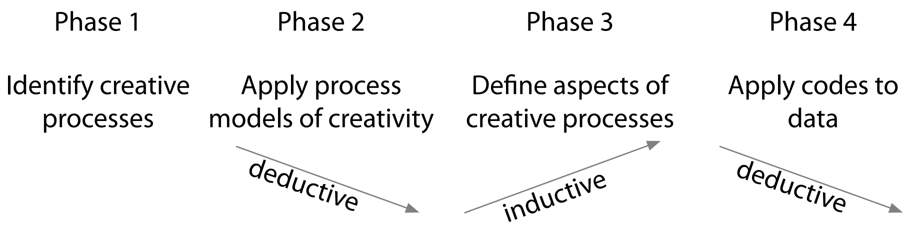


Figure 4.7: Overview of the data analysis approach

the core of the prototypes developed. However, the process flows and dynamics are very similar in both cases. In addition, the unified view of both process flows allows the anonymization of the involved team members, especially when statements of individuals are presented and analyzed (cf. Section 4.7).

Phase 1: Identifying creative intensive processes

Using the data collected, I first identified creative work processes based on the definition of the creative process (cf. Section 2.4.1 on page 31). A process involves creativity when it contains unclear problems that require the development of new ideas and solutions. For the PD, many situations were identified where creative work was done, such as improving the pitch, especially finding the right angle to sell the idea, and finding possible connections to other companies using the idea. In addition, creative work was done in many steps of the PoV phase, such as finding the hypothesis to pursue and appropriate technical solutions. The individual interviews confirmed my observation that they were very creative in their work. They reported that they needed creative input at all stages of their work, as many small and large problems arose during the software development process. As the team encountered new problems during their work, they had to solve them both as a team and individually, especially in the coding tasks.

The identified creative processes cover the PD process, teamwork, and individual work. As intended, the various meeting formats had a different task focus, with daily meetings involving a high degree of coordination and planning and weekly meetings involving more discussion and goal setting. Teams discussed and shared information to brainstorm ideas or focus on aspects of the prototype, technical issues, or time constraints. They also coordinated work within the group, distributing tasks and asking for and offering support. Focus and efficient resource planning were especially prevalent during the tight timeframe of the PoV phase.

At the individual level (i.e., activities they performed mainly on their own), they researched, sketched ideas, coded, and tested. Coding, in particular, was reported as the main activity during the PoV phase and described as a creative task. Coding requires a constant search for solutions to more or less open problems, partly depending on individual experience and the uniqueness of their coding approach. They also had to plan and coordinate their work well, as they worked independently and expected their teammates to report and submit their progress daily. Individual planning was used primarily in the context of the tickets they began working on, based on the Scrum logic of *grooming*, i.e., refining and elaborating on a ticket and the tasks it contains (Schwaber & Sutherland, 2011).

Phase 2: Applying creative process theories

Previously, process models representing creative work were discussed, particularly Walla's 4-Stage Process and Amabile's Dynamic Componential Model. Walla's 4-stage model of creative work consists of *preparation, incubation, illumination* and *verification* (cf. Section 2.4.1 on page 25). Transferring these to the observed processes, the challenge arises that the cognitive bases of incubation and illumination could neither be properly observed nor reported by the study participants in the interview. This approach to the creative process corresponds to a cognitive account of the creative thinking process, but cannot be applied in an observable process analysis.

Alternatively to Wallas' model, the Dynamic Componential Model (DCM) was used as an analysis frame for creative work (Amabile, 2012). The DCM differentiates between organizational innovation processes and individual/group creativity. As the collected data captures the latter, I focus on that. Amabile and Pratt (2016) considers five stages: *task presentation, preparation, idea generation, idea validation* and *outcome assessment*. As I gathered examples from my observation and interviews of these stages, I encountered certain problems: Task presentation could be observed at the beginning of the creative process, e.g., during pitch preparation when the SPO tries to understand the main idea of the idea provider, or similarly when the PoV team is introduced to the idea. However, this phase was closely related (I would say inseparable) to the preparation phase, where the actors gathered the knowledge to understand the unclear problem, and to the idea generation phase, where they also directly started to find a solution to the problem. Thus, the three phases of the DCM model seem to be inextricably linked when applied to my case data. In addition, many tasks that I consider very important for creative work, such as coordinating and distributing tasks within the team, do not find an appropriate place in this stage model. Therefore, neither model of the creative process fits as a framework for analyzing creative process data.

Phase 3: Defining creative process aspects

An inductive data analysis approach creates a theory based on patterns in the data (cf. Corbin and Strauss 2011). However, this is still done with theory in mind. In addition to the processes identified in Step 1, I reread the interviews and meeting minutes repeatedly. The aim was to identify recurring action patterns essential to the creative outcome. It was not my aim to create an exhaustive list of codes, but rather to capture recurring features that seemed most prevalent and important during the interactive accomplishment of the creative work.

Based on the core definition of creativity (Runco & Jaeger, 2012), creative work is characterized by developing something new. For example, by developing designs through brainstorming sessions or trial-and-error coding. Here, divergent thinking methods are primarily applied to develop new and useful ideas for an ill-defined problem. Often, this is aligned with researching information about the problem to find inspiration for good ideas.

The second definitional aspect of creativity focuses on usefulness and applicability. To ensure that, some form of idea evaluation is necessary. Here, ideas and solutions are critically assessed and scrutinized. This often leads to new problems, which require new ideas. Thus creative work is characterized as iterative.

Although both aspects - creation, and evaluation - are essential for creative work, they are not enough to describe it adequately in the business context. Creative work is often not just a matter of finding new ideas but also of finding a suitable path to a vaguely defined goal. When *something* new is developed, the result, as the output, is creative, as well as the path that led there. This puts a strong emphasis on planning work. Since the progress of teamwork is not very predictable, goals and work packages are constantly renegotiated in the various meeting formats. Constant planning and re-planning is a typical phenomenon of flexible, creative work (cf. Dönmez, Grote, and Brusoni 2016).

This planning in turn requires a rough goal, something to strive for. Even if the concrete design goal is vague at the beginning, partly unknown, there is a vision of what is to be created. This was sometimes an intense process of negotiation for the team, especially at the beginning of the PoV. However, these considerations can also be found in individual creative work. When translating the tickets into concrete work steps, the goal is always defined first, and the necessary steps are derived from this.

The process analysis also repeatedly showed connections between creative work and technical systems. Microsoft Teams significantly shapes teamwork, and coding is realized via GitHub and other software components. The technical element is crucial for the implementation of creative (team) work (cf. Gabriel, Monticolo, Camargo, and Bourgault 2016) but is not included as an independent aspect. Technical and methodological aspects may be included in the other aspects mentioned above. For example, work planning is highly dependent on the Kanban board. Mural boards and Figma slides were primarily used for team brainstorming.

Based on the tasks observed I derived four main process aspects: *intention, creation, evaluation*, and *planning*, in short: ICEP, cf. Table 4.1.

Table 4.1: Overview of the ICEP model elements

	Explanation	**Leading question(s)**
Intention	find and specify goal of creative process; envision potential outcome	What is the issue? What is my vision for a possible solutions?
Creation	create new ideas and ways to reach the set intention	How could I approach/solve it? What can I generate to reach the vision?
Evaluation	critical appraisal of generated ideas and outcome(s)	Is the idea feasible? Would it solve my issue/reach the goal? Does the generated outcome solve the primary problem?
Planning	set workable steps to reach set intention; set milestones and distribute work	What would need to be done to implement the idea? What are the priorities? What are specific steps to approach this task?

Phase 4: Coding creative processes

The ICEP elements were applied to the data as codes using Atlas.ti. This served two purposes: first, to test how these four aspects can be meaningfully applied to the data, and second, to generate examples of these four aspects. In what follows, I will detail the ICEP aspects, the empirical evidence found in my ethnographic study, and the literature discussed on creative processes. To maintain a degree of anonymity for the study participants, the detailed results will be reported based on three roles: Developer (A to E), Manager (SPO and -PO), and Ideator.

4.7 Model of creative process features

The previously created differentiation of creative work into four core aspects -ICEP- will be specified in the following. Based on the collected data, explanations are added at different process levels: the overall prototype development process (PD), the four weeks of explicit prototype design (PoV), and weekly/daily iterations and tasks.

4.7.1 Intention

Theories analyzing the creative process usually differentiate between problem finding, ideation/evaluation, and implementation (for an overview, cf. Abdulla and Cramond 2018). However, the often proposed first stage of *problem finding* falls short, as it only focuses on a problem, an obstacle, or an objective that requires creative work to be solved. This might often be the case; however, I like to stress another aspect that comes along with it: it is not the problem per se that is the start of a creative process, but more so the vision of something we want to achieve. Creative work does not always solve problems; it can create and envision something new. As the SPO put it:

> ”Innovation is not always immediately an answer to a problem. You also have the approach that first arouses curiosity about something or brings an enthusiasm factor to it. It’s not always the solution to the problem that comes first. Of course, it would be nice to solve a problem, but to ideate and move freely, you have to answer more than just the classic customer problem.” (SPO)

I suggest not focusing on problem identification but instead formulating an intention. An intention focuses on the vision, the outcome to be achieved through the creative process. When the intention is the focus of creative work, two effects result: First, the vision becomes clearer, which is especially important for teamwork so that all team members can align their work. Second, an intention is a future-oriented vision that allows for a better critical evaluation of the ideas developed. Certainly, a vision can be to solve a specific problem. However, formulating a vision allows for a wider range of idea generation than being limited to just one problem.

Setting an intention involves two steps: first, creating a thorough understanding of the creative challenge at hand, and second, developing a vision of what is to be achieved. The main goal is to understand the challenge and focus on finding new ideas. Thus, goal setting is the main activity that is especially important for teamwork in order to align work efforts:

> ”The [understanding] comes out of the first conceptual phase, that when the first conceptual phase goes well, everyone in the team has the same understanding and that not everyone is working on something in parallel. Then there are difficulties in bringing it together because it just doesn’t fit.” (Developer C)

Intention works similar to Wallas (1926) first stage - preparation - of the creative process, in which one aims to best understand the creative challenge (cf. Section 2.4.1 on page 25). Here, *intention* is meant in a more precise way as to what the vision of the creative outcome is. For the business context in which this model is best applied, the focus of creative work is put on the usefulness aspect of the creativity definition of ”new and useful” (Runco & Jaeger, 2012). The intention clarifies what is to be achieved, even if that might still be vague in the case of complex creative tasks.

For the PD process, the intention was often discussed and required clarification, as the prototype developed is only the means to the actual goal: the assessment of the value of an idea.

> ”It’s all about the proof of value. So I would see the product’s actual evidence of value in that sense. So not the prototype itself, but rather the evidence that has to be provided.” (PO)

> ”What is the [prototype] process responsible for? What goals should it fulfill, and so on? Actually, it’s not there to just give people resources for four weeks, and then they can just pursue their interests, and then it continues somehow. It’s there for people who usually don’t have the opportunity to access such resources themselves, especially developer resources, to help them understand: ”Okay, so I have a good idea here or not? And can we do something with it?”” (PO)

The actual prototype development during the PoV process requires a different angle to *intention*, as the challenge is to find a certain aspect of the ideator’s idea which can be implemented within four weeks:

> ”All these prototypes have in common is that we identify at the beginning what the aspect is that we want to achieve.” (Developer D)

The pitch is taken as a starting point, as an orientation on where to go, but the precise vision is worked upon as a team:

> ”So the most important thing is that we first look at the pitch: Is there a clear thesis in it that needs to be verified, if not, we try to find it with the ideal provider. That’s what we did this time. So [Prot1] didn’t have this thesis, in my opinion. And then we supplemented it, so to speak, or tried to sharpen it with [the ideator]: What is the idea we want to test?” (Developer E)

> "After the first meeting, I sat down and thought about / What is the 'circadian rhythm'? So first of all, to understand the idea behind it. Which problems does it want to solve with which approaches, like 'circadian rhythm' and something like that?" (PO)

As the PoV phase is divided into weekly sprints, these are used to plan tasks and to set a vision of the achievements of the following week:

> "So usually, we have a weekly cycle where we plan at the end of the last week or the beginning of the week already; what do we want to do in the week? There is also a little bit of grooming, so a little bit, yeah, okay, what does that mean now exactly, every single ticket, what do we want to achieve there?" (Developer D)

> "We talked again about the final week, so what are the must-haves that we have to have so that we can also provide the proof of value? And we made a checklist of everything that has to work, what we need, what's nice to have, what's a must-have, and so on." (PO)

During the PoV phase, most tasks for the developers are coding tasks, which are organized as tickets on a Kanban board. Those tickets are somewhat vague in their scope, and developers choosing such a ticket must first elaborate on it to create workable tasks. This process is called *grooming*, which includes the aspect of *intention* in the form of visual creation for specific coding tasks.

> "So first of all, there's something in the beginning, in the front, called grooming. Where you basically break down a ticket or a task a little bit, what exactly is being done. And you don't usually do that alone, but in a team or at least with one or two people. Where you look at the task as a user story or so. And you look again: Did I understand that correctly? So what is supposed to come out of it in the end? And

> when that is clear, you can also coordinate it with the product owner." (Developer E)

The importance of intention-setting becomes most apparent when missing or when not clearly achieved within the team:

> "The team had rather problems with the fact that there were too few specifications and that they had to do a lot of preparatory work, especially in this first week, to define what our mission actually is." (Developer D)

> "In many places, we have experienced too much 'ownership,' where people have said precisely: I don't think what you are building now will be a good product in the long term. Sometimes I lost a bit of patience and said, "Yes, that's right: "Yes, that's right. But our 'delivery bill' is not the product that is monetized and sold on the market afterward, but for us, this experiment is the test, the 'feedback,' that is our product, and we try to identify with that. Not with what will be brought to market in a year." (Developer D)

As mentioned above, intention setting can take effort and time to accomplish. Thus, it can be a creative task in itself. For the PD, two process phases are dedicated to sharpening the intention of the prototype to be developed: during the pitch preparation, to sell a round-up pitch to the panel; at the beginning of the PoV phase, to define hypotheses that can be tested with the prototype.

For both prototypes, the team took some dedicated time at the beginning of the PoV phase to set their intention for the following weeks. This process was in itself creative:

> "It depends on what you want to build now. And what style. I make a mood board. And from that, I get inspired. And from that, I

> usually come up with 3 or 4 wild ideas, and then I pick out a concept." (Developer D)

> "It was a bit of breaking it down further and further, first of all, to understand the idea, then to realize what [the ideator] wants with the concept. And then: what do we build from [the ideator's] idea? That was my approach to the problem." (PO)

> "We sort of thought out ourselves in the team what we could do. We collected ideas, [a developer] then created an overview. Schematically sorted somehow, what features could be integrated and what added value that would bring." (Developer B)

4.7.2 Creation

Creation describes the core of creative work: when ideas emerge. This can be achieved through creative methods such as brainstorming and discussions when one takes the ideas of others and extends them. Earlier models of the creative process assumed that "preparation" is separate from "ideation" (e.g., Wallas 1926). As explained above, these two phases of analyzing the creative challenge and generating ideas and solutions are difficult to distinguish in practice. As we read and search for answers and inspiration, we are already generating ideas and potential solutions. At the level of the overall PD process, this was evident during the pitch preparation between the SPO and the ideator:

> "Actually, [the pitch] changed a lot! I met [the SPO], and she asked me to answer ten questions [...] I gave her the answers, and she just passed those questions to the other POs or others. They came to me and asked some straightforward questions; at that time, I couldn't answer them directly or intuitively. With [the SPO] and me, we just brainstormed by ourselves: How can we improve it the best? What is the Unique

> Selling Point (USP)? How can we present that well in the [panel] in front of [the Chief Executive Officer (CEO)]?" (Ideator)

On the PoV level, creation is an explicit part of generating the PoV intention, including the generation of features that are to be developed:

> "At the very beginning, I think we defined [the ideator's pitch] as creative 'input,' as an example, with the task: let's think about how we translate this intention into 'doing'." (Developer D)

> "The first week is always the busiest for me in terms of brainstorming." (Developer E)

During the weekly iterations, tasks are planned, and depending on the course and evaluation of the work, new tasks and even features need to be developed. Thus, throughout the whole PoV phase, the creation of new ideas is needed:

> "I think you always need this creativity because you constantly come up against limits, not to say walls. Or also, in the implementation: Even though we have these three hypotheses, we are very accessible. They were also very general in [Prot2]. I also think I don't know; in the end, we didn't directly implement any of the ideas that we had at the beginning but based on them, we somehow thought about something again or something like that." (PO)

> "So I think [one developer] had ideas even on Friday of the fourth week. This 'heatmap' and stuff. So no, it [flow of creative ideas] doesn't stop. It's more a question if the feature makes it in then, by the end." (Developer B)

As the tasks performed by the PoV team are diverse, their creative input also looks different:

> ”Sometimes it’s about actually brainstorming, sticking a sticky note somewhere. Sometimes it’s just about drawing diagrams and stuff like that.” (Developer D)

Most commonly, creative work is performed around coding, which was repeatedly reported as being very creative:

> ”I also think writing code is very creative, how you encode the code, how you do that. There are a lot of possibilities there as well. There are also many solutions to how to do the app’s architecture in the front.” (Developer C)

> ”For me, I think, and for many people, it is a very creative process. So development work is anything but: Okay, now I have the 08/15 scheme, which is simply prayed down, but you often think about it like this: Okay, how can I tackle the problem now? How do I have to solve it? How? How has it been solved before, but what was different? Or you are then confronted with a wide variety of restrictions, which can be of all kinds. Maybe you can’t get to the data the way you want. Who knows. So you often come up with creative solutions.” (Developer E)

Another typical creative task, at least for some developers with a focus on the front end, is the design of digital tools:

> ”Figma is a tool for wireframing. It’s not so much for sticky notes but more for when we say we want to design together what the web interface looks like. It’s just a matter of dragging and dropping a button into it. Then we have a quick layout for our website, for example.” (Developer D)

For *creation*, the methods applied can vary greatly, from thinking, discussing in the team, brainstorming, and, as described by one developer, researching and the creation of a mood board for inspiration:

> "I often do a bit of research. We often do that together with the team. It depends on what you want to build now. And what style? I make a mood board. And from that, I get inspired. And from that, I usually come up with 3 or 4 wild ideas, and then I pick out a concept." (Developer A)

Creative input is a measure of balance, where there is too much and too little. Too much, in the sense that many new ideas complicate processes that actually do not need extensive creative input.

> "But that also brings problems. Because the moment we allow ourselves to be creative at every point of the process, we also block the efficiency of getting from A to B." (Developer D)

> "You can also stop 'brainstorming' at some point and prepare for the interviews. See that the prototype is stable. Don't touch it anymore, and don't fix anything at the last minute. That usually doesn't 'fix' anything." (Developer B)

Too little creative input by directly devaluing ideas or subordinating their meaningfulness to other necessities of efficiency:

> "I think the main problem has been that maybe we could have been better, or perhaps we could have been more creative, but we were all thinking in a very profit-oriented way or thinking in a project-experienced way. This means that many potential ideas were quickly discarded because we saw that nothing would come of them right away. In other words, we are a startup and brainstormed the disruption of

> the future from the very beginning because we knew that after these four weeks, we would have to inspire someone. And that means that creativity has always very quickly broken down again into pragmatism, where we said: Okay, whatever we come up with now, someone will have to want to use it in their everyday life in four weeks. And our experience has simply been: too much creativity and people get scared." (Developer D)

4.7.3 Evaluation

Evaluation is crucial to know whether the idea one came up with or the work done is in line with the set intention. This is similar to Wallas *verification* stage of the creative process, in which one evaluates the idea(s) found for a problem to check whether they fit and suffice (cf. Section 2.4.1 on page 25). One can evaluate ideas and work steps alone, through critical observation, and with others, through discussions and feedback.

Certain roles come with an attributed competence for the evaluation of ideas and work progress. On the PD-process level, the SPO has the role of actively checking and evaluating the progress made, e.g. by the ideator during the pitch preparation:

> "And then this pitch is first worked out to such an extent that [the SPO] thinks, "Yes, it now also has a good chance of being successful in the [prototype development process]"." (Developer E)

As well as during the PoV process, the SPO can work as a guidance figure:

> "We have such an arrangement with [the SPO] that we get her in on a pull principle, if we have comprehension questions or we want to have a status." (Developer A)

On the PoV-process level, the whole team is responsible for the progress of their work, which is why they also together evaluate their work, starting with the ideator's pitch:

> "A pitch was made, in this case by [ideator], with an idea for a product or something, an extension, whatever. And our task should be, so our self-conception or my self-conception, that we check or evaluate the value of this idea. And we examine whether this is a good idea, a good idea that has potential, and, so to speak, that the thesis behind the idea concept is also correct." (Developer E)

As the ideator "owns" the originally pitched idea, the team aims to balance their own idea input with the originally pitched idea. Thus, the ideator is seen as a valuable source for feedback for their work being on the right track:

> "I think that was, for me that was so the most challenging part, once to understand: What can we build from all that was pitched? And what is important there? And then to validate that: Have we understood this correctly? Is this a partial aspect of the idea you had? That is the task for me, to be there as a sparring partner for the idea generator, to say: Yes, you are still on the right track. It makes sense for us to build it." (Developer B)

> "So we kind of had to agree on a feature set. We can't build something where we don't know what it will do. [...] we kind of presented to [the ideator] what we were thinking about, what we could put in there. That was important in a way. We then had a 'kick-off meeting' where we presented it to [the ideator], where we asked [the ideator] again, "What did you have in mind?" And where I asked again, "What do you want [Prot2] not to be?". So where do you not want [Prot2] to go? What didn't you envision?" (Developer A)

Especially during the PoV process phase, external feedback through interviews is critical to evaluate the overall worth of the prototype developed:

> ”We also always ask the users: ”Would you continue to use it?”, ”Is it interesting for you?” and from that, we make it a bit dependent on whether the prototype was a success. If we say, ”Cool job, but I wouldn’t use it”, then that’s not satisfactory.” (Developer B)

> ”We can then use [the prototype] to test the idea. And that’s usually done with people who have real customers or simulated customers, where feedback is gathered. It depends on what the thesis was, whether you check it based on data or the basis of people. But it’s a crucial step because if you don’t do that, then in principle, we haven’t been able to check or validate anything, then it’s a fail.” (Developer E)

Since testing did not take place in parallel with prototype development as originally planned, but only at the end of the PoV phase, there was no evaluation of the work process, at least from a more objective external perspective:

> *Interviewer: How did you recognize the missing tests?* ”Simply because we don’t have any feedback and work blindly. So we have working hypotheses, what we think is good, for example, and we check them promptly. With the old prototypes, we already noticed how important it is to get feedback early on, and we had made it a point always to do that. That’s why I think it’s a shame that it didn’t work out this time.” (Developer E)

The missing feedback on the developed features made it difficult to decide what features to develop further and which ones to do better and not invest too much time and effort in:

> ”The most significant value we gained, or what we wanted to do, is the

> 'feedback' from the people who saw the 'tool' blindly; how do you say it, saw it cold, out of nowhere? [...] Okay, certain aspects of the Prot2 idea are excellent. We should build on that. Other factors nobody seems to need. It was an excellent idea, but we would not recommend developing it further." (Developer D)

Within the PoV team, the weekly meetings were used to evaluate their progress and decide what to build and focus on next:

> "We then reflect in short iterations with us, for example, in weekly segments, whether we're still on the right track." (Developer D)

> "We went through this canvas [overall project plan] and then simply wrote the Jira tasks based on that. And then we looked each week to see how far we had come or not. We did that in this Weekly, which is somehow also extremely important." (PO)

On the task level, the individual worker has the freedom to give and seek feedback on their work and those of others freely:

> "And when it comes to something where I know change is happening globally in the software, I always bring one in. Just to have a mirror. "Is this the right way, or am I thinking stupid?". It's also a bit about voting. Am I allowed to do this? Is it right what I'm doing? Maybe a kind of insecurity. But I'd instead do it now than undo everything and start over." (Developer A)

Course corrections will not be done when evaluation is missing, as with the user tests explained above. Thus, evaluation is not just needed for the ideas but also for the implementation that follows:

> "I saw that the bot was being worked on, with difficulties up to and

> including Friday, so that about a week was spent, and nothing came of it, and I missed the question - both from those working on the ticket and from the PO in place - does it make sense to pursue this further?" (Developer B)

4.7.4 Planning

Planning is a crucial aspect of creative work, to coordinate the flow of work as it unfolds over time. Since creative work is usually unpredictable in advance, the exact steps must be decided as the work unfolds, requiring periods of reflection and planning. In mainstream creativity models, this aspect is less of a focus because when you "do it," you already know or figure out during the process how best to do it. However, there is a coordination effort required to align the work, especially when teams are doing creative work.

Most tasks I could observe during my ethnographical fieldwork were such as *planning*. This is biased by the meetings I accompanied (dailies, weeklies, etc.). However, it also shows its prevalence in teams engaging in creative tasks. Research from the perspective of the routine dynamics shows that clarity in the workflow helps to uncover cognitive resources for the actual creative work (Cardinal, 2001):

> "Of course, creative freedom comes with planning and coordinating the whole thing. That means that, for example, we also talked more about coordination and alignment and the next steps in our daily meetings." (Developer D)

In contrast, a highly standardized, less knowledge- and creative-intensive work process would require a minimum amount of coordination, or at least not repeatedly (Trkman, 2010). In the case of straight-forward task coding, that would mean planning the ticket and working through them:

> ”Building small bites on the way to implementation, which you can then work through relatively stringently.” (Developer A)

For the PoV process level, the PO planned the outline of the project with the minimum gains for a positive process outcome and distributed the tasks over four weeks:

> ”I started making a prototype canvas and looked at the different expansion stages for such a prototype. So what is a low-five variant? What do we have to have in any case after four weeks to test to validate this hypothesis or not or investigate it? And then, I linked it more to these different expansion stages.” (PO)

> ”And then, as I just said, we did it in such a way that we went through this canvas and then simply wrote the Jira tasks based on that. And then we looked each week to see how far we had come or not. We did that in these Weeklies, which are extremely important.” (PO)

Planning, similar to *creation*, can be done in many ways, from thinking and listing to do’s up to more complex methods like tickets on a Kanban board.

> ”We tend to use such tools [Jira board] to structure our work. If it’s now: We have five things that need to be built; let’s write that in the ticket, then everyone can immediately pull a ticket so that we don’t get in each other’s way during the implementation.” (Developer D)

> ”I need a little structure. I like planning a lot. I am very much in favor of this Jira board work in that we have tickets and stories. [...] And then I don’t have to do too much conceptual thinking. I just have to execute. I like that in the doing phase.” (Developer A)

Similar to *evaluation*, *planning* can be assigned to a certain role, who is mainly responsible for it. In my ethnography case, the PO holds an important role in the coordination of teamwork:

> ”Someone who looks at it from this perspective: Okay, what are the milestones? [The PO] simply has a different view on it, which is why it’s essential, because you get to the tunnel in the development work, and then you tend to think: Okay, this one still has to be finished. And it’s essential to get feedback in time to re-challenge the product, challenge it, and rethink it. You need this other role that pays more attention to that.” (Developer E)

Work progress during the PoV-process phase was mainly tracked during the weeklies, which was especially used for *evaluation* and *intention*. The daily meetings were specifically designed for the precise planning of teamwork and to coordinate support from other team members:

> ”A Daily is basically: seven to nine developers, each answering the question: What have I been doing for the last 24 hours? What do I have planned for the next 24 hours? Where do I have my problems?” (Developer D)

Grooming was already presented here as a task of intention-setting, and it also entails a great focus on planning:

> ”So first of all, there’s something in the beginning, in the front, called grooming. Where you basically break down a ticket or a task a little bit, what exactly is being done. [...] you still clarify it technically. So how could you implement that technically? So depending on that, you just exchange ideas. We do that now with infrastructure, services, and so on. After that, the ticket is ready for the developer.” (Developer E)

4.7.5 Generalizability across process levels

In the above explanation of the ICEP model, I have already used examples from different processes that differed in terms of levels of abstraction. Based on the process analyses, four facets, in particular, can be identified that describe creative work: *intention, creation, evaluation,* and *planning.* Furthermore, the coding of the processes showed that these process features could be found on all process levels.

Based on the Pockets of Creativity (PoC) principle, creative tasks can be analyzed hierarchically on different process levels. In this case, the PD process serves as the macro level, the PoV process as the meso, weekly iterations as the micro, and specific tasks as the activity level. On all levels, all elements of the ICEP model can be found, which speaks to the general validity of the proposed model.

This effect of generalizability can also be found in the creativity and innovation model from Amabile (2016, cf. Section 2.4.2 on page 38): the DCM shows similar patterns on organizational innovation stages as individual creative processes. Thus, macro-processes on the organizational level follow the same pattern as micro-processes on the individual level.

To illustrate the generality effect, one PO explained it for *intention* on several process levels:

> ”A kickoff at the beginning, where we consider with the ideator once: What do we want to build? What are the hypotheses? That’s kind of the first standardized building block for me: working out the main ideas and then planning week by week: what do we want to achieve in the week?” (PO)

In the following, I collected examples from the ethnography in which processes are described, which show all four aspects of the ICEP model on all process levels. The

PD process was summarized by the SPO:

Creation	"So, phase one, I [assuming one is an ideator] have an idea, I take the online form, and I say something about the concept against the background of assuming it goes live tomorrow. That's kind of the first step.
Intention	And then, [I, the SPO] start to enter into an interactive process with that person mainly to develop a shared understanding. And prototypes also play a role in this first stage.
Evaluation	Then comes the second stage, the [pitch to the panel], three minutes, 20 minutes in total, including discussion.
Creation and Planning	And then comes the actual teamwork with the implementation. And that is, yes, the prototype development." (SPO)

The PoV process also includes all four aspects, from the hypothesis to the prototype development to the test of value:

Intention	"The prototype phase starts with the development team taking the pitch that went through the panel itself and trying to pick out the essence to establish the one point - we used to call tester value - that we have to implement. It's not a product that we build, which must be ready for the customer. The goal is to gain insights that we can then use to drive this idea forward.
Evaluation	And pushing it further means that we provide proof for one of our units, for example. Here in this idea, which sounds cheap on paper, there is real potential in quotation marks. [...]

Planning	Then we make a plan on how to get to that goal in the four weeks
Creation	and then we build.” (Developer E)

The weekly iterations include all ICEP elements as the Weekly serves as a small retrospective, in which the team reflects in their work and set new goals for the following week:

Creation	”We have basically weekly sprints to implement the tasks as much as possible.
Planning	So it’s more of a Kanban style. So, we work as much as we can, not full Scrum style.”
Intention	We set ourselves concrete goals that we want to achieve. [...]
Evaluation	The weekly is like a mini retro, where we look back and reflect on ourselves.” (Ideator)

The daily (mostly coding) work of developers was also described with all four ICEP elements:

Intention	”My day starts by defining the problem,
Creation	doing architecture, writing the code,
Evaluation	testing that.
Planning	It’s just a lot of small iterations, so you just look at what needs to be done, find bugs faster, and fix those.” (Developer D)

More complex tasks, such as the one of *grooming*, also entail all four ICEP aspects:

Intention	”There’s something at the beginning called grooming. Where you basically break down a ticket or a task a little bit, what exactly is being done. And you don’t usually do that alone, but in a team or at least with one or two people. Where you look at the task as a user story or so. And you look again: Did I understand that correctly? So what is supposed to come out of it in the end?
Evaluation	And when that is clear, you can also coordinate it with the product owner. Yes, so that tells me whether you have understood that. [...]
Creation	So how could you implement that technically? So depending on that, you just exchange ideas.
Planning	Okay, we do that now with infrastructure ABC, services ABC, and so on, etc. After that, the ticket is ready for the developer.” (Developer E)

The examples from the ethnography listed here show that all four elements of the ICEP model can be detected on each process level. The order of these elements is less important. Although it makes sense to start the process with an *intention*, a concrete and clarified intention can develop during the work. It would also make sense that *evaluation* follows *creation*, so something has first been created which can be evaluated.

4.7.6 Implications of the ICEP-model

The basic assumption of the ICEP model is that creative work follows a pattern in various forms of creative processes. The model further assumes that this pattern can be described in terms of the areas of *intention, creation, evaluation* and *planning.* These areas are content-wise separable and describe the core of creative work.

In contrast to the prevailing process models of creativity, which primarily focus on the creative activity of individuals from the psychological point of view, the model focuses on observable activities of creative work. This has therefore excluded purely implicit cognitive processes such as incubation and illumination. At the same time, this allows communication about these four areas by process performers as well as process planners. While purely psychological process models allow the creative work to be influenced only by the creative individual, the ICEP model can also be used by third parties – i.e., individuals not involved in the process to plan and manage a creative process.

In order to plan a creative process and adapt it to improve performance, a comprehensive understanding of the prevailing processes is required. As already mentioned, process analyses can be carried out through process modeling. The following chapter, therefore, analyzes how the ICEP model can be used to represent creative processes in detail using KMDL.

4.8 Chapter summary

This chapter summarizes the ethnographic study I conducted at Axel Springer's subsidiary *Ideas Engineering* to analyze the patterns of creative intensive work processes. I examined the prototyping process in which Axel Springer employees can pitch an idea that has the potential to be promising for the company in some way. This prototyping process includes a sub-process in which a team of developers turns the idea into a prototype to test the value of the pitched idea. I have followed two of these processes with different ideas, especially regarding the creativity needed by the PoV team in developing the prototype.

Based on the processes I have studied, I have developed a model that captures the fundamentals of the creative process. This model includes four basic elements that I believe are essential to the proper execution of creative work:

- *intention*, as the clear vision of what is to be developed
- *creation*, as the development of new ideas and ways to achieve that vision
- *evaluation*, as the critical evaluation of the idea(s) developed
- *planning*, as the arrangement of precise steps to achieve the goal set.

Essentially, all models are wrong, but some are useful.

Box (1979)

5. Modeling creative-intensive business processes

How can creative-intensive processes best be modeled? In this chapter, one way to model creative work is described. The central tension between process predictability required for modeling processes and the flexibility needed for creative work to unfold is meant to be met by integrating the Intention, Creation, Evaluation, Planning (ICEP) model to the Knowledge Modeling Description Language (KMDL).

The following analysis is based on a method proposed for domain-specific modeling language development, aiming to advance an existing modeling language better to suit certain business processes (Frank, 2013). Frank proposes five main steps for developing specified modeling languages ”as one approach that makes sense” (p.139). These five steps are explained in the Table 5.1 with their goal and approach.

Step 1, clarification and scoping, is based on research of existing modeling methods that might be suitable for modeling domain-specific processes - in this case, creativity. This also requires an analysis of the exact modeling purpose to match it with existing methods. In the second step, exact modeling requirements are determined. The previously conducted analysis of creative intensive processes led to the five propositions (cf. Section 3.4 on page 74) as well as the ICEP model. Based on both, the exact requirements for a modeling approach for creative work and a

Table 5.1: Overview of the methodological approach to developing a modeling language for creative work, along with the concrete steps taken in this chapter.

Step	**Clarifying scope and purpose**	**Analysing requirements**	**Language specification**	**Developing modeling tool**	**Evaluation and refinement**
Goal	Understand, why and how creative work is modeled	Specifying modeling requirements for creative work	Analyzing fitting modeling language	Adding model elements for creative work to KMDL	Evaluation and refinement
Approach	• basics of business process modeling (sec. 5.1.1) • analyzing creative process modeling approaches (sec. 5.1.2)	• defining modeling purpose for creative work (sec. 5.2.1) • developing meta-model for creative processes (sec. 5.2.2)	• choosing KMDL as a modeling language for creative work (sec. 5.3) • introducing KMDL (sec. 5.3.1)	• develop abstract syntax and semantical foundation (sec. 5.3.2) • modeling procedure and guidelines (sec. 5.3.3)	• show modeling examples (sec. 5.3.4) • fit with propo-sitions of creative work (sec. 5.3.5) (further evaluation in Chapter 6)

metamodel for the creative-intensive process are derived. In step 3, a modeling language best fits the previously determined modeling requirements is sought. KMDL is selected to represent creative processes, which are described in detail. Then, in step 4, the modeling extensions for creative work are developed. The modeling procedure and the guidelines for the new modeling method follow this. In step 5, an example process is used to illustrate the new modeling method. More comprehensive evaluation approaches are found in the following chapter to evaluate and refine the proposed modeling method.

A general, concise introduction to process modeling is necessary for the extension of a modeling language. This chapter, therefore, begins with a general introduction and a description of the modeling guidelines since the subsequent modeling development refers to these and derives quality standards from them. This is followed by Franks' (2013) proposal for developing domain-specific modeling extensions in five steps. The chapter concludes with an overview of the developed modeling methodology and its correspondence to the developed propositions of creative work.

5.1 Basics of Business Process Modeling

A diverse set of business process modeling languages and adaptations were developed, primarily to represent formal control-flow sequences of activities of crucial business processes. Thus modeling languages serve as a tool to visualize business processes and make those tangible and manageable. Modeling languages are "an instrument for coping with the complexity of process planning and control" (Becker, Rosemann, & von Uthmann, 2000, p.31). As such, these models are used to capture and simultaneously simplify the processual business world. They abstract from unnecessary details and provide a tool for the documentation, analysis, and improvement of processes, as needed for business process management (Gadatsch, 2020).

The usefulness of applying modeling techniques is less questioned. However, the scope and extent of how processes are best modeled are a matter of ongoing debate (Rosemann, 2006b). Researchers focused intensely on business processes from the early 1990s on (Davenport, 1993; Hammer & Champy, 1993; Thomas & McGarry, 1994). This led to an increase in methodologies and techniques to analyze business processes. Especially when practitioners were introduced to the Business Process Model and Notation (BPMN) from 2004, other research streams and more specified modeling techniques emerged (Chinosi & Trombetta, 2012; White, 2004).

Until today, new modeling languages and further developments are developed again and again to meet better the respective process peculiarities (e.g., Aguilar-Saven

2004; Becker and Zirpoli 2009; Erasmus, Vanderfeesten, Traganos, and Grefen 2020). With a growing number of modeling languages and tools, the modeling process becomes more complex, and the differences between languages, including their potential advantages and disadvantages, are harder to evaluate. In addition, with the proliferation of process models in the workplace, not only modeling experts but also more and more employees, such as management, need to work with them. This trend reinforces the need to quickly understand these languages and the models they generate (Gronau, 2022).

5.1.1 Modeling as a tool to analyze business processes

There are mainly two different modeling approaches for business process models. A pragmatic approach to capturing and understanding processes and a rigorous approach to analyzing processes require more sophisticated qualitative assessment and analysis mechanisms. Overall, modeling is usually applied to those one wants to focus on, such as change processes, process restructuring, or third-party involvement. Modeling is usually not done to complete the entire process landscapes (Rosemann, 2006a).

Visual (or diagrammatic) modeling languages generally represent process features with a set of graphical symbols and representational metaphors to express the model elements and their relationships to each other. The process features are represented as symbols or shapes in such graphical models. The main process elements are visualized in geometric shapes and graphs connected by edges, represented by lines connecting the symbols (Diestel, 2005).

As a language, visual modeling requires syntax: The abstract syntax is usually defined by some meta-classes, the structural relationships between these meta-classes, and some constraints (He, Ma, Shao, & Li, 2007). The concrete syntax of a modeling language describes the visual representation of the instances of its constructs. This function requires special consideration if the models are to be made accessible to many different user groups. The contribution of graphical representations to understanding complex facts is supported by various design principles (cf. Moody 2009). The goal of graphical representation is, on the one hand, to make the concepts of a language as intuitive as possible while, on the other hand, to avoid unintended semantic associations and assumptions by the user that lead to misinterpretations. The first goal requires a set of clear visual metaphors that are easy to interpret. The second goal, which is more difficult to achieve, requires both the language developer and the modeler to know the clearly defined language relations and rules of modeling in the specific language. Those are typically defined within a metamodel of a language, in which the semantical foundation is set out.

A process model represents a blueprint for multiple process instances with a similar structure. Process models often have a two-level hierarchy, each consisting of a series of activity models (Weske, 2012). The symbols used in the models do not have a direct and immediate reference to the process characteristics they stand for. Instead, a reference is established only indirectly through concepts that relate to these characteristics and are activated by the appearance of symbols. A reader's interpretation or perception of a model becomes possible only when that reader has a concept or mental model associated with the symbols (O. Thomas & Fellmann, 2009).

Not just the reading of the models, especially the creation of such models, is based on the modeler's mental representation of the perceived reality and assumed relations and causation about changes (Grum, 2021). Modeling is thus a highly subjective endeavor, allowing for creativity in the modeling process. "Modelling is a highly creative process. It requires skills in planning, making, or executing. It is often claimed that it is not to be formalizable. It requires deep insight into the background, skills, careful simplification, experience, and ingenuity." (Thalheim, 2012, p.79). Creative efforts are needed to best adapt the requirements and rules of the modeling language to the complexity of the reality being modeled (Laguna & Marklund, 2018). Creativity in process models goes back to the experience of the modeler with the modeling language and the tool used. It does not seem to be related to the individual creative abilities of the modeler (Figl & Weber, 2012). This indicates that the ingenuity required for the modeling process, although not fully formalizable, is based on experience and skills acquired over time rather than on integrating new ideas.

One skill required for optimal modeling of business processes is to choose the level of detail of modeling appropriately. Since processes can be analyzed at all levels of abstraction, from the abstract meta-process level to the execution of a specific task, the modeling should follow the goals one has in mind (Rosemann, 2006b). Furthermore, two levels of complexity must be mastered to represent actual work with modeling tools properly. These correspond to breadth and depth: the definition of the scope of the process to be modeled and the way the work is performed.

Business process modeling guidelines

Business process modeling can be done using a diverse set of languages, and the most commonly used ones are BPMN, Event-driven Process Chain (EPC), PICTURE and Unified Modeling Language (UML) (Sultanow, Zhou, Gronau, & Cox, 2012; W. Wang, Ding, Dong, & Ren, 2006). Software tools like Architecture of Integrated Information Systems (ARIS), Signavio, Camunda, and ProVision – to name a few – support the efficient and correct usage of diverse modeling languages (W. Wang et al., 2006; Zuhaira & Ahmad, 2020). However, "despite existing tool support, there is a notable uncertainty among practitioners about how to create process models that analysts and business professionals can easily analyze and understand. Available modeling frameworks and guidelines [...] provide insight into the major quality categories, but remain too abstract to be directly applicable in practice." (Mendling, Reijers, & van der Aalst, 2010, p.1). Such general rules were established to unify modeling languages' usage and ensure the model's quality. Becker et al. (2000) introduced the *Guidelines of Modeling* (GOM) with three basic characteristics of a model:

- Correctness - syntactic (consistent and complete) and semantic (structure of model corresponds to the real world) correctness
- Relevance - only include elements to the model which carry meaning
- Economic efficiency - models are limited in their feasibility to capture complex real-world phenomena, which causes cost/benefit constraints

Additionally, GOM proposes three optional guidelines:

- Clarity - models need to be readable and easy to understand
- Comparability - clear guidelines for modeling conventions
- Systematic design - clearly defined relation to other information models, like data models

Based on GOMs' generally valid principles of qualitative models, a set of universal process modeling guidelines established in the literature is also referred to as *seven Process Modeling Guidelines* (7PMG). Those guidelines refer more precisely to the modeling challenge at hand (Mendling, Reijers, & van der Aalst, 2010). These are meant to maximize the utility and enrich the understanding of the final model for modelers and readers alike:

1. Use as few elements in the model as possible.
2. Minimize the routing paths per element.
3. Use one start and one end event.
4. Model as structured as possible.

