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Abstract. The importance of involving enterprise stakeholders in organizational transformation and development processes has been acknowledged in many scholarly publications in the context of business information systems research. Method and tool support for this is particularly explored and provided by the field of participatory enterprise modelling (PEM). In PEM, modelling sessions involving all relevant stakeholders and guided by a modelling facilitator are a central element. However, the published work on PEM is not very extensive with respect to structuring such modelling sessions, in particular when combining analytical and design parts. It is hence hard for novice modelling facilitators to plan a workshop, to switch between different workshop phases and to react to unforeseen events. Since existing literature covers only generic aspects of workshop moderation, we fill this gap in providing an initial model that can serve to inform, structure and guide PEM sessions. The model has been developed by analysing examples from real-world modelling sessions.

Keywords: Enterprise Modelling, Participation, Innovation Management, Digital Transformation

1 Introduction

The importance of involving enterprise stakeholders in organizational transformation and development processes has been acknowledged in many scholarly publications in the context of business information systems research. Recent examples are digital transformation, where the employees' contribution is explicitly considered as success factor, technology adoption and innovation with respect to the design of diffusion processes, and enterprise architecture management when using "influence-centric" strategies for establishing architecture principles. Method and tool support for how to involve stakeholders is offered by the field of enterprise modelling (EM), in particular in participatory EM (PEM). In PEM, modelling sessions involving all relevant stakeholders and guided by a modelling facilitator are a central element. Published work on PEM and participatory modelling sessions includes method support, tool recommendations, advice for role distributions, and best practices (cf. Section 3).

However, the published work on PEM is not very extensive with respect to structuring activities or sequences of activities within the modelling sessions, in particular when combining analytical and design parts. What would be the best flow of activities for identifying digitization options in an enterprise and designing solutions for the most promising ones? When and how to switch from elicitation activities of the sessions (e.g., for collecting input from participants) to structuring, design and reflection of activities? In our impression, existing literature primarily covers more "generic" aspects for modelling sessions, like general preparation and planning, role distribution or questions to ask, than specific aspects of how to conduct such sessions (cf. Section 3).

The intention of our research is to contribute to a more diversified picture of participatory modelling sessions by describing and analysing the "inner structure" of activities and discussing the experiences collected. These experiences are based on different industrial case studies of PEM with different goals. The cases and their analysis form the first contribution of this paper. Based on this, we further derive typical behavioural and metacognitive abilities needed for the different activities in PEM as well as criteria for shifting from one activity to another. We aggregate and consolidate our findings into a generalized process model of PEM which is our second contribution. This model incorporates procedural knowledge as well as abilities and decision criteria for shifting between activities. With this, we aim to contribute to the body of knowledge related to PEM as well as to inform practitioners that plan and execute PEM sessions.

The rest of the paper is structured as follows. Section 2 introduces the research methods applied, Section 3 summarizes the background for our work and discusses related work. Section 4 describes a structured literature research conducted in order to identify relevant research focusing on fine-grained participatory modelling sessions. Section 5 is focused on the industrial cases studies of PEM. Section 6 analyses the cases, presents observations and derives the recommendations for structuring activities in PEM. Section 7 summarizes our findings and discusses future work.

2 Research Approach

Work presented in this paper is part of a research program aiming at methodological and tool support for PEM. The research program includes experiments in controlled lab environments aiming at testing the effects of interventions in the methods and tool support on model results and the behavior of participants. Moreover, field work is conducted with real-world enterprises applying PEM to solve specific tasks or problems defined by the enterprises. This study is related to the field work and supposed to both contribute to the existing body of knowledge regarding PEM and guide practitioners engaged in planning PEM sessions. The focus of this paper started from the following research question which is based on the motivation presented in Section 1:
RQ: In the context of participatory enterprise modelling, how should modelling sessions be structured and conducted?

The research method used for working on this research question is a combination of literature study, descriptive case study and argumentative-deductive work. Based on the research question, we started identifying research areas with relevant work for this

question and analysed the literature in these areas. The purpose of the analysis was to find theories or experience reports on activities in participatory and collaborative modelling suitable for structuring analysis and design work and their combination. Since the literature study showed a lack of publications in this area (see Section 3.2), we decided to analyse own material from qualitative case studies in order to contribute to the field (see Section 5). Yin (2013) differentiates various kinds of case studies [1]: *explanatory*, *exploratory* and *descriptive*. The case studies presented in Section 5 have to be considered as *descriptive*, as they are used to describe the combination of analysis and design activities in PEM sessions in real-world environments.

Based on the reconstruction of the case study material and an analysis of resulting experiences in relation to the findings of the literature analysis, we inductively derive a generic process model for PEM. The model is enriched with required behavioral and metacognitive abilities to conduct the suggested activities as well as a list of typical decisions that have to be taken by a moderator in PEM sessions.

3 Background and Related Work

3.1 Collaborative and Participatory Enterprise Modelling

In general, enterprise modelling (EM) addresses the systematic analysis and modelling of processes, organization and product structures, IT-systems and any other perspective relevant for the modelling purpose with the help of enterprise modelling methods [2] used for capturing, communicating, and sharing enterprise knowledge [3]. Depending on the way and extent of involvement of enterprise stakeholders in modelling, some EM methods can be characterized as *collaborative* or *participatory*.