5. Avoid OR routing elements.
6. Use verb-object activity labels.
7. Decompose a model with more than 50 elements.

GOM, as well as 7PMG, can and should be applied to all modeling languages and approaches as they serve as a basis for quality and usability. More specific guidelines come along with the particular languages one uses for modeling purposes.

5.1.2 Existing approaches to model creative work[1]

The extension of a modeling method envisages analyzing the previously existing modeling approaches as a first step (Frank, 2013). Creativity is an integral part of knowledge-intensive business processes. As already mentioned, this leads to the fact that creative work within process modeling is represented in a rather abstract way. Almost all modeling languages treat creative work no differently than any other task. A complex creative task is usually represented in a box as one task. An extensive literature review was conducted on the representation of creative work within process modeling. Based on this, three different approaches to modeling could be identified: Process Variability, Process Flexibility, and Pockets of Creativity modeling.

First, process variation, potentially containing creative efforts, is captured by repeatedly modeling the various process instantiations (Gottschalk, Van Der Aalst, Jansen-Vullers, & La Rosa, 2008). Second, since flexibility is the basis for creative work, modeling process flexibility through cases or modules could be used for creative work (van der Aalst & ter Hofstede, 2005). Third, process segments that contain some form of creativity (such as Pockets of Creativity (PoC)) can be identified by an additional symbol (Karow & Reul, 2012). In the following, these three approaches are presented more comprehensively.

[1] This and the following section are based on the paper: Haase, Thim, and Bender (2021)

Modeling process variability

Variability of processes refers to the visualization of several alternative process instances for the same process (Valença, Alves, Alves, & Niu, 2013). This is technically possible with all notation languages. The same process can be repeatedly modeled to show the nuanced differences between the processes for each variant or for typical differences between variants. A thorough analysis and comparison of different modeling techniques capturing methods for process variability were performed in Hallerbach, Bauer, and Reichert (2010); La Rosa, Dumas, ter Hofstede, and Mendling (2011).

Modeling variations of creative processes can help show the differences between process instances of as-is models. However, the method is also effortful, as repeated models must be created and compared. Creative work will typically show differences with each process performance, so many variations must be detected and visualized.

Modeling process flexibility

A set of methods have been developed to model some degree of flexibility in the process. As process flexibility is the precondition for creative work to unfold, modeling flexibility also seems like a promising start to model creative work. Different forms of flexibility within processes are distinguished, with under-specification (accounts for hard-to-predict in-advance processes when the actual execution of a process becomes apparent through the performance) being most relevant for creative processes. Under-specification is typically visualized with placeholders (Mulyar, van der Aalst, & Russell, 2008). In the context of creative tasks, such placeholders could be used for PoCs, in which the detailed performance becomes apparent only through the performance. Yet Another Workflow Language (YAWL) (van der Aalst & ter Hofstede, 2005) is so far the only modeling language able to visualize flexibility by under-specification (Kir & Erdogan, 2021; Schonenberg, Mans, Russell, Mulyar, & van der Aalst, 2008). YAWL builds on Petri-nets and includes placeholders for tasks, which's specifics are unknown before the performance (van der Aalst & ter Hofstede, 2005).

Another approach aims to capture flexibility in built-time by modeling the intentions of a task and strategies to reach those, but not the actual task performance (Bentellis & Boufaïda, 2008). Processes are represented in modules (MAPs), from which each contains a *source intention*, a *target intention* and a *strategy*. Thus, for each MAP, an entry and final state are defined, plus a strategy to reach it. This method allows for a high level of process flexibility and a more detailed representation within those MAPs than the YAWL approach. The actual process flow is not visualized, only the entry and exit points.

In a similar line, the BPMN got extended to account for such processes, which are somewhat unpredictable and evolve through enactment (Case Management Model and Notation (CMMN); Freund and Rücker 2016). CMMN was originally invented to represent case management which requires human intervention. Here, within the overall process flow, it is known when such a case will arise and what tasks will be required. CMMN is even recommended for modeling creative tasks (Cham, 2015). However, it is commonly seen as a solution for specific cases within an overall standardized process and exception handling (Marrella & Lespérance, 2013). CMMN is thus rather less prone to capture processes with high levels of flexibility and in-situ adaptations.

Modeling Pockets of Creativity

A limited amount of research has tried to map creativity directly. ARIS was extended to capture PoCs (Karow, 2011). A specific PoC-Symbol, looking like a swirl to indicate the iterative nature of creative work, was introduced to represent a creative sub-task within a workflow. This PoC can then be further described and specified on an associated PoC-sheet (Karow & Reul, 2012). This approach is a significant step to visualizing creative challenges within the process landscape, as they must first be identified and modeled. The modeling approach also shows high levels of flexibility. Processes benefit from first modeling the overall process flow and separately modeling flexible elements, as this modularity then allows for easier adjustments over time (Bhat & Deshmukh, 2005). However, this method falls relatively short of describing the specific nature of the creative work. It rather indicates where creative work is required within a process sequence. The creative task itself is still unboxed.

Evaluating existing modeling approaches

These modeling approaches above capture the creative process flow only approximately, as the aspects relevant to creative work, like typical process phases and methods for creative work, are yet invisible (cf. Table 5.2). For flexibility, as the most crucial feature of creative work, several methods exist to represent, e.g., under-specification and task iterations. The variability approach could be applied in the creative work context, especially for a higher-level process analysis like stage-gate models, as they are often used in innovation processes (Schell, 2008). However, the variability approach does not fit well for a more detailed analysis of repeated creative performance. A creative process can hardly be predefined on a detailed process level as it establishes through the enactment. For a more nuanced approach, process aspects of flexibility within each process need to be modeled. As such, the representations of cases (like CMMN), placeholders (YAWL), and PoCs (ARIS adaptation) give an approximation to the visualization of creative tasks. However, as these keep the creative tasks within boxes, those approaches do not allow for depicting creative work specifics.

For some modeling purposes, the visualization of a PoC as an entity representing creative tasks might be sufficient. However, more creativity-specific modeling approaches could become useful for managing and improving creative output. Adequate modeling methods are required to illustrate the important aspects of

Table 5.2: Overview of the modeling approaches discussed for the modeling of creative processes

	Variability	**Flexibility**	**PoCs**
Explanation	showing alternative process instances	indicating constant change and unspecific process flow	indicating creative processes and tasks
Modeling approach	repeatedly modeling instances of changed process	using placeholders, modules and boxes	swirl added to creative task
Examples	*can be applied to all modeling languages*	YAWL, MAPs, CMMN	ARIS adaptation
Shortcomings	unspecific, effortful, no specifics to creative processes	unspecific, hides process flow, no specifics to creative processes	unspecific, no explication of creative specifics within process flow

creative work. "Whereas many business processes are fairly static only at a high level, at finer-grained levels such as activities, are more agile and unpredictable." (Martins & Zacarias, 2015, p.315). The challenge is, therefore, to make the agility of creative work with modeling methods visible at the activity level. At best, in such a general way that it can be used and applied across domains (Czech et al., 2020).

5.2 Modeling requirements for creative intensive processes

The modeling methods developed so far to capture (aspects of) creativity fall short. Developing a new method requires a concrete understanding of the creative process. This will be presented later in the form of a metamodel. The development of a modeling method is also subject to a concrete modeling goal. As explained above, process modeling can analyze and track processes. In complex creative work, a deep understanding of the processes seems desirable, but not the complete reproducibility of the processes. This highlights the central dilemma of modeling creative work: modeling approaches aim at a detailed description of processes that cannot be predicted precisely in the case of creative work. It is necessary to find a middle ground between the simplified ”black box” view of creative tasks practiced so far and their actual performative complexity.

5.2.1 Defining the modeling purpose

In general terms, the goals of business process management (BPM) are discovering, modeling, monitoring, analyzing, and improving business processes. Modeling languages thus serve as a tool to communicate properly and share process understandings among process associates (Zacarias, Martins, & Gonçalves, 2017). This can provide a deeper understanding of the human activities within business processes, so individuals performing only some part of the process better understand the overall process landscape better (Dumas et al., 2013). It can also assess the alignment between ideal process flows and actual execution (Schmiedel & vom Brocke, 2015).

In the modeling of creative work applied here, two specific goals emerge: recognizing and understanding creativity within the processes landscape and potentially improving the way(s) creativity is performed within these processes. This basic idea that visualized and recorded processes increase understanding of processes' specifics and interdependencies also holds for creative work. Process modeling generates an instrument to define expectations toward process and task performance. From this perspective, various measures can follow a thorough process understanding: resource allocation (like budget, equipment, time, and employees), efforts enhancing creative output (through access to knowledge, communication practices, training of employees and teams), and risk management (through the implementation of review cycles with associated employees, Cham 2015).

Managing creative work requires, above all, the management of knowledge and individual creative skills. A thorough understanding of the process can improve the actor's performance by increasing the understanding of when in the process (what kind of) creativity is best needed. Based on the Dynamic Componential Model (DCM) (cf. Section 2.4.2 on page 38), creative work relies on task-related knowledge, creative cognitive competencies, and motivation to act (Amabile, 2012). Following research on "reflective talk" of organizational routines, explication of shared mental models can improve workflow and support process adaptations (Dittrich et al., 2016). Thus, modeling creative work routines can be a way to enable participating employees to share their mental process models to align their understanding of work procedures better.

Process transparency can enable creative work because actors can better train their skills and knowledge if they know exactly what the process (step) requires. Also, organizational studies have shown that a detailed examination of the creative process at work and its characteristics and challenges helps actors improve their performance and strengthen their understanding of future creative work (Byrge & Hansen, 2013). This effect can also be seen in teams, as explaining how creative work should best be done in a group can align team members' shared mental models, which positively affects overall creative output (Martins & Terblanche, 2003). Overall, modeling important features of creative work can promote its management and performance, leading to more efficient and creative work.

5.2.2 Developing a metamodel for creative intensive processes

So far, creative work has been described based on literature and the ethnographical approach to assessing diverse forms of creative work. A transformation into modeling methods requires a more abstract and universal form of information presentation. A metamodel enables an abstract representation of the relevant aspects of creative work.

A metamodel is a model of a model, in this case, of creative work. It analyzes and constructs frames, rules, and constraints applicable and useful for modeling a predefined class of problems (Adamo, Di Francescomarino, & Ghidini, 2020). In the case of business process metamodels, functional, informational, and behavioral aspects of business processes are captured (Martins & Zacarias, 2015). Metamodels commonly capture all relevant aspects and relations graphically. This already represents a form of modeling, usually based on UML (e.g., Yamamoto, Yamamoto, Ohashi, Inomata, and Aoyama 2018; Zacarias et al. 2017) or Entity Relationship (ER) models (e.g., Wagner 2003).

The principle and usage of a metamodel

A metamodel visualizes behavior primarily based on interaction patterns between process elements (Wagner, 2003). Adamo et al. (2020) analyzed the types of process elements used in metamodels based on 36 primary studies covering process metamodels. They collected all process elements which appeared at least twice in the metamodels, leading to 91 elements, which could be reduced to 12 macro-elements: *activity*, *event*, *state* (like precondition), *sequence flow* (like gateways), *data flow* (like conversation or knowledge), *data object* (artifact), *actor* (role), *resource*, and less common: *time*, *value* (cost), *goal*, and *context*.

Adamo and colleagues also analyzed the relations between model elements. The *is_a* relation between activity types are most common, just as *carries_out* between actor and activity. Thus, an *activity* is in the center of each model, as almost all elements are connected to it. Further, metamodels also represent elements of the structural layer (Martins & Zacarias, 2015). These are the elements representing the functional aspect (like activity and (sub)process), informational aspect (product and product kind), and behavioral and organizational aspects (role and actor). The essential elements are (partly):

Behavior:	best practices that guide an organization
Business process:	is a behavior element based on a set of ordered activities; intended to produce products or business services
Product:	item that is produced or consumed during business activities
Product kind:	represents several types of products
Business role:	responsibility for performing specific activities to produce, either directly or indirectly, versions of one or more products
Actor:	organizational entity that performs one or more business roles

All these model elements can be applied in a metamodel to represent certain types or aspects of processes. In the following, these are used to visualize the metamodel of creative-intensive processes.

A creative process metamodel

A metamodel of creative work is created using the ER diagram notation. A basic ER model is composed of entity types that classify the process elements of interest and specify relationships between the elements (Chen, 1976). Typical graphical notations of ER models are rectangles for entity types and diamonds for relationship types, connected by lines (Weske, 2012).

Martins and Zacarias' (2015) collection of metamodel elements was adopted to creative work processes:

Behavior:	creative work
Business process:	creative intensive process (CiP), including PoC
Product:	creative processes outcome, like an idea or creative product
Product kind:	represents several types, like idea vs. product
Business role:	team(s) and individual(s)
Actor:	an individual performing creative work

The previous chapters analyzed creative intensive work, leading to a collection of process elements relevant to creative work:

- Creative work consists of PoC, with creative sub-processes and stable-sub-processes (cf. Section 2.4.3 on page 42).
- Creative work entails all aspects of the ICEP model (cf. Section 4.7 on page 109)
- Based on the interactionist model of organizational creativity, creative work evolves through the interaction of the individual with the team and organizational level (cf. Section 2.4.2 on page 35)
- Creative work leads to output, like ideas, and when these are further elaborated, to creative products (cf. Section 2.3.3 on page 19)

A metamodel for creative intensive work can be proposed (Figure 5.1). A creative intensive process consists of at least one PoC, performed by at least one individual or a team of at least two individuals. The PoC can consist of undefined numbers of PoC-levels, each composed of creative and stable sub-processes. A creative sub-process consists of at least one intention and can further entail creation, evaluation, and planning. The creative sub-processes lead to ideas, whereas the overall creative-intensive process can lead to a creative product.

The creative meta-process entails all crucial aspects necessary for the following modeling approach. All model elements are based on literature and ethnographic approaches to analyzing creative work in an occupational setting. The model entails the possibility of including as many process levels as necessary to properly represent complex creative process landscapes. It also allows for the combination of standardized, thus non-creative sub-processes. The outcome of creative sub-processes, and ideas, cannot be assumed to be mandatory. Ideas, defined as novelty incursion, are also partly a product of luck and contain a definitional dependence on being recognized as an idea.

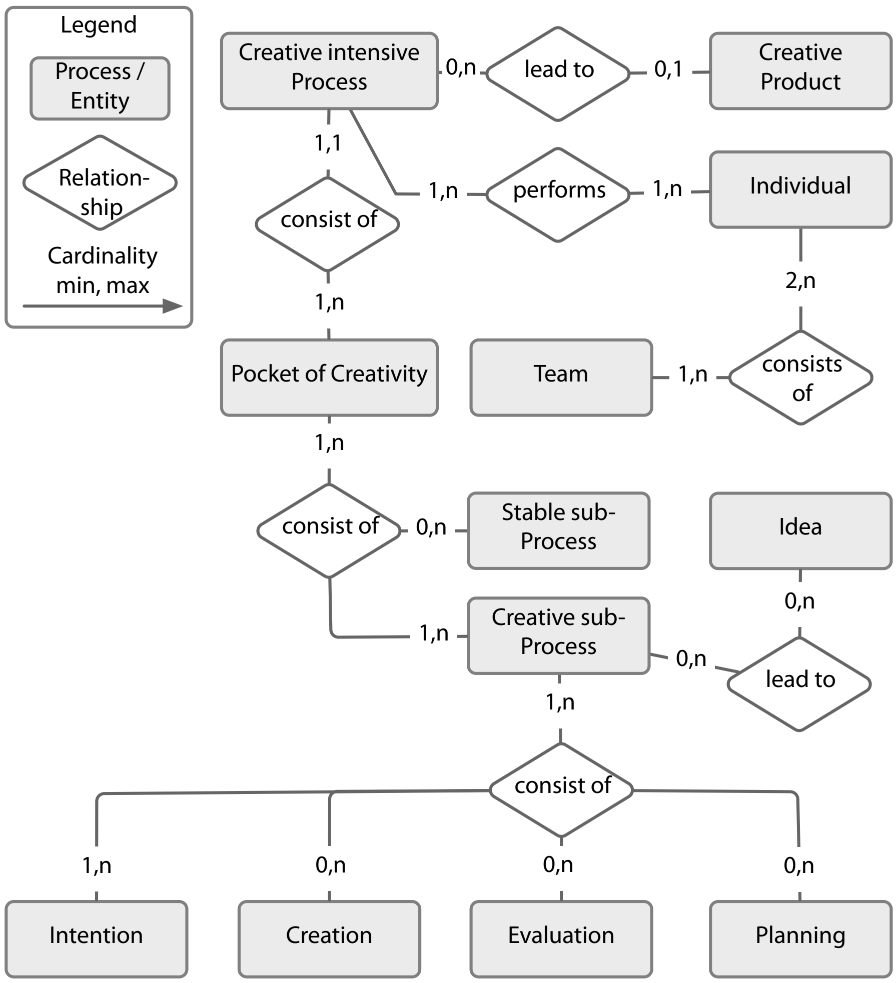


Figure 5.1: Metamodel of creative intensive processes

In contrast, assuming that PoCs lead to creative products, as those usually contain several creative sub-processes, thus enhancing the chance to be based on new and useful ideas. Plus, a product is generally complex, improving the likelihood of at least some aspects being judged as creative. However, the model assumes that creative output is created, and the actual quality of products from process instances needs to be evaluated individually for each process instance.

5.2.3 Summary of the prior sections

This chapter introduces process modeling basics and already-known ways to model creative work with common modeling languages. So far, those modeling languages miss capturing the specifics of creative work, which keeps modeled creative tasks in boxes.

The goal of modeling here is the analysis and possible improvement of creative work. As the previous chapter on actual creative work in a professional setting shows, creative work is based on four process aspects: Intention, Creation, Evaluation, and Planning. Models incorporating these aspects into the process could help analyze creative work as it is performed and improves creative performance. In preparation for the following modeling approach, a metamodel for creative intensive processes was developed that encompasses all relevant process elements of creative work. Thus, the first two steps for developing a modeling extension have been elaborated, which form the basis for the following extension of the modeling language with KMDL.

5.3 Developing KMDL extensions for CiP

The process elements from the creative metamodel are to be transferred into a concrete modeling language. This requires the selection of a modeling language that is as suitable as possible. This refers to the proposed third step, the language specification. Comparatively, modeling methods show considerable diversity in terms of the scope of objects they cover and the primary modeling goal they pursue (Sultanow et al., 2012). Since creative work is a form of knowledge work, searching for suitable languages focuses on those that cover knowledge.

Although various modeling methods exist, only a few focus on knowledge-intensive processes. Grum (2021) compared different modeling languages' ability to cover knowledge transfer. Based on his analysis, KMDL shows the best fit for the coverage of the behavioral perspective of process models, which aligns with the requirement of creative work as individual-driven process performance. In comparison, PROMOTE and Business process oriented knowledge management (GPO-WM) focus on knowledge but with different foci. The PROMOTE language anchors knowledge objects into the process flow of business processes (Karagiannis & Telesko, 2000) and GPO-WM focuses on information distribution within business processes (Heisig, 2002). Other modeling languages that do not focus on knowledge can also be used for creative work, as the example of the ARIS extension by Karow and Reul (2012) shows.

A comprehensive analysis of modeling approaches in knowledge management identified KMDL as the best language for representing knowledge. Ben Hassen, Turki, and Gargouri (2019) compared business process modeling languages (BPMN, UML, PROMOTE, KMDL, and others) on several dimensions of how well they represent functional, organizational, behavioral, informational, and knowledge aspects of business processes. They conclude that KMDL best represents the knowledge dimension. BPMN, the most widely used (Compagnucci, Corradini, Fornari, & Re, 2021) and studied language (Zarour, Benmerzoug, Guermouche, & Drira, 2019), performed significantly worse on the knowledge dimension, suggesting that BPMN is not suited explicitly for representing knowledge-intensive processes. Overall, ”KMDL has proven itself in practice, and many examples can be found in business and academic contexts” (Grum, 2021, p.87).

KMDL was selected for an extension to creative work for several reasons:

- KMDL covers knowledge explicitly, which is an essential aspect of creative work (cf. Section 2.3.1 on page 17)
- KMDL shows an explicit focus on knowledge transfer within business processes, which is the closest to the needs of creative-intensive processes
- KMDL shows a greater scope in the process aspects which can be expressed, compared to direct alternatives of PROMOTE and GPO-WM
- KMDL is a semi-formal modeling language, thus inherently allowing for a certain degree of flexibility

5.3.1 Modeling with KMDL

KMDL was developed in 2003 as a modeling language focusing on knowledge transformation within business processes (Gronau, Palmer, Schulte, & Winkler, 2003). It is based on the assumption that business processes can best be executed and improved through effective knowledge processing. By locating knowledge flows within the company and capturing the link to individuals and teams. Especially person-related knowledge is not directly recognizable and requires precise analysis. Here, KMDL enables systematic compilation. Several adaptations and variants of KMDL were developed since (Gronau, 2012; Gronau et al., 2010; Gronau & Fröming, 2006; Gronau et al., 2005; Grum & Gronau, 2017). The following work related to KMDL is based on its latest version KMDL 3.0 (Gronau, 2020), which is currently researched and further developed.

KMDL enables the capturing, creation, and distribution of knowledge along business processes. KMDL is a semi-formal modeling language with a fixed set of symbols and defined syntax. It entails a process and knowledge perspective (Gronau, 2020). These different perspectives entail different view concepts allowing a process system to be looked at from different perspectives. The process perspective primarily describes the control flow along the business process. It is focused on mapping process-organizational relationships. The knowledge perspective visualizes the handling of knowledge, information, and physical objects for completing knowledge-intensive tasks. Here, knowledge-intensive tasks are visualized and further specified.

Every modeling method includes a set of elements the language is composed of: the element and property types, relationships, and language rules, as well as the overall modeling procedure (Karow, 2011). *Element type* covers all the essential components of the language, which symbolize different aspects of a process. The *property type* describes the instantiation of the process elements as the attribute of a specific element applied in the model. A *relationship* is a language construct describing the connection between the language elements, like connectors. A *language rule* combines the elements, property, and relationship to a complete syntax. The *modeling procedure* provides guidelines for using the modeling language. Techniques are provided on how to derive the model based on the processes perceived in real-life.

In the following, all these modeling elements are described for KMDL 3.0 for the process and activity view separately, based on the literature aggregation from Grum (2021), the 3.0 version description from Gronau (2020), as well as KMDL associated publications (Gronau, 2012; Gronau et al., 2010; Gronau & Fröming, 2006; Gronau et al., 2005).

KMDL process view

The process view, as the most critical view of the process perspective, describes the relevant operational process from the perspective of the sequence of activities (process steps) and thus clarifies the tasks to be processed one after the other. Further, the resources used to process the task are assigned to the tasks in the process view. Thus, this view is similar to other established modeling languages, like EPC or BPMN. Business processes connect tasks, services, information, and roles. Their processes and connections are displayed on the process view (cf. Figure 5.2). The process view visualizes the structure of a process and related tasks using arrows and Boolean operations. More specifically, input and output can be defined for the processes in terms of tasks, process interfaces, information systems, and roles. In the following, the process view elements are described in more detail.

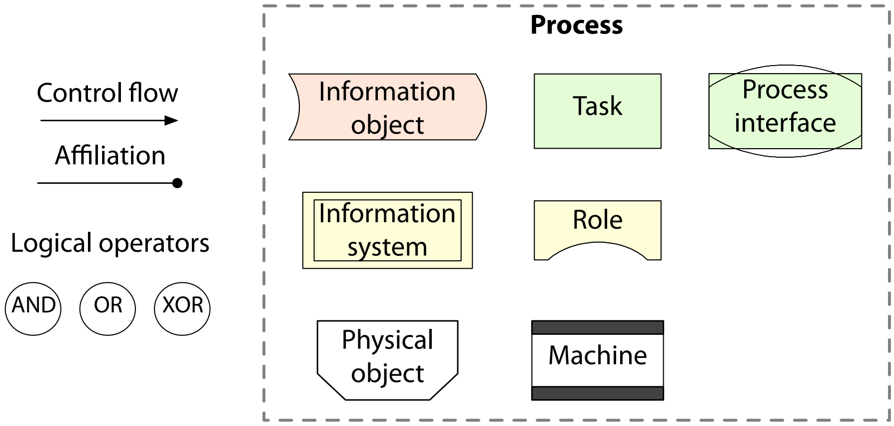


Figure 5.2: KMDL process view elements, from Gronau (2020)

Task: represents a set of activities that are not further refined within the selected level of detail, at least from a process perspective. Tasks can be repeated in the process and serve to structure them. For labeling tasks, the default is object-verb, as recommended for improved understanding (Mendling, Reijers, & Recker, 2010).

Role: Each task at the process level is assigned at least one role that is responsible for processing the task. The assignment of a role to one or more persons takes place from the knowledge perspective. Roles are described in a person-neutral way: no names are given, and only the roles of the persons involved in the task are described. Groups of people, like a team or department, can also be assigned a role.

Information system: represents information or communication technology used in the process. From the point of view of information retrieval, an information system is used for the computer-aided acquisition, storage, processing, maintenance, analysis, use, disposition, transmission, and visualization of information. Information systems can generate or process information objects through algorithms such as sorting, combining, or calculating mathematical functions.

Process interface: used to connect individual processes into process chains. Process interfaces also offered the possibility of cross-process evaluation and improved modeled knowledge conversions.

Logical operators: are used to link subsequent tasks. If tasks follow one after the other, no operator is inserted. There are 3 forms for specific dependencies: Conjunction (AND; "a and b"), which is identified in process models by the "AND" symbol $\textcircled{\wedge}$. Disjunction (XOR; "a or b") which represents an exclusive OR and is identified by the symbol $\textcircled{\scriptsize XOR}$. Adjunction (OR; "a or b or [a and b]"), which is represented as inclusive OR by the symbol $\textcircled{\vee}$.

Information object: information can exist as text, drawings, or diagrams on paper and in electronic form, documents, audio files, bitmaps, video formats, etc. Information exists independently of individuals and can contain explicable knowledge. Information objects can be input or output objects of tasks. If an information object is an input object, its content contributes to the task; if it is an output object, it is a result of the task. Information objects are represented in the process perspective and on the system boundaries of an activity. Examples of information objects are "recipe" or "standard operating procedure." The modeler decides whether an information object is to be considered in the process perspective.

Physical object: only modeled if they are required to transform knowledge within the process. For example, from the knowledge perspective, knowledge gain can be shown when an expert examines a physical object. It is assumed that physical objects contain knowledge gained through appropriate investigation methods. Similarly, what knowledge is necessary to create or produce a physical object can be shown.

Machine: Technical devices, such as cyber-physical production systems, can serve as information carriers. Due to the data processing function of devices, it has proven beneficial to model them with a separate symbol since they also have a physical representation, unlike information systems.

Relationship: specific relationships are defined to describe the connection between model elements, like arrows and affiliations, specifically the assignment of roles to tasks and the assignment of information systems to tasks.

Modeling guidelines for the process view

First, all relevant process aspects need to be collected to model processes from the process view. The modeler defines the abstraction level of operations and depends on the modeling purpose. The same is the case for deciding what the relevant aspects of the process landscape are to be. The modeler decides these issues of model granularity and level of detail, while the following guidelines apply equally to all process models performed with KMDL.

Tasks can be connected directly through arrows, or information or physical objects are linked between tasks. Thus, information and physical objects can be used as input or output for the process. The criterion for the connection function of the information or physical object is its importance for the next task. Logical operators can merge and branch based on previous decisions in a task.

Roles of individuals and teams are assigned to tasks through affiliations (no arrows). The same role is assigned repeatedly within one process when this role is directly involved with several tasks.

The symbol for physical objects is used if assumed to contain embedded knowledge relevant to the modeled process. If information flows cross the organizational boundary, the objects outside the organization are displayed on the dashed frame of the process boundary, indicating an external input. This dashed boundary indicates a set of tasks of a comprehensive process.

KMDL activity view

The KMDL activity view, as the critical view for the knowledge perspective, describes the knowledge conversions in a business process on a more granular level than the process view. The activity view is only used for knowledge-intensive tasks to limit the modeling effort. In the activity view, tasks are viewed from the process view and examined concerning the knowledge flows within them. The task is divided into a series of activities, the so-called conversions. Tasks are knowledge-intensive if there is a presumption that person-related knowledge may be required to complete the task or if cyber-physical systems are involved in completing the task.

On the activity view, tasks contain knowledge conversions, with information and knowledge objects as input/output. Conversions are performed based on the SECI model, which includes *socialization, externalization, combination* and *internalization* as ways to transform knowledge (Nonaka, Toyama, & Konno, 2000). Further, *interpretative abstraction* was added as a way to extract knowledge from physical objects. Further, knowledge conversions can be specified by requirements, and knowledge objects (information object and physical object) required for conversion are affiliated with a person, team(s), or intelligent machine (cf. Figure 5.3).

The KMDL knowledge perspective provides different notation elements to model knowledge handling within a task. Some elements are known from the process view but might have a different use in the activity view. All elements are shortly explained below.

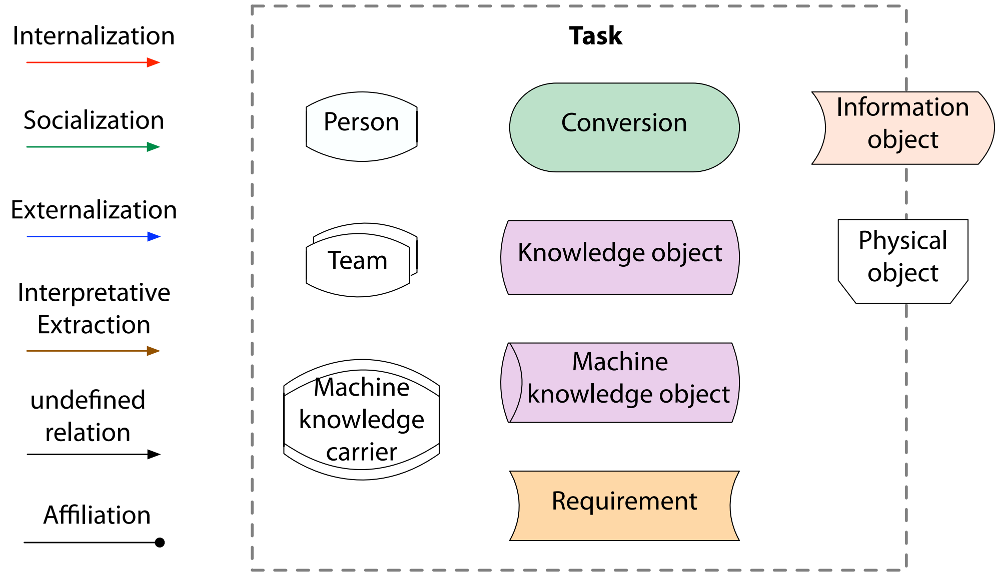


Figure 5.3: KMDL activity view elements, from Gronau (2020)

Task: indicates the reference between the different modeling perspectives. A task in the activity view refers to a task in the process view. Tasks on both views are named the same.

Conversion: describing the creation, application, and distribution of knowledge and the creation, distribution, and preservation of information. They have input and output objects, represented by information and knowledge objects. The conversion activity uniquely determines the conversion type indicated through colored arrows. The relation can be undefined if the knowledge transformation is unknown or irrelevant. Conversions are labeled in the present tense, like "Create prototype". Conversions are always linked via knowledge and information objects as input and output objects. A direct linking of two conversions is factually wrong because the meaning of the conversion as a descriptor of the knowledge transformation is lost.

Knowledge objects: represent the knowledge of a person or a team. The knowledge object maps the competencies, experiences, skills, and attitudes of the person or team. Knowledge objects can be input or output objects of conversions.

If a knowledge object is an input object of conversion, its content contributes to the conversion; if it is an output object of the conversion, it is a result of the conversion. Knowledge objects are directly modeled to a person or a team with an affiliation. Each knowledge object modeled this way indicates that this person possesses this knowledge. If a machine exhibits knowledge, a separate symbol of machine knowledge can be used for its knowledge.

Information / physical object: represent information / physical object, as indicated on the process view. They are represented only at the system boundary of activities since they ”originate” from the process perspective.

Requirement: knowledge-related requirements are placed on conversion to perform it successfully. The knowledge of persons or teams can cover requirements. A requirement can be differentiated into technical, methodical, social, and action-oriented requirements. The requirement object is modeled directly to conversion through an affiliation. Their fulfillment is achieved by persons involved in the conversion and their associated knowledge objects.

Person / undefined person: represents a natural person in the case of an as-is-model or an ideal person in the case of a target model. Persons are knowledge carriers. For this reason, knowledge objects are modeled with an affiliation to the person.

Team: A team represents a group of people who work together on a knowledge-intensive task. Teams are also knowledge carriers. The knowledge modeled to a team through knowledge objects represents the team’s collective knowledge. This consists of all the individuals in the team plus the knowledge that exists through the group, such as rules of conduct or approaches to solving problems. Teams are named either by the name of a department or by the individual name of a project team. If a person has a special influence in the group, this person is modeled separately.

Machine Knowledge Carrier: If machines exhibit knowledge and this is to be considered in the modeling, the carrier of machine knowledge can be used for additional differentiation.

Conversion types: The conversion types describe the type of knowledge conversion indicated by colored arrows: socialization (green), externalization (blue), internalization (red), interpretative extraction (brown), and undefined (black).

Modeling guidelines for the activity view

The process from the process view is further defined in the activity view. The defined tasks, roles, and input- and output objects are transferred to the activity view. Based on the activity view elements and their properties described above, specific features of the tasks can be further specified. KMDL focuses on knowledge-intensive processes, which are tasks requiring person-associated knowledge.

Each modeled activity requires at least one knowledge-intense task. Tasks and conversions describe activities with verb-object connections. Tasks are connected through arrows to indicate their direction. Activity models are always linear and cycle-free.

Tasks can include (knowledge) objects when deemed important for task performance. Information and physical objects are modeled on the dashed line of activity and are connected to tasks with an arrow. Both objects are unrelated to context and exist without an affiliation to a specific role or person. In contrast, a knowledge object is always connected to some form of an individual entity. Requirements are associated with conversions by an affiliation. They can be added when specific preconditions for conversion need to be met for the conversion.

Task-related knowledge objects are used as input as well as output from conversions. From every conversion, a knowledge object has to emerge. Naming knowledge objects should reflect their specific character at a time to reflect their development for knowledge conversions. To specify the mode of knowledge transfer, colored arrows are used to indicate the knowledge transformation as internalization (red), socialization (green), externalization (blue), interpretative extraction (brown), or as undefined (black).

KMDL language rules

The KMDL elements for both process and activity view and their properties and relationships are combined with language rules to create a complete syntax. Figure 5.4 on page 162 shows the KMDL metamodel, which includes all process and activity view language elements and their potential relations.

In addition to the modeling rules for the model elements defined above, some more rules apply to generic models:

- KMDL-based models contain at least one task/conversion or composition of tasks/conversions
- each conversion has at least one incoming and one outgoing edge to visualize the knowledge flow
- conversions are indirectly connected through (machine) knowledge objects or information objects
- Physical and information objects which enter a process/task or result of it are put on the process/task border and can be directly integrated into a subsequent task
- Activity models are always linear and cycle-free. Iterations are indicated on the process view only.

This collection of modeling elements, rules, and guidelines is the basis for the following modeling extensions developed to capture creative work.

5.3.2 Developing abstract syntax and semantical foundation for KMDL extensions of creative work

In this section, KMDL is the basis to advance further to include aspects of creative work. Syntactic specifications for creative work are derived from the theoretical foundations in conjunction with the requirements laid out in the metamodel of creative-intensive processes in Section 5.2.2.

All elements from the creative metamodel are collected and matched to develop the necessary extensions with KMDL elements. For those aspects of the creative metamodel without a suitable KMDL counterpart, new KMDL features are added. To do that effectively, the new design is based on nine principles for designing effective visual notations (Moody, 2009). Newly added shapes and forms are designed in such a way to enhance cognitive effectiveness, as ”research in diagrammatic reasoning, [...] shows that the *form* of representations has an equal, if not greater, influence on cognitive effectiveness as their *content*.” (Moody, 2009, p.758, emphasis from the original). This supports the importance of the visual form on the felt easiness of understanding models – especially for novices.

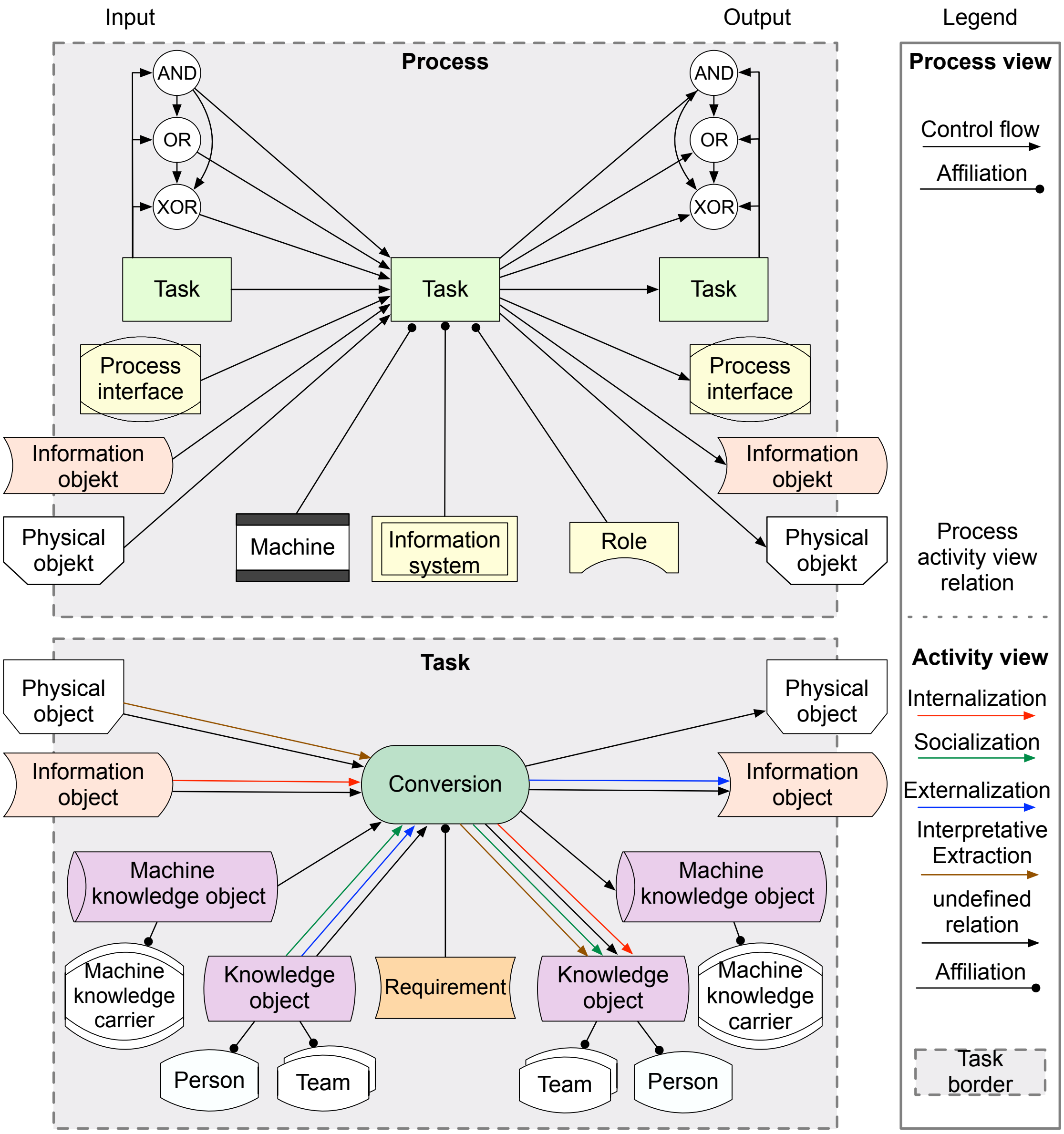


Figure 5.4: KMDL-Metamodel, based on Grum (2021), adapted to the 3.0 version from Gronau (2020)

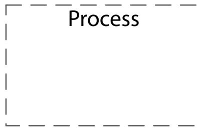
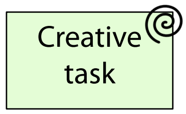
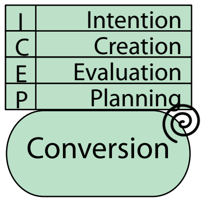
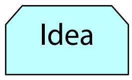
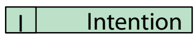
Applying design principles for visual notations

KMDL extensions for creative work are derived based on the following design principles from Moody (2009):

1. Principle of semiotic clarity: 1:1 correspondence between semantic construct and graphical symbols
2. Principle of perceptual discriminability: Different symbols should be distinguishable from each other (e.g., by changing several features to distinguish information)
3. Principle of semantic transparency: Using visual representations whose appearance suggests their meaning
4. Principle of complexity management: Include explicit mechanisms for dealing with complexity (e.g., modularization, hierarchies)
5. Principle of cognitive integration: Include explicit mechanisms to support the integration of information from different diagrams
6. Principle of visual expressiveness: Use the full range and capacities of visual variables
7. Principle of dual coding: Use text to complement graphics
8. Principle of the graphic economy: The number of different graphical symbols should be cognitively manageable
9. Principle of cognitive fit: Use different visual dialects for different tasks and audiences

Table 5.3 shows the overview of the creative metamodel elements matched with KMDL components and newly derived features.

Table 5.3: KMDL-extensions for creative work, based on the creative intensive process metamodel

Meta model components Explanation	**Corresonding KMDL component**	**Further requirement**	**Visualization**
Creative intensive process (CiP) High-level process, which contains several tasks and sub-tasks, supposedly leading to a creative output	Task with activity border		
Pocket of creativity Flexible, possibly iterative task as an element of the cip	Conversion	Indicating flexibility, iteration of sub-task	
Stable sub-process Well-structured task as an element of the creative sub-process	Conversion		
Creative sub-process Flexible, possibly itterative task as an element of the creative sub-process	Conversion	Indicating flexibility, iteration of sub-task	
Idea Output of acreative sub-process	Knowledge object	Ideas are not explicitly documented, exist as an elaborated thought	
Creative product Output of a creative intensive process, which is new and useful	Information object / physical object		
Intention An aspired goal state which the creative task aims to reach, typically in form of a problem	Requirements	Specification of the goal of the creative task	

…to be continued.

Meta model components Explanation	**Corresonding KMDL component**	**Further requirement**	**Visualization**
Creation Process step aiming for the breadth of ideas	Conversion	Specific indication of a conversion as an ideation task	C Creation
Evaluation Process step aiming to evaluate ideas	Conversion	Specific indication of a conversion as an evaluation task	E Evaluation
Planning Process step aiming to plan iteration phase/implementation	Conversion	Specific indication of a conversion as a planning task	P Planning
Individual Individual actors performing the cip	Person		
Team A team is comprised of individual actors, performing the cip	Team		

The principle of semiotic clarity requires a new form for each new feature. New symbols are added for new elements like *Idea* and the ICEP elements. These shapes should be different in form and state (principle of perceptual distinctness), so *Idea* gets a new shape and an unused color compared to the KMDL context. The ICEP symbols each have the same color as *process* and *implementation* to indicate their dependence on them.

At best, the meaning should be intuitively deduced from the symbol (principle of semantic transparency). The symbol *idea* was chosen in its present form because of two associations: First, it is meant to look like an open box, and second, it is the opposite of a physical object (the idea symbol is a horizontally mirrored physical object), which is meant to indicate the opposite nature of an idea to a physical object. Furthermore, the vortex is introduced to show the creative aspects of the process elements related to the iterative nature of such processes, already introduced by Karow (2012) to denote creative tasks.

Since processes are complex, some structures should be used to reduce this complexity (principle of complexity management). KMDL provides different process levels by distinguishing between process and activity views. The modularization of the creative work is complemented by the ICEP symbols associated with the implementation. In this line, complexity is also reduced by modeling tasks within frames (principle of cognitive integration). Visual expressiveness increases the readability of the models by using different visual indicators. Visual distinctions are based on shape, color, and symbols, such as the vortex. In addition, dual coding is applied through these various visual indicators and written descriptions for each character. Only the first letters are used in the ICEP model to save space.

The principle of cognitive fit can be interpreted as given by extension for creative work per se. Creative tasks have historically been modeled using the standard KMDL elements. Adding modeling specifics for creative tasks creates a dialect of KMDL better tailored to creative work.

Applying the ICEP model to KMDL

With ICEP elements in the KMDL modeling language, process specifications for creative work are added. In Table 5.3, ICEP specifications have already been introduced with the *creative sub-process*. Here, an implementation is specified by the four elements of the ICEP model, identified by the initial letters of each element. Instantiations can be used to specify the methods or people that are (primarily) responsible for each element. Thus, an implementation can further specify what is to be done (*Intention*), how the newness in this task is achieved (*Creation*), how the quality of the work is ensured (*Evaluation*), as well as how the process is controlled (*Planning*).

Not all aspects need to be modeled, as KMDL focuses on the necessary process aspects. However, every creative task requires a textitintention to avoid the risk of a chaotic process. It is also recommended always to model all four aspects. This would ensure that the task(s) are well planned and that there is a shared knowledge of the expected output. Not being able to specify these aspects can be seen as a sign of under-specification of the process steps.

To better illustrate the ICEP model within KMDL, an example of creative implementation from the ethnographic study at Axel Springer is used. Here, a front-end design is to be created with the main goal of achieving an appealing, intuitive design for a website. The developer reports using a mood board to gather ideas and inspiration for the general design framework. The actual design is then implemented using Figma, an interface design tool. The developer solicits feedback from the idea generator and the Product Owner (PO) to review the look and usability.

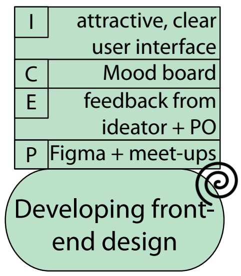


Figure 5.5: Example for a creative conversion including the ICEP model

Figure 5.5 shows one way to model the described design process. Due to space constraints, the descriptions for the ICEP aspects are brief. If known, more information could be added, such as an exact meeting format for feedback with the idea generator and PO. Also, Figma could be considered the program for actual design generation rather than design planning. The differences are not always apparent, as one method or interaction with others can lead to different aspects. For example, feedback from the idea generator can also lead to new ideas.

However, since the primary goal of a feedback session with the idea generator is to evaluate the work done, it is modeled as *Evaluation* rather than *Creation*. These are definitional ranges that the modeler can use and set according to their suitability assessment.

Adapted KMDL metamodel for creative work

The derived modeling extensions for creative work are set out above for the activity view, as this is where specific process features for creative work are best described. The same logic of the ICEP model from the activity view can also be applied to the process view. A task can also be assigned as creative by adding the swirl. The ICEP elements can similarly be specified for creative tasks. Figure 5.6 shows an overview of the KMDL process view, including creativity specifications.

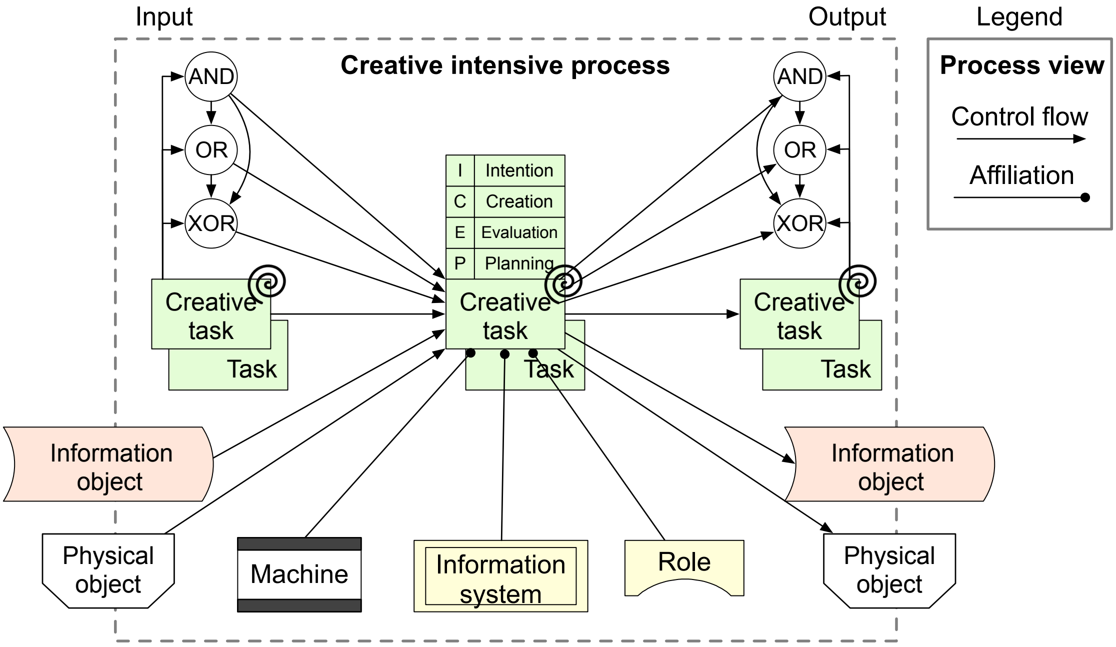


Figure 5.6: Adapted KMDL-metamodel for creative work on the process-level

For the activity level, Table 5.3 on page 164, provides the newly added process elements for creative work. A conversion can be specified by the ICEP elements when considered creative. Knowledge objects are not creative, as they represent personal knowledge. Instead, the new symbol of an idea is introduced to represent a developed creative thought or shared mental vision. Also, machines that carry knowledge are not considered to be creative. This is due to the current technological inability of machines to create unique output beyond the scope of pre-programmed scripts (Das & Varshney, 2022; Miller, 2019). This could be adjusted in the future by technological advancement in artificial creativity. Figure 5.7 shows an overview of the KMDL activity view, including creativity specifications.

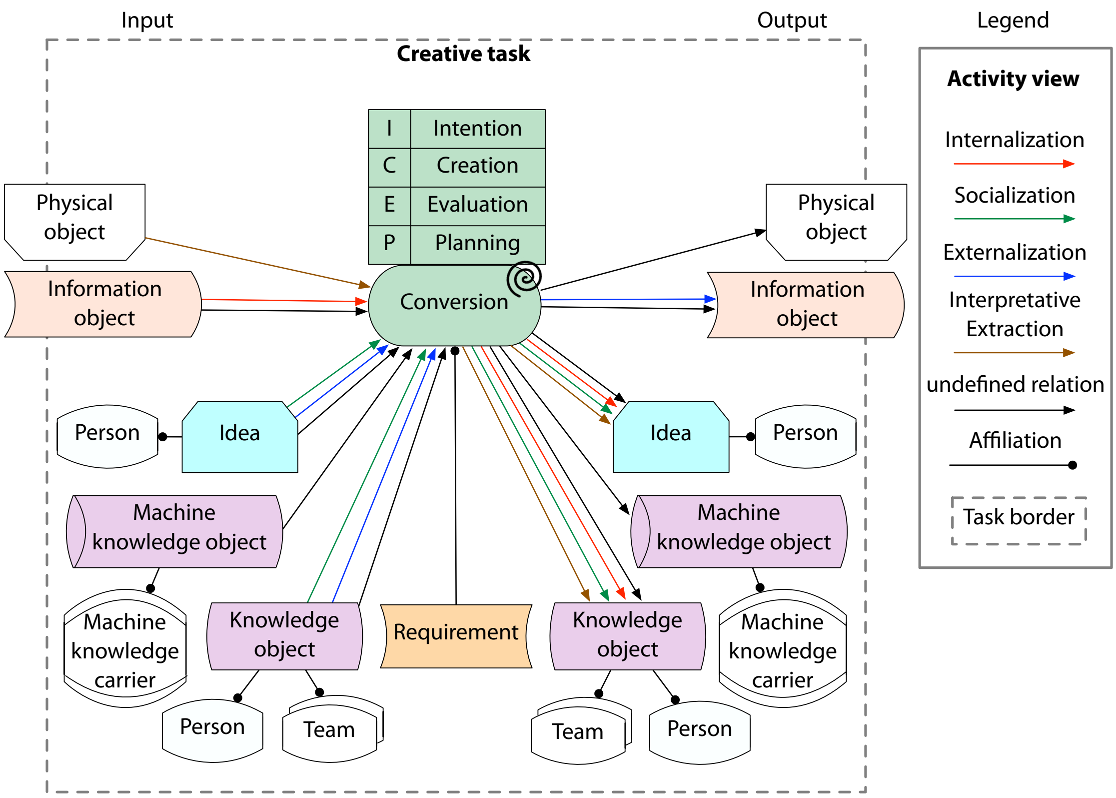


Figure 5.7: Adapted KMDL-metamodel for creative work on the activity-level

5.3.3 Modeling procedure and guidelines

Process modeling is the visual construction of complex socio-technical systems. The main goal is to capture the complexity of the processes through the modeler's subjective assessment of what is relevant and essential enough to become part of the model. This process of "translating" processes into models follows a typical procedure that applies to any modeling language and is supported by general modeling guidelines. These modeling conventions aim to ensure consistency in the use of modeling techniques. This leads to reduced diversity, better comparability of models, and better clarity in the analysis of models (Becker, Kugeler, & Rosemann, 2003).

The modeling process usually includes three main steps: elicitation, modeling, and verification. First, the subject of the model must be revealed and understood. This is mainly done by specialists or experts familiar with the process landscape. In the dialog, the process characteristics are revealed. The focus is on the correct and complete interpretation of the process as it unfolds (or should unfold). This informal knowledge of the process can then be transferred into the formal modeling language by paraphrasing the key aspects and process features. The standard language rules support this transition but limit the process model to the aspects that a modeling language provides. In the third step, the created model must be checked for correctness, completeness, and comprehensibility (Hoppenbrouwers, Proper, & van der Weide, 2005).

Before elaborating on these three steps of the modeling process for creative work with KMDL, two rather fundamentally different modeling approaches need to be separated: Modeling can be divided into *as-is* vs. *to-be* modeling (Speck & Schnetgöke, 2003). *As-is* modeling focuses on actual process performance and requires knowledge of actual performance with all relevant aspects. Modeling existing processes as they are performed improves the understanding of relevant relationships and existing problems and inefficiencies within the process landscape (Becker et al., 2003).

To-be models aim at solving current process-related problems and weaknesses, such as inefficient processes in terms of cost, time, communication between organizational units, and unspecified processes (Becker et al., 2003). In contrast, *to-be* modeling aims at improved target processes carried out in the future. They are often based on current as-is models and their evaluation.

KMDL with the creativity specifications can be applied to both actual and target modeling. The decision on their use depends on the final modeling goal: process understanding or improvement.

Elicitation

To identify all relevant process features, a person with process and domain knowledge needs to think about how the processes work in a given scenario. The modeler decides what is considered appropriate depending on the modeling objective. This also applies to the granularity of the process specifications and the level of detail (Becker et al., 2003). Therefore, at least two people are required in most modeling scenarios: a process expert with extensive process knowledge and a modeler with extensive modeling knowledge - at best (Frederiks & van der Weide, 2006).

General guidelines on how to collect such process knowledge were provided by Dumas and colleagues (Dumas et al., 2013, p.167):

1. Identify the process boundaries: Events that trigger the process and those that indicate the end.
2. Identify activities and events: Focus on the most important activities, and events carried out
3. Identify resources and their handovers

4. Identify the control flow
5. Identify additional elements

In the context of creative work, the biggest challenge for the process survey is identifying creative tasks. Due to their close relationship to knowledge-intensive tasks, which tasks are creative-intensive may be unclear. Based on the definition of creative-intensive processes (cf. Section 2.4.4 on page 46), the key aspects of creative work are twofold: uncertainty about the actual process performance and uncertainty about the process outcome. This suggests two ways to determine whether tasks are creative: First if the process outcomes are expected to be novel and valuable, the process leading to them requires at least one creative task. Second, if the process steps to achieve a particular goal are unclear, the process requires creative tasks.

Modeling

When modeling (potentially) creative work, the focus should be on product outcomes. The associated tasks should be considered creative if these explicitly require new features and are not sufficiently specified before the process flow. Guiding questions could be:

- Are all dimensions of the product known before starting the process?
- Is this product adapting in unforeseeable ways across process runs?

Similarly, if the process itself is not sufficiently specified. Creative work is then required to find the right way to achieve a specific goal, even if the process outcome remains similar.

- Is it known which process steps are required before the process runs?
- Is it known what the process steps are before the process runs?

Creative tasks or implementations must follow once creative products are identified. For creative tasks/implementations, all four aspects of the ICEP model can be specified, but at least the intention must be determined. A creative task without a clear intention, an intended goal, is likely to be chaotic (Lillrank, 2003). A chaotic process can also be modeled, but it is generally believed that such processes should be avoided in business processes because they lead to inefficiency. If a creative task cannot be specified with an intention, a creative task defining the intention of the creative task should be included in the process (in the case of *to-be* modeling or process improvements).

Possible guiding questions are listed to facilitate the modeling of creative tasks with the ICEP model. Not all of these questions are applicable in all modeling contexts, nor can they always be answered adequately. They are intended to guide the modeler in modeling these aspects of the creative process.

Intention	What is the purpose of this activity? What are clear criteria that must be met?
Creation	How is the *newness* brought into the solution? What is being done to formulate a solution? Who is responsible for developing a solution?
Evaluation	How is applicability handled? How is the quality of the work performed checked? Who will be responsible for evaluating the solution?
Planning	How is the work coordinated? What is used to organize the work process? Who will be responsible for planning the work process?

Complex creative tasks with creative sub-processes can include *ideas* as task results. These can be considered a product that exists as elaborated thoughts. Since ideas are always part of creative work, they may not always be explicitly modeled. They may become relevant in process models when ideas are necessary preconditions for the development of products or when a process outcome is closer to an idea than to a (physical) product. To model an idea, the following guiding questions may be helpful:[2].

- Is there an essential idea that is used in a (creative) task/conversion? (*idea as an input*)
- Is there an essential idea that is the result of a creative task/conversion? (*idea as an outcome*)
- Is the process outcome an idea that is used in the following process? (*idea as process outcome*)

Verification

The developed process models must be checked for quality in (at least) two ways: formal and informal specification (Frederiks & van der Weide, 2006). The standard specification refers to the conformance between the model(s) and the language guidelines. Do the models adhere to the language's abstract syntactic and semantic rules? Experienced modelers are better and more efficient at creating correct syntactic models (Thalheim, 2012). The software can support the modeling process by guiding the development of more comprehensive and accurate models.

In the case of KMDL, *Modelangelo*[3] is a software tool supporting the modeling process by providing all modeling elements and only allowing possible element connections.

[2]Further modeling specifications based on expert evaluation, see Section 6.4

[3]Access to the tool: modelangelo.com

Informal specifications are best validated by the process expert who provided the information for the process in the first place. The models are ”translated” into their native language to check for consistency and completeness. This allows any misunderstandings, errors, or missing elements to be corrected or added.

5.3.4 Modeling examples for creative work

For better comprehensibility, the proof-of-value process from the study with Axel Springer is modeled below as an example of the use of KMDL for creative work. The proof-of-value (PoV) process was described in Section 4.6.1 on page 100 and illustrated in Figure 4.6 on page 100. Aligned with the developed modeling extension for creative work, the process model contains more specific information, as shown in Figure 5.8. The documents entering and leaving the process are evaluated as creative because they both contain newly developed information.

All process tasks are creative as new knowledge is created. As an exception, the Dailies were not marked as creative, as the primary goal of a Daily in the context of the study was the work alignment within the PoV-team (here, PoV-team refers to the developer together with the PO). Creative work could also happen daily, although this was not explicitly intended and is relatively rare. In contrast, the Weeklies aim to create new, adjusted tasks within the team based on past performance and progress.

Some tasks are specified with all four ICEP aspects, as a clear understanding of all these aspects could be derived. For example, the *Task planning* follows the ”typical” structure of team meetings to create project matters with the support of a Kanban board. In contrast, *Define PoV goal* is a task in which implementation varied between both prototypes. There were several meetings with different attendants, and a source for *Evaluation* was unclear. Similarly, the *Test results* was supposed to be in the form of interviews with third parties to get feedback about the developed

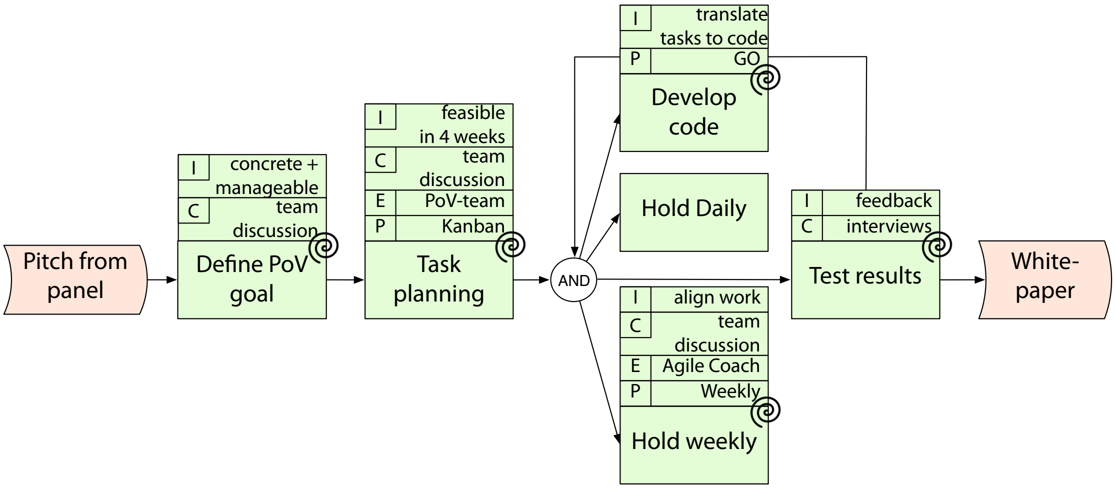


Figure 5.8: Proof-of-value process, with task specifications on the process-level, using KMDL for creative work

prototype. However, any evaluation for this process and a structured performance plan were missing.

The final result, the Whitepaper, is written by the PoV team, with the support of the Senior Product Owner (SPO) and mainly entails a description of the whole PoV process and the learning they collected from the interviews and tests. The PoV is finalized with the finished Whitepaper.

This overall PoV process is further specified at the activity level. Figure 5.9 shows the first two tasks, *Define PoV goal* and *Task planning*. Defining the goal aims to specify the playing field so that more concrete testable hypotheses can be derived. This is done within the PoV team and with the support of the ideator who best knows the core idea for the prototype. The SPO supports this task with specific knowledge from previous PoV runs, which plays no role in evaluating the work done. The result of their joint work is a set of written hypotheses. These hypotheses are then taken to a PoV team meeting, where key features are developed to test the hypotheses. The team brings their experience with software tools while the ideator checks if the core idea of the prototype is still fulfilled. The tools were brainstormed using Miro, a digital teamwork tool. As a result, the team and the ideator agreed on a set of features to be developed.

The PoV team meets again with the ideator to create concrete, feasible tasks and collect them as tickets and stories on a Kanban board. Here, the developers evaluate the decisions, as they can assess feasibility based on their previous software development experience. As a result, a Kanban board is created with a set of tasks and stories. This set of characteristics is ”translated” into tasks and milestones. The Kanban board is the basis for the further work of the team. All developers and the PO use it to coordinate individual work. During dailies, the team coordinates its work progress in a short meeting and updates the board (cf. Figure 5.10). Once a week, the PoV team meets with an Agile coach to review the team's progress and reassess goals for the following week. For this meeting, a dedicated Miro board is used where the PoV team assesses their progress, teamwork, and subsequent tasks. The Agile Coach facilitates this meeting and supports communication within the team. As a result, the team adjusts the tasks on the Kanban board.

In the PoV phase, the developed software is to be tested to align the further software development process with potential user needs. In both prototype examples, however, this testing was carried out relatively late in the PoV phase. This resulted from the later requirement of a functioning, stable software (cf. Figure 5.11). For testing, a developer meets with a tester who knows very little about the developed prototype. During an interview, the tester provides direct feedback about the user's experience with the software. Testers are encouraged to be as honest and authentic as possible. Their feedback is collected and documented. As the last task within the PoV process, the PoV team writes the whitepaper. Here, the team collects the experiences with the prototype development, answers the hypotheses raised, and presents the feedback from the tests and interviews. The SPO supports the writing process based on their knowledge of the previous PoV phases.

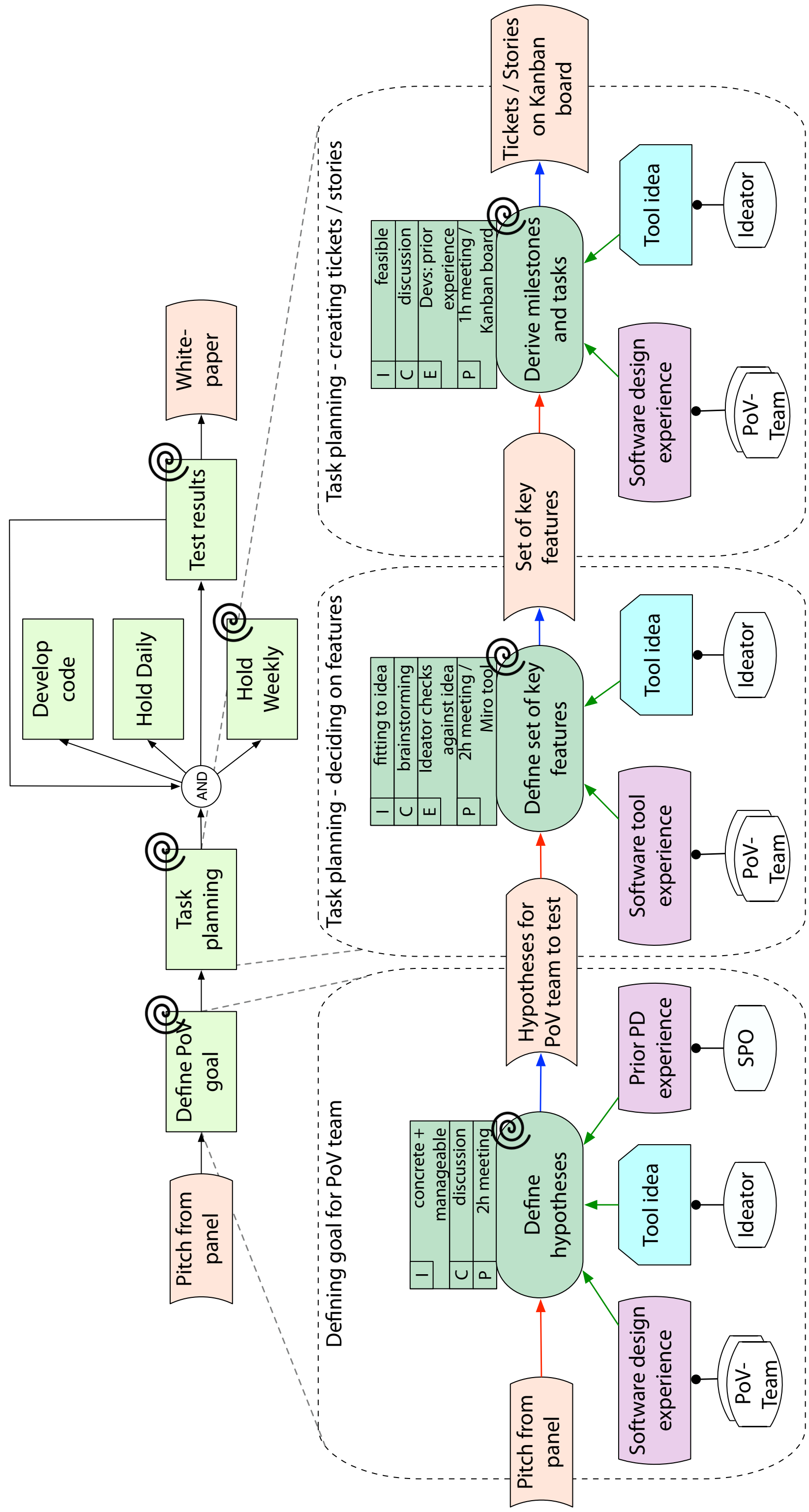


Figure 5.9: Proof-of-value process, with task specifications on the activity-level, using KMDL for creative work

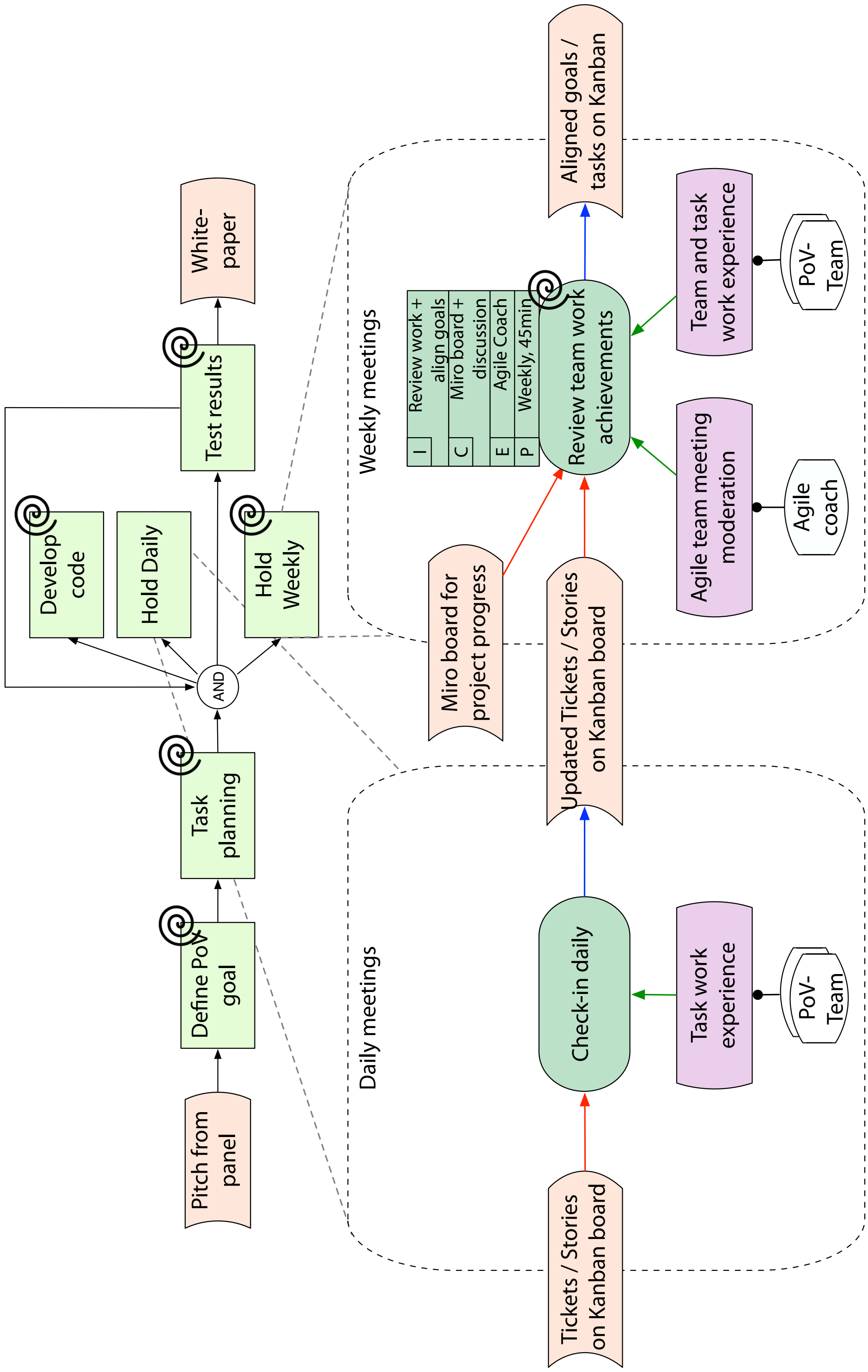


Figure 5.10: Proof-of-value process, with task specifications on the activity-level, using KMDL for creative work

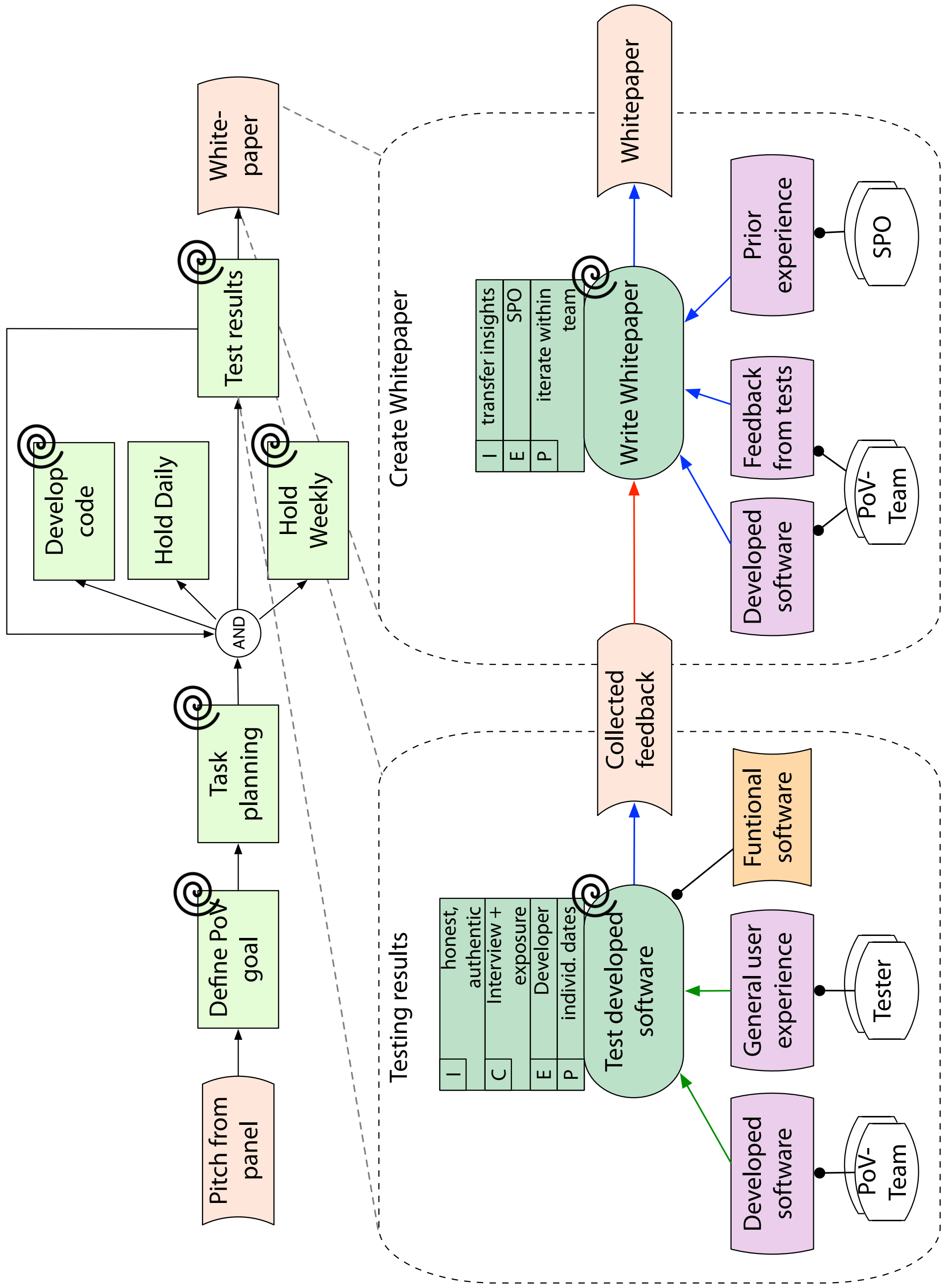


Figure 5.11: Proof-of-value process, with task specifications on the activity-level, using KMDL for creative work

5.3.5 Fit to the propositions of creative work

Based on the literature on creative work from a routine dynamics perspective, five propositions were derived to guide the modeling process (cf. Section 3.4). The following section outlines how the presented modeling extension addresses them.

Proposition 1: Creative work can be modeled properly with business process notations. As the present chapter shows, the modeling extension enables a more specific representation of creative work. The approach does not describe all iterative steps of complex creative work. Instead, the process steps are still somewhat abstract, but the ICEP model allows for the specification of task characteristics typical of creative work. The extent to which these specifications adequately capture creative work needs to be evaluated externally. For this, please refer to the following chapter.

Proposition 2: Creative work is characterized by uncertainty about the process sequence and the process outcome. This typical characteristic of creative work is the central criterion for recognizing a creative task and, thus, modeling it. As described above in the modeling procedure for elicitation (cf. Section 5.3.3 on page 171), a creative task is modeled when the process steps to achieve an outcome are unclear in advance and when a process outcome is new or requires new features to be developed.

Proposition 3: Standardized processes may involve sub-processes that require deviation from previous process flows, which can lead to creative outputs. This ”variation by design” argument refers to the fact that creative work requires process deviation to produce output variation. By not specifying all specific process steps but generalizing at some level, the inclusion of process outputs is still possible without requiring model adjustments. One challenge for the modeler is evaluating the potential variation within a process between process runs. For example, the modeling examples presented above apply to the two prototype development processes from the Axel Springer study. However, if a future PoV team decides to change the structure of the PoV process through new meeting formats or a different test scenario, the process models would need to be adjusted.

Proposition 4: Creative work can be standardized on all process levels. The proposed modeling extension based on the ICEP model can be adapted to the process and activity view. The process features are found at all process levels with different levels of abstraction. As described in Section 4.7.5 on page 125, the ICEP elements can be found on different process levels. Thus, the modeler can choose any level of process specification and apply the ICEP principle.

Proposition 5: The creative process can be distinguished into phases of ideation and evaluation. The dichotomy of creativity in imagination and evaluation is based on the core definition of new and valuable. This was used as a starting point for the ICEP model development and is represented by *Creation* and *Evaluation*. Thus, both aspects can be specified for all creative tasks. A distinction between tasks that focus more on ideation than on evaluation can be specified by naming the tasks accordingly.

5.4 Chapter summary

This chapter presents a new modeling extension for creative work based on KMDL. By examining the modeling methods potentially suitable for modeling creative work - process flexibility, variability, and modeling PoCs - the limitations of these methods, in particular, could be analyzed and then overcome in the proposed modeling approach. First, general guidelines for business process modeling were introduced to provide a foundation for the following methodological extensions.

A proposed metamodel of creative work aims to integrate the critical findings on creative work from the literature and the ethnography presented in Chapter 4.

Based on this metamodel, all modeling elements required to represent creativity are derived and transferred to these modeling conditions in the KMDL modeling language; the language specifics are described in detail. Based on the current use of KMDL, a concrete abstract syntax and semantic foundation are developed and extended to include the specifics of creative work. Specifically, guiding questions for modelers to use the modeling extension are presented, along with concrete modeling examples.

The literature review addressing creative work from the RD perspective resulted in general statements about creative work. The proposed modeling extension for creative work aims to address all of these and thus sufficiently cover creative specifics. The extent to which the methods developed here are considered purposeful and useful is discussed in the following chapter.

Methods have no truth value, only pragmatic value.

Moody (2003b)

6. Evaluating the modeling method for creative work

In this chapter, the previously developed modeling extension for creative work is applied beyond the rapid prototype design process context from the ethnographic study to other business process contexts. La Rosa, Aalst, Dumas, and Milani (2017) suggests that a modeling approach is validated in three steps: first, by applying it to real-world process variants; second, by applying the method to models not created by the author; and third, by review by domain experts. I present a three-step evaluation method for the developed modeling language to test all three validation criteria. The first step provides for process modeling of actual creative work processes. For this purpose, three process experts, each working creatively in different fields, were interviewed. Their creative work processes were evaluated and modeled according to the proposed modeling method.

In the second step, a comprehensive expert study was conducted. A group of modeling experts learned about the modeling extensions, evaluated them, and applied them to concrete process examples. In a third step, a second study was conducted with a larger number of KMDL users to evaluate the modeling extensions in terms of their applicability and usability. Both studies were conducted in the form of surveys following a heuristic evaluation approach (cf. Nielsen 1994). The goal is to find usability problems in a design by having several people interact with the design in question. This method is used to tune the evaluation of the developed modeling method. Evaluating a method requires judgment about fit and suitability rather than factual truth. People tend to find different problems with a design, partly because design and usability are a matter of subjective taste.

While the previous chapters aimed to answer the main research questions ”What are the characteristics of the CiP to be modeled?” and ”How can CiPs be visualized using a modeling notation language?”, this chapter aims to elaborate on the latter question by evaluating and adapting the proposed modeling method. Since the modeling extension was developed based on a case study, the evaluation is based on different creative process contexts. The created process models from three different contexts represent application examples of the modeling method. Based on the feedback from the experts, adjustments are made to the final proposed modeling method and presented at the end of this chapter.

6.1 Exemplary process models

Case studies allow for in-depth analysis and are comparable to other scientific methods in terms of significance, rigor, and generalizability (Flyvbjerg, 2006). Case studies, however, are a method of depth that lacks breadth. To counter this, other application contexts are used here, at least as examples, and the modeling extension is applied to them. The modeling extension is developed using a case, the prototype development process of Axel Springer. The original context comes from software design, where code is used to develop new software solutions.

In contrast, processes from other domains were sought that also have degrees of freedom in the process flow and achieving results. In some domains, this is obvious, such as in the design industry. Taking brand design as an example, many creative processes can be found in which visual products are developed to represent a brand.

Creative work is less noticeable when the primary process goal is not a creative product, as in software development and design. But there are good examples of creative work, especially in knowledge-intensive activities. In sales, for example, ways must be found to place products in a way that is appropriate for customers. Analyzing customer needs and, in the best case, adapting them shows great potential for creativity.

Sales work also tends to be very output-oriented. In the search for non-output-oriented work, social work was examined more closely. The primary goal is to achieve change in dysfunctional human systems. The example of social family assistance shows that in supporting dysfunctional family structures, the goal of assistance and the ways to achieve it must be developed anew with each family. Thus, the need for creative work is also found here, especially on the part of the family helper.

In the following, I present all three process descriptions. These are intended to illustrate the applicability of my modeling extension to show that it is also possible outside the context of prototype development. Approximately one-hour interviews were conducted with each process expert, i.e., the employees working in the processes. These interviews were based on the modeling procedure and modeling guide described in Section 5.3.3. Process models were created based on these process analyses, which were discussed with the experts and adapted. All examples are presented here in anonymized form.

6.1.1 Example of brand design

The brand designer interviewed works in a start-up company developing an app that provides recruitment services. The designer has previously done similar processes in other companies and independently. The work on the app involved designing the entire app brand, including the logo, visual appearance in images, and typeface.

These processes took place over a year, and various specific creative processes became apparent.

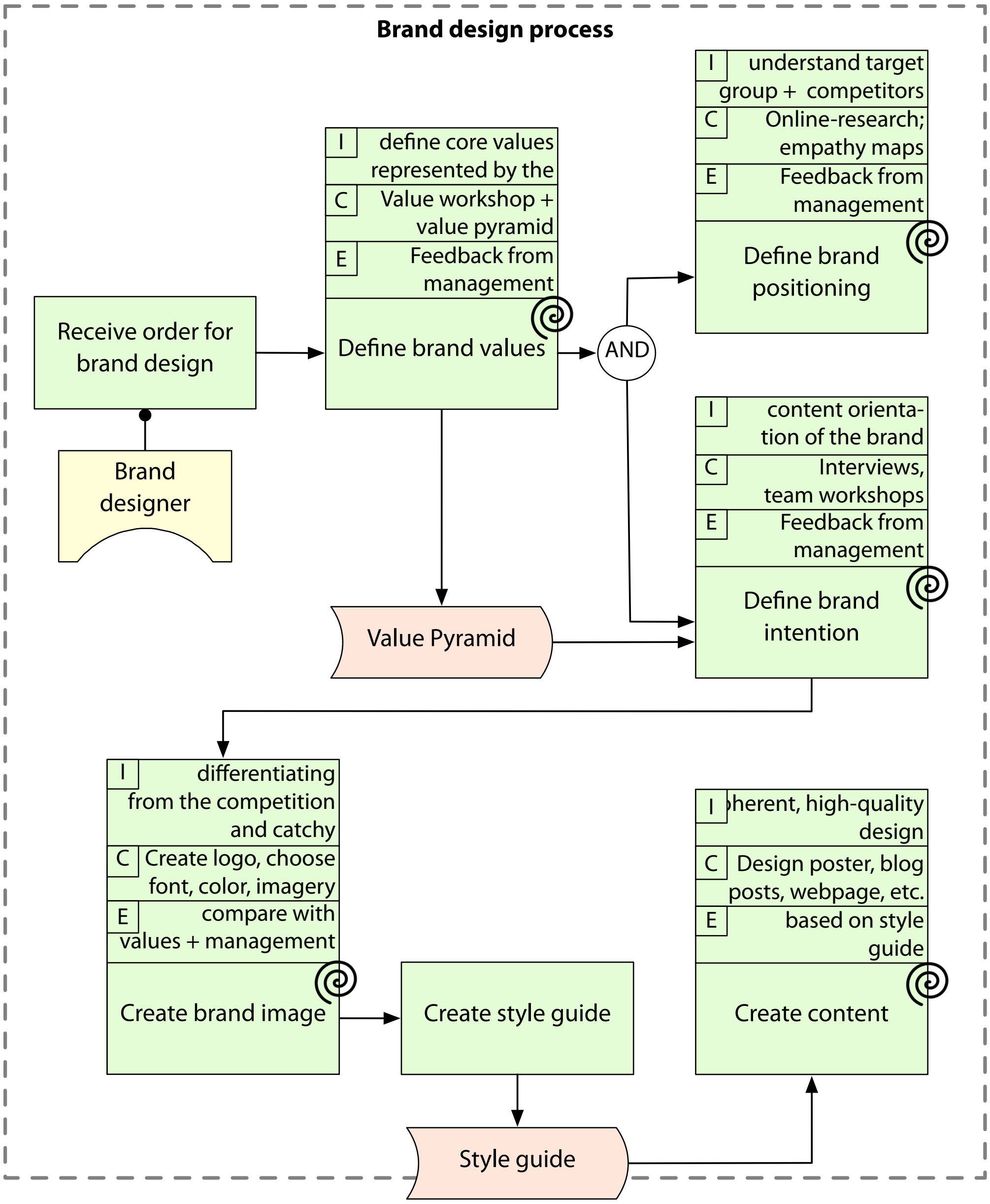


Figure 6.1: Overall brand design process

Brand design can be interpreted in many ways and does not follow a strict process flow. Thus, it is already part of the designer's creative work to shape this process, who is primarily responsible for developing the brand design. The brand design process always starts with a briefing and "ends" with the actual implementation, such as the app's design, website, and promotional content. Of course, the brand design process can be seen as ongoing, as brands are always subject to changes that require adjustments.

The core consists of five process steps, each of which can be subdivided into a series of processes (cf. Figure 6.1). Brand design first begins with the development of core values. For this purpose, a value pyramid is developed for specific goals. Above all, the ideas developed in the following steps are focused on and evaluated. The next step is to develop the desired positioning in the market and the brand's intention. This intention sets content standards and provides guidelines for logo, typeface, and appearance. Once these are developed, a concrete style guide is created, which other designers can use to begin the concrete implementation of the content.

To illustrate concrete creative processes, the development of the brand image was examined in more detail (cf. Figure 6.2). This is a process that extends over several weeks. It is a typically creative, i.e., iterative, process in which logo, color, typeface, and image are developed or selected. It starts with a mood board, a visual collection of ideas corresponding to previously developed values. The ideas for the logo, font, color, and image are always discussed with management, as their decision is ultimately critical. However, direct competition (i.e., other apps in HR services) is always considered. One of the most important tasks of a brand is its recognition value, which requires a strong visual differentiation from the competition.

Since the development of the logo is a concrete and typically creative process with a clear creative output, it was considered in more detail, i.e., at the activity level (cf.

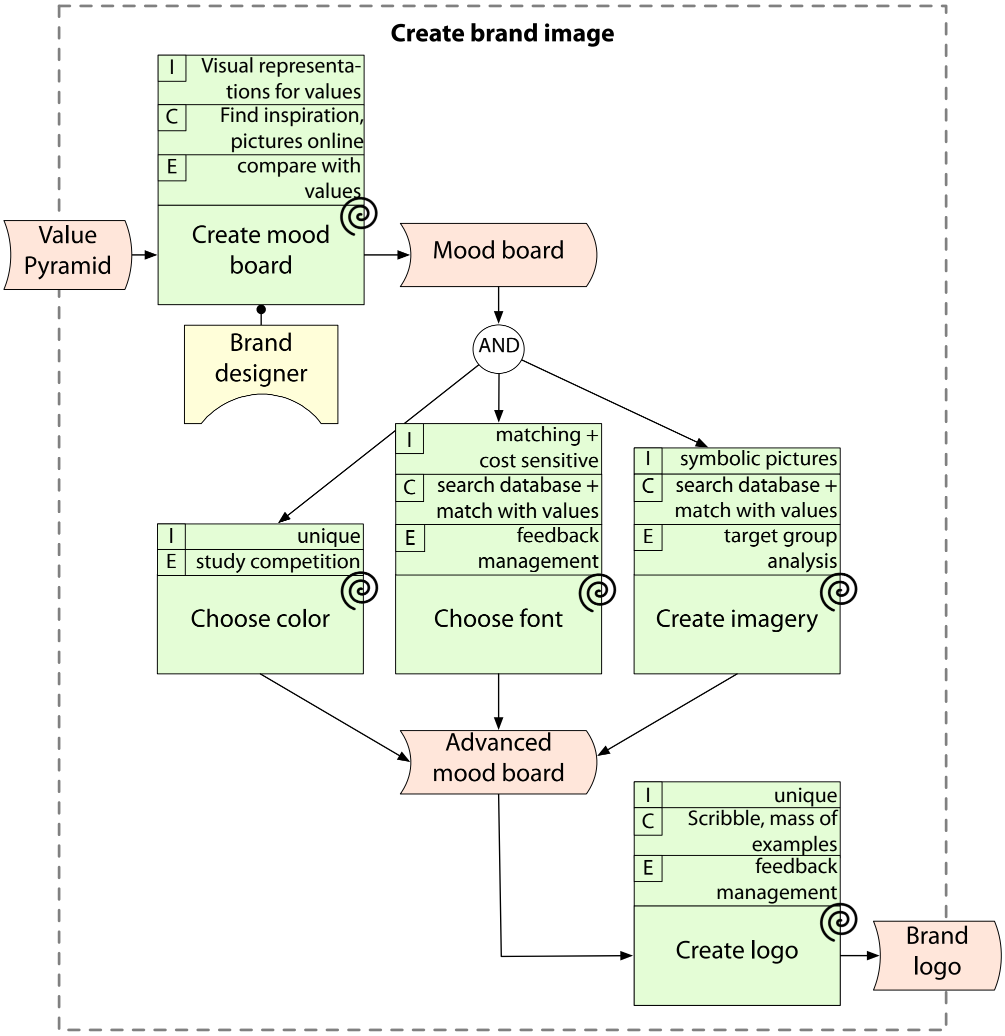


Figure 6.2: Overall brand image design process

Figure 6.3). Here, starting from the mood board, the designer drew initial sketches by hand. The value analysis is the basis for the association and evaluation of ideas. At this point, what counts most is mass, i.e., a large number of logo designs. In the next step, these are discussed with the management, whereby not only individual taste counts but the extent to which a logo can represent the core values. Selected logos are then contrasted with the competition to create the most precise possible distinction. These process steps are iterative. Logo sketches are often created and discussed with management, and a variant is gradually agreed upon.

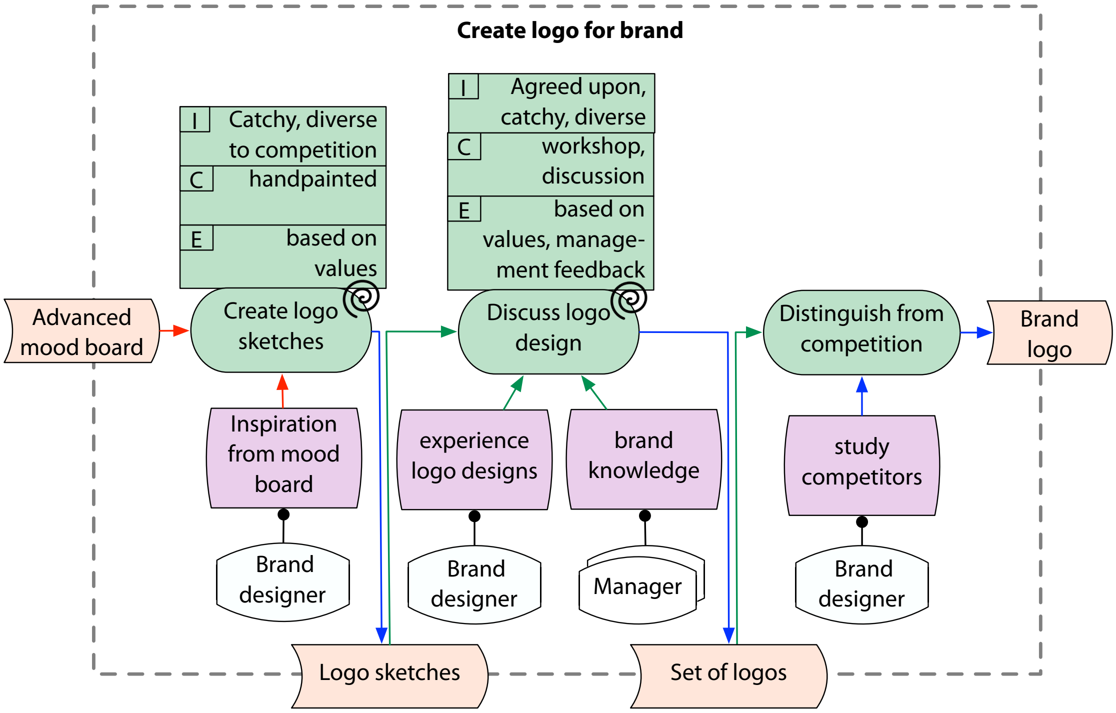


Figure 6.3: Activity view of the logo design process

The process modeling shows that the application of the ICEP model is possible on all process levels presented. During modeling, it was difficult to illustrate the iterative nature of the activity. Many of the process steps shown separately here depend on each other in parts. For example, the design of the logo depends on the general color scheme or is adjusted depending on the color choice. Furthermore, it would be possible to zoom into the process flows in even more detail and analyze workshop flows, for example. Appropriate adjustments would be possible to achieve more specific modeling goals. The focus here was on the general representation of the parts of the creative process, which was possible at all levels.

6.1.2 Example of software sales

The software package sales process was conducted with an employee of a global software company. In his position, he sells comprehensive software packages that are tailored to the needs of entire companies. Sales, as such, is not a typical creative process since no creative product is developed. Nevertheless, there are always challenges that require creative solutions.

The sales manager described his typical sales activity on the basis of 5 process phases (cf. Figure 6.4): An internal company software records the usage and purchasing behavior of customers. On this basis, information is output about new customers or those with changed user behavior. This serves as a preliminary stage for the sales representative to contact the management of these companies. First, the need for software support is discussed. This can either lead to the sale of concrete software and software that is used in the form of workshops. The development of customized workshop content, in particular, is a creative process that requires different scopes and methods depending on the level of knowledge of the company's employees.

Alternatively, and this is the actual goal of the salesperson, he or she can work more intensively with management to change business processes so that they can benefit more from the software solutions. This involves analyzing potentials and problems in the process flows together with management. Usually in the form of workshops in which design thinking methods produce concrete solutions. In the next step, the sales representative then derives customized software solutions. Service companies then develop these together with the customer.

The more intensive cooperation with the company management with regard to the development potential of companies is a complex creative task. Figure 6.5 shows this at the activity level. It starts with a workshop where the sales manager works with the company management on goals and development trends. The sales manager brings in the potential of the software, which can show possible developments. In the next step, these are analyzed more concretely in the company. To this end, on-site interviews are conducted in individual departments to derive

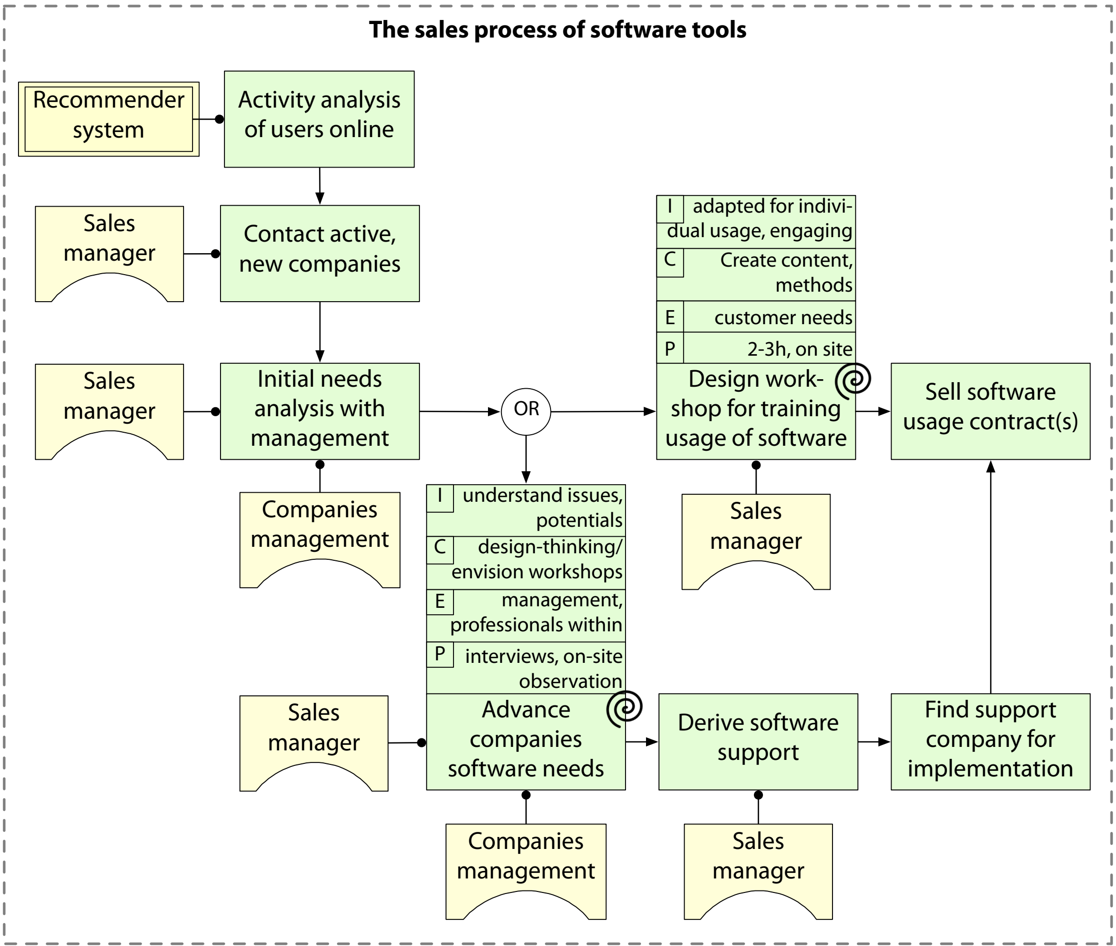


Figure 6.4: Overall sales process of software tools

further software potential. Concrete software packages can then be offered and sold on this basis.

The process shown here represents a variant of the process flow typical of its distribution. Process iterations are common here, depending heavily on the goals and commitment of the customer. If the analysis and possible process adjustment with the companies become too complex, the vendor would try to refer the case to other departments of his company. His focus should be on selling software, not business consulting. However, this process step is difficult to generalize and was therefore not included in the modeling. In addition, the actual sale of the software,

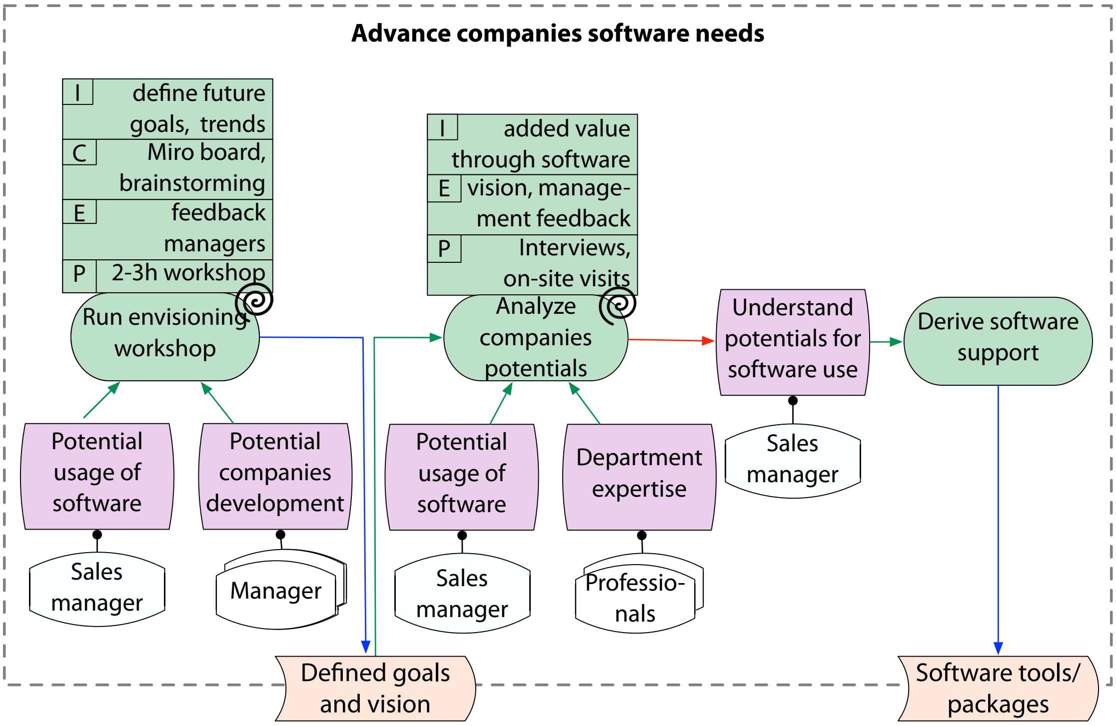


Figure 6.5: Activity view of the process to advance company's software needs

the last step in the process model, can be very complex if technical adjustments have to be made. However, this is no longer directly within the sphere of influence of the seller and is therefore not included in this model.

6.1.3 Example of social work

Social work aims to change social systems for the better. Since this is also monetized and corresponds to value creation, it can be analyzed and modeled according to the principles of business processes.

The process analyzed here originates from the context of child care coordinated by the Youth Welfare Office in Germany. Families can contact the office with parenting and care problems or are reported there. Staff at the office then first check whether the case involves direct counseling or whether family support should work directly with the family. If so, the case is discussed between the Youth Welfare Office and social pedagogical assistance (SPA), i.e. associations in which social workers are active in an advisory capacity. There the case is assigned to a social worker (cf. Figure 6.6). This is where my interviewee starts her work and has a first conversation with the family, mostly with the mother, to discuss the problems and especially the goals of help. Everything that follows is very iterative and does not follow a clear process structure. As needed, discussions with the mother take place and the family is supported in organizational activities. In parallel, cases are discussed within the team, and externally led supervision takes place once a month. These processes are repeated until the goals set at the beginning are achieved.

In the interview, we identified two creativity-intensive processes, each of which attempts to solve individual problems, some of which are emotional. Supervision refers to the challenges that social workers experience in their work or even within the team. The counseling sessions between the social worker and the parent focus on the dysfunctionalities within the family. Since these also describe the core of social work, this was analyzed in detail at the activity level.

At the beginning of the joint work, the problem is first worked out (cf. Figure 6.7). Since the families usually come to the social welfare office with clear problem definitions, a creative finding process is not usually required here, but must be prepared in a structured and clear manner. However, the solution process is creative in the sense that alternative behaviors are developed and tested together. In this process, the ideas of the social workers are essential for responding to challenges in a family system-related way. The extent to which this works only becomes apparent through the application (”homework”) in the family.

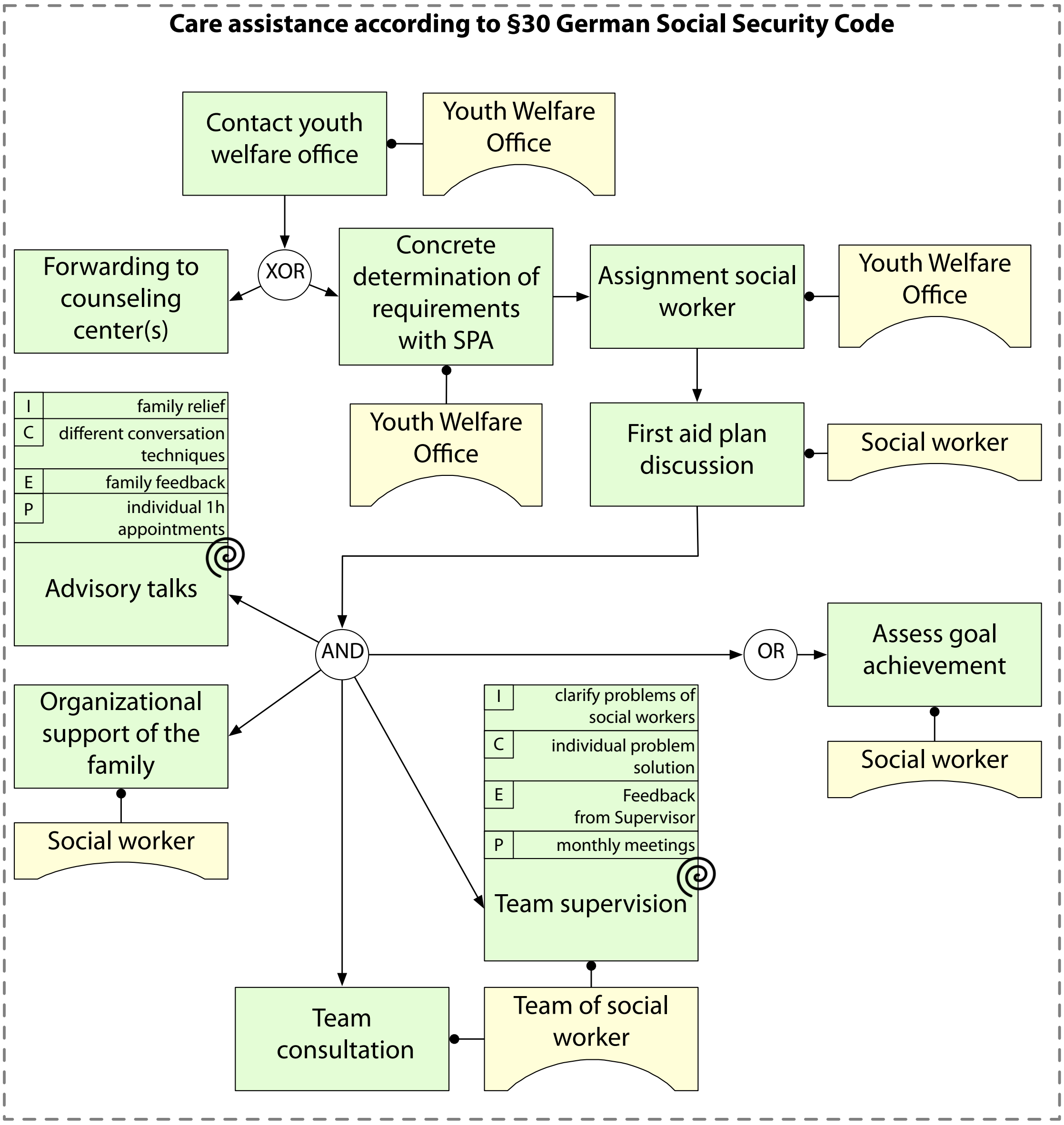


Figure 6.6: Overview of the social work support process (SPA stands for social pedagogical assistance)

The process modeling also shows in this example that creative work processes can be represented in varying degrees of detail at different process levels. Since the activity view could be represented very concretely in this example, it became clear at which point of the process new ideas must be introduced again and again.

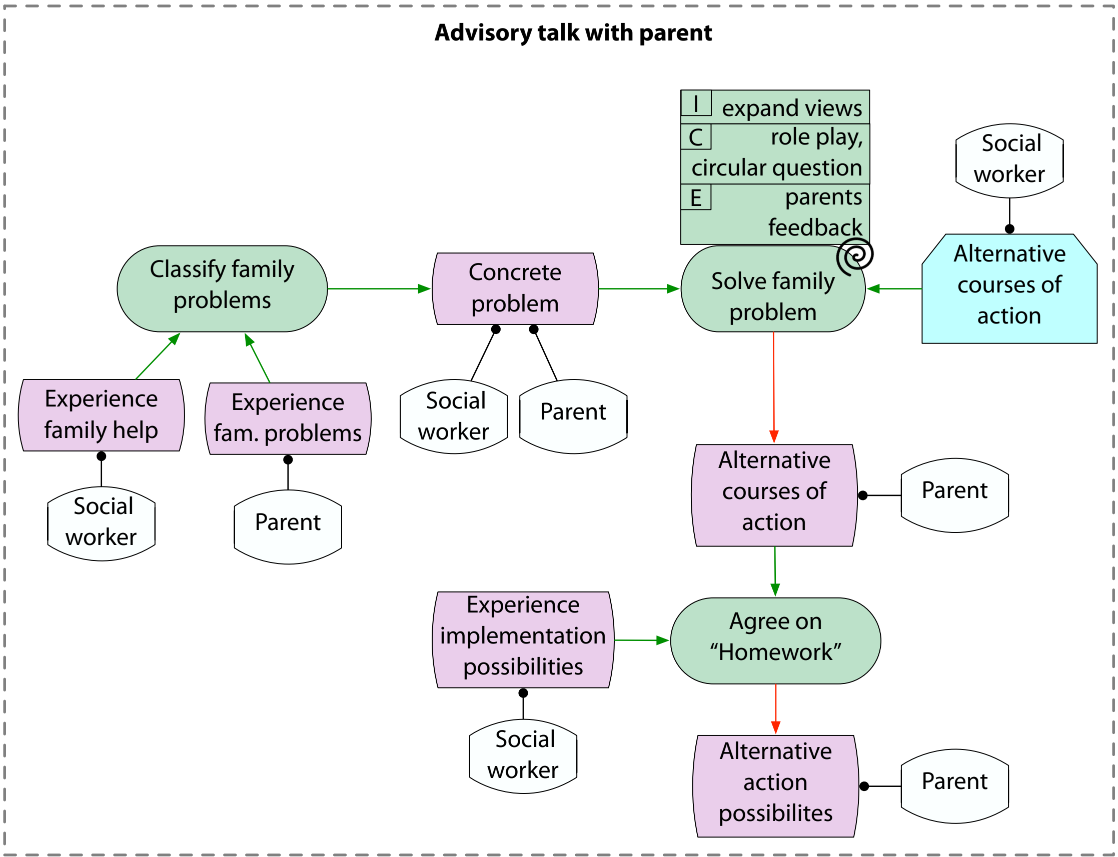


Figure 6.7: Activity view of the advisory process between social worker and parent

Either in the form of suitable consulting methods or possible solutions. Since every family has its dynamics and every client has individual needs that need to be met in counseling, the social worker always needs new input, i.e., ideas about which approaches could help here in concrete terms.

6.2 Application of the modeling method by experts

The process examples so far are intended to show the general application of the developed modeling method. Further evaluation steps foresee third parties' application and evaluation of the method. The initial survey study required a small group of experts to learn and apply the modeling method for creative work with KMDL.

To increase the data richness of the evaluation, a mixed-methods approach with qualitative and quantitative data analysis is conducted (Venkatesh, Brown, & Bala, 2013). Based on previous studies that have defined criteria for measuring the quality of a modeling method, open-ended questions and scales are used. In the following, the design of the evaluation study is explained in detail.

6.2.1 Setting and participant description

The expert study was conducted using the online survey tool *SosciSurvey*. Modelers with experience in modeling KMDL sought to obtain authentic, high-quality feedback. Experience in modeling makes a difference in individual competence to model and read a modeled process, with more experienced modelers producing a better modeling result (Mendling, Reijers, & Cardoso, 2007). Previous studies that have conducted user tests with different raters recommend the use of 3 to 5 raters since a higher number of raters usually does not reveal much more new information (Nielsen, 1994). This number is small but suitable for evaluating relatively low-complexity applications, especially if the evaluators have a homogeneous, comparable body of knowledge in the context of the method being evaluated and thus an equal chance to assess the method (Caulton, 2001).

The experts sought should be technically familiar with the KMDL modeling language and have general knowledge of process management and modeling methods. To ensure these minimum characteristics, a pool of 16 master's students was formed who had recently been trained in using KMDL. The students were selected based on their outstanding performance in a university master's course on knowledge management, especially their modeling performance with KMDL. Four of them agreed to participate in the study.

Communication with the experts took place by e-mail, in which they were first informed about the aim of the study and the conditions of participation. Their participation was voluntary, and they could revoke it at any time. In the event of full participation in the study, they received remuneration of €50. The timing of the study was agreed upon with the experts. They had one week to complete the questionnaire and do the required modeling in April 2022. Since all experts learned how to use KMDL in German, the evaluation study was also conducted in German (cf. Appendix D on page 286 for the entire survey in its original German version and Appendix E on page 302 for the full English translation).

6.2.2 The example of a game design process

In the study, participants must read a process and model themselves using the KMDL extension for creative work. This requires using a process example that is comprehensive enough to allow for complex process modeling while being easily understood by the study participants. Therefore, the business process for developing a digital game was chosen. Games are a type of process product that most (young) people are familiar with, and their development is creative-intensive.

Game design as a creative process has already been analyzed from a routine dynamics perspective, highlighting the dynamic and complex features of this creativity-intensive work as it unfolds over time. Compared to Axel Springer's rapid prototype design process studied previously, game design requires a different form of software design: game development entails the need to develop fictional content and has fewer opportunities for code reuse (compared to traditional software design) and a lack of oversight of system coding requirements as they unfold while working on it (Pascarella, Palomba, Di Penta, & Bacchelli, 2018). With these high demands for flexibility and the development of new code and content, the game design provides an appropriate case for applying the modeling method to creative work.

To gain a thorough procedural understanding of the game development process, I conducted a personal interview with a game designer.[1] The game designer interviewed is professionally trained and has several years of experience in digital game development. Before the interview, the interviewee first explained the basic game development process using the recent process he went through for a third-person action game he developed. Digital game development consists of a series of creative processes. For example, the story for a game must be developed, as well as virtual worlds, objects, and characters. We agreed to focus in detail on level design, as this is a comparatively independent and manageable sub-process in terms of time (for comparison, game story development can take weeks to months, while a level design usually takes only hours to days). This is where a level, or game unit, is created. In the best case, a level should be exciting for the player, fit the type of game interaction, and be different from the already-known games on the market. During the interview, the process steps were recorded, and a sketch of these process flows was developed in parallel with the explanations (cf. Figure App.C.1 in Appendix C on page 284). Based on this sketch, the process steps, their sequence, and iterations were discussed, and the sketch was adapted in detail.

The level design process aims to develop a game environment with local features such as landscapes, paths for the characters, obstacles, and game pieces (Schell,

[1]The analyzed processes were also part of the following work: Haase et al. (2021)

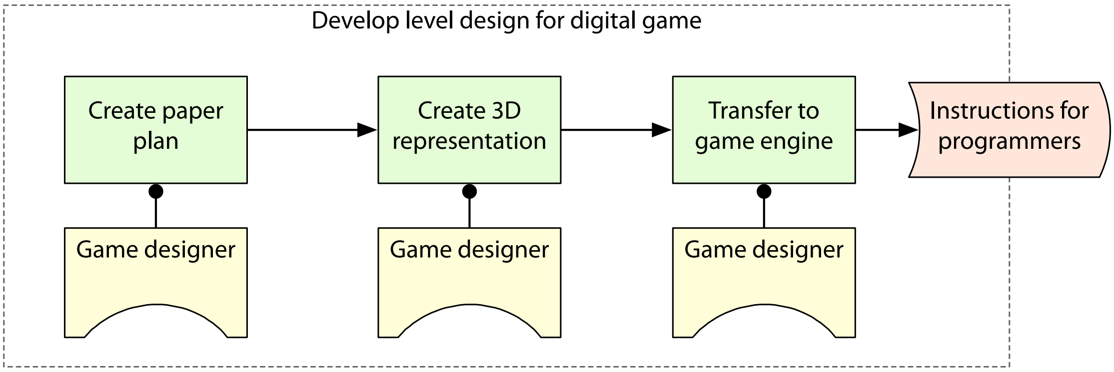


Figure 6.8: Three main steps of a level design process performed by the game designer

2008). To achieve a complete level design, three main steps were performed in sequence (cf. Figure 6.8). A set of tasks was identified for each step, some of which were performed repeatedly, albeit in a modified form compared to the first process run. In particular, the first task, the creation of a paper plan, consisted of many sub-processes that were performed once in a logical order but in a different order in subsequent iterations. Here, the vision of a level is drawn on paper, with paths, landmarks, buildings, etc. The steps required for this task had the highest degree of flexibility, with many task iterations and ”jumps” between individual tasks.

Once the game developer was satisfied with the paper plan created, these level design ideas were replicated with physical building blocks in the second phase of the process. First, a color and shape code for the 3D elements was defined to model all aspects of the game (such as landscapes, characters, and game pieces), which were positioned on a table according to the paper plan. Then, the positioning was checked and improved. The adjusted design was documented with photos and short videos of the scenery. By repeatedly checking all perspectives and possible movements, the functionality of the design was improved. These review steps were first performed alone, then again with colleagues. Colleagues' suggestions for improvement were collected with post-its on the 3D elements and later incorporated. The finished design was again documented with photos and videos.

In the third step, the design was transferred to the virtual world using a game engine to start programming the game. The game designer used virtual 3D objects as placeholders and developed the virtual plane based on the previously created photos and videos. The actual programming of the game is done by software programmers in the following steps. For this purpose, the game designer creates a list of requirements and instructions that must be implemented by the programmers.

6.2.3 Survey description

The challenge arose that the study participants had to be taught modeling and complex process knowledge in the shortest possible time. And this had to be done as efficiently as possible so as not to lose their attention in the survey. The study was therefore clearly and concisely divided into five topic blocks:

1. Recap of the KMDL modeling method and guidelines
2. Presentation of the modeling extension for creative work, including a query of initial associations and evaluations
3. A process model is shown to be read and described
4. A process is described to be modeled using KMDL and the extension for creative work
5. Open questions and items to evaluate the modeling extension

For part one, the KMDL 3.0 version was shortly described, along with Figure 5.2 on page 153 and Figure 5.3 on page 157 from the previous chapter. This was done to refresh their modeling knowledge of KMDL and to align their active memory for the following assessment.

In part 2, the modeling extension for creative work was introduced. First, the main challenge to modeling creative processes was explained: creative processes are typically less predictable in advance, with iterative loops and a high degree of process flexibility. However, modeling creative work is worthwhile regarding the importance and need for creative input in increasingly complex business processes. The modeling extension was introduced by explaining the ICEP model. Here, the first input was asked from the participants regarding their thoughts, questions, or potential issues they came up with.

In the following, the *creative task* was introduced, with the swirl as the signal for creativity. Next, the *idea* symbol was introduced, followed by the ICEP modeling elements. The individual associations and potential issues they would see were asked for all these new modeling elements. Next, a creative task and conversion in combination with the ICEP elements were introduced. First theoretically, then with a concrete example. Again, the experts were asked for their associations, thoughts, or issues they might see.

Part 3 presents the example of a concrete game development process, as explained above. To focus on a more precise process, the level design process was more specifically explained in text in German and as a process, model using KMDL (cf. Figure 6.9). The English translation:

The process describes the level creation from a blank sheet of paper to the final design from which programming tasks can be derived. Here the game designer sketches initial paths, obstacles such as boundaries and objects, and potential places of interaction. The fit and variety of the design are attempted to be increased by thinking through game interactions. Once a satisfactory sketch is created on paper, it is transferred to a 3D model. Simple 3D objects are placed on a table, perspectives are tested in space, and object positions are adjusted. Colleagues are consulted to evaluate the design. This results in an adapted design, which is then digitized in the next step and transferred to the game engine. Here, the game designer creates an initial rough digital game model and derives concrete programming tasks for the game programmers.

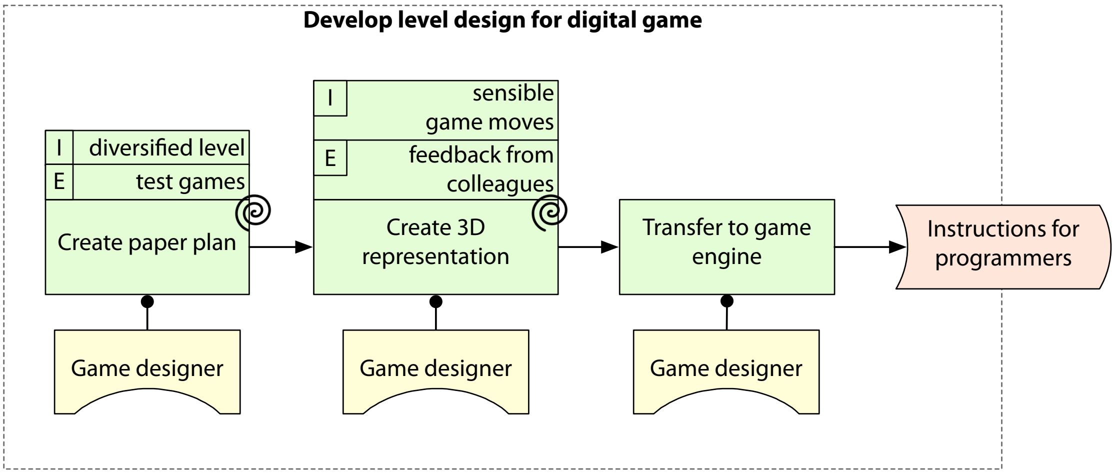


Figure 6.9: Level design process used as a modeling example in the expert evaluation study, graphically adapted

The experts were asked to "read" the following activity model, based on the first task, "Create paper plan". They were instructed to describe the following activity model (cf. Figure 6.10) as precisely as possible. Then, they could write about any challenges, problems, or issues they encountered when "reading" the model.

In part 4, another sub-process from the level design was explained in detail. Figure 6.9 was presented again for an overview of the main level-design process. The experts were then asked to model this process using KMDL and the presented modeling extension. They could do so with pen and paper, digital with *Modelangelo*, or a comparable visualization tool. They were instructed to send the model to my mail address within a week.

The process description the experts should "translate" into KMDL with the modeling extensions for creative work was as follows:

Once a satisfactory sketch has been created on paper, it is transferred to a 3D model. Freddy, the game designer, places simple 3D objects on a table, using his

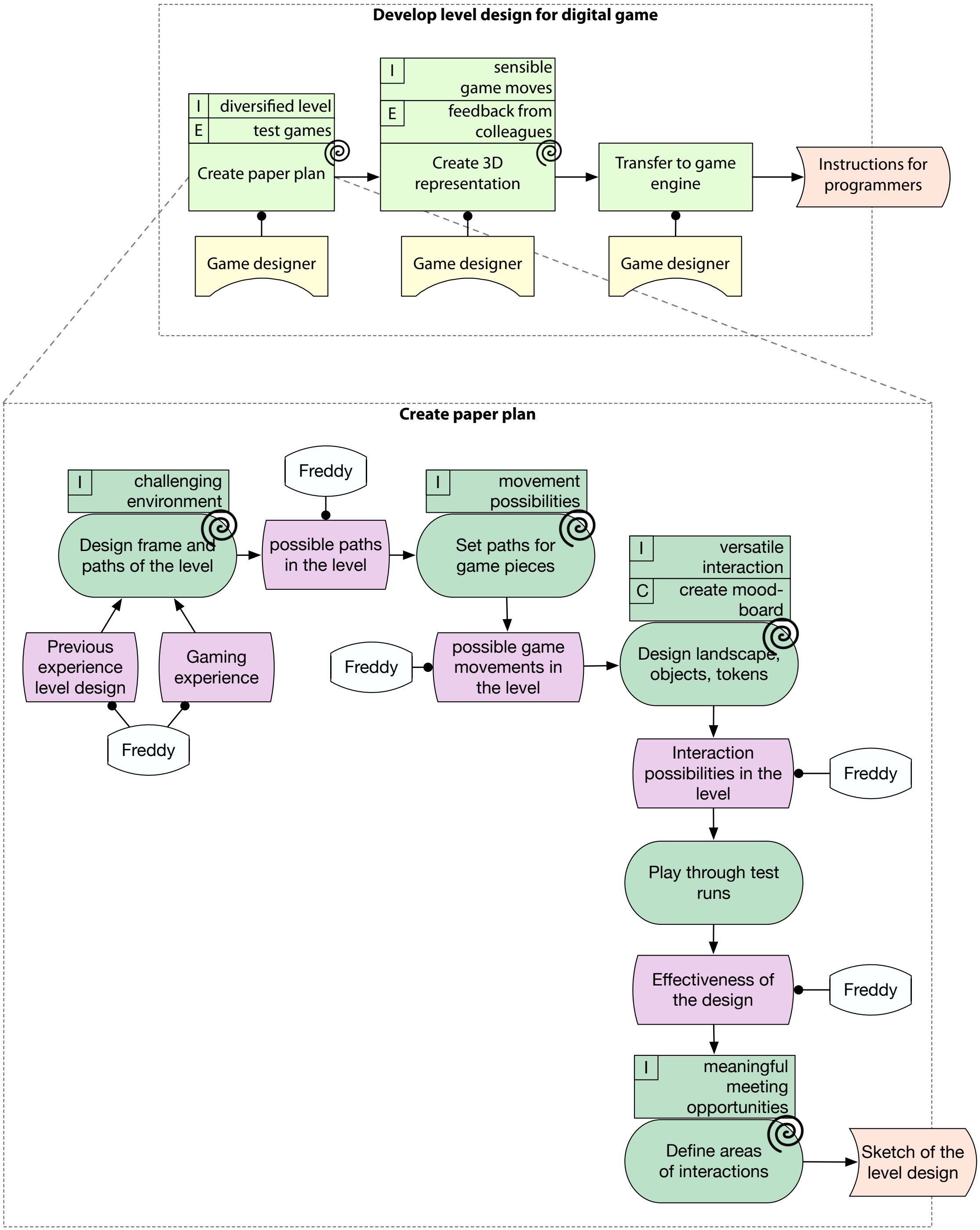


Figure 6.10: Activities performed in the level design process

level-design experience. As soon as all elements are in place, the perspectives are checked. This indicates where and how the model elements need to be adjusted. The challenge here is to design a game that is a challenging and exciting game environment. As soon as an adjusted model is ready, Freddy spontaneously calls in the colleagues in the office. They also bring in game design experience and provide feedback on his model. Together they brainstorm how to make the model even more interactive. Through their discussions, Freddy comes up with an idea: the game could be even more exciting if it were possible to use flying objects to move around. With this idea, he readjusts his model again. As soon as he is satisfied with the adjustments, the 3D model is photographed from all sides. These photos serve as a template for the next step, the transformation of the design into the game engine.

In part 5, open questions were raised to evaluate the modeling method. First, the criteria of process models based on (Becker et al., 2000) were presented for *relevance*, *economic efficiency*, *clarity* and *comparability* (cf. Table 6.1). *Correctness* – which is also a part of GOM – was not assessed by the experts but will be assessed for the models produced by the experts. *Systematic design* (clearly defined relation to other information models, like data models) did not apply as no other related models are important in this study context. The questionnaire ends with open questions about the modeling extension and allows the experts to add other thoughts, feedback, or critical remarks.

6.2.4 Evaluation of the expert assessment

The collected GOM criteria can be evaluated quantitatively, but the results for the four participants are rather to be understood as rough tendencies. The GOM-criteria were evaluated as a degree of fulfillment on a scale from 1 (not fulfilled) to 5 (completely fulfilled). Especially *relevance* and *economy* were rated positively. *Clarity* showed a mixed pattern, as all four experts rated it differently. *Comparability* also tended to be rated positively, with one expert being skeptical, cf. Table 6.1.

Table 6.1: KMDL modeling extension evaluation by experts based on Guidelines of Modeling (GOM)

GOM aspect	Explanation	Mean	SD	Min	Max
Relevance	only include elements which carry meaning	4.25	0.50	4	5
Economic efficiency	good balance between details modeled and modelling efforts	4.00	0.00	4	4
Clarity	model is readable and easy to understand	3.50	1.29	2	5
Comparability	models follow clear modeling rules	3.50	1.00	2	5

The open questions throughout the survey allowed the experts to raise questions and issues they came across when introduced to certain modeling extension aspects. For the swirl attached to creative tasks and conversions, the associations were in line with the set attention of ”repetition” and ”iteration”. It also invoked rather negative associations with confusion and messiness. One expert suggested using a star symbol instead. As the overall associations align to indicate a form of creativity, the swirl is kept as a sign of that.

The introduced element for ”idea” was encountered positively. Separating an idea from general knowledge elements was perceived as valuable for representing creative process flows. Ideas, so one expert reflected it, allow understanding the randomness of some processes to be performed successfully. Ideas come partly by chance and over an unknown course of time, differentiating a process relying on such ideas from those well-planned knowledge-based processes modeled so far with KMDL. Further, this randomness in the process flow can be better understood regarding individual performance or relying on people’s interactions.

The ICEP concept was evaluated as intuitive and easy to follow. The level of detail was positively evaluated as being specific enough to allow a more detailed understanding of the process without having to add more tasks. However, it was also noted that the appearance of the models is rather confusing due to the ICEP elements assigned to tasks and conversions. This creates a dilemma with respect to the desired level of detail in the modeling and the simultaneous need for comprehensibility.

Concerning relevance, the proposed modeling extensions were assessed as very helpful (which is in line with the reported relevance of the GOM scale with 4.25 from 5). Especially the ICEP elements are seen as an efficient way to add more specified information to the process. They "highlight the additional input and aspects of creative tasks" (feedback from one expert).

In terms of efficiency, the additional effort to model the proposed modeling extensions was assumed as minimal and comparable to the general modeling efforts required for KMDL. This is in line with all experts rating economic efficiency in the GOM scale with 4 from 5. Some concern was posed about "ideas", as they come with less specified definitions when a thought can be modeled or should be modeled as an explicit idea in the model.

In terms of clarity, the experts' evaluation showed some divergence regarding whether the modeling rules fully provide clarity or not. This aligns with a rather critical assessment of clarity in the GOM scale. Two out of four experts see that clarity is enhanced through the ICEP elements as they add more specific process details. The other two are critical as the ICEP elements precisely limit clarity by adding too much visual complexity to the models.

Concerning comparability, the provided modeling rules were assessed as very clear and concise. However, one expert pointed to the need to specify further "ideas". These and some further questions concerning the modeling rules enforced the need for better specifications of those. As the experts reported to the overall understanding of the ICEP concept and the proposed modeling extensions just fine, their suggestions led to some small adjustments and add-ons to the overall modeling guidelines (cf. Section 6.4, on page 221).

6.2.5 Analysis of the process models

The analysis comprises two parts: reading a process model and modeling a creative process. The experts were asked to "read" the model presented in Figure 6.10. They shortly described the process flow and successfully incorporated the ICEP elements as presented (for their full answers, cf. Appendix F, on page 316). What becomes apparent is a certain challenge in the interpretation of the C of the ICEP model. C describes the method which is used for a creative task or the person responsible for this step. However, in the experts' translations, they understood the creative method ("create mood board") as a separate task or as the result of the conversion. Originally, the game designer reported the usage of a mood board as a way to enrich the ideas incorporated in the landscape design. Thus, the mood board works like a parallel process with the means to support the idea generation for this specific design step. As two experts reported not knowing the usage of a "mood board", their misunderstanding might result from that. However, the C will be further specified and enriched with examples for future modelers to better comprehend.

In the following task, the experts were asked to model a process based on a text description. Since some of the models were created by hand, I transferred them all into uniform models. This increases readability and comparability among the models. See Appendix G on page 321 for the original German versions. Using the English model translations, their correctness is analyzed and improvements are derived to further explain the modeling rules.

Expert 1 has modeled the process of "Create 3D representation" comparatively succinctly (cf. Figure 6.11). The direct connection of two conversions is formally incorrect; it would have required a knowledge object or an idea as an output or input object. The final step to creating the photographs also requires a conversion to represent the actual photograph. Here it is incorrectly abbreviated because the photo is derived directly from a knowledge object. The expert has used a conversion for the idea to include flying objects, which is formally correct but misses the chance to use the idea object. Thus, this modeled process suggests that the ”enable movement through flight” step is expected in this overall process and was not added as a new idea by the game designer.

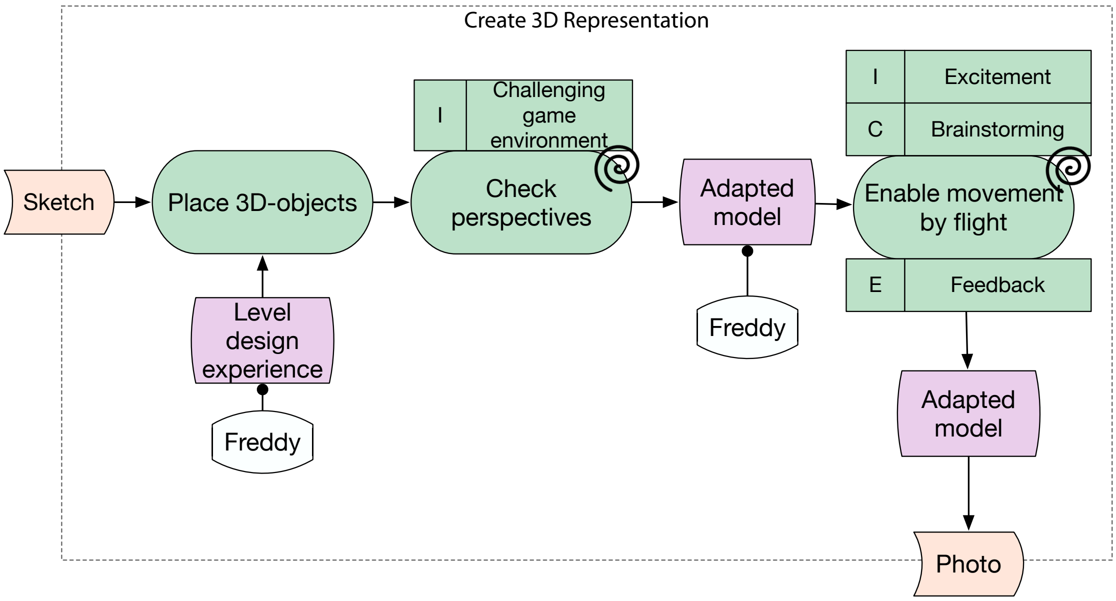


Figure 6.11: Modeled task from expert 1

The creative conversions were correctly assigned, and the ICEP elements were correctly added. The E for "Enable movement by flight" is very vague with "Feedback" as it is unclear who or what provides the feedback. As this information was given in the text, it should be added. The model shows an overall correct and successful application of the ICEP principle. It also points to the need to explain the ICEP elements and the idea element more clearly.

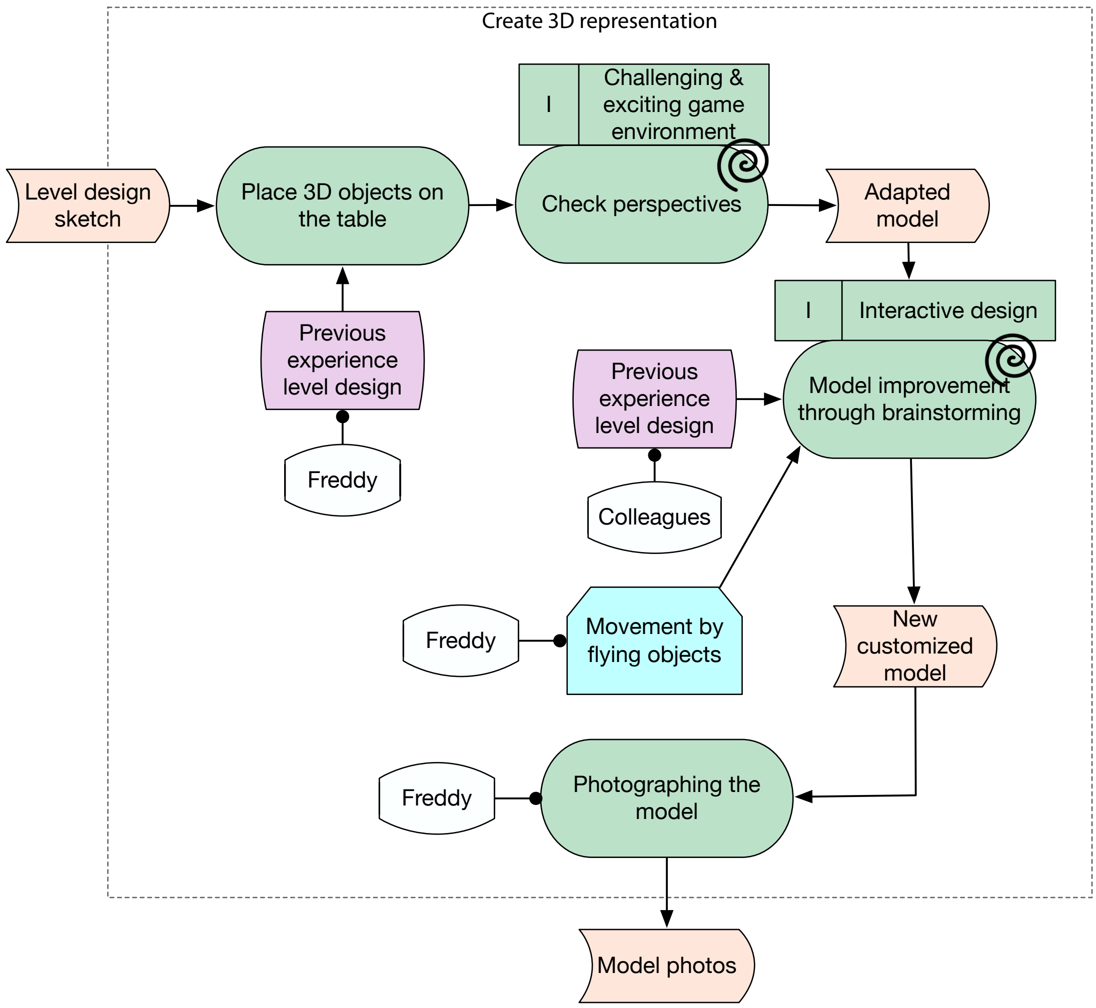


Figure 6.12: Modeled task from expert 2

Expert 2 also successfully applied the creative conversion, an ICEP element, and the idea symbol (cf. Figure 6.12). The expert correctly added the idea by Freddy to a creative conversion. However, the expert missed adding the C to the task. Instead, the creative method of "brainstorming" was added to the conversion. Further, "colleagues", as several people, would require the team symbol and information objects to be modeled on the dashed line. Concerning the ICEP elements, the minimum of the "I" was added to creative tasks, but the text provided more information to be used for the ICEP elements.

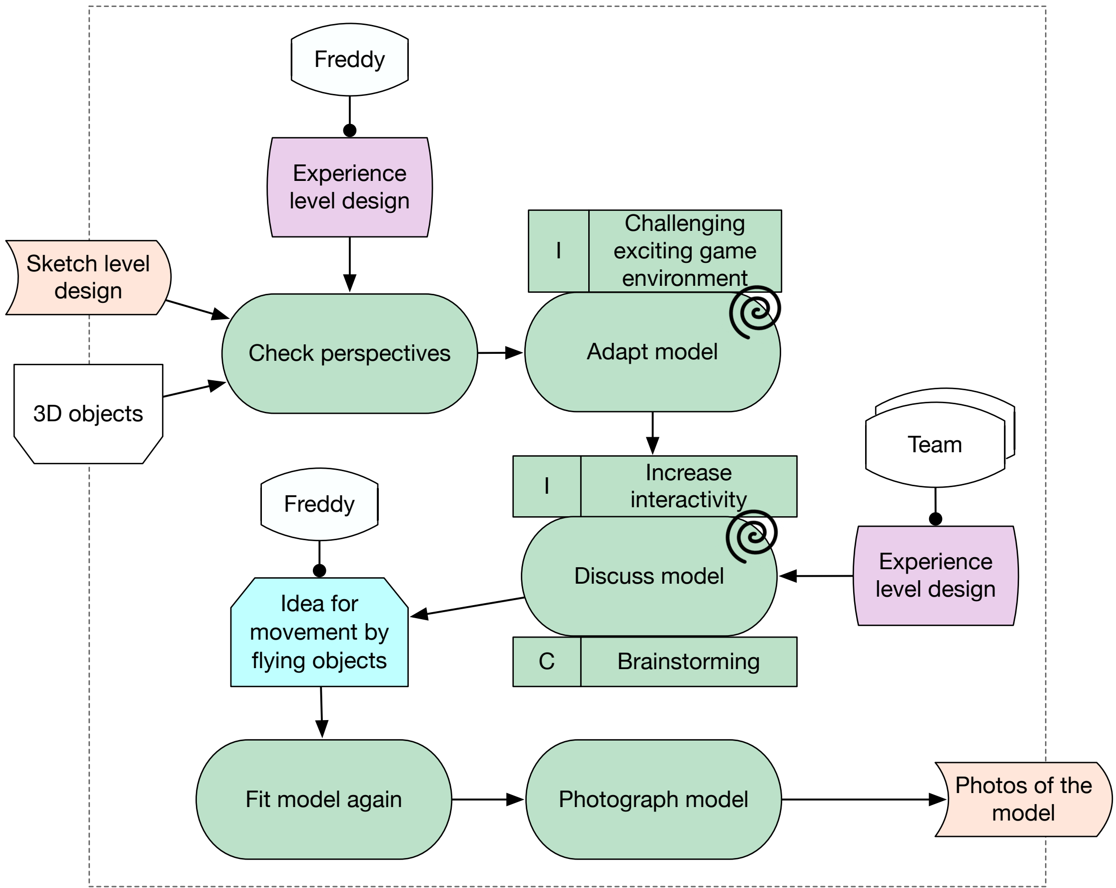


Figure 6.13: Modeled task from expert 3

Expert 3 successfully applied the creative conversion, ICEP elements, and the idea symbol (cf. Figure 6.13). Here, conversions are also wrongly directly connected. Compared to the model from expert 2, the idea here is modeled as the outcome of the group discussion, which is a possible interpretation of the text. As the idea led to another conversion to adjust the model, the idea could then be incorporated into the model.

Expert 4 also successfully applied the creative conversion, ICEP elements, and idea symbol (cf. Figure 6.14). Here, all conversions correctly follow an output object. The idea of ”movement by flying objects” was derived through the discussion, as it was explained in the text. However, in this model, the idea is not followed up upon. It would represent the text more closely if the arrow were inverted.

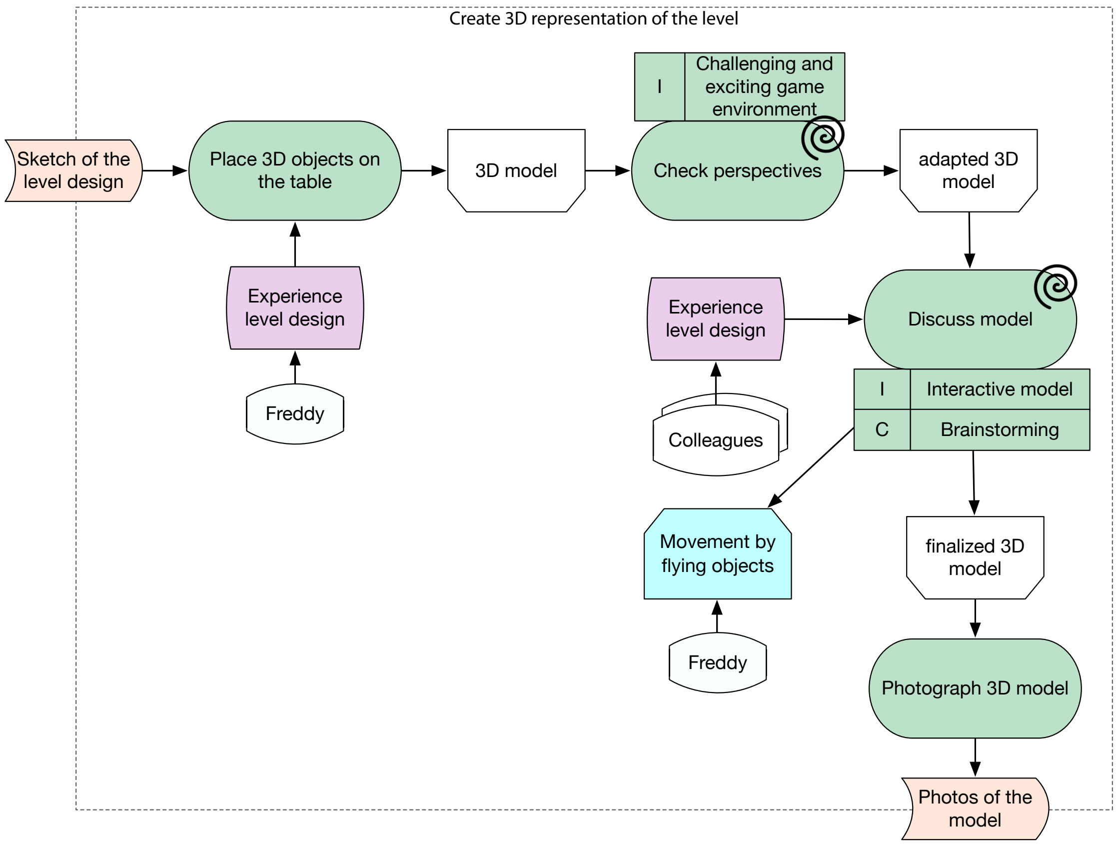


Figure 6.14: Modeled task from expert 4

6.3 A survey to evaluate the modeling method

To evaluate the effectiveness and usability of the modeling extensions, this second study involves a larger group of KMDL users. The goal is to identify usability issues with the developed method by having multiple people interact with it. While the previous study had few participants who extensively learned and used the method, this study targets many participants who grasp the basics of the method and quantitatively evaluate it. The results will be used in conjunction with the previous study to refine the modeling method.

6.3.1 Setting and participant description

The study was conducted as part of the lecture on Business Process Management in the winter semester 2022/2023. In this lecture, Bachelor students are taught the basics, such as process analysis tools, including various modeling methods. In the lecture on KMDL, the extension to capture creative processes was presented. The ICEP model was presented, as well as the concrete transfer to KMDL modeling. Following the lecture, students were asked to complete a questionnaire. Of the 158 students in the course, 58 participated in the study. 51 records were complete and are therefore included in the following analysis. 43% of the participants were female, with 34% between the ages of 18-20, 34% between 21-23, and 32% older than 24.

6.3.2 Survey description

An online survey was made available to students for one week following the lecture. The study participants had already learned the basics of the new modeling method in the lecture. However, to bring everyone to the same level of knowledge, the modeling method was briefly introduced at the beginning of the survey, similar to the study before. The study was divided into a total of three topics:

1. Presentation of the modeling extension for creative work, including a query of initial associations and evaluations
2. A process is modeled in which parts are appropriately assigned by the participant
3. Items to evaluate the modeling extension

In the first step, the modeling extension for creative work was introduced (cf. Appendix H on page 325 for the entire survey in its original German version and Appendix I on page 336 for the full English translation). The main challenges of modeling creative processes were highlighted, including their unpredictability, iterative nature, and flexibility. Despite these challenges, it was emphasized that modeling creative work is important due to the increasing need for creative input in complex business processes. The ICEP model was then introduced as the modeling extension, and participants were asked for their initial thoughts, questions, or concerns about the model.

The concept of the *creative task* was introduced, with the swirl symbol representing creativity. The *idea* symbol was then introduced, followed by the ICEP modeling elements. Participants were asked about their individual associations and potential issues they saw with these new modeling elements. The combination of a creative task and conversion with the ICEP elements was then introduced, both theoretically and with a concrete example. The experts were again asked for their associations, thoughts, or any potential issues they saw with this combination.

In the second step, a concrete example was used to let the participants interact concretely with the modeling method. For this example to be understood as best as possible by the students, the development of term paper in a team was chosen. The process was presented as a model, cf. Figure 6.15. First, the participants were asked which activities in the model were creative-intensive. In addition, statements were presented that the students were asked to assign to the ICEP elements. There was also a fallback category for inappropriate statements (cf. the survey task in the Appendix I, on page 341). This procedure should ensure that the students apply and think through the method before they evaluate it afterward.

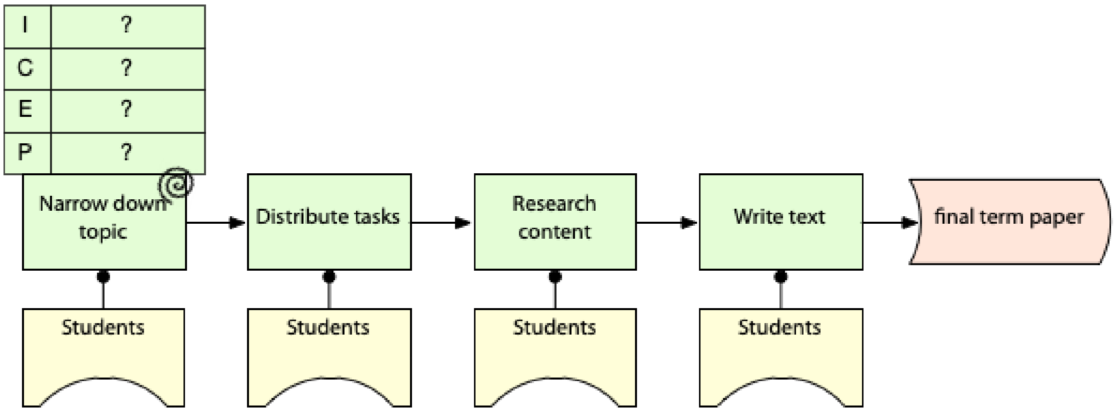


Figure 6.15: Example process model used in the evaluation survey

The last part presents a set of items for evaluating the method. These are composed of several sources that determine the quality of process models: the 3QM-framework (Overhage, Birkmeier, & Schlauderer, 2012) in combination with the Guidelines of Modeling (GOM) model (Becker et al., 2000) and scale for assessing subjective evaluation of modeling extensions by Moody (2003b). This scale is based on the Technology Acceptance Model (TAM) to measure the perceived ease of use (PEOU), the perceived usefulness (PU), and the intention to use (ITU) of a modeling method. The 15 items of Moody's original scale were adapted slightly to fit the context of the KMDL modeling extensions (for the full list of items, see Appendix I, page 342 to 343). The scale uses a 5-point Likert scale, from "strongly disagree" to "strongly agree." In the event that a participant could not answer one of the items, a fallback option of "cannot assess" was provided. All items were presented in random order.

For PEOU, example items are: "I found the procedure for applying the method complex and difficult to follow" (reversed item) and "I found the method easy to learn". For PU, example items are "Overall, I found the method to be useful" and

"Overall, I think this method does not provide an effective solution to the problem of representing creative processes" (reversed item). For ITU, two items were used: "I would definitely not use this method to document large process models" (reversed item) and "I intend to use this method in preference to other process modeling languages".

6.3.3 Data analysis

As a first step in the questionnaire, notes could be left on modeling explanations. Here, there were only 5 responses, four of which included general appreciation for the topic of creativity in conjunction with modeling tools, while another suggested that this method for modeling creativity extends the scope of KMDL too far and may require its own language.

The modeling task introduced following the explanation is primarily designed to get respondents to engage with the method. Due to the semiformal nature of KMDL and the room for interpretation, it is impossible to evaluate it unambiguously based on the roughly described process of creating the term paper. However, the way the tasks were handled gives an indication of how unambiguously the modeling method was applied. It should be pointed out again at this point that the study participants received a very brief introduction to the methodology only shortly beforehand.

To the question of which of the process steps are creative-intensive, about 52% answered task 1 (narrow topic down), 10% task 2 (Distribute tasks), 33% task 3 (Research content), and 77% task 4 (Write text) - multiple answers were possible. This shows a relatively straightforward tendency, although there is still room for individual interpretation. For example, the task "Research content" was not specified further and could therefore be seen as a purely knowledge-intensive task in the sense of a previously concretely defined content search or as a creative-intensive task in which the search process should lead to further ideas and approaches for the paper to be written. With the guidelines given in the survey, both are conceivable.

The assignment of task steps to the individual ICEP elements as well as the fallback option ”inappropriate” is also open to interpretation. Depending on the individual process conception of ”narrowing down the topic”, different assignments are conceivable.

For each category there are two intended assignments, see Figure 6.16, corresponding to the colored assignment of subtasks to the categories. It can be seen that a large number of deviations from the intended assignment were made on the part of the students. However, the intended assignments occur most frequently (with the exception of the task ”Distribute tasks”, which was frequently assigned to ”Planning”, whereby this represents the following step in the process modeling).

The 15-item questionnaire was analyzed using PEOU, PU, and ITU subscales. Table 6.2 shows an overview of these subscales and the expert ratings regarding the KMDL modeling extension for creative work (the complete item list can be found in Appendix J on page 345). The scale is designed such that higher scores indicate positive acceptance rates. The results indicate generally positive ratings, with mean scores above average. In particular, usefulness was rated positively, indicating a perception of a general need for such a modeling extension. Ease of use was also rated positively, which can be seen as particularly positive given the short learning time. Study participants had little time to become familiar with the material, and rejection due to confusion or lack of understanding would also have been conceivable.

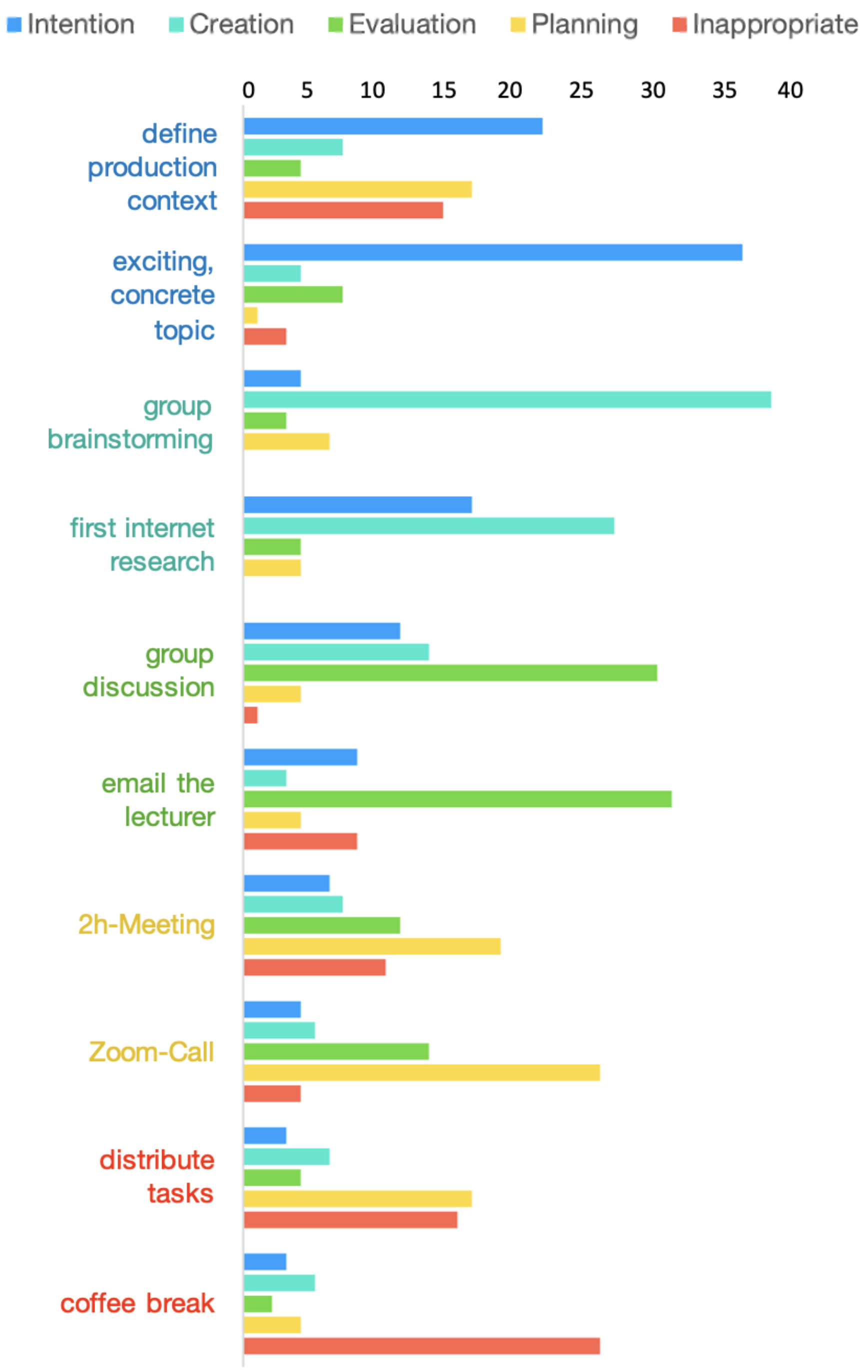


Figure 6.16: Overview of the number of subtasks assigned to the ICEP model

Table 6.2: KMDL modeling extension evaluation based on TAM

TAM sub-scale	Explanation	N items	α	Mean	SD
Perceived ease of use	a person believes that using a particular system would be free of effort	6	.86	3.56	0.35
Perceived usefulness	a person believes that using a particular system would enhance his or her job performance	8	.88	3.75	0.48
Intention to use	a person intends to use a particular system	2	.65	2.89	0.97

Note. Scale from 1-5; sub-scale explanations are based on (Davis, 1989, p.320)

Individual items tended to be rated mediocre and questioned the efficiency and transferability to more comprehensive process models. I.e. some see the efficiency or clarity of the models questioned by the extension. This matches the expert feedback from the previous survey. The modeling extension makes the models appear overcrowded to a certain degree.

Intention to use was rated medium, which again makes sense in the context of the respondents: the study participants are familiar with KMDL and other modeling methods but have no professional need to use such methods. Hence the high variance in the assessment of future use can be given in individual cases but does not have to be.

The GOM criteria were rated on a scale of 1-100, with higher values indicating better fulfillment of the modeling aspects. *Economic efficiency* and *relevance* tended to be rated lower than *clarity* and *comparability*, see Table 6.3. All ratings showed considerable variance as participants exhausted the entire rating range of 1-100, indicating a high difference in subjective ratings. In summary, the ratings tended to be positive, indicating supportive perceptions of the modeling method.

Table 6.3: KMDL modeling extension evaluation by experts based on Guidelines of Modeling (GOM)

GOM aspect	Explanation	Mean	SD
Relevance	only include elements which carry meaning	66.16	25.63
Economic efficiency	good balance between details modeled and modelling efforts	64.52	18.58
Clarity	model is readable and easy to understand	74.41	22.50
Comparability	models follow clear modeling rules	73.25	25.27

6.4 Finalizing the modeling extensions

Based on the two studies evaluating the modeling extension for creative work with KMDL, improvements to the modeling guidelines can be derived. The issues that arose when the experts read and wrote the creative process models can be partly attributed to missing practice in modeling with KMDL and partly to incorrect application of the introduced modeling extension. All survey participants know the basic modeling approach, process management, and KMDL. However, they are not daily working with and applying these modeling tools. Their assessment serves as a sanity check for the ICEP model and the provided explanation.

The adjustments are minor as the evaluation shows overall positive outcomes and, in general, a successful application of the proposed modeling extension. For example, it was unclear whether the indication of a creative task on the process level requires all associated conversions on the activity level to be creative. This is not the case, as overall creative tasks tend to be to some degree creative, as well as well-structured (cf. the PoC principle in Section 2.4.3, page 42). Further, whether unspecified ICEP elements are not modeled or modeled as empty was questioned. For the sake of conciseness, those under-specified ICEP elements are not modeled.

The additions made here are based on the modeling guidelines listed in Section

5.3.3. The need to clarify the ICEP elements is aimed to be met with Figure 6.17. Here, those elements which are most relevant for the accurate modeling of creative tasks are specified. Physical and information objects as input and output are straightforward, especially as they derive from the process level.

An idea – only modeled when essential for the fulfillment of the creative conversion or an outcome of such – is always connected to a person or team (just like a knowledge object). When the idea becomes more generalized, it can be transformed into a concrete physical or information object through a conversion.

A task requirement is modeled when some skill or knowledge is essential for successfully fulfilling the task. As more information is modeled to the task through the ICEP elements, such information is not modeled by the requirement. For example, a creative conversion is performed through a specific creative method like brainstorming; knowing this method is essential for the actors to perform the task. Usually, this method-knowledge would be modeled with a requirement. As the ICEP concept is introduced, such a method would be modeled as the C and for reasons of parsimony, not simultaneously as a requirement.

For the ICEP elements, the intention is essential to the model. Even the vaguest and underspecified creative tasks require a purpose, so they have a raison d'être as a business process. However, a creative process is best guided by all four aspects known before its execution. C, E, and P basically describe methods and/or people responsible for the specific aspects of creative work, respectively. As such, they can represent sub-processes of the creative task. For example, creating a mood board to collect inspiration for a design process is a creative process in itself (and can certainly be modeled as such, if relevant enough). However, if the modeler sees this process *as a means to the end of finding ideas* for the actual design process, then the mood board creation is modeled as the C for this design process. Similarly, planning a creative task by creating a Kanban board can also be seen as a separate

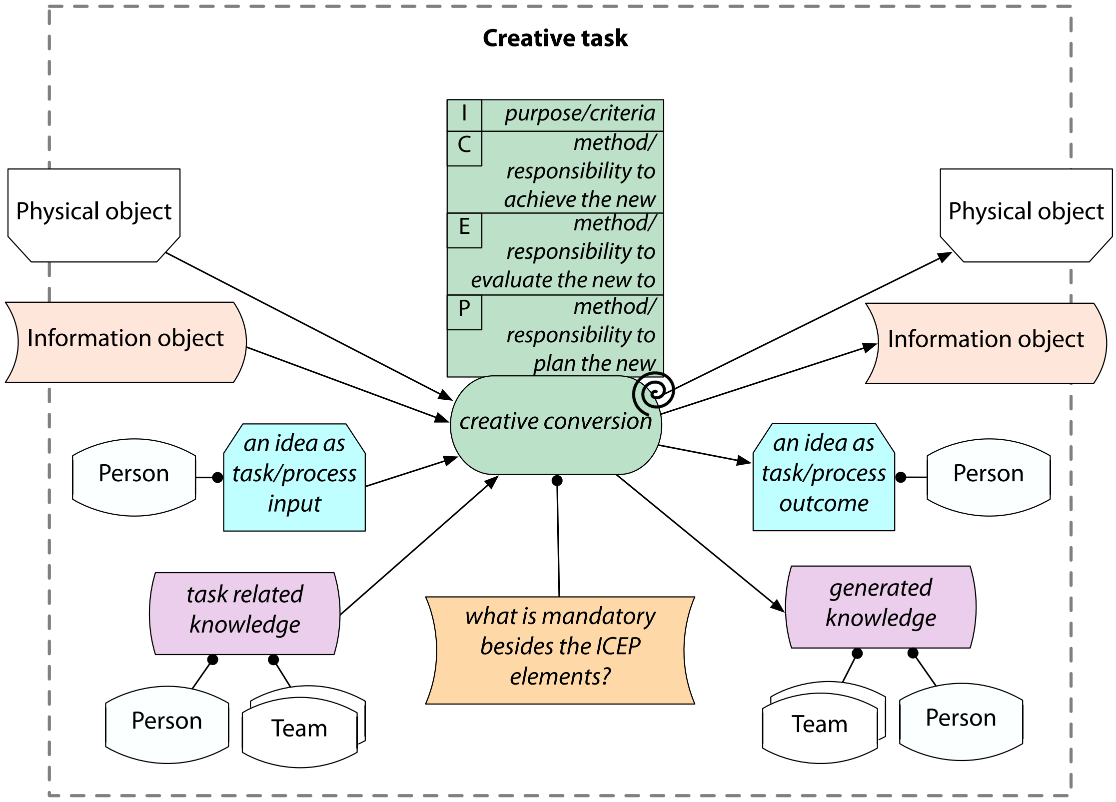


Figure 6.17: Explanations (in italic) for the creative conversion critical modeling elements

process step. If this is done within the scope of the creative task, it can be modeled as the P of this creative task.

These examples are intended to illustrate that it takes a subjective, situational assessment by the modeler to recognize activities as relevant process steps or aspects of a creative task. As KMDL is a semi-formal modeling language, so are the extensions for creative work based on the modelers' assessments and ascribed significance.

6.5 Chapter summary

The previously developed modeling extensions for creative work were applied to three different process contexts and assessed and critically evaluated by four KMDL modeling experts and 51 KMDL users. The application of the modeling method to 3 different business processes from different domains, plus the example of a game-level design process from the expert study, demonstrate the transferability and potential generalizability of the proposed modeling method beyond the context of the Axel Springer use case. The overall positive evaluation of the method confirms its quick learnability, comprehensibility and potential applicability.

The evaluation-survey participants evaluated the modeling extension for creative work as generally useful and in tendency also as easy to use. However, a trait-off became apparent between a model's clarity and easy readability with the proposed information extension by the ICEP elements. Adding the ICEP elements to the tasks and conversions seems useful but hampers the model's readability. At the same time, the economic efficiency was assessed as high, indicating that the amount of information gained through the additions to the model justifies the potential drawbacks in clarity.

The modeling examples given by the experts should not be taken as a guide for future modeling, as they contain errors and ambiguities. Rather, the 3 examples of process models presented at the beginning of the chapter should be used for this purpose. As an aid for future modeling attempts, Figure 6.17 also provides brief explanations of how to correctly and accurately model creative tasks.

"Begin at the beginning," the King said, very gravely, "and go on till you come to the end: then stop."

Lewis Carroll, Alice in Wonderland

7. Discussion

In this chapter, I will discuss the results of the research conducted as part of this dissertation. It begins with an evaluation of the two main research questions. This will include the implications of the results and their contribution to the overall understanding of creative-intensive business process modeling. We will also discuss the limitations of the research and suggest areas for future study. Throughout the chapter, we will also place our findings in the context of the existing literature in the field and consider their implications for theory and practice. The goal of this chapter is to provide a thorough examination of the research and its significance and to provide a foundation for future research in this area.

7.1 Revisiting the research questions

The stated research problem concerns the question of the granularity of creative work: How can creative work, which is complex, iterative, and unpredictable, be specified in a way that makes it manageable? This addresses the dilemma between too much process detail on the one hand and oversimplification on the other. This general research objective is divided into two main research questions in order to find an appropriate answer. The first one clarifies the main features of creative intensive process (CiP), while the other one transfers them into a precise modeling extension.

First research question: What are the characteristics of CiPs to be modeled?

To create a representation of anything, one needs a thorough understanding of the topic at hand. By drawing on previous research from different perspectives and observations from the field, I attempt to develop such a foundation for CiPs. Building on the foundational understanding of creative business processes, the observations made in the ethnographic study aim to expand the understanding of key features of creative processes. Theorizing led to a descriptive and explanatory conceptualization of creative work in the form of the ICEP model (Corbin & Strauss, 2011).

Second research question: How can CiPs be visualized using a modeling notation language?

Creativity is a common aspect of business process landscapes, so current modeling methods aim to capture it. However, a literature review of these various methods revealed their shortcomings. Existing methods are either very tedious (e.g., repeated modeling of slightly different process flows) or keep the creative activity in a black box. Therefore, a new way to model creative processes is proposed. The previously developed process characteristics of CiP were transformed into a metamodel. Concrete modeling elements can then be derived on this basis.

In the search for a suitable modeling language that is already close to the topic of creativity, KMDL was identified. KMDL is specified for knowledge-intensive business processes. Since ”creativity-intensive processes are knowledge-intensive processes that generate creative products” (Seidel, Shortland, Court, & Elzinga, 2010, p.193), KMDL is a suitable requirement for a modeling extension for creative work. All elements from the CiP metamodel were mapped using the existing elements of KMDL 3.0. New proposals were made for missing elements. This is true for the ICEP elements and for *idea*.

7.2 Summary of findings

Each step in answering the research questions raised led to several outcomes worthy of discussion. First, creative work was defined in the context of business processes, along with the specification of CiPs. In terms of the modeling method to be developed, core characteristics of creative work were defined, the ICEP model. In addition, all prerequisites for modeling creative work were analyzed and finally transformed into modeling elements.

7.2.1 Characteristics of creative business processes

The difference between a *creative* and a non-creative process is a matter of degree (Mumford et al., 1991): creative processes involve more undefined problems, generate new and useful ideas based on divergent and convergent thinking; they involve repeated switches between divergent and convergent thinking, leading to the recombination or reorganization of existing knowledge.

A creative business process is characterized by the fact that it contains creative and highly standardized sub-processes. Further, a CiP is defined as a creative task or as a process containing at least one of those creative sub-processes (cf. Section 2.4.3, page 42). A process becomes creative-*intensive* if the main goal of such process is the creation of *something new and useful*.

The analysis of the representation of creative work in the routinization literature revealed a variety of theoretical assumptions about the compatibility of creative work and standardized work processes. Since the majority of (especially current) work suggests a dualism of the two seemingly contradictory processes (of creativity and routinization), I conclude that creative work can in principle be perceived as routinized and predictable to a certain extent and thus can be successfully modeled.

One aspect that explains when a process can be modeled in advance of the process flow is the degree of predictability. Especially ”creative projects” that aim to develop something new in a previously unknown way are very difficult to predict in advance in the exact procedures. Any modeling approach would leave the actual working mechanisms in the dark. However, the study at Axel Springer showed that what we commonly refer to as ”creative projects” also tend to follow highly structured or routinized patterns. The specific process steps and content of these creative projects unfold as the process unfolds. Nevertheless, recognizing that creative work is subject to generalizable patterns is a helpful prerequisite for further modeling approaches.

Another finding from the literature review on creativity within routines is the notion that small creative outputs can also be found through small changes in routine outputs. In terms of BPM, this means that modeling standardized processes still provides room for small creative outputs without requiring adaptation to this creative input. Common modeling tools model creative work using standard methods (e.g., vom Brocke and Schmiedel 2015). This standard approach can be considered sufficient to model it adequately for many examples of minor creative output.

7.2.2 The ICEP model to manage creative work

The ethnographic study to improve the understanding of the process characteristics of CiPs is based on two process runs of a team’s prototype development performance. The analysis of patterns in their creative work performance led to the development of the ICEP model.

The ICEP Model aims to capture the essential process aspects of creative work. I (intention) is a prerequisite for any business process, as this provides a form of purpose and reason for its execution. C (creation) and E (evaluation) correspond to the aspects of creativity included in the core definition (to create *something new and useful*, Runco and Jaeger 2012). *C* describes a method, tool, or person responsible for generating the *new*. *E* describes a method, tool, or person responsible for the critical evaluation of the *new*. *P* (planning) is also required for any business process; however, for flexible processes that are difficult to predict, ongoing planning of the exact process flow and tasks to be completed becomes an essential requirement.

The ICEP elements can be recognized and assigned at all process levels and for all levels of process abstraction. They are general characteristics of creative processes. I further claim that they are also general to all types of creative business processes. The elements of *C* and *E* reflect the definition of creativity and make it universally valid. *I* and *P* are particularly relevant in a business context because efficiency is an important driver of business processes. However, the concept was developed based on a single ethnographic case from the context of rapid prototype design. This assertion requires further support and studies from other domains to be credible.

ICEP model of creative work

I	Intention	a meaning, a purpose, whereto the task is performed
C	Creation	achieving new ideas or solutions
E	Evaluation	verifying the worth of an idea or solution
P	Planning	(ad-hoc) management of evolving work processes

The ICEP model represents another stage process model similar to the model of DCM or Wallas (cf. Section 2.4.1, page 25). The main purpose of these models is to simplify the overall complexity of creativity. While previous models have proven useful in certain contexts, the ICEP model is specifically placed in the context of business process management. It abstracts from the individual cognitive level of performance (cf. Wallas' model) and simplifies the creative process compared to Woodman's and Amabile's models of organizational creativity and innovative work.

The ICEP elements are not subject to dependencies in the sense of a time reference. The order of the elements is therefore rather arbitrary. Whereby I comes first because it is a basic requirement of creative work to know approximately the purpose of a task in order to approach it successfully. Moreover, it is logically necessary that C comes before E because something must be developed before it can be evaluated. In practice, however, these processes are subject to strong iterative loops and interdependencies, so their order becomes moot. P is a constant part required to manage the steps of a creative task. Therefore, it cannot be put in a clear order with the other elements.

In practice, the complexity of creative work requires simplification in order to be manageable by focusing on the key elements required for creative work. Enriching process models with a thorough understanding of creativity can support efforts to improve creative performance. From an individual perspective, there are many ways to improve creative performance. Based on a self-conducted meta-analysis, it was shown that various training and direct effect manipulations can efficiently improve creative performance. Time-intensive methods such as continuing education courses and creativity training showed the best effects, but are very costly. In comparison, direct methods such as exercise, meditation, and the use of sensory primes are much less expensive and comparatively effective (Haase et al., 2023). However, such methods would have to be directly integrated into the processes.

To achieve an improved process understanding for creative work, the ICEP model has the potential to be used as a general management tool. It could be useful for analyzing current work and designing new processes. While the application of the model is not perfect, as the simplification is accompanied by a neglect of the specifics of the creative process, such as scheduling or resource allocation (cf. Seidel, Shortland, et al. 2010), it can be a helpful start to focus and organize the *essential* elements of a complex creative process.

Software tools are often used to support the management of creative work. A clear understanding of creative work can help in selecting appropriate supporting software. In an analysis of creative support systems (CSS), Wang and Nickerson (2017) found that an CSS is particularly effective if it supports a previously neglected aspect of creative work. These software tools can focus purely on ideation, idea selection, overall process management, or individual motivation. Analyzing current work processes with the ICEP model could reveal which aspects of the creative process are not yet sufficiently specified or could benefit from tool support.

7.2.3 Modeling creative business processes

Conceptual modeling aims to represent real-world systems. A modeling method thus serves as a filter to organize the seemingly unstructured complexity of the observable real world. Creativity strikes us as particularly complex and difficult to observe. However, the research presented and discussed here also shows that creativity is a general, repetitive, and predictable aspect of professional work. It can therefore be modeled efficiently. A particularity arises from the uncertainty about the exact process flow and the specific outcome to be achieved. Some sub-processes exhibit more variability and flexibility than others. However, standardized process flows can be identified at all process levels: from meta-processes such as product design to cognitive thought patterns. In particular, the interplay between idea development -ideation- and critical reflection -evaluation- occurs as a regular pattern.

The CiP metamodel summarizes all previously discussed aspects of creative work in professional contexts. The previously presented theories, definitions, and ethnographic findings were combined into a formal model that describes creative work (cf. Figure 5.1 on page 148). The model distinguishes between process levels: A CiP at the highest level is composed of PoC, which includes creative and stable sub-processes. The creative sub-processes consist of the four ICEP elements. CiPs are performed by individuals or teams. A CiP as a higher-level creative process leads to creative products. A creative sub-process, on the other hand, leads to ideas.

KMDL has been further developed to include the ICEP model as additional functions for tasks and conversions. For all four elements, a short description can be created to specify the creative work. The *I* must be added because a minimum level of knowledge about the purpose of the task is required for its proper completion. The other three aspects are specified as best as possible. If no specification can be made for *C, E* or *P* because it is unknown or unclear, the creative process is not yet properly specified. Since the modeling goals can be diverse, it is up to the modeler to model the processes according to their use. Specifying all four aspects of ICEP for each creative task is desirable from a process optimization perspective.

The two evaluation studies have shown that KMDL-experienced modelers can successfully apply the modeling extension for creative work. Since both studies were comparatively short, it can be assumed that the effort required to learn the modeling extension is relatively low. The experts found the ICEP model intuitively applicable to the process models. The vortex and the idea symbol were also evaluated as valuable additions to the specification of creative work. Modelers in the second study could also successfully map process steps to ICEP elements. However, evaluations from both studies indicate that process specification leads to visual clutter, especially in larger models. Adding the ICEP aspects to the tasks and transformations made the models overall bulkier and less intuitive to read. It is possible that a limit was reached where enough detail was added to the model without it becoming too unwieldy. Accordingly, not much more should be added, or an entirely different form of presentation would be required.

Based on the proposed modeling method, creative work can be recognized and described. Most common modeling languages are based on the control flow paradigm and describe processes as a predefined sequence of activities (cf. Dumas et al. 2013). Here, the modeling extension follows this logic only for the main process steps. More specific tasks performed under the guidance of the creative task can be included in the ICEP framework. Such processes may include planning tasks, performing creative methods such as brainstorming sessions, or performing iterations for evaluation purposes. In this way, we can focus on the key steps taken to carry out the overall creative process, while indicating the associated work steps and methods that accompany it.

A recent study examined the use of process models for agile work (Moyano, Pufahl, Weber, & Mendling, 2022). It found that these process models were the least common, especially in the change-prone development and testing phases of software development. In contrast, the analysis and design phases were more often guided by process models (mostly based on BPMN and UML). The software developers interviewed reported that their workflows could change drastically during agile sprints. This would result in many time-consuming model adjustments that were disproportionate to the added value of the models. Therefore, they did not model these phases or only modeled them in a very abstract way. The modeling extension I propose could provide a middle ground to enable efficient modeling for agile, potentially creative work. Moyano et al. (2022)'s study showed a strong benefit of such models for process management: ”practitioners highlight the role of business process models in defining the flow of information, supporting requirements specification, and facilitating complex projects” (p.24). The dilemma of modeling creative work presented earlier points to the challenge of finding a middle ground between too much detail and oversimplification. Creative processes can be modeled clearly and in detail by ”capturing” the complexity of the processes with the ICEP model.

7.3 Implications

The insights gained so far have the potential to be relevant beyond the context of this thesis. On the one hand, by aggregating the existing knowledge and linking it to each other, insights from different perspectives on creativity can be gained. On the other hand, approaches have been identified that allow for exciting further research and application. In the following, I will briefly discuss the potential relevance for potential users and open research questions.

7.3.1 Implications for professionals

Creative work can be analyzed, understood, recorded, and thus managed. The perception of the over-complexity of creativity can be countered by focusing on the core aspects of creative work. These can be defined differently depending on the management objective: For individual creative thinking processes, this would be the interplay of divergent and convergent thinking. For overall organizational innovation processes, the distinction between person-, team- and organization-related aspects according to Woodman et al. (1993) is helpful. For the analysis of individual processes carried out by individuals or teams, I would suggest the ICEP model as a framework for analysis.

Overall, the proposed modeling extension can be used to represent ongoing process flows, to understand them, to analyze them, and, at best, to improve them. It can also be used for planning and designing creative business processes. To do this, managers should focus on the main tasks and the main process flow, and for each step ask how the ICEP elements are addressed and with what methods and responsibilities. In this way, the uncertainties associated with creative work would be captured in a manageable way while still laying the groundwork for creative work. This type of process planning would also reveal gaps. For example, when creative sub-processes do not follow the methods for generating novelty.

Appropriate adjustments can and should be made here.

The flexibility and agency associated with creative work require that processes be continually reevaluated and realigned accordingly. Although modeling may seem overly complex, especially for rapidly changing processes, such visual models can help understand these changes and identify their influencing factors (cf. Fortwengel et al. 2017). In studying routine creative work, Dittrich and colleagues (2016) found that communication patterns are important in establishing and changing mutual understandings of routine actions. What the authors call ”reflective conversations” allow organizational actors to reinforce existing routines or design new ones. Process models help guide conversations about processes and potential variations in practice. Thus, using more models for creative work could limit perceived fuzziness and facilitate the alignment of collaborative work.

7.3.2 Implications for future research

The theoretical model proposal developed in the form of the ICEP model and the modeling extension provided for KMDL benefits from further research to examine the value of these two concepts. The ICEP model is proposed as a more comprehensive management tool, but its value review is limited to the modeling application. Focusing on these four process aspects suggested by the ICEP model could help analyze and improve the *essence* of creative work. Since the proposed use and application of the model as a management tool are not explicitly tested, these assumptions require further study and practical applications.

A detailed processual understanding of creative work is the prerequisite for individual situational improvement methods. Our current understanding of creative work processes is not accurate enough. Since process modeling is an effective tool for analyzing business processes, including creativity in modeling could also be helpful for the goal of situational support of individual creative work.

Modeling methods are developed based on a theoretical understanding of reality. If this changes, the modeling method can also be adapted. Since creativity is an active area of research, especially in the context of work, it is to be expected that our theoretical understanding of this complex construct will change. Accordingly, modeling methods should also be questioned and adapted as necessary in the future. For example, current creativity research specifies the form of the creative problem addressed: there are specific individual preferences for different types of problem spaces, which is associated with improved performance (Cromwell, Haase, & Vladova, 2022). Specifying process models for creative work, in addition to the type of problem being addressed, could allow for more specific process adaptations.

Another branch of research on creativity focuses on the possibility to enhance individual performance by different (training) methods. Training leading to long-term effects can enhance individual creative performance, but situational stimuli can also successfully improve it (Haase et al., 2023). Such situational influences have been less studied (Sassenberg, Moskowitz, Fetterman, & Kessler, 2017; Sassenberg et al., 2022), compared to the extensive studies on training methods (e.g. Ma 2009; Rose and Lin 1984; Scott et al. 2004a). However, own research shows that engagement with certain stimuli (which elicit open-ended, associative thinking, Haase 2020) can effectively enhance subsequent creative performance, while other stimuli degrade it (such as mathematics, Haase and Hanel 2022). So it matters what we do before we engage in creative tasks. Thus, tracking the process flow at the level of specific activities could help improve subsequent creative activities if they are properly connected.

The ICEP model and its adaptation to KMDL has the potential to be used in contexts other than creativity: The basic structure of specifying tasks with methods, tools, and responsibilities can be applied to business processes such as knowledge-intensive processes or for case management (cf. CMMN). Adaptations of modeling languages are becoming more specific to certain modeling contexts, such as manufacturing processes (Erasmus et al., 2020), production processes (Vjestica et al., 2021), or sensitive business processes (Ben Hassen et al., 2019). However, other types of business processes would need to be further specified to know which ICEP elements to use in which context and which to add. For example, because of their conceptual proximity, knowledge-intensive business processes could be specified by I, E, and P. However, this would require concrete studies to test transferability and usefulness.

Significant efforts are being made to develop smarter - potentially intelligent - software and machines. In this sense, research is also aimed at developing methods for software to create artifacts and ideas of value (Colton et al., 2015). While the trend is toward AI supporting human creativity (cf. Miller 2019), the result is a close interconnection between machine and human creativity. This requires all the more an appropriate representation of creative process flows. Since everything is always in flux and an ongoing process, we need to better conceptualize this constant flow and change of events (vom Brocke et al., 2021). Perceiving process models less as entities and more as possibilities could support this idea.

7.4 Critical evaluation

Any research project requires some decisions regarding the focus of the analysis, the operationalization, and the evaluation of the results. All of these can limit the validity of the results. Therefore, I discuss below the limitations related to the literature review, data collection and analysis, and the final modeling method.

7.4.1 Concerning the literature analysis approach

The research questions were approached from three perspectives: psychological, organizational science, and business informatics. Thus, it was not possible to evaluate the entire literature on two major research topics: creativity and business process modeling. A focus on the process representation of creative work was chosen pragmatically but certainly falls short of finding and discussing all relevant aspects. Also, the representative literature review on creative routines does not claim to be comprehensive in the sense that all literature discussing creativity from the perspective of routine dynamics is found and discussed, but aims at finding a reasonable number of papers reflecting the ongoing debate.

7.4.2 Concerning the data collection and analysis approach

The process data were mainly collected in one research setting: digital ethnography in the context of Axel Springer. This reflects the field of software engineering in a rather creative work environment. Attempts to generalize the results can therefore be made for the field of software engineering, but for other work contexts, I would exercise caution as further research is needed. The process data collected for the application of modeling extension from the fields of brand design, sales, social work, and digital game design will attempt to provide evidence to generalize the usefulness of the methods on a broader scale.

Ethnographical study

The data collected at Axel Springer is based on a number of participants who all have a very positive attitude towards their creative teamwork, in the sense that they understand and present themselves as agile, very flexible, creative, and close to the trends of technological developments. This is not a limitation per se. However, analyzing creative work in such a context may reveal a positive bias that is not so easily found in other professional contexts (see, for example, the bias against creativity, Lee, Chang, and Choi 2017).

The prototype development process I studied begins with an idea pitch. Thus, the genesis of the idea that is tested in this process is outside the process I observed. Therefore, the initial idea production could not be explicitly considered.

Instead, how these ideas were formed, expanded, and implemented to some degree was analyzed. Of course, various creative processes and idea developments were observed, but they all related to the initial core idea.

Due to the home office policy in place for the company's employees, a digital ethnography was conducted. The digital format limited data analysis to conversations and interactions within the digital space, such as chats, video calls, and digitally shared files. Some of the contextualizations of teamwork were lost, such as spontaneous interactions between team members that I could have observed in the office (Gluesing et al., 2003). In addition, informal conversations were hindered by my presence in virtual meetings. I always shared my video to make my presence and actions transparent, which were mainly limited to listening and taking notes. At the same time, my visual presence could remind participants that an external person was listening, which potentially influenced their behavior.

Research shows that creative work is particularly difficult to transfer to the digital world. For example, fixation on the screen alone leads to less cognitive flexibility, which gets in the way of developing great creative ideas (Backström, Berglund, & Omorede, 2022; Brucks, 2022). The same work with presence in the office could have led to a greater variety of creative methods, meeting formats, and thus different patterns of creative work. At the same time, this restriction of the digital is appropriate to the work reality of many companies, so my observations are at least transferable to digital creative work contexts.

ICEP model

In the development of the ICEP, the focus was on simplicity to fit into a modeling language. Therefore, potentially other relevant aspects were not explicitly considered. Technology support, for example, may be included in the *C, E* and *P* if deemed relevant enough, but is not modeled as a stand-alone aspect. The same is true for resource constraints that may underlie the work, such as time, money, and personnel. Creative processes involve risk because it is unclear exactly how the work will be done and for what purpose. The E aims to balance this risk by applying controls and evaluations to the work done, but limited to the current development of an idea. The risk that a creative product will be found not (sufficiently) users cannot be predicted, but may need to be tested (cf. Becker et al. 2011). Further validation studies might reveal the need for such specifications in other work contexts.

Modeling evaluation studies

The expert study includes a process model of the level design of an online game. Based on an interview with a game designer, a comparatively small section of the overall much more extensive process landscape of game design was selected to be manageable for the following online study. A larger scope of processes would certainly result in more modeled processes that can be analyzed. However, an online study with the planned 2 hours is already borderline long with regard to the motivation and concentration of the participants.

Similarly, the process model of term paper preparation used in the second evaluation study represents a simplified process example that is as intuitive as possible for the study participants. Thus, some validity in terms of transferability to practice is lost. Participants in both studies were familiar with the method and context and were even able to use the method successfully in the context of a short online tutorial. The study participants do not normally use KMDL or any other modeling language in their working lives. Thus, the studies are a proof of concept and demonstrate the ability to quickly learn and apply the proposed modeling method. However, the studies fall short when evaluating the actual application in practice.

7.4.3 Concerning the process modeling extension

The proposed method of introducing creativity into the modeling makes the modeling more complex and the visual representation more convoluted. In the feedback on this method, it was critically noted that this noticeably limits the readability and manageability of the models. Uniform representation methods would be helpful here, for example through the software tool *Modelangelo*, which simplifies modeling and promotes clarity. This shows potential for future software enhancements.

Every language reflects the world in terms of the speaker's perception. However, language is also a limitation of what can be expressed. *Linguistic Relativity* describes the effect of language on thought and action. Language enforces what we see of reality and how we think about it (Proper & Bjeković, 2020). Applied to a modeling language, this means that a modeler focuses primarily on what can be modeled. In the context of my modeling extension, it is quite positive that creativity can now be explicitly considered in KMDL modeling. At the same time, the focus is on the ICEP. "These frameworks run the risk of basically creating tunnel vision" (Proper & Bjeković, 2020, p.20). Moreover, in this way, those who work with the models also capture the processes within these modeled boundaries.

When modeling creative processes, the modeler encounters the problem of the "creative threshold" (cf. Karow 2011, p.214). As described earlier, creative processes differ from non-creative processes more in degree than in kind. That is, standardizing creative work, possibly by modeling and improving the process, makes it considerably less flexible and thus potentially less creative because individual freedom is lost. How long is a task still considered creative and should be modeled as such? The method described here suggests that the criteria of output (is something new to be created?) and process uncertainties (is it unclear how the goal is to be achieved?) should be used as a guide. However, both questions are subjective to be answered by the modeler.

Methods should be used and applied, not just developed. Moody (2003a) argues for the need to evaluate modeling methods developed by researchers with actual practitioners. Methods must not only be theoretically useful but must also prove themselves in practice and be recognized as useful by potential users. Further evidence of practicality can only be gained by working with practitioners who use this modeling method and test its impact and utility over time. My evaluation falls short here because it is based on a sample of students who evaluated the modeling extension method. Applicability in practice also depends heavily on how conveniently the methods can be used. This, in turn, depends heavily on software that provides suitable methods in an easily accessible form. For the proposed modeling extension to be widely used, it would need to be integrated into modeling software (such as *Modelangelo*) so that modelers and practitioners can use it easily.

7.5 Final summary

Starting from the general conceptualization of organizational creativity, a thorough understanding of the basic mechanisms for potentially successful creative work within organizations is required: the organization creates the environmental conditions and boundaries for all work that arises, its expectations, goals, and management strategies, and allocates its resources to specific departments and individuals - thus it is important to understand the specifics of the individual processes that occur within such an organization in order to best define the basis for individual and group creative behavior.

Overall, I see great potential in my work for a better understanding of creativity that goes hand in hand with the notion of manageability: creativity is fuzzy and often appears counterintuitive, as multiple conflicting aspects require an appropriate balance for creativity to flourish. Yet, as the work on routines and creativity has shown, creative professional work is highly repetitive, predictable, and manageable.

The proposal for modeling these processes presented here can enable an analysis, an understanding, and in the best case an adaptation of these processes. In order to better understand the complex interplay of situational, individual and processual influences on creativity, further research and, above all, the application and critical reflection of the ICEP model as well as model extensions based on practical experience are necessary.

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Appendix

Appendix A: Review creative routines

This appendix contains an overview of all papers included in the review about creativity and routines. They are listed alphabetically within the conceptual subgroups: creativity extends routines, routines are inherent in creativity, creativity is inherent in routines, and creative routines.

Papers arguing for *creativity extends routines*

Author (year)	Bucher (2016)
Title:	The Interplay of Reflective and Experimental Spaces in Interrupting and Reorienting Routine Dynamics
Outlet:	Organization Science
Key points:	Variation can come from outside routines, like through Obstfels 'Creative Projects', which might lead to new working routines over the long run

Author (year)	Ford (1996)
Title:	A Theory of Individual Creative Action in Multiple Social Domains
Outlet:	Academy of Management Review
Key points:	creative and habitual actions are competing with each other, with a common focus on habitual acts, as they are safe and easy - real creative achievements can only be done outside routines
Author (year)	Hargadon (2006)
Title:	When Collections of Creatives Become Creative Collectives: A Field Study of Problem-Solving at Work
Outlet:	Organization Science
Key points:	Creativity is a rather unguided, social-interaction-process, happening in a social setting of the organization; the organization guides these creative collective processes by setting norms, expectations, and resources
Author (year)	Obstfeld (2012)
Title:	Creative Projects: A Less Routine Approach Toward Getting New Things Done
Outlet:	Organization Science
Key points:	Routine work and creative projects differ in degree and not in kind - along a continuum of repetitive and non-repetitive action; when the questions ”What is going on here” and ”What do I do next” cannot be answered clearly, its a creative project, which does not follow any routine anymore

Papers arguing for *routines are inherent in creativity*

Author (year)	Becker (2009)
Title:	Innovation routines: Exploring the role of procedures and stable behavior patterns in innovation
Outlet:	book: Organizational routines: Advancing empirical research
Key points:	Innovation - even radical ones - can be the result of formalized processes; standardization can foster ongoing innovations within a company
Author (year)	Cardinal (2001)
Title:	Technological Innovation in the Pharmaceutical Industry: The Use of Organizational Control in Managing R&D
Outlet:	Organization Science
Key points:	Incremental and radical innovation processes can benefit from control mechanisms on the process, and the outcome - those controls could come in form of standardization/routinization
Author (year)	Fortwengel (2017)
Title:	Studying organizational creativity as process: Fluidity or duality?
Outlet:	Creativity and Innovation Management
Key points:	Creativity is a complex social practice that relies on individual competencies as well as shared, recurrent practices
Author (year)	Gilson (2005)
Title:	Creativity and Standardization: Complementary or Conflicting Drivers of Team Effectiveness?
Outlet:	Academy of Management Journal

Key points:	Creative and routinized work seem to go hand in hand in teamwork, as they need and show both aspects
Author (year) Title: Outlet: Key points:	Lombardo (2014) Constraint-Shattering Practices and Creative Action in Organizations Organization Studies Limitations as constraints are inherent aspects of the creative process and creative products
Author (year) Title: Outlet: Key points:	Malmelin (2015) Spontaneous and routinized spheres of creative interaction 31st EGOS Colloquium Creative work depends on routinized, agreed-upon aspects of the process as well as undefined, flexible aspects - both create a coexisting stream of synergetic action
Author (year) Title: Outlet: Key points:	Ortman (2018) Dancing in chains: Creative practices in/of organizations Organization Studies Creativity and routines are important aspects of work, as both come with clear beneficial effects; the balance is of the essence
Author (year) Title: Outlet: Key points:	Rosso (2014) Creativity and Constraints: Exploring the Role of Constraints in the Creative Processes of Research and Development Teams Organization Studies Creative work can benefit from routinized work - especially when it orders, structures the work, and still leaves room for enough individualization

Author (year)	Sele (2016)
Title:	Unpacking the Dynamics of Ecologies of Routines: Mediators and Their Generative Effects in Routine Interactions
Outlet:	Organization Science
Key points:	Innovation and routines are intertwined - innovation is a random process that unfolds in action only, and routines can guide this process

Papers arguing for *creativity is inherent in routines*

Author (year)	Aroles (2016)
Title:	Rethinking Stability and Change in the Study of Organizational Routines: Difference and Repetition in a Newspaper-Printing Factory
Outlet:	Organization Science
Key points:	Repetition is never simply the copy of a process but an active, emergent, creative process of routine replication
Author (year)	D'Adderio (2014)
Title:	The Replication Dilemma Unravelled: How Organizations Enact Multiple Goals in Routine Transfer
Outlet:	Organization Science
Key points:	Change within routines results due to the need for adaptation as improvements, which can be seen as a creative act
Author (year)	Deken (2016)
Title:	Generating Novelty Through Interdependent Routines: A Process Model of Routine Work

Outlet:	Organization Science
Key points:	Stretching and flexing existing routines in order to allow for more creative work might be more successful and of less risk of falling apart than introducing new routines
Author (year)	Sele (2016)
Title:	Unpacking the Dynamics of Ecologies of Routines: Mediators and Their Generative Effects in Routine Interactions
Outlet:	Organization Science
Key points:	Innovation and routines are intertwined - innovation is a random process that unfolds in action only, and routines can guide this process
Author (year)	Lillrank (2003)
Title:	The quality of standard, routine and nonroutine processes
Outlet:	Organization Studies
Key points:	Creativity is possible for routine work (as those include a breadth of behavioral options/diversity of processes) and necessary for non-routine work, as both process and product are unknown before the process run

Papers arguing for *creative routines*

Author (year)	Cohendet (2016)
Title:	Always Playable: Recombining Routines for Creative Efficiency at Ubisoft Montreal's Video Game Studio
Outlet:	Organization Science

Key points:	Creative output can be enhanced by enforcing flexibility within the working routine, together with the enhancement of individuals' power to judge the quality of ideas
Author (year) Title: Outlet: Key points:	Goh (2019) From Actions to Paths to Patterning: Toward a Dynamic Theory of Patterning in Routines Academy of Management Journal Flexibility and change in business processes are best captured through traces as those create routines through their enactment - creative results can thus be a result of such traces
Author (year) Title: Outlet: Key points:	Sonenshein (2016) Routines and Creativity: From Dualism to Duality Organization Science Routines and creativity are interdependent, as routines can be creative and they can lead to creative outcomes; this connection goes beyond the creative agency of individuals enacting the routine, but creativity is also inherent to routines themselves

Appendix B: Interview guide

This appendix contains the interview guide as it was used in the interviews with the participants of the Axel Springer ethnography. Interview questions were adjusted due to the specific role of the interviewee and during the course of the interview based on his or her answers.

Part 1: Basics

- What is your current role in the project? What are you responsible for?
- What is your professional background?
- *Experienced with prior PD:* What prior Prototype Development rounds have you been a part of?

Part 2: Processes

PoV-process:

- How does the prototype phase work from your point of view?
- What are typical phases or steps?
- Is there a typical daily routine? What does it look like?
- *Ideator:* How did the process prior to the PoV look like?
- *PoV-Product Owner (PO):* What are your specific tasks as the PO? How were you practically involved in the PoV-process?
- *Experienced with prior PD:* How is this different from other Prototype Development rounds?

Own standardized work:

- When you start your workday: what are you sure will happen and how?
- What kind of work/activity is standardized for you?
- Are there any repeating patterns for you?

- Where do these patterns come from - from outside or through you?

Changes over time:

- To what extent have working patterns changed within the project? - why?

Interaction with others:

- What do typical intersections with others look like?
- What patterns exist in the processes when working with others?

Part 3: Creativity

Overall:

- To what extent is your work creative?
- When and how do you explicitly have the opportunity to work creatively?
- When are you expected to be creative?
- What does it take for you to work creatively?

Degrees of freedom:

- Where in the process are there freedoms that you could fill creatively?
- Where would you like to see more freedom and opportunities for creativity?

Part 4: Ending

- How do you rate the prototype in terms of its creativity?
- When you look at the product, where did the ideas for the final development come from - team interaction or individual work?
- Did you find my presence in the process disruptive or influential in any way?

Appendix C: Level design process sketch

In this appendix, the sketch of the level-design process from the interview with the game developer is presented. The sketch does not follow any modeling guidelines and aims to represent the complex process flow of a level design as it is performed by the game developer. Black arrows indicate the process flow, with dashed arrows showing ”jumps” back to prior performed tasks. Text in grey represents additional information to the tasks, like the number of iterations for a set of process steps (collected within circles), time taken for the main process steps, and the goal set for these main process steps.

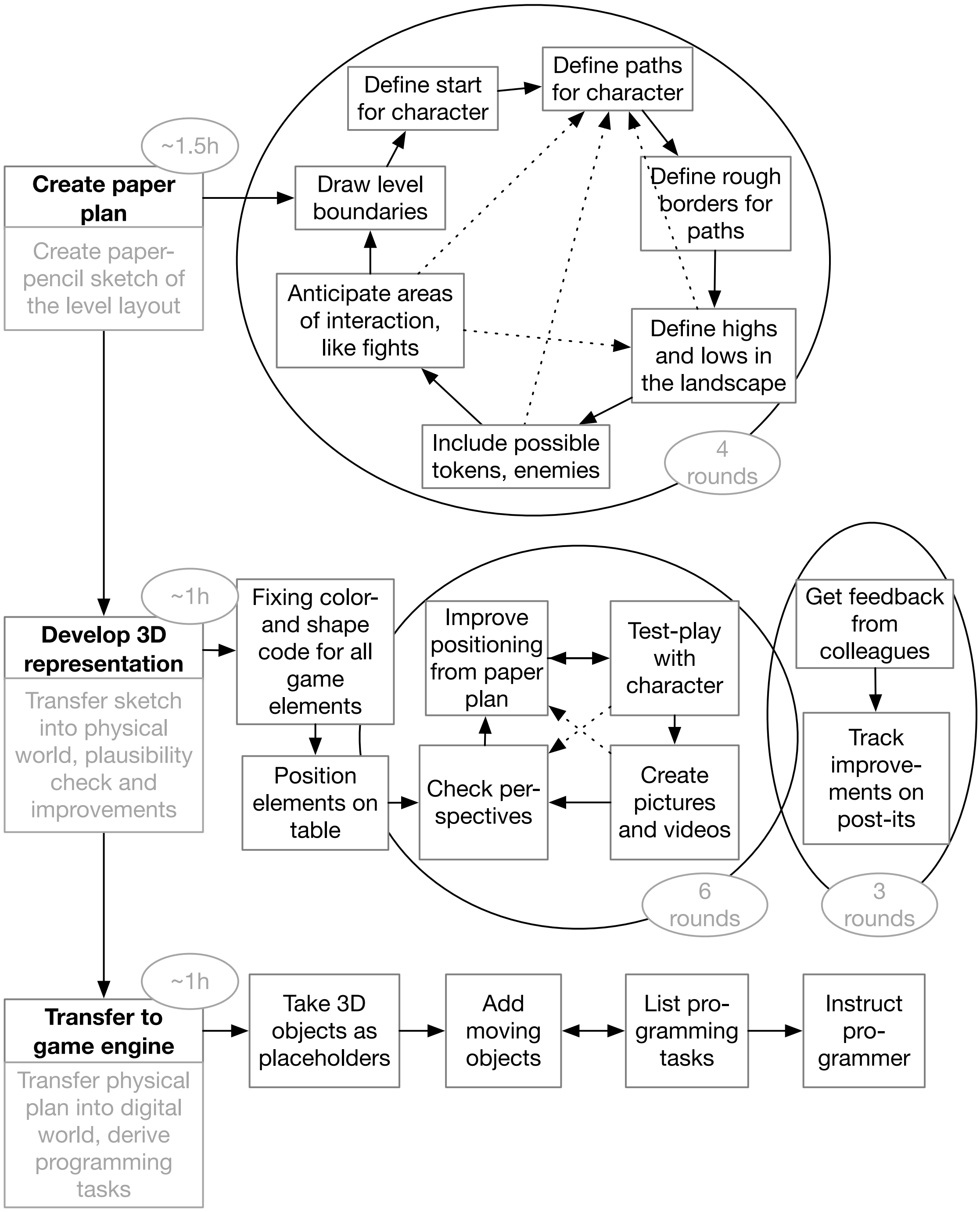

Figure App.C.1: Representation of the process steps performed for the level-design of a digital game development

Appendix D: Expert study – German

This appendix shows the expert study in its original form in German. KMDL modeling experts were asked to apply and evaluate the modeling extensions for creative work.

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0% ausgefüllt

Werte KMDL-Expert*innen,

wie Sie letztes Sommersemester gelernt haben, dient **KMDL der Modellierung von wissensintensiven Geschäftsprozessen.** Nun sind viele wissensintensive Prozesse auch kreativ-intensiv. Immer dann, wenn der Anspruch besteht, dass der Prozess zu einem neuwertigen und nützlichen Ergebnis führen soll. Bislang gibt es wenige - aus meiner Sicht unzulängliche - **Möglichkeiten kreativitätsspezifische Prozesscharakteristika in der Prozessmodellierung festzuhalten.** Daher habe ich eine Modellierungserweiterung entwickelt, die versucht die für den kreativen Prozess relevanten Aspekte mit KMDL darzustellen.

Die Folgende Studie dient dazu, meine Modellierungserweiterung kritisch zu hinterfragen. **Sie haben dabei die Rolle des Anwenders, Kritikers und gern auch Visionärs,** wenn möglich.

Die Studie enthält folgende Themeneblöcke:

1. Recap der KMDL Modellierung zur Auffrischung des damals gelernten
2. Vorstellung meiner Modellierungserweiterung mit ersten kritischen Bewertungen
3. Es wird ein Prozessmodell gezeigt, dass Sie lesen und beschreiben sollen.
4. Es wird ein Prozess beschrieben, der von Ihnen modelliert werden soll.
5. Es folgen offene Fragen und Items zur Evaluierung der Methode.

Für die Durcharbeitung der Studie werden **etwa 2h** anvisiert. Sie können jederzeit die Studie unterbrechen und zu einem späteren Zeitpunkt weiterführen.

Bei Fragen stehe ich gern zur Verfügung: jhaase@lswi.de

Viel Spaß!

Information on data protection

Information on data protection

We process your personal data in compliance with the applicable data protection regulations, in particular the EU General Data Protection Regulation (GDPR) and the Brandenburg Data Protection Act (BbgDSG).

The data controller is:

University of Potsdam

Represented by the president, Prof. Oliver Günther, Ph.D.

Am Neuen Palais 10

14469 Potsdam

Telephone: +49 331 977-0

Telefax: +49 331-97 21 63

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Purpose of the processing

The data will be collected along a study validating the modeling extension of KMDL to include creative-intensive work.

Lawfulness of processing

The legal basis for data processing is your consent to the processing of personal data (Art. 6 para. 1 sentence 1 lit. a GDPR).

Withdrawal of consent

You have the right to withdraw your consent at any time and without reason. The withdrawal of consent does not affect the lawfulness of processing based on consent before its withdrawal.

Duration of data processing

The data will be used anonymously.

Recipients of your data

Your data will not be transmitted to third parties or other recipients within the University of Potsdam.

Your rights:

You have the right to obtain from the controller confirmation as to whether or not your personal data is being processed, and, if that is the case, access to the personal data and additional information (right of access). You also have the right to obtain from the controller without undue delay the rectification of inaccurate personal data. If the legal requirements of Art. 17 or 18 GDPR are met, you are entitled to the erasure of your personal data or to a restriction of processing. Please note that restricted processing of the data may not be possible in every instance. You have the right to receive your personal data in a structured, standard and machine-readable format or to request the transfer to another controller (right to data portability, Art. 20 GDPR). Furthermore, you may object to the processing of your personal data under the conditions set forth in Art. 21 GDPR.

In order to exercise your rights, we kindly request that you contact:

Jennifer Haase

Universität Potsdam
Digitalvilla am Hedy-Lamarr-Platz
Karl-Marx-Straße 67
14482 Potsdam

Mail: Jennifer.haase@wi.uni-potsdam.de

Tel.: 0331 - 977 362 032

Access to your personal data can be requested from the Chief Information Officer (University of Potsdam, Karl-Liebknecht-Str. 24-25, 14476 Potsdam). The corresponding form can be found on his website: https://www.uni-potsdam.de/de/praesidialbereich/praesident-vizepraesidenten/cio.html.

You can contact the university's data protection officer if you have questions regarding data protection:

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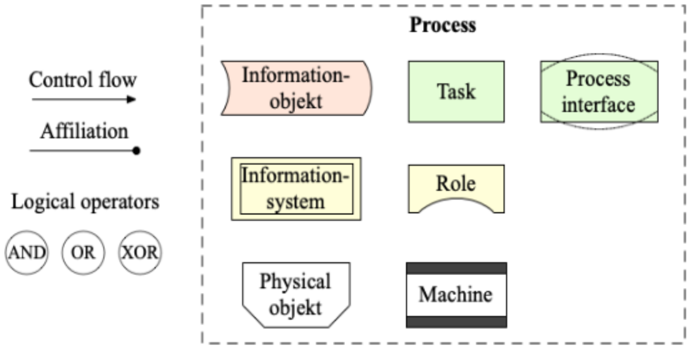
Telefax: +49 331 977- 701821

E-Mail: datenschutz@uni-potsdam.de

If you think that the processing of your personal data infringes the GDPR, then you have the right to lodge a complaint with the supervisory authority for data protection.

Dies dient der Wiederholung der Modellierungsgrundlagen mit KMDL.



Zur Erinnerung, dies sind die KMDL-Prozesselemente.

Task / Aufgabe: Eine Aufgabe stellt eine Reihe von Aktivitäten dar, die innerhalb des gewählten Detaillierungsgrades nicht weiter verfeinert werden, zumindest aus Prozesssicht. Aufgaben können im Prozess wiederholt werden und dienen der Strukturierung von Prozessen. Für die Beschriftung von Aufgaben wird standardmäßig das Objekt-Verb verwendet.

Role / Rolle: Jede Aufgabe auf Prozessebene ist mindestens einer Rolle zugeordnet, die für die Bearbeitung der Aufgabe verantwortlich ist. Rollen werden personenneutral beschrieben: Es werden keine Namen genannt, sondern nur die Rollen der Personen beschrieben, in denen sie an der Aufgabe im Prozess beteiligt sind. Es können auch Personengruppen mit der Abteilung als Rolle dargestellt werden, z.B. Entwickler oder Produktion.

Information system / Informationssystem: stellt die im Prozess verwendete Informations- oder Kommunikationstechnologie dar. Aus Sicht der Informationsbeschaffung dient ein Informationssystem der computergestützten Erfassung, Speicherung, Verarbeitung, Pflege, Analyse, Nutzung, Disposition, Übertragung und Visualisierung von Informationen.

Process interface / Prozessschnittstelle: Prozessschnittstellen dienen dazu, einzelne Prozesse zu Prozessketten zu verbinden. Prozessschnittstellen bieten zudem die Möglichkeit der prozessübergreifenden Auswertung.

Information object / Informationsobjekt: Informationen werden als "Informationsobjekt" modelliert. Informationen können als Text, Zeichnungen oder Diagramme auf Papier und in elektronischer Form, als Dokumente, Audiodateien, Bitmaps oder Videoformate vorliegen. Informationen existieren unabhängig von Personen und können explizierbares Wissen über Personen enthalten. Informationsobjekte können Eingabe- oder Ausgabeobjekte von Prozessen sein. Informationsobjekte werden in der Prozessperspektive und an den Systemgrenzen einer Aktivität dargestellt. Beispiele für Informationsobjekte sind "Rezept" oder "Standardarbeitsanweisung". Der Modellierer entscheidet, ob ein Informationsobjekt in der Prozessperspektive oder als persönliches Artefakt betrachtet werden soll.

Physical object / Physisches Objekt: Physische Objekte werden modelliert, wenn sie für die Modellierung wissensintensiver Prozesse erforderlich sind. Es wird davon ausgegangen, dass physische Objekte Wissen enthalten, das durch geeignete Untersuchungsmethoden gewonnen wurde. In ähnlicher Weise kann gezeigt werden, welches Wissen notwendig ist, um ein physisches Objekt zu erstellen oder zu produzieren.

Machine / Maschine: Im Zeitalter der cyber-physischen Produktionssysteme können auch Maschinen als Informationsträger dienen. Aufgrund der datenverarbeitenden Funktion von Geräten hat es sich bewährt, diese mit einem eigenen Symbol zu modellieren, da sie im Gegensatz zu Informationssystemen auch eine physische Repräsentation haben.

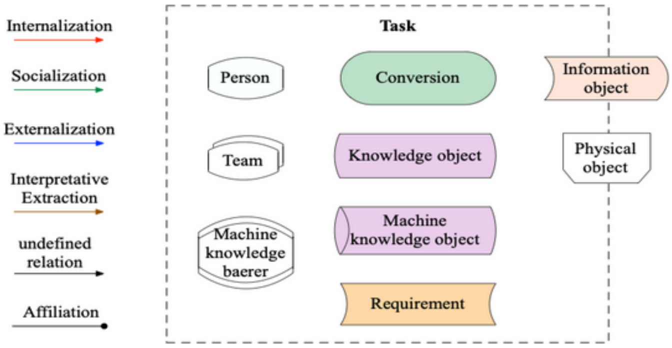
Relation / Relation: Zur Beschreibung der Beziehungen werden zwei Formen unterschieden: Zuordnung von Rollen / Informationssystemen zu Aufgaben (Affiliation) und Darstellung des Aufgabenverlaufs über gerichtete Pfeile (Control flow)

Logische Operatoren:
Konjunktion (AND; "a und b"), die in Prozessmodellen durch das "AND"-Symbol dargestellt werden

Disjunktion (XOR; "a oder b"), die ein exklusives ODER darstellt

Adjunktion (OR; "a oder b oder [a und b]"), die als einschließendes ODER dargestellt

Dies dient der Wiederholung der Modellierungsgrundlagen mit KMDL.



Zur Erinnerung, dies sind die KMDL-Aktivitätselemente.

Task / Aufgabe: Die Aufgabe stellt den Bezug zwischen den Wissenskonvertierungen in der Aktivitäsperspektive und der Prozessperspektive her. Eine Aufgabe in der Aktivitätssicht ist zum Beispiel ein Verweis auf eine Aufgabe in der Prozesssicht.

Knowledge object / Wissensobjekte: Beschreiben Artefakte, die das Wissen einer Person oder eines Teams repräsentieren. Das Wissensobjekt umfasst die Abbildung der Kompetenzen, Erfahrungen, Fertigkeiten und Einstellungen der Person oder des Teams. Wissensobjekte können Input- oder Output-Objekte von Konversionen sein. Ist ein Wissensobjekt ein Input-Objekt einer Konversion, so trägt sein Inhalt zur Konversion bei, ist es ein Output-Objekt der Konversion, so ist es ein Ergebnis der Konversion. Wissensobjekte werden einer Person oder einem Team zugeordnet. Jedes so modellierte Wissensobjekt zeigt an, dass diese Person dieses Wissen besitzt. Wenn eine Maschine Wissen aufweist, kann für ihr Wissen ein eigenes Symbol für Maschinenwissen verwendet werden.

Conversion / Konvertierung: Konversionen beschreiben die Erstellung, Anwendung und Verteilung von Wissen sowie die Erstellung, Verteilung und Bewahrung von Informationen. Sie haben Eingabe- und Ausgabeobjekte, die durch Informations- bzw. Wissensobjekte repräsentiert werden. Der Konvertierungstyp und die Konvertierungsart werden eindeutig durch die Input- und Output-Objekte einer Konvertierung bestimmt. Konversionen sind immer über Wissens- und Informationsobjekte als Input- und Output-Objekte verknüpft. Eine direkte Verknüpfung von zwei Konversionen ist sachlich falsch, da die Bedeutung der Konversion als Deskriptor der Wissenstransformation verloren geht.

Information object / Informationsobjekte: Stellen im Allgemeinen Informationen dar. Während Wissensobjekte immer innerhalb einer Aktivität dargestellt werden, werden Informationsobjekte immer nur an der Systemgrenze einer Aktivität dargestellt, da sie aus der Prozessperspektive "stammen".

Requirement / Anforderung: Die wissensbezogenen Anforderungen, die an eine Konversion gestellt werden, um sie erfolgreich durchzuführen, werden durch das Objekt "Anforderung" erfasst. Anforderungen können durch das Wissen von Personen oder Teams abgedeckt werden. Eine Anforderung kann in technische, methodische, soziale und handlungsorientierte Anforderungen unterschieden werden, wobei das Anforderungsobjekt über die Kante "Zugehörigkeit" direkt an das Objekt modelliert wird.

Person / Person oder undefinierte Person: Das Objekt "Person" repräsentiert eine reale Person oder, im Falle eines Zielmodells, eine ideelle Person in einer Organisation, die Aufgaben in einem Geschäftsprozess erfüllt und dabei eine oder mehrere Rollen einnimmt. Personen sind Wissensträger. Aus diesem Grund werden Wissensobjekte mit der Kante "Zugehörigkeit" zum Wissensträger Person modelliert, wobei zur Kennzeichnung von Personen die Anrede mit dem Nachnamen verwendet wird, z.B. "Herr Meyer" oder "Frau Schmidt".

Team / Team: Ein Team stellt eine Gruppe von Personen dar, die gemeinsam an einer wissensintensiven Aufgabe arbeiten. Teams sind auch Wissensträger. Das in einem Team modellierte Wissen (in Form von Wissensobjekten) stellt das kollektive Wissen des Teams dar. Teams werden entweder durch den Namen einer Abteilung oder durch den individuellen Namen eines Projektteams benannt, z.B. Marketing- oder Produktteam "Candy".

Machine knowledge bearer / Träger von Maschinenwissen: Wenn Maschinen über Wissen verfügen und dies bei der Modellierung berücksichtigt werden soll, kann zur zusätzlichen Differenzierung ein eigenes Symbol für den Träger des Maschinenwissens verwendet werden.

Konvertierungstypen: Die Konvertierungstypen beschreiben die Art der Wissenskonvertierung: Sozialisierung, Externalisierung, Internalisierung, Extrahierende Interpretation und Undefiniert. Hinweis: im folgenden wird auf diese Differenzierung nicht eingegangen.

Die Problemskizzierung

Kreative Arbeit zeichnet sich insbesondere dadurch aus, dass neuwertige Ideen in die Arbeitsaktivitäten einfließen, wodurch neue Produkte entstehen. Diese **kreativen Prozesse sind meist wenig vorhersehbar, weisen Itterationsschleifen und ein hohes Maß an Prozessflexibitlität** auf. Damit sind sie für Modellierungsansätze besonders schwer zu greifen.

Es gibt viele Praxisbeispiele wo Mitarbeiter, oder auch ganze Teams, sehr regelmäßig kreative Prozesse durchlaufen. Aufgrund des hohen Wiederholungsgrades lohnt es sich, auch diese in Form von Modellierungen festzuhalten.

Bisherige Modellierungsansätze - auch KMDL - abstrahiert eine kreative Aufgabe. Bspw. wird dann "Produktidee entwickeln" oder "Werbekampagne konzipieren" als Aufgabe definiert. Diese enthält meist eine Reihe von Aufgaben, die aber aufgrund des kreativen Charakters nur schwer vorhersehbar und müßig zu modellieren sind. D.h. **es ergibt sich die Herausforderung, dass kreative Prozesse "besser", also konkreter Modelliert werden sollten,** als bislang möglich, ohne jedoch in das klein-klein jeder einzelnen Aktivität zu fallen.

Der Lösungsvorschlag

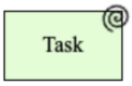
Auf Basis einer ethnografischen Studie mit Softwareentwicklern, die in Teams wiederholt kurzweilige Rapid-Prototypes entwickelt haben, konnte ich **eine Reihe an Mustern in deren Arbeitsabläufen definieren,** die ich als Grundlage der folgenden Moderllierungserweiterung genutzt habe. Meine **Grundlegende Idee ist dabei, das Modellierungsprinzip von KMDL zu bewahren** und für kreative Aufgaben, die nur schwer eine detailliertere Analyse ermöglichen, **zumindest Eckpunkte des kreativen Prozesses mit zu modellieren.**
Diese vier Charakteristika sind:

Intention -- was ist das Ziel der Aufgabe?
Creation -- welche Ideen/Möglichkeiten sehe ich zum Ziel zu gelangen?
Evaluation -- wie bewähren sich die Ideen?
Planning -- was muss ich konkret tun um zum Ziel zu kommen? was sind die nächsten Schritt?

Diese vier Elemente - ICEP-Modell genannt - weisen Kerncharakteristika kreativer Arbeit auf: da bei kreativen Aufgaben Weg und Ziel (zum Teil) unbekannt sind, müssen diese im Laufe des Prozesses erarbeitet werden. Dabei ist **die Erarbeitung einer *Intention* eine vorraussetzung für die erfolgreiche kreative Arbeit im Berufskontext.** Ohne diese gäbe es sonst kein Evaluationskriterium, ob man auf dem richtigen Weg ist. *Creation* enthält die Methode um zu den neuen Ideen zu kommen. *Evaluation* die Methode oder auch die Verantwortlichkeit, um die Passung der Idee(n) zum Ziel zu bewerten. *Planning* ist ein konstantes Element kreativer Arbeit, da im Prozess erst der Ablauf konkretisiert werden kann.

1. Gibt es zu dieser groben Konzeptbeschreibung Fragen, Ideen, Hinweise?

Um eine **Aufgabe als kreativ zu deklarieren** kann diese mit einem Kringel am Aufgaben- und Konversions-Symbol versehen werden.

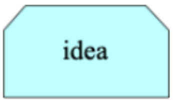


Beide Symbole werden analog zu den bisherigen Aufgaben- und Konversionselementen modelliert.

2. Welche Assoziation/en verbinden Sie mit diesem Kringel?

3. Gibt es zu diesem Modellierungselement Fragen, Ideen, Hinweise?

Ein typischer Aspekt im kreativen Prozess ist die (weiter)Entwicklung von Ideen. Daher wird ein neues Element eingefügt.



Eine "Idee" kann als Vorstufe eines Produkts modelliert werden, was bspw. aus einer Konversion als Ergebnis herauskommt. Es kann aber auch an eine Person direkt ranmodelliert werden, wenn diese eine Idee in einer Konversion einbringt. **Eine Idee wird analog einem Wissensobjekt modelliert, und auch nach dem aktuellen Stand im Prozess konkret benannt.** Die Differenzierung der Idee vom Wissensobjekt ist, dass dies maßgeblich im kreativen Prozess weiterentwickelt, und bestmöglich in ein kreatives Ausgangsobjekt umgewandelt werden soll.

4. Welche Assoziation/en verbinden Sie mit diesem Idee-Symbol?

5. Gibt es zu diesem Modellierungselement Fragen, Ideen, Hinweise?

Wie zuvor beschrieben lässt sich kreative Arbeit durch 4 Charakteristika modellieren: Ideation - Creation - Evaluation - Planning. Die **Großbuchstaben in den Symbolen deklarieren die Kategorie, der Text rechts kann instantiiert werden.** D.h. hier kann knapp formuliert werden, wie die jeweilige Kategorie umgesetzt wird.

I	Intention
C	Creation
E	Evaluation
P	Planning

I: beschreibt das Ziel der Aufgabe, also die kreative Herausforderung

C: Methode, mit der kreative Ideen hervorgebracht werden sollen

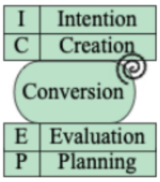
E: Methode, durch die der Prozessverlauf kritisch hinterfragt wird

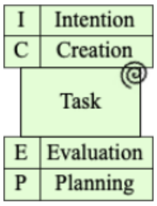
P: Methode, mit der die (Team)Arbeit zeitlich geplant wird

6. Welche Assoziation/en verbinden Sie mit diesen Kasten-Symbolen?

7. Gibt es zu diesen Modellierungselementen Fragen, Ideen, Hinweise?

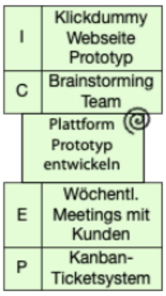
Die ICEP-Elemente werden direkt an die Aufgabe und Konversion modelliert. Dadurch kann jede kreative Aufgabe und Wissenstransfer (Konversion) spezifiziert werden. Dabei **müssen nicht alle Aspekte spezifiziert werden**. Auf Ebene der **Konversionen muss mindestens die Intention**, bzw. die Methode zur Bestimmung der Intention modelliert werden. Dies ergibt sich aus dem Umstand, dass keine kreative Aufgabe ohne eine klare Vorstellung des Ziels, der Intention der Aufgabe erfolgreich ablaufen kann.



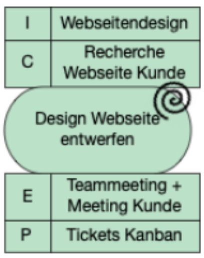


Ein Beispiel:

Ein Software-Entwicklungsteam bekommt den Auftrag für einen Kunden eine neue digitale Plattform zu konzipieren, auf denen Zulieferer Informationen austauschen können. Dafür wird eine kreative Aufgabe auf Prozesseben modelliert: "Plattform-Prototypen entwickeln". Diese kann anch ICEP Modell wie folgt spezifiziert werden:



Auf Aktivitätsebene wird die Prototypen-Aufgabe weiter spezifiziert. Dabei erhält der Front-End Entwickler die Aufgabe, ein Design der Webseite zu entwickeln.



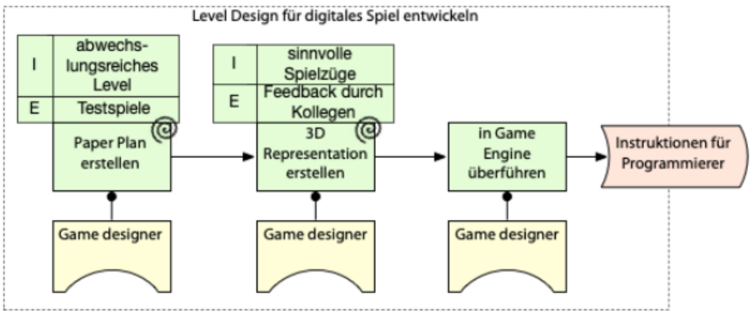
8. Gibt es zu diesen Modellierungsbeispielen Fragen, Ideen, Hinweise?

9. Beispiel eines kreativen Prozesses: digitales Game-Design

Einführung in den Prozess der von Ihnen gelesen und modelliert wird.

Game-Design besteht aus einer Reihe von kreativen Prozessen. Für ein Spiel muss die Story entwickelt werden, virtuelle Welten, Gegenstände und Personen. Ein Teilprozess dessen ist das Level-Design. Hier wird konkret ein Level, d.h. eine Spieleinheit entworfen. Dahei ergibt sich die Herausforderung, dass diese Level für den Spieler spannend sein soll, für die Art der Spielinteraktion passend und insgesamt von den bereits am Markt bekannten Spielen im besten Fall abweichen soll. Der Spieler soll eine Herausforderung darin finden, sich in diesem Level zurechtzufinden. Dadurch ergibt sich der Anspruch kreativer Arbeit.

In einem Interview mit einem Game-Designer habe ich im Detail den Prozess des Level-Designs erfasst. Hier ist der Prozess grob dargestellt.

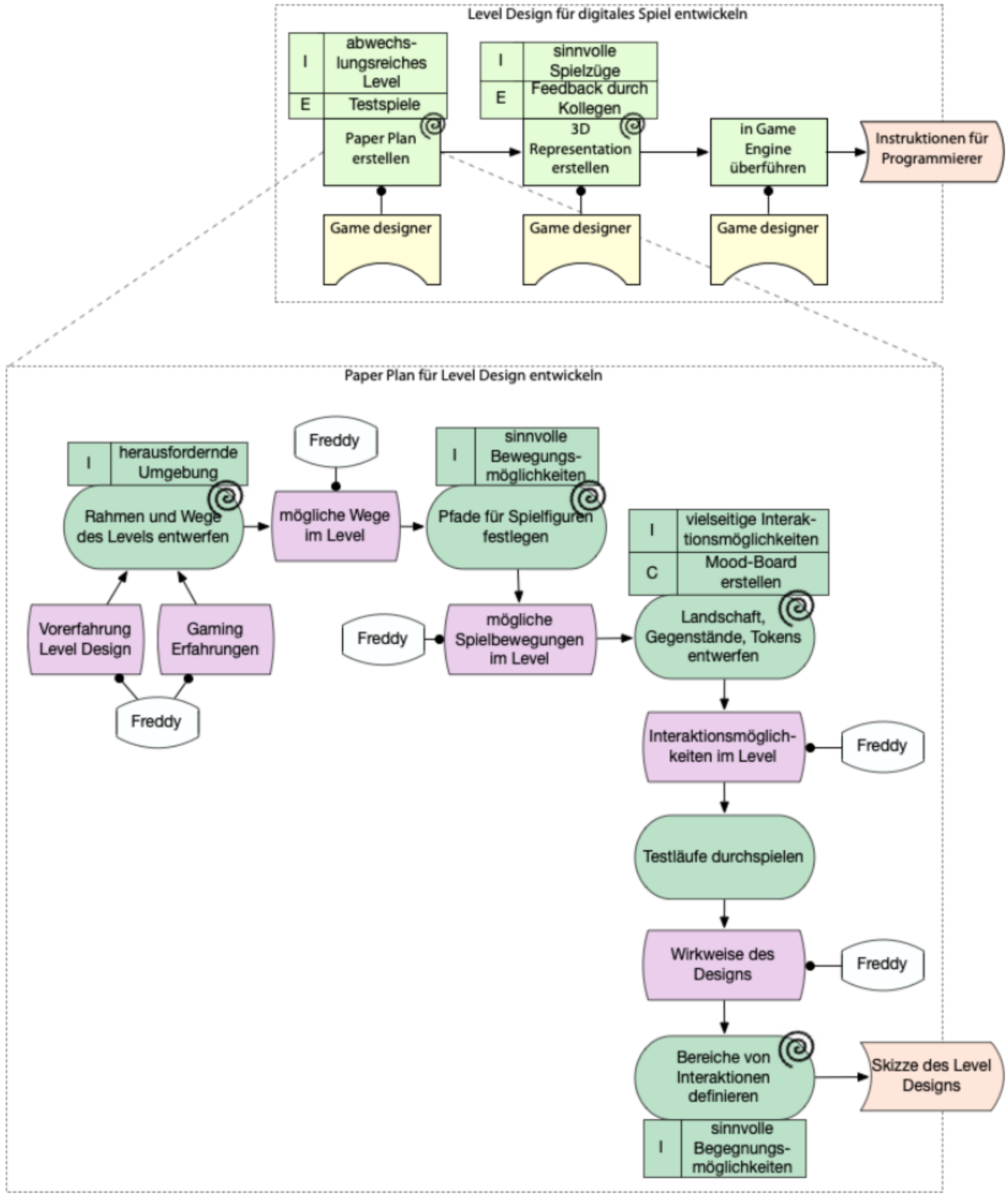


Der Prozess beschreibt die Level-Erstellung vom blanken leeren Blatt (Paper Plan erstellen), bis hin zum fertigen Design, von dem Programmieraufgaben abgeleitet werden können.

Der **Paper Plan** wird mit Stift und Papier entworfen. Hier skizziert der Game-Designer erste Pfade, Hindernisse wie Grenzen und Gegenstände, sowie potentielle Orte der Interaktion. Die Passung und die Vielfalt des Designs wird versucht zu erhöhen, indem gedanklich Spieleinteraktionen durchdacht werden. Sobald auf Papier eine zufriedenstellende Skizze geschaffen wurde, wird diese **in ein 3D Modell übertragen.** Dabei werden einfache 3D-Objekte auf einem Tisch platziert, die Perspektiven im Raum getestet und dadurch Objektpositionen angepasst. Kollegen werden zur Evaluierung des Designs hinzugezogen. Dadurch ergibt sich ein angepasstes Design, das dann im nächsten Schritt digitalisiert und **in die Game Engine überführt** wird. Hier erstellt der Game Designer ein erstes grobes digitales Modell des Spiels und **leitet konkrete Programmieraufgaben für die Spieleprogrammier*innen ab.**

Vorstellung des Prozessen der von Ihnen gelesen werden soll:

Wenn wir in die erste kreative Aufgabe auf Aktivitätseben reinzoomen, ergibt sich folgende mögliche Modellierung.



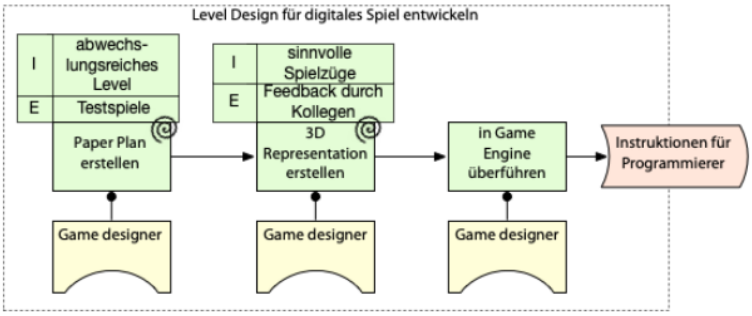
10. Versuchen Sie das obige Modell zu „lesen".

Beschreiben Sie den hier ablaufenden Prozess so umfasend wie möglich.

11. Welche Herausforderungen / Probleme / Unsicherheiten etc. erlebten Sie beim „lesen" des Modells?

12. Modellierung der 3D Modell Erstellung beim Level-Design

Wie zuvor dargestellt, wird der erarbeitete Paper-Plan in ein 3D Modell überführt.
Zur Einordnung nochmal der Überblick des Prozesses:



Der Prozess der 3D Modellerstellung wird hier im Detail beschrieben, damit dieser **von Ihnen modelliert** werden kann.
Dies können SIe gern auf Papier machen, oder auch mit Modellangelo oder der Visio/OmniGraffle-Datei. Kleiner Hinweis: die Konversionsart (Farbe der Pfeile) spielen keine Rolle und können gern schwarz gezeichnet werden.

Schicken Sie ihr fertiges Modell bitte **via Mail** zu: jhaase@lswi.de

Beschreibung des Prozesses der von Ihnen modelliert werden soll.

3D Representation des Levels erstellen:
Sobald auf Papier eine zufriedenstellende Skizze geschaffen wurde, wird diese in ein 3D Modell übertragen. Dabei werden zuerst vom Game Designer Freddy einfache 3D-Objekte auf einem Tisch platziert. Da dieser bereits Erfahrungen im Level Design hat, bringt er diese in diese Aufgabe mit hinein. Sobald alle elemente stehen werden die Perspektiven geprüft. Dadurch zeigt sich, wo und wie die Modellelemente angepasst werden müssen. Die Herausforderung ist hier das Entwerfen einer möglichst herausfordernden und spannenden Spielumgebung. Sobald ein angepasstes Modell steht, holt Freddy spontan die Kolleg*Innen im Büro dazu. Diese bringen auch Gamedesignerfahrungen mit und geben Rückmeldung zu seinem Modell. Gemeinsam brainstormen Sie, wie man das Modell noch interaktiver gestalten kann. Durch deren Diskussionen kommt Freddy auf eine Idee: das Spiel könnte noch spannender werden wenn die Fortbewegung durch Flugobjekte ermöglichen. Mit dieser Idee passt er sein Modell nochmal neu an. Sobald er mit den Anpassungen zufrieden ist, wird das 3D Modell von allen Seiten fotografiert. Diese Fotos dienen als Vorlage für den nächsten Schritt, der Überführung des Designs in die Game-Engine.

13. Welche Herausforderungen / Probleme / Unsicherheiten etc. erlebten Sie beim „scheiben" des Modells?

Im folgenden Abschnitt sollen Sie über die zuvor vorgestellten und angewandten Methode zur Erfassung typisch kreativer Prozesse reflektieren. Wenn von 'Model' oder 'Methode' die rede ist, bezieht sich dies jeweils spezifisch auf KMDL+Erweiterung zur Erfassung kreativer Prozesse.

14. Wie beurteilen Sie die folgenden Kriterien für Prozessmodelle in Bezug auf die vorgestellte Modellierungserweiterung?

Ein „Modell", auf das hier Bezug genommen wird, wäre ein KMDL-Modell mit den neuen Modellierungserweiterungen zur Erfassung kreativer Arbeit.

	nicht erfüllt				voll erfüllt
Relevanz – enthält nur Elemente, die von Bedeutung sind	○	○	○	○	○
Wirtschaftliche Effizienz – gutes Gleichgewicht zwischen modellierten Details und Modellierungsaufwand	○	○	○	○	○
Klarheit – das Modell ist lesbar und leicht zu verstehen	○	○	○	○	○
Vergleichbarkeit – Modelle folgen klaren Modellierungsregeln	○	○	○	○	○

15. Sind Sie der Meinung, dass die hinzugefügten Modellierungselemente für die kreative Arbeit relevant sind?

Bitte erläutern Sie, warum, oder warum nicht.

16. Halten Sie die Prozessmodelle, die die zusätzlichen Modellierungselemente enthalten, für effizient?

Bitte erläutern Sie, warum, oder warum nicht.

17. Sind Sie der Meinung, dass die hinzugefügten Modellierungselemente, die für die kreative Arbeit relevant sind, die Klarheit der Prozessmodelle erhöhen oder vermindern?

Bitte erläutern Sie, warum, oder warum nicht.

18. Sind Sie der Meinung, dass die zusätzlichen Modellierungselemente, die für die kreative Arbeit relevant sind, mit klaren Regeln einhergehen?

Bitte erklären Sie, warum oder warum nicht.

19. Gibt es finale Hinweise, Kritik, Anerkennung oder was auch immer Sie sich noch von der Seele schreiben wollen?

Vielen Dank für Ihre Teilnahme!

Wir möchten uns ganz herzlich für Ihre Mithilfe bedanken.

Ihre Antworten wurden gespeichert, Sie können das Browser-Fenster nun schließen.

Appendix E: Expert study – English

This appendix shows the expert study as translated into English. KMDL modeling experts were asked to apply and rate the modeling extensions for creative works.

0% completed

Dear KMDL experts,

As you learned last summer semester, **KMDL is used to model knowledge-intensive business processes**. Now, many knowledge-intensive processes are also creative-intensive. Whenever there is a requirement that the process should lead to a novel and useful result. So far, there are few - in my view inadequate - **ways to capture creativity-specific process characteristics in process modeling**. Therefore, I have developed a modeling extension that attempts to represent the aspects relevant to the creative process using KMDL.

The following study serves to critically examine my modeling extension. **You will have the role of user, critic and, if possible, visionary.**

The study contains the following topics:

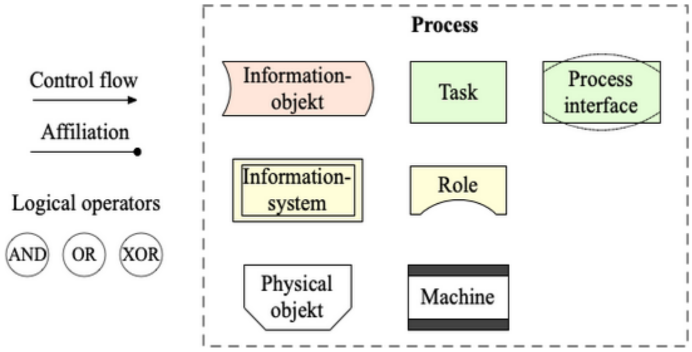
Recap of KMDL modeling to refresh what was learned at that time.
Presentation of my modeling extension with first critical evaluations.
A process model is shown for you to read and describe.
A process is described that you are to model.
Open questions and items to evaluate the method follow.

Approximately 2h are targeted for working through the study. You can interrupt the study at any time and continue it at a later time.

Please feel free to contact me with any questions: jhaase@lswi.de

Have fun!

This serves as a review of the modeling basics with KMDL.



As a reminder, these are the KMDL process elements.

Task: A task represents a set of activities that are not further refined within the selected level of detail, at least from a process perspective. Tasks can be repeated in the process and are used to structure processes. For the labeling of tasks, the object verb is used by default.

Role: Each task at the process level is assigned to at least one role that is responsible for processing the task. Roles are described in a person-neutral way: No names are given, only the roles of the people in which they are involved in the task in the process are described. Groups of people can also be represented with the department as the role, e.g. developer or production.

Information system: represents the information or communication technology used in the process. From the point of view of information procurement, an information system is used for the computer-aided acquisition, storage, processing, maintenance, analysis, use, disposition, transmission and visualization of information.

Process interface: Process interfaces are used to link individual processes to form process chains. Process interfaces also offer the possibility of cross-process evaluation.

Information object: Information is modeled as an "information object". Information can exist as text, drawings or diagrams on paper and in electronic form, as documents, audio files, bitmaps or video formats. Information exists independently of people and can contain explicable knowledge about people. Information objects can be input or output objects of processes. Information objects are represented in the process perspective and at the system boundaries of an activity. Examples of information objects are "recipe" or "standard operating procedure". The modeler decides whether an information object should be considered in the process perspective or as a personal artifact.

Physical object: Physical objects are modeled if they are required for modeling knowledge-intensive processes. Physical objects are assumed to contain knowledge obtained through appropriate research methods. Similarly, it can be shown what knowledge is necessary to create or produce a physical object.

Machine: In the age of cyber-physical production systems, machines can also serve as information carriers. Due to the data-processing function of machines, it has proven useful to model them with their own symbol, since, unlike information systems, they also have a physical representation.

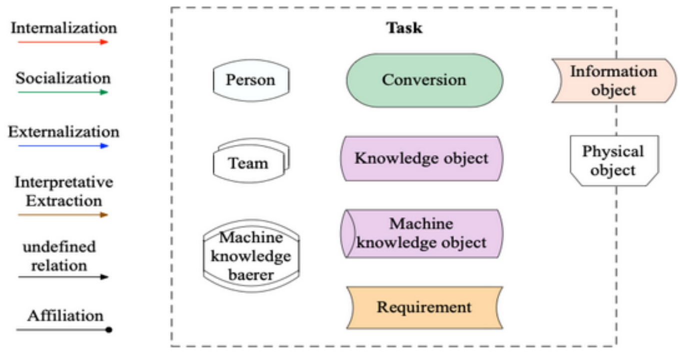
Relation: Two forms are distinguished for the description of the relations: Assignment of roles/information systems to tasks (affiliation) and representation of the task flow via directed arrows (control flow).

Logical operators:
Conjunction (AND; "a and b"), represented by the "AND" symbol in process models.

Disjunction (XOR; "a or b"), which represents an exclusive OR

Adjunction (OR; "a or b or [a and b]"), which is represented as an inclusive OR

This serves as a review of the modeling basics with KMDL.



As a reminder, these are the KMDL activity elements.

Task: The task provides the reference between the knowledge conversions in the activity perspective and the process perspective. For example, a task in the activity view is a reference to a task in the process view.

Knowledge object(s): Describe artifacts that represent the knowledge of a person or team. The knowledge object includes the mapping of the competencies, experiences, skills, and attitudes of the person or team. Knowledge objects can be input or output objects of conversions. If a knowledge object is an input object of a conversion, its content contributes to the conversion; if it is an output object of the conversion, it is a result of the conversion. Knowledge objects are assigned to a person or a team. Each knowledge object modeled in this way indicates that this person has this knowledge. If a machine has knowledge, a separate symbol for machine knowledge can be used for its knowledge.

Conversion: Conversions describe the creation, application and distribution of knowledge as well as the creation, distribution and preservation of information. They have input and output objects represented by information and knowledge objects, respectively. The conversion type and the conversion mode are uniquely determined by the input and output objects of a conversion. Conversions are always linked by knowledge and information objects as input and output objects. A direct linking of two conversions is factually incorrect, since the meaning of the conversion as a descriptor of the knowledge transformation is lost.

Information object(s): Generally represent information. While knowledge objects are always represented within an activity, information objects are always represented only at the system boundary of an activity, since they "originate" from the process perspective.

Requirement: The knowledge-related requirements that are placed on a conversion in order to carry it out successfully are captured by the "requirement" object. Requirements can be covered by the knowledge of people or teams. A requirement can be divided into technical, methodological, social and action-oriented requirements, where the requirement object is modeled directly to the object through the "affiliation" edge.

Person or undefined person: The "person" object represents a real person or, in the case of a target model, an ideal person in an organization who performs tasks in a business process and takes on one or more roles in the process. Persons are knowledge carriers. For this reason, knowledge objects are modeled with the edge "affiliation" to the knowledge carrier person, whereby the salutation with the surname is used to identify persons, e.g. "Mr. Meyer" or "Ms. Schmidt".

Team: A team represents a group of people working together on a knowledge-intensive task. Teams are also knowledge carriers. The knowledge modeled in a team (in the form of knowledge objects) represents the collective knowledge of the team. Teams are named either by the name of a department or by the individual name of a project team, e.g. marketing or product team "Candy".

Machine knowledge carrier: If machines have knowledge and this is to be taken into account in the modeling, a separate symbol for the bearer of machine knowledge can be used for additional differentiation.

Conversion types: The conversion types describe the type of knowledge conversion: socialization, externalization, internalization, extracting interpretation, and undefined. Note: the following does not discuss this differentiation.

The problem outlining

Creative work is characterized in particular by the incorporation of novel ideas into work activities, resulting in new products. These **creative processes are usually not very predictable, exhibit iteration loops and a high degree of process flexibility**. This makes them particularly difficult for modeling approaches to grasp.

There are many practical examples where employees, or even entire teams, go through creative processes on a very regular basis. Due to the high degree of repetition, it is worthwhile to also record these in the form of modeling.

Previous modeling approaches - including KMDL - abstract a creative task. For example, "develop product idea" or "design advertising campaign" is then defined as a task. This usually contains a number of tasks, which, however, are difficult to predict and idle to model due to the creative character. I.e., **the challenge arises that creative processes should be modeled "better", i.e., more concretely, than has been possible so far**, but without falling into the small-small of each individual activity.

The proposed solution

Based on an ethnographic study with software developers who repeatedly developed short-form rapid prototypes in teams, I was able to define **a set of patterns in their workflows** that I used as the basis of the following modeling extension. **My basic idea here is to preserve the modeling principle of KMDL** and **to model at least cornerstones of the creative process** as well for creative tasks that are difficult to analyze in more detail.

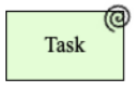
These four characteristics are:

Intention -- what is the goal of the task?
Creation -- what ideas/possibilities do I see to get to the goal?
Evaluation -- how do the ideas prove themselves?
Planning -- what do I need to do specifically to get to the goal? what are the next steps?

These four elements - called the ICEP model - show core characteristics of creative work: since path and goal are (partly) unknown in creative tasks, they have to be worked out in the course of the process. The **development of an intention is a prerequisite for successful creative work in a professional context**. Without this, there would otherwise be no evaluation criterion as to whether one is on the right path. Creation contains the method to come to the new ideas. Evaluation contains the method or the responsibility to evaluate the fit of the idea(s) to the goal. Planning is a constant element of creative work, because only in the process can be concretized**.**

1. Are there any questions, ideas, notes about this rough concept description?

To declare a task as creative it can be marked with a swirl at the task and conversion icon.

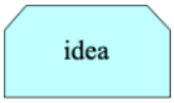


Both symbols are modeled analogously to the previous task and conversion elements.

2. What association/s do you associate with this swirl?

3. Are there any questions, ideas, notes about this modeling element?

A typical aspect in the creative process is the (further) development of ideas. Therefore, a new element is inserted.



An "idea" can be modeled as a preliminary stage of a product, e.g., what comes out of a conversion as a result. However, it can also be modeled directly on a person if this person introduces an idea in a conversion. **An idea is modeled analogously to a knowledge object, and also named concretely according to the current status in the process.** The differentiation of the idea from the knowledge object is that this is to be further developed significantly in the creative process, and converted as best as possible into a creative output object.

4. What association/s do you associate with this idea symbol?

5. Are there any questions, ideas, notes about this modeling element?

As described before, creative work can be modeled by 4 characteristics: Ideation - Creation - Evaluation - Planning. **The capital letters in the symbols declare the category, the text on the right can be instantiated.** I.e. here can be formulated briefly how the respective category is implemented.

I	Intention
C	Creation
E	Evaluation
P	Planning

I: describes the goal of the task, i.e. the creative challenge.

C: method by which creative ideas are to be generated

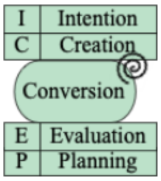
E: method by which the course of the process is critically scrutinized

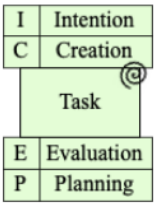
P: method used to schedule (team) work

6. What association/s do you associate with these box symbols?

7. Are there any questions, ideas, notes about these modeling elements?

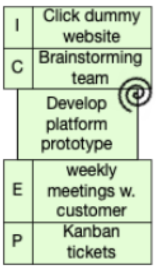
The ICEP elements are modeled directly to the task and conversion. Thus, each creative task and knowledge transfer (conversion) can be specified. **Not all aspects have to be specified.** At the conversion level, **at least the intention,** or the method for determining the intention, must be modeled. This results from the fact that no creative task can run successfully without a clear idea of the goal, the intention of the task.



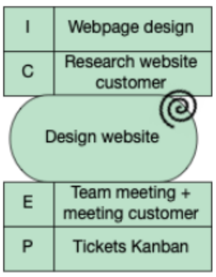


An example:

A software development team is given the task of designing a new digital platform for a customer on which suppliers can exchange information. For this, a creative task is modeled at the process level: "Develop platform prototypes". This can be specified in the ICEP model as follows:



At the activity level, the prototype task is further specified. Here, the front-end developer is given the task of developing a design for the website.



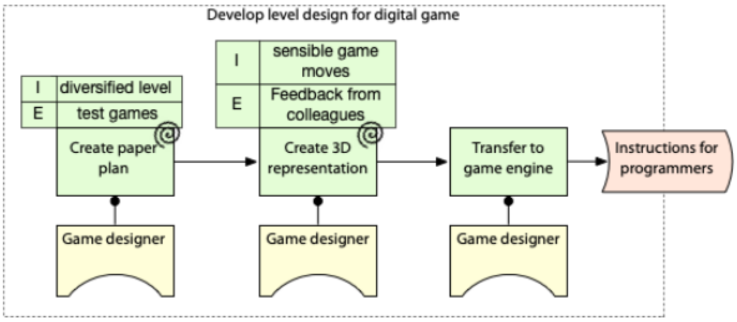
8. Are there any questions, ideas, notes about these modeling examples?

9. Example of a creative process: digital game design

Introduction to the process you are reading and modeling.

Game design consists of a series of creative processes. For a game, the story needs to be developed, virtual worlds, objects and people. A sub-process of this is level design. Here, a level, i.e. a game unit, is specifically designed. The challenge is that this level should be exciting for the player, suitable for the type of game interaction and, in the best case, differ from the games already known on the market. The player should find a challenge in finding his way through this level. This results in the demand for creative work.

In an interview with a game designer, I captured the process of level design in detail. Here is a rough outline of the process.

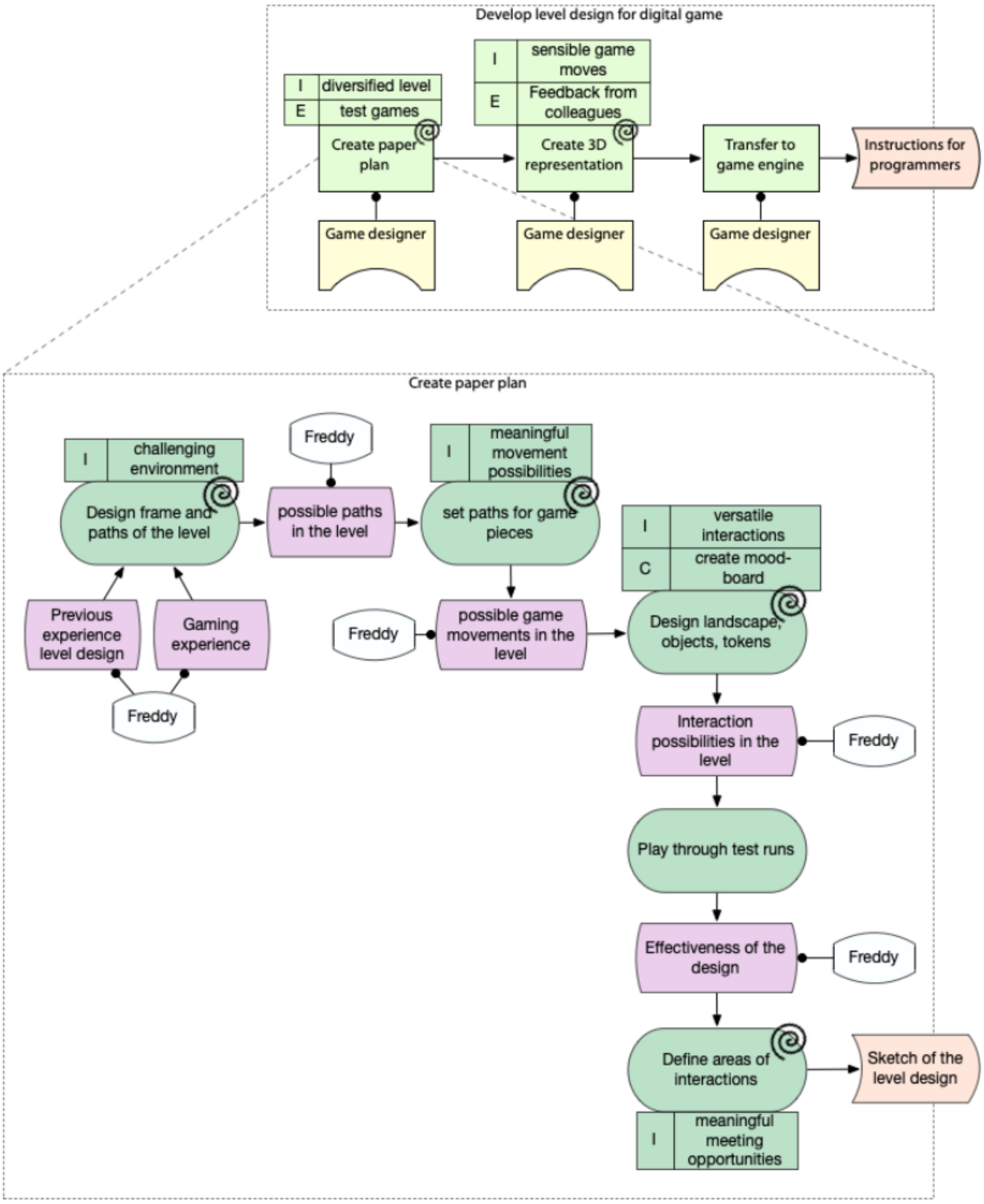


The process describes the level creation from a blank sheet of paper (creating a paper plan), to the final design from which programming tasks can be derived.

The **Paper Plan** is designed with pen and paper. Here the game designer sketches initial paths, obstacles such as boundaries and objects, and potential places of interaction. The fit and variety of the design is attempted to increase by mentally thinking through game interactions. Once a satisfactory sketch is created on paper, it **is transferred to a 3D model**. This involves placing simple 3D objects on a table, testing perspectives in space, and thereby adjusting object positions. Colleagues are brought in to evaluate the design. This results in an adapted design, which is then digitized in the next step and **transferred to the game engine**. Here, the game designer creates an initial rough digital model of the game and **derives concrete programming tasks for the game programmers.**

Presentation of the process you are going to read:

If we zoom in to the first creative activity-level task, we get the following possible modeling.



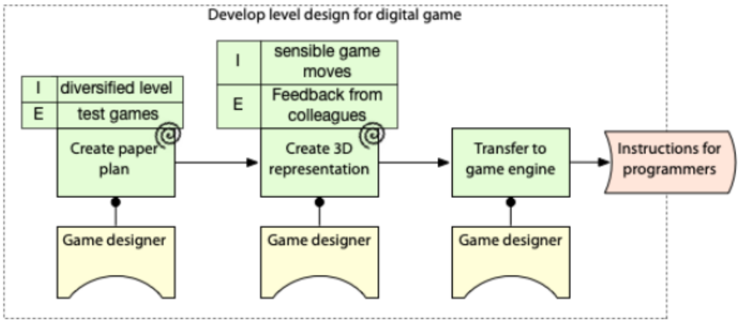
10. Try to "read" the model above.

Describe the process taking place here as comprehensively as possible.

11. What challenges / problems / uncertainties etc. did you experience when "reading" the model?

12. Modeling 3D model creation in level design

As shown before, the developed paper plan is transferred into a 3D model.
For classification, here is an overview of the process:



The process of 3D model creation is described here in detail so that you can model it.

You are welcome to do this on paper, or with Modellangelo or the Visio/OmniGraffle file. Small hint: the conversion type (color of the arrows) do not play a role and can be drawn in black.

Please send your **finished model via mail** to: jhaase@lswi.de.

Description of the process you want to model.

Create 3D representation of the level:
Once a satisfactory sketch is created on paper, it is transferred to a 3D model. First, the game designer Freddy places simple 3D objects on a table. Since he already has experience in level design, he brings this into this task. As soon as all elements are in place, the perspectives are checked. This shows where and how the model elements need to be adjusted. The challenge here is to design the most challenging and exciting game environment possible. As soon as an adjusted model is ready, Freddy spontaneously calls in his colleagues in the office. They also bring game design experience with them and give feedback on his model. Together they brainstorm how to make the model even more interactive. Through their discussions, Freddy comes up with an idea: the game could be even more exciting if the locomotion were made possible by flying objects. With this idea, he readjusts his model again. Once he is satisfied with the adjustments, the 3D model is photographed from all sides. These photos serve as a template for the next step, the transfer of the design into the game engine.

13. What challenges / problems / uncertainties etc. did you experience when “writing” the model?

In the following section, you are asked to reflect on the previously presented and applied method for capturing typical creative processes. Whenever 'model' or 'method' is mentioned, it refers specifically to KMDL+Extension for capturing creative processes.

14. How would you evaluate the following criteria for process models in regard to the modeling extension presented?
A "model" referred to in the items would be a KMDL model with the new modeling extensions to capture creative work.

	not fulfilled				fulfilled fully
Relevance – only include elements which carry meaning	○	○	○	○	○
Economic efficiency – good balance between details modeled and modelling efforts	○	○	○	○	○
Clarity – model is readable and easy to understand	○	○	○	○	○
Comparability – models follow clear modeling rules	○	○	○	○	○

15. Do you consider the added modeling elements relevant for creative work?
Please explain why, or why not.

16. Do you consider the process models which include the added modeling elements efficient?
Please explain why, or why not.

17. Do you think the added modeling elements relevant for creative work add or diminish clarity of the process models?
Please explain why, or why not.

18. Do you think the added modeling elements relevant for creative work come with clear rules? Please explain why or why not.

19. Any final notes, criticism, appreciation, or whatever else you want to get off your chest?

Thank you for your participation!

We would like to thank you very much for your help.

Your answers have been saved, you can now close the browser window.

Appendix F: Expert study, models read by experts

The four experts in the evaluation study ”read” a process model (cf. Figure 6.10, on page 205). Their answers are presented in their original German version, followed by an English translation.

Expert 1

Das Designen eines Levels für ein digitales Spiel erstreckt sich über drei Aufgaben: Paperplan erstellen, 3D Präsentation erstellen und diese in eine Game Engine überführen. Die Aufgaben werden vom Game Designer ausgeführt, in diesem Fall Freddy. Die erste Aufgabe soll ein abwechslungsreiches Level zum Ziel haben und die Erreichung wird durch Testspiele kontrolliert.

In der ersten Aufgabe entwirft Freddy zunächst einen Rahmen und Wege des Levels, mit dem Ziel, dass die Umgebung für die zukünftigen SpielerInnen herausfordernd ist. Seine Vorerfahrung im Level Design sowie seine Gaming Erfahrungen unterstützen ihn dabei. Sobald der Rahmen steht, werden Pfade für die Spieler festgelegt, sodass diese sinnvolle Bewegungsmöglichkeiten haben. Daraufhin werden mithilfe eines Mood-Boardes Landschaft, Gegenstände und Tokens entworfen, sodass die Spielenden vielseitige Interaktionsmöglichkeiten haben. Das Durchspielen der Testläufe scheint ein unkreativer Schritt zu sein, der aber die Wirkweise des Designs verdeutlicht. Dadurch kann Freddy Bereiche für Interaktionen definieren, um sinnvolle Bewegungsmöglichkeiten zu schaffen. Diese Bereiche ergeben die Skizze des Level Designs.

Designing a level for a digital game spans three tasks: Creating a paper plan, creating a 3D presentation, and transferring it to a game engine. The tasks are performed by the game designer, in this case Freddy. The first task should aim at a varied level and the achievement is controlled by test games.

In the first task, Freddy first designs a framework and paths of the level, with the goal that the environment is challenging for future players. His previous experience in level design as well as his gaming experience support him in this process. Once the framework is in place, paths are defined for the players so that they have meaningful movement options. Then, using a mood board, landscape, items, and tokens are designed so that players have versatile interaction options. Playing through the test runs seems like an uncreative step, but it illustrates how the design works. This allows Freddy to define areas for interactions to create meaningful movement possibilities. These areas result in the sketch of the level design.

Expert 2

Freddy nutzt sein seine Erfahrung über Level Design und Gaming um Rahmen und Wege eines Levels zu entwerfen mit der Absicht eine herausfordernde Spielumgebung für den Nutzer zu schaffen.

Mit dem Hintergedanken von sinnvollen Bewegungsmöglichkeiten (Figuren können nicht durch Wände gehen, müssen über Wände klettern oder ähnliche) werden Pfade festgelegt.

Um vielseitige Interaktionsmöglichkeiten zu bieten werden mithilfe eines Mood-Boards (eine mirunbekannte Methode) die Landschaft, Gegenstände und Tokens entworfen.

Anschließend können Testläufe durchgespielt werden.

Mit Freddys Wissen über die Wirkweise des Desigs werden Bereiche von Interaktionen definiert, um sinnvolle Begegnungsmöglichkeiten zu erstellen. Letztendlich entsteht daraus eine Skizze des Level Designs

---

Freddy uses his experience in level design and gaming to design the framework and paths of a level with the intention of creating a challenging game environment for the user.

With the idea of meaningful movement, (characters can't walk through walls, have to climb over walls or similar) paths are defined.

To provide versatile interaction possibilities, the landscape, objects, and tokens are designed with the help of a mood board (a method unknown to me).

Afterward, test runs can be played through.

Using Freddy's knowledge of how the design works, areas of interaction are defined to create meaningful encounter possibilities. Ultimately, this results in a sketch of the level design.

Expert 3

Bei der Entwicklung eines Paper Plans für ein Level Design, entwirft Freddy Rahmen und Wege des Levels. Dabei bringt er seine Vorerfahrung über das Level Design und über Gaming mit ein. Das Ziel ist es eine herausfordernde Umgebung zu kreieren. Danach werden Spielfiguren festgelegt, damit sinnvolle Bewegungsmöglichkeiten möglich sind. Nach der Fertigstellung dder Pfade werden Landschaften, Gegenstände und Tokens entworfen. Um vielseitige Interaktionsmöglichkeiten zu schaffen, wird ein Mood-Board erstellt. Daraufhin werden Testläufe durchgespielt. Mit dem Wissen über die Wirkweise des Designs definiert

Freddy die Bereiche der Interaktionen, damit sinnvolle Begegnungsmöglichkeiten geschaffen werden können. Daraus entsteht eine Skizze des Level Designs.

When developing a paper plan for a level design, Freddy sketches out the framework and pathways of the level. He brings his prior experience with level design and gaming to the table. The goal is to create a challenging environment. Then, game pieces are determined to allow for meaningful movement options. After completing the paths, landscapes, items, and tokens are designed. To create versatile interaction possibilities, a mood board is created. Test runs are then played through. Knowing how the design will work, Freddy defines the areas of interaction so that meaningful encounter opportunities can be created. From this, a sketch of the level design is created.

Expert 4

Die Erstellung des Paper Plans für das Level Design beginnt damit, dass der Rahmen und die Wege des Levels entworfen werden, dies ist eine kreative Conversion. Dazu nutzt Freddy als Game Designer seine Vorerfahrung im Level Design und seine Gaming Erfahrung. Sein Ziel ist Entwicklung einer herausfordernden Umgebung. Anschließend werden Pfade für die Spielfiguren festgelegt, wobei die Bewegungsmöglichkeiten sinnvoll entwickelt werden sollen. Daraufhin werden Landschaft, Gegenstände und Tockens entworfen, wobei vielfältige Interaktionsmöglichkeiten geboten werden sollen. Dies soll durch die Erstellung eines Moodboards gewährleistet werden. Anschließend werden Testläufe durchgeführt, wodurch Freddy als Game Designer Kenntnisse über die Wirkweise des Designs gewinnt. Darauf basierend definiert er Bereiche von Interaktionen, die sinnvolle Begegnungsmöglichkeiten gewährleisten sollen. Das Ergebniss dieser kreativen Aufgaben ist die Skizze des Level Designs.

The creation of the paper plan for the level design starts with designing the framework and the paths of the level; this is a creative conversion. For this, Freddy, as a game designer, uses his previous experience in level design and his gaming experience. His goal is the development of a challenging environment. Paths for the game characters are then defined, with the movement options being developed in a meaningful way. This is followed by designing landscapes, objects, and tokens while providing multiple interaction possibilities. This is to be ensured by the creation of a mood board. Subsequently, test runs are carried out, whereby Freddy as a game designer gains knowledge about how the design works. Based on this, he defines areas of interaction that should ensure meaningful encounter possibilities. The result of these creative tasks is the sketch of the level design.

Appendix G: Expert study, created models

The models produced by the four experts in the evaluation study as discussed in Section 6.2.5 on page 209, are presented in their original German version.

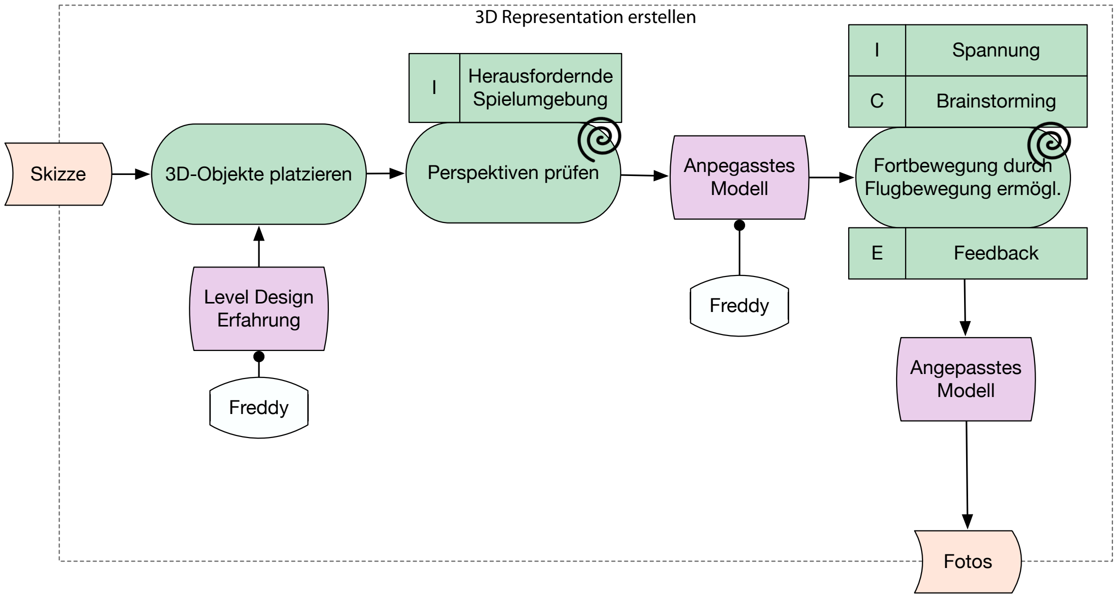


Figure A.G.1: Modeling task from expert 1 in German

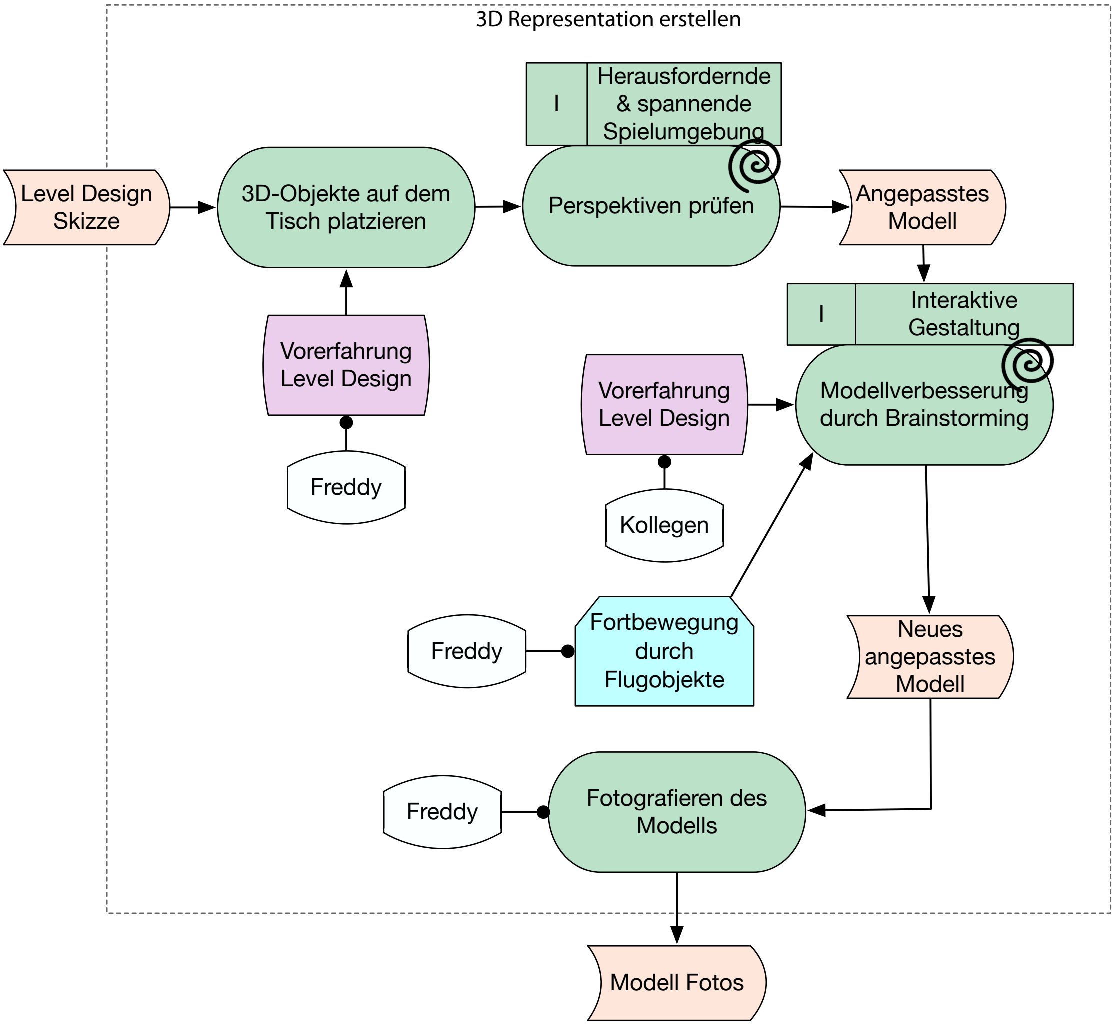


Figure A.G.2: Modeling task from expert 2 in German

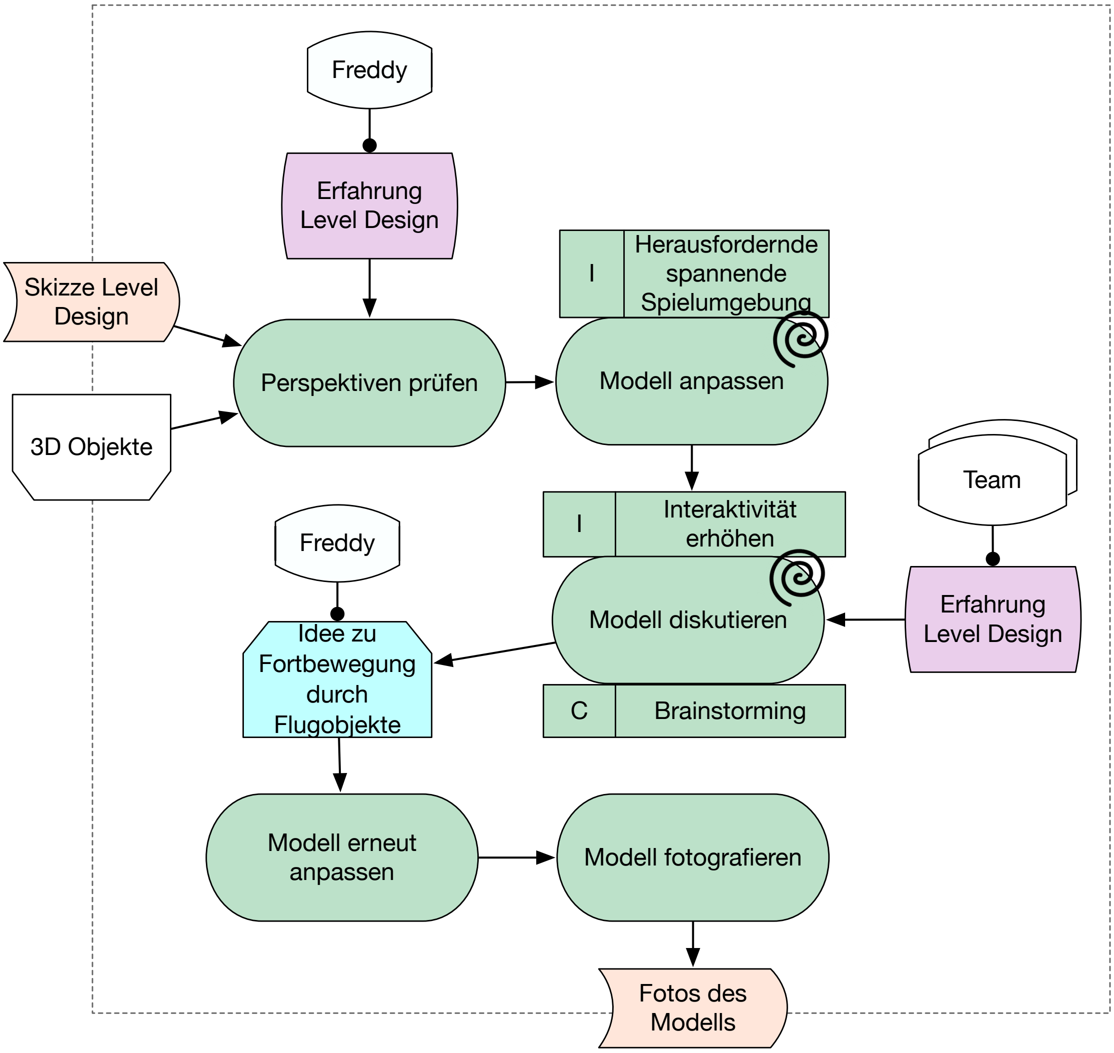


Figure A.G.3: Modeling task from expert 3 in German

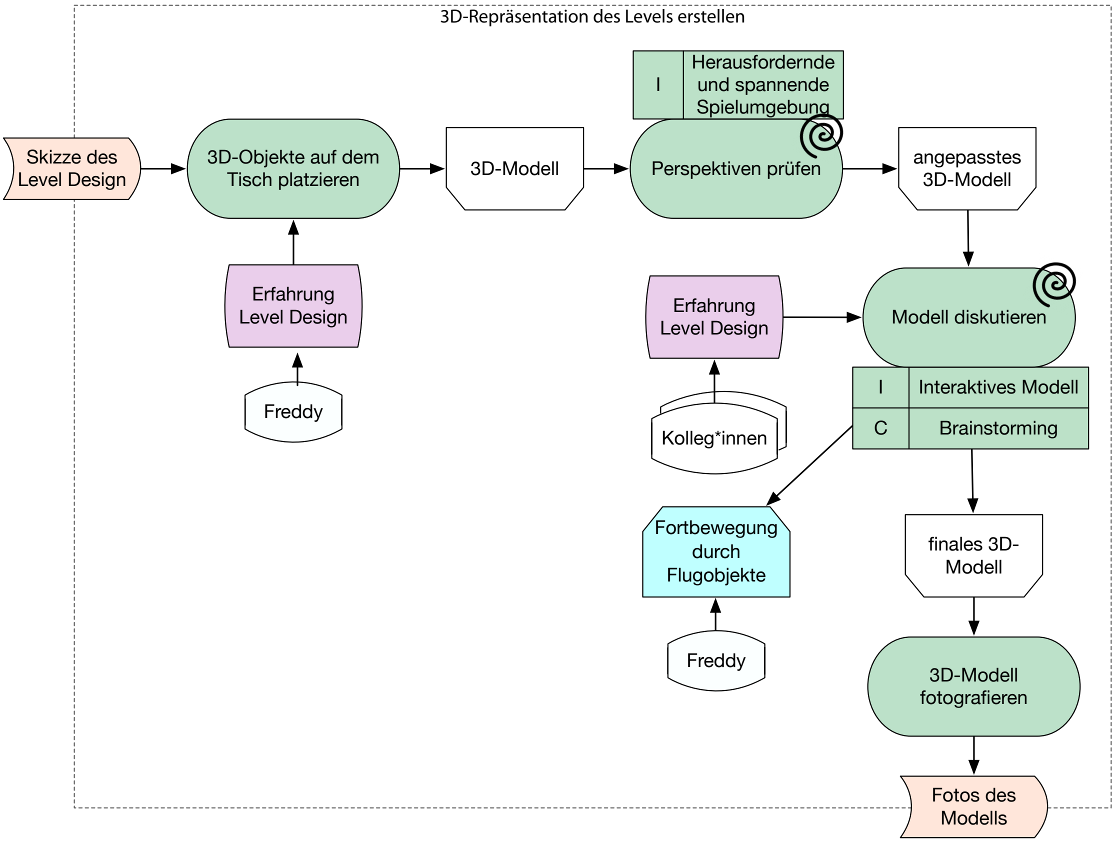


Figure A.G.4: Modeling task from expert 4 in German

Appendix H: Evaluation survey – German

This appendix shows the evaluation survey in its original form in German. KMDL modeling users were asked to rate the modeling enhancements for creative works.

weizenbaum
institut

Werte KMDL-Expert*innen,
wie Sie bereits gelernt haben, dient **KMDL der Modellierung von wissensintensiven Geschäftsprozessen.** Nun sind viele wissensintensive Prozesse auch kreativ-intensiv. Immer dann, wenn der Anspruch besteht, dass der Prozess zu einem neuwertigen und nützlichen Ergebnis führen soll. Bislang gibt es wenige **Möglichkeiten kreativitätsspezifische Prozesscharakteristika in der Prozessmodellierung festzuhalten.** Daher habe ich eine Modellierungserweiterung entwickelt, die versucht die für den kreativen Prozess relevanten Aspekte mit KMDL darzustellen.
Die Folgende Studie dient dazu, meine Modellierungserweiterung kritisch zu hinterfragen. **Sie haben dabei die Rolle des Anwenders und Kritikers.**
Die Studie enthält folgende Themeneblöcke:

1. Vorstellung meiner Modellierungserweiterung
2. Es wird ein Prozess modelliert, bei denen Teile von Ihnen passend zugeordnet werden sollen.
3. Es folgen offene Fragen und Items zur Evaluierung der Methode.

Für die Durcharbeitung der Studie werden **etwa 10-15 Min** anvisiert. Sie können jederzeit die Studie unterbrechen und zu einem späteren Zeitpunkt weiterführen.
Bei Fragen stehe ich gern zur Verfügung: jennifer.haase@hu-berlin.de

Viel Spaß!

Die Problemskizzierung

Kreative Arbeit zeichnet sich insbesondere dadurch aus, dass neuwertige Ideen in die Arbeitsaktivitäten einfließen, wodurch neue Produkte entstehen. Diese **kreativen Prozesse sind meist wenig vorhersehbar, weisen Itterationsschleifen und ein hohes Maß an Prozessflexibitlität** auf. Damit sind sie für Modellierungsansätze besonders schwer zu greifen.
Es gibt viele Praxisbeispiele wo Mitarbeiter, oder auch ganze Teams, sehr regelmäßig kreative Prozesse durchlaufen. Aufgrund des hohen Wiederholungsgrades lohnt es sich, auch diese in Form von Modellierungen festzuhalten.
Bisherige Modellierungsansätze - auch KMDL - abstrahiert eine kreative Aufgabe. Bspw. wird dann "Produktidee entwickeln" oder "Werbekampagne konzipieren" als Aufgabe definiert. Diese enthält meist eine Reihe von Aufgaben, die aber aufgrund des kreativen Charakters nur schwer vorhersehbar und müßig zu modellieren sind. D.h. **es ergibt sich die Herausforderung, dass kreative Prozesse "besser", also konkreter modelliert werden sollten,** als bislang möglich, ohne jedoch in das klein-klein jeder einzelnen Aktivität zu fallen.

Der Lösungsvorschlag

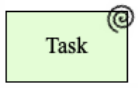
Auf Basis einer ethnografischen Studie konnte ich **eine Reihe an Mustern in kreativen Arbeitsabläufen definieren,** die ich als Grundlage der folgenden Moderllierungserweiterung genutzt habe. Meine **grundlegende Idee ist dabei, das Modellierungsprinzip von KMDL zu bewahren** und für kreative Aufgaben, die nur schwer eine detailliertere Analyse ermöglichen, **zumindest Eckpunkte des kreativen Prozesses mit zu modellieren.**

Diese vier Charakteristika sind:
Intention -- Was ist das Ziel der Aufgabe?
Creation -- Welche Ideen/Möglichkeiten sehe ich zum Ziel zu gelangen?
Evaluation -- Wie bewähren sich die Ideen?
Planning -- Was muss ich konkret tun um zum Ziel zu kommen? Was sind die nächsten Schritt?

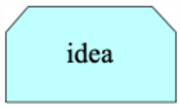
Diese vier Elemente - ICEP-Modell genannt - weisen Kerncharakteristika kreativer Arbeit auf: da bei kreativen Aufgaben Weg und Ziel (zum Teil) unbekannt sind, müssen diese im Laufe des Prozesses erarbeitet werden. Dabei ist **die Erarbeitung einer *Intention* eine vorraussetzung für die erfolgreiche kreative Arbeit im Berufskontext.** Ohne diese gäbe es sonst kein Evaluationskriterium, ob man auf dem richtigen Weg ist. *Creation* enthält die Methode um zu den neuen Ideen zu kommen. *Evaluation* die Methode oder auch die Verantwortlichkeit, um die Passung der Idee(n) zum Ziel zu bewerten. *Planning* ist ein konstantes Element kreativer Arbeit, da im Prozess erst der Ablauf konkretisiert werden kann.

Gibt es zu dieser groben Konzeptbeschreibung Fragen, Ideen, Hinweise?

Um eine **Aufgabe als kreativ zu deklarieren** kann diese mit einem Kringel am Aufgaben- und Konversions-Symbol versehen werden.



Ein typischer Aspekt im kreativen Prozess ist die (weiter)Entwicklung von Ideen. Daher wird ein neues Element eingefügt.



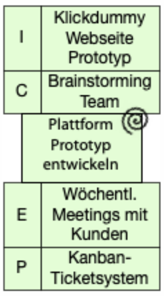
Eine "Idee" kann als Vorstufe eines Produkts modelliert werden, was bspw. aus einer Konversion als Ergebnis herauskommt. Es kann aber auch an eine Person direkt ranmodelliert werden, wenn diese eine Idee in einer Konversion einbringt. **Eine Idee wird analog einem Wissensobjekt modelliert, und auch nach dem aktuellen Stand im Prozess konkret benannt.** Die Differenzierung der Idee vom Wissensobjekt ist, dass dies maßgeblich im kreativen Prozess weiterentwickelt, und bestmöglich in ein kreatives Ausgangsobjekt umgewandelt werden soll.

Wie zuvor beschrieben lässt sich kreative Arbeit durch 4 Charakteristika modellieren: Ideation - Creation - Evaluation - Planning. Die **Großbuchstaben in den Symbolen deklarieren die Kategorie, der Text rechts kann instantiiert werden.** D.h. hier kann knapp formuliert werden, wie die jeweilige Kategorie umgesetzt wird.

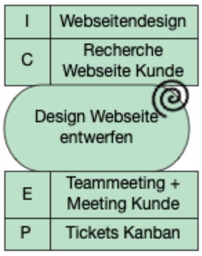
I	Intention
C	Creation
E	Evaluation
P	Planning

I: beschreibt das Ziel der Aufgabe, also die kreative Herausforderung
C: Methode, mit der kreative Ideen hervorgebracht werden sollen
E: Methode, durch die der Prozessverlauf kritisch hinterfragt wird
P: Methode, mit der die (Team)Arbeit zeitlich geplant wird

Ein Beispiel:
Ein Software-Entwicklungsteam bekommt den Auftrag für einen Kunden eine neue digitale Plattform zu konzipieren, auf denen Zulieferer Informationen austauschen können. Dafür wird eine kreative Aufgabe auf Prozesseben modelliert: "Plattform-Prototypen entwickeln". Diese kann nach ICEP Modell wie folgt spezifiziert werden:



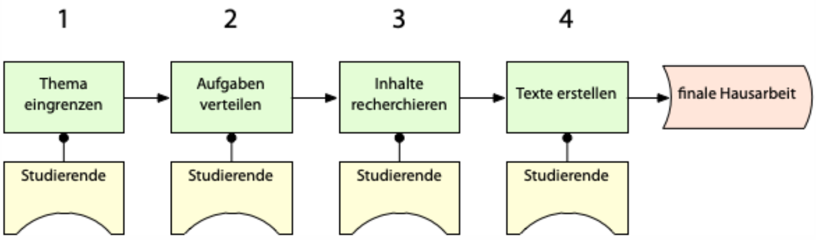
Auf Aktivitätsebene wird die Prototypen-Aufgabe weiter spezifiziert. Dabei erhält der Front-End Entwickler die Aufgabe, ein Design der Webseite zu entwickeln.



Gibt es zu diesem Beispiel Fragen, Ideen, Hinweise?

Eine Anwndungsübung am Beispiel eines kreativen Prozesses: Hausarbeit innerhalb einer Studierendengruppe erstellen

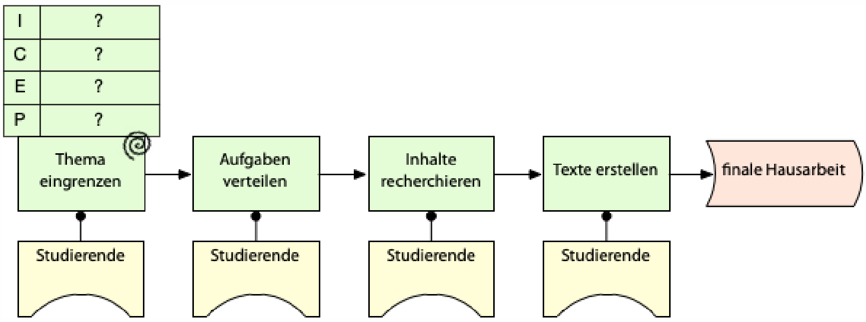
Stellen Sie sich folgenden kreativen Arbeitsprozess vor: Sie sind Teil eines 5-köpfigen Teams, dass innerhalb eines Semesters zum Thema "Die Zukunft KI-gestützter Produktionsprozesse" eine Hausarbeit erarbeiten soll. Ihr Vorgehen könnte grob vereinfacht in folgende Schritte eingeteilt werden:



Welche der vier Aufgaben ist bzw. sind aus Ihrer Sicht kreativ-intensiv?

- [ ] Aufgabe 1
- [ ] Aufgabe 2
- [ ] Aufgabe 3
- [ ] Aufgabe 4

Angenommen der erste Prozessschritt "Thema eingrenzen" zum Thema "Die Zukunft KI-gestützter Produktionsprozesse" wird nach dem ICEP-Prinzip modelliert. Welche Aussagen könnten dann I, C, E, und P zugeordnet werden? Welche Aussagen passen nicht dazu?



Ordnen Sie die Aussagen (Items) links der jeweiligen passenden Kategorie zu. Es sind mehrere Zuordnungen pro Kategorie möglich.

Items

- Kaffeepause
- Gruppen-Brainstorming
- spannnendes, konkretes Thema
- Produktionskontext definieren
- Gruppendiskussion
- Zoom-Call
- 2h-Meeting
- erste Internetrecherche
- Dozenten mailen
- Aufgaben verteilen

I - Intention

C - Creation

E - Evaluation

P - Planning

unpassend

Wie beurteilen Sie die Modellierungserweiterung für kreative Arbeit mit KMDL?
Bitte vergeben Sie die Option "kann ich nicht einschätzen" nur, wenn es unvermeidlich erscheint.

	stimme gar nicht zu	stimme nicht zu	weder noch	stimme zu	stimme voll zu	kann ich nicht einschätzen
Ich fand die Vorgehensweise bei der Anwendung der Methode komplex und schwer nachvollziehbar.	◯	◯	◯	◯	◯	◯
Ich bin <u>nicht</u> zuversichtlich, dass ich jetzt in der Lage bin, diese Methode in der Praxis anzuwenden.	◯	◯	◯	◯	◯	◯
Die Anwendung dieser Methode würde es erleichtern, große Prozessmodelle an die Benutzer zu kommunizieren.	◯	◯	◯	◯	◯	◯
Ich fand es schwierig, die Methode auf den Beispielprozess anzuwenden.	◯	◯	◯	◯	◯	◯
Ich beabsichtige, diese Methode gegenüber anderen Prozessmodellierungssprachen zu bevorzugen.	◯	◯	◯	◯	◯	◯
Komplexe Prozesse, die mit dieser Methode dargestellt werden, wären für die Benutzer schwieriger zu verstehen.	◯	◯	◯	◯	◯	◯

	stimme gar nicht zu	stimme nicht zu	weder noch	stimme zu	stimme voll zu	kann ich nicht einschätzen
Insgesamt denke ich, dass diese Methode <u>keine</u> effektive Lösung für das Problem der Darstellung kreativer Prozesse bietet.	○	○	○	○	○	○
Ich fand die Regeln der Methode klar und einfach zu verstehen.	○	○	○	○	○	○
Insgesamt finde ich die Methode schwierig zu handhaben.	○	○	○	○	○	○
Insgesamt halte ich die Methode für nützlich.	○	○	○	○	○	○
Ich fand die Methode leicht zu erlernen.	○	○	○	○	○	○
Insgesamt denke ich, dass diese Methode eine Verbesserung gegenüber der Standard-KMDL-Modellierung darstellt.	○	○	○	○	○	○

	stimme gar nicht zu	stimme nicht zu	weder noch	stimme zu	stimme voll zu	kann ich nicht einschätzen
Ich würde diese Methode definitiv <u>nicht</u> für die Dokumentation umfassender Prozessmodelle verwenden.	○	○	○	○	○	○
Ich glaube, dass diese Methode den Aufwand für die Dokumentation komplexer Prozesslandschaften verringern würde.	○	○	○	○	○	○
Die Verwendung dieser Methode würde die Pflege von Prozessmodellen erschweren.	○	○	○	○	○	○
Die Methode würde es den Anwendern erleichtern, die Korrektheit der Prozessmodelle zu überprüfen.	○	○	○	○	○	○

Wie würden Sie die folgenden Kriterien für Prozessmodelle in Bezug auf die vorgestellte Modellierungserweiterung bewerten?

Ein "Modell", auf das in den Punkten Bezug genommen wird, wäre ein KMDL-Modell mit den neuen Modellierungserweiterungen zur Erfassung kreativer Arbeit.
Bitte vergeben Sie die Option "kann ich nicht einschätzen" nur, wenn es unvermeidlich erscheint.

gar nicht erfüllt — voll erfüllt

0 10 20 30 40 50 60 70 80 90 100

Wirtschaftlichkeit - gutes Gleichgewicht zwischen modellierten Details und Modellierungsaufwand ☐ Kann ich nicht einschätzen

Relevanz - es werden nur Elemente einbezogen, die von Bedeutung sind ☐ Kann ich nicht einschätzen

Vergleichbarkeit - die Modelle folgen klaren Modellierungsregeln ☐ Kann ich nicht einschätzen

Klarheit - das Modell ist lesbar und leicht zu verstehen ☐ Kann ich nicht einschätzen

Bitte geben Sie Ihr Geschlecht an.

- ○ Weiblich
- ○ Männlich
- ○ Diverse

Bitte wählen Sie Ihre Altersgruppe aus.

- ○ 18-20
- ○ 21-23
- ○ 24-27
- ○ 28-31
- ○ älter als 31

Gibt es finale Hinweise oder Kommentare?

Appendix I: Evaluation survey – English

This appendix shows the evaluation survey in its translated form in English. KMDL modeling users were asked to rate the modeling extensions for creative works.

weizenbaum
institut

Dear KMDL experts,

As you have already learned, **KMDL is used to model knowledge-intensive business processes.** Now, many knowledge-intensive processes are also creative-intensive: Whenever there is a requirement, that the process should lead to a novel and useful result. So far, there are few **ways to capture creativity-specific process characteristics in process modeling**. Therefore, I have developed a modeling extension that attempts to represent the aspects relevant to the creative process using KMDL.
The following study serves to examine my modeling extension critically. In doing so, **you have the role of user and critic**.

The study contains the following topic blocks:

- Presentation of my modeling extension
- A process is modeled in which parts are appropriately assigned by you.
- Open questions and items for the evaluation of the method follow.

Approximately **10-15 min** are targeted for working through the study. You can interrupt the study at any time and continue later.

Please feel free to contact me with any questions: jennifer.haase@hu-berlin.de

Have fun!

The problem outlining

Creative work is characterized in particular by the incorporation of novel ideas into work activities, resulting in new products. These **creative processes are usually not very predictable, and exhibit iteration loops and a high degree of process flexibility**. This makes them particularly difficult for modeling approaches to grasp.

There are many practical examples where employees, or even entire teams, go through creative processes on a very regular basis. Due to the high degree of repetition, it is worthwhile to also record these in the form of modeling.

Previous modeling approaches - including KMDL - abstract a creative task. For example, "develop a product idea" or "design an advertising campaign" is then defined as a task. This usually **contains several tasks, but due to their creative nature, they are difficult to predict and idle to model. I.e.,** the challenge arises that creative processes should be modeled "better", i.e., more concretely, than has been possible so far, but without falling into the small-small of each individual activity.

The proposed solution

Based on an ethnographic study, I was able to **define a set of patterns in creative workflows** that I used as the basis of the following modeling extension. My **basic idea here is to preserve the modeling principle of KMDL** and t**o model at least cornerstones of the creative process** as well for creative tasks that are difficult to analyze in more detail.

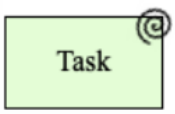
These four characteristics are:

Intention -- What is the goal of the task?
Creation -- What ideas/possibilities do I see to get to the goal?
Evaluation -- How do the ideas prove themselves?
Planning -- What do I need to do specifically to get to the goal? What are the next steps?

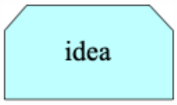
These four elements - called the ICEP model - show core characteristics of creative work: since path and goal are (partly) unknown in creative tasks, they have to be worked out in the course of the process. The **development of an *intention* is a prerequisite for successful creative work** in a professional context. Without this, there would otherwise be no evaluation criterion as to whether one is on the right path. *Creation* contains the method to come to the new ideas. *Evaluation* contains the method or the responsibility to evaluate the fit of the idea(s) to the goal. *Planning* is a constant element of creative work, because it is only in the process that the process can be concretized.

Are there any questions, ideas, hints to this rough concept description?

To **declare a task as creative** it can be marked with a squiggle at the task and conversion icon.

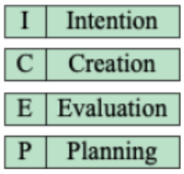


A typical aspect in the creative process is the (further) development of ideas. Therefore, a new element is inserted.



An "idea" can be modeled as a preliminary stage of a product, e.g., what comes out of a conversion as a result. However, it can also be modeled directly on a person if this person introduces an idea in a conversion. **An idea is modeled analogously to a knowledge object, and also named concretely according to the current status in the process.** The differentiation of the idea from the knowledge object is that this is to be further developed significantly in the creative process, and converted as best as possible into a creative output object.

As described before, creative work can be modeled by 4 characteristics: Ideation - Creation - Evaluation - Planning. **The capital letters in the symbols declare the category, the text on the right can be instantiated.** I.e. here can be formulated briefly how the respective category is implemented.



I: describes the goal of the task, i.e. the creative challenge.

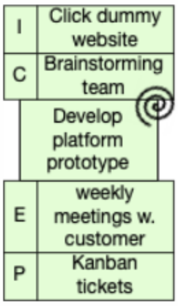
C: method by which creative ideas are to be generated

E: method by which the course of the process is critically scrutinized

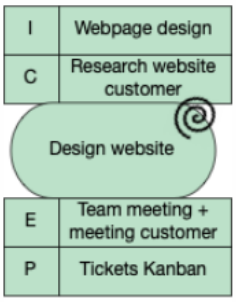
P: method by which the (team) work is planned in terms of time

Example:

A software development team is given the task of designing a new digital platform for a customer on which suppliers can exchange information. For this, a creative task is modeled at process level: "Develop platform prototypes". This can be specified according to the ICEP model as follows:

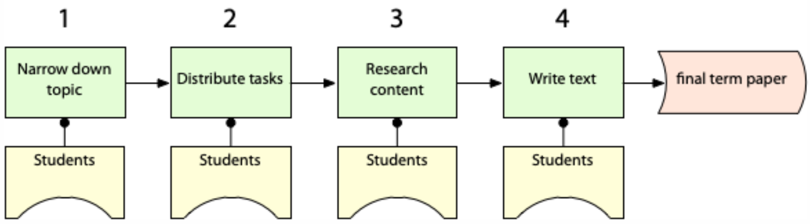


At the activity level, the prototype task is further specified. Here, the front-end developer is given the task of developing a design for the website.



Are there any questions, ideas, hints about this example?

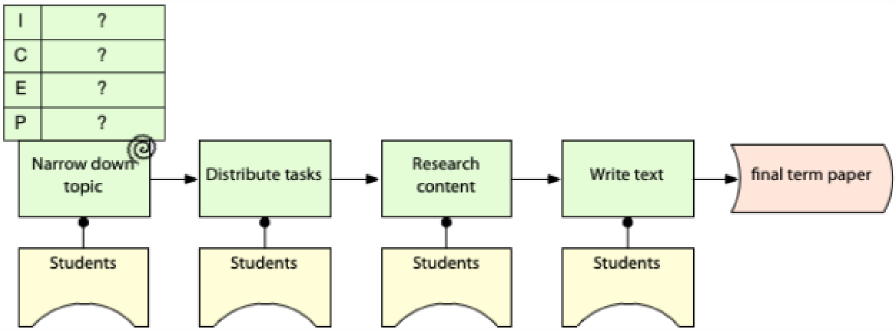
An application exercise using the example of a creative process: Creating a term paper within a group of students. Imagine the following creative work process: You are part of a 5-person team that is to develop a term paper within one semester on the topic "The future of AI-supported production processes". Your procedure could be roughly simplified into the following steps:



Which of the four tasks is or are creative-intensive in your view?

- [ ] Task 1
- [ ] Task 2
- [ ] Task 3
- [ ] Task 4

Assume that the first process step "Narrowing down the topic" on the topic "The future of AI-supported production processes" is modeled according to the ICEP principle. Which statements could then be assigned to I, C, E, and P? Which statements do not fit?



Assign the statements (items) on the left to the appropriate category. Multiple assignments per category are possible.

Items

Zoom-Call

Distribute tasks

exciting, concrete topic

2h-Meeting

Define production context

Email the lecturer

first internet research

Coffee break

Group discussion

Group brainstorming

I - Intention

C - Creation

E - Evaluation

P - Planning

inapproproate

How do you assess the modeling extension for creative work with KMDL?
Please assign the option "cannot assess" only if it seems unavoidable.

	disagree at all	Disagree	neither nor	agree	totally agree	cannot assess
Overall, I think this method does not provide an effective solution to the problem of representing creative processes.	○	○	○	○	○	○
Complex processes represented using this method would be more difficult for users to understand.	○	○	○	○	○	○
I would definitely not use this method to document large process models.	○	○	○	○	○	○
I intend to use this method in preference to other process modeling languages.	○	○	○	○	○	○
I found the rules of the method clear and easy to understand.	○	○	○	○	○	○
Overall, I found the method difficult to use.	○	○	○	○	○	○

	disagree at all	Disagree	neither nor	agree	totally agree	cannot assess
I found the method easy to learn.	○	○	○	○	○	○
This method would make it easier for users to verify whether process models are correct.	○	○	○	○	○	○
Overall, I think this method is an improvement to the standard KMDL modeling.	○	○	○	○	○	○
I believe that this method would reduce the effort required to document complex process landscapes.	○	○	○	○	○	○
I found the procedure for applying the method complex and difficult to follow.	○	○	○	○	○	○
Overall, I found the method to be useful.	○	○	○	○	○	○
	disagree at all	Disagree	neither nor	agree	totally agree	cannot assess
Using this method would make it easier to communicate large process models to end users.	○	○	○	○	○	○
I am not confident that I am now competent to apply this method in practice.	○	○	○	○	○	○
Using this method would make it more difficult to maintain process models.	○	○	○	○	○	○
I found it difficult to apply the method to the example process.	○	○	○	○	○	○

How would you evaluate the following criteria for process models in relation to the modeling extension presented?

A "model" referred to in the items would be a KMDL model with the new modeling extensions to capture creative work. Please assign the option "cannot assess" only if it seems unavoidable.

not fulfilled at all										fulfilled fully
0	10	20	30	40	50	60	70	80	90	100

Clarity - the model is legible and easy to understand ☐ cannot assess

Relevance - only elements that are significant are included ☐ cannot assess

Economy - good balance between modeled details and modeling effort ☐ cannot assess

Comparability - the models follow clear modeling rules ☐ cannot assess

Are there any final notes, criticisms, appreciations you want to share?

Appendix J: Evaluation survey results

The questionnaire results for all TAM items are presented, and sorted according to the three sub-scales. The summary is presented in Section 6.3.3 on page 218.

Table A.E.1: KMDL modeling extension evaluation by 51 experts based on TAM

TAM item	Item	Mean	SD	Min	Max
PEOU	I found the procedure for applying the method complex and difficult to follow. (reversed)	3.45	0.96	1	5
PEOU	Overall, I found the method difficult to use. (reversed)	3.26	1.25	1	4
PEOU	I found the method easy to learn.	3.67	0.89	1	5
PEOU	I found it difficult to apply the method to the example process. (reversed)	3.29	1.08	1	5
PEOU	I found the rules of the method clear and easy to understand.	4.15	0.96	3	4
PEOU	I am not confident that I am now competent to apply this method in practice. (reversed)	3.21	1.30	1	5
PU	I believe that this method would reduce the effort required to document complex process landscapes.	3.61	0.96	2	5
PU	Complex processes represented using this method would be more difficult for users to understand. (reversed)	3.24	0.99	1	5
PU	This method would make it easier for users to verify whether process models are correct.	3.71	0.90	2	4

...to be continued

TAM sub-scale	Item	Mean	SD	Min	Max
PU	Overall, I found the method to be useful.	4.28	0.73	2	5
PU	Using this method would make it more difficult to maintain process models. (reversed)	4.28	0.73	2	5
PU	Overall, I think this method does not provide an effective solution to the problem of representing creative processes. (reversed)	2.97	1.09	1	5
PU	Overall, I think this method is an improvement to the standard KMDL modeling.	4.17	1.09	1	5
PU	Using this method would make it easier to communicate large process models to end users.	3.96	0.95	1	4
ITU	I would definitely not use this method to document large process models. (reversed)	2.25	0.92	1	5
ITU	I intend to use this method in preference to other process modeling languages.	3.46	1.20	1	5

Note. PEOU = perceived ease of use, PU = perceived usefulness, ITU = intention to use.