Collaborative modelling emphasizes the aspect of *joining several experts* into a coordinated effort [4]. In contrast to that, EM *involving users or enterprise stakeholders* is called *participative modelling* [5]. In the scope of this paper, we focus on participatory enterprise modelling (PEM) which by nature includes collaboration activities between enterprise stakeholders and modelling experts during joint modelling sessions. The aim with a participative approach for EM is to simultaneously work with different stakeholders in a collaborative way to avoid conceptual deviations (misalignment) between the stakeholders and their different perspectives. The necessity for this has also been put forward e.g. by vom Brocke & Thomas (2006) [6].

Many advantages are attributed to participatory enterprise modelling, among them improved quality of the models, better acceptance of the modelling results by the stakeholders [7] and improved knowledge sharing between stakeholders by co-creation of models [8]. Although these advantages were observed in many modelling projects [9] and investigated in a number of experiments, there is still a need for empirical work examining the phases and activities of PEM sessions in real-world cases. Much published work on participatory modelling is more exploratory and argumentative than explanatory and conclusive. In our research, we address this gap by developing a model for participatory modelling sessions that can be used to plan and structure such sessions.

3.2 Known Research Streams in Regard to PEM

Regarding the *processes of PEM*, many approaches and methodologies refer to the whole enterprise modelling project to be executed. Stirna et. al (2007) present guidelines for EM projects. For modelling, they suggest creating different models representing different perspectives simultaneously [9]. Similarly, Sandkuhl & Lillehagen (2008) describe the overall modelling processes following the C3S3P methodology, but focus on the early phases only. In some publications, one may also find phases such as elicitation, modelling, verification and validation [10, 11]. Many authors agree that PEM is an iterative process, going in cycles through these phases [12–15]. In this regard, several authors emphasize the importance of reaching a joint understanding of previous results [9, 15]. With regard to individual activities in PEM, rarely distinct phases are analysed in more detail [14, 16]. In this regard, Rittgen (2007) studied the formalization process with regard to negotiation patterns derived from communication processes.

In regard to *roles for enterprise modelling*, one of the most established distinctions is between *method experts* and *domain experts*. The former are those who are trained in the modelling method and notation. The latter are experts representing the stakeholders of the company who contribute with their knowledge and experience [9, 12, 15]. With regard to method experts, more detailed roles refer to the facilitator leading the modelling sessions, and the tool operator formalizing the model [9, 15, 17]. Rittgen (2010) even tried to identify roles based on empirical data, and found 4 different profiles: *facilitator*, *modeler*, *editor*, and *consultant*, the latter three possibly influenced by modelling literacy and different levels of motivation. Based on the role structure in a team, Rittgen (2010) found different cooperation styles within the teams. Also in this regard, involving stakeholders is widely considered as important [9, 13, 15, 17]. In participative enterprise modelling, often, persons are involved who are not experts in modelling, but in their domain. One way to handle this challenge is to train the participants [9] or to use a modelling language which is easy to handle for domain experts [13].

Another area of research are *tools for PEM*. Concerning the use of tools, Stirna et. al (2007) give a very concrete advice to start with an analogous tool such as a plastic wall where everyone may equally contribute, and later formalize the model by a method expert with a computerized tool. Similar to a whiteboard, a tabletop may also enable participants to simultaneously work [18], although space limitations of the whiteboard may restrict usage possibilities to smaller models. One may, however, extend the workspace by using additional devices such as tablet, as suggested by Nolte et al (2016), which represent private spaces where sub-groups may work on their ideas.

To sum up, there exist case studies and approaches of how to carry out participative enterprise modelling projects. These, however, are described in a rough way, i.e. as more or less general guidelines. Only a few approaches in the area of process modelling consider the formalization of models in more fine-grained manner, but they focus on modelling experts and neglect other stakeholders. Hence, there is a lack of work on how to structure and shape the course of participative modelling sessions.

4 Structured Literature Analysis

Since only a few relevant approaches were identified by the authors among relevant research areas in PEM, a structured literature analysis was performed to broaden the knowledge about relevant works. It aimed at identifying research work from participatory and collaborative enterprise modelling that explicitly addresses phases, activities or steps of modelling sessions. In order to identify relevant work, we decided to perform a systematic literature review (SLR) based on the procedure proposed by Kitchenham [19] that consists of six steps described in this section. Step 1 is to define the research questions for the SLR. Starting from the main RQ for our work presented in Section 2, we identified the following literature-focused research questions (RQL) for the SLR:

RQL 1: What published work exists on tasks or activities to be performed in modelling sessions? The aim of this RQ is to find a set of basic activities or tasks that could be used to analyse and describe the elements of the PEM sessions in our industrial cases

RQL 2: What approaches exist for deciding on the structure or sequence of activities when conducting PEM sessions? In addition to basic elements of PEM (see RQL 1), this RQL aims at finding recommended sequences or patterns of activities for defined purposes of PEM sessions, such as process or goal modelling.

RQL 3: What recommendations exist for the transition between tasks in PEM sessions? In order to provide a reply to the main RQ presented in Section 2, RQL3 aims at identifying either a selection of basic activities (from RQL 1) or – preferably – a recommended sequence of activities in a PEM session, including how to recognize when to move on to design and to organize this transition.

Step 2 is to specify the literature sources to be taken into account. We decided to examine the AIS electronic library (AISeL), IEEE Xplore and Scopus. Publications with significant impact on research should reach one of these major outlets. Step 3 addresses the construction of the search query that starts from a first query (called the query for the initial "population" of papers) which is stepwise refined (called "intervention"), for example by adding synonyms to the initial search terms or by adding more terms for more precise specification of the search. The final search queries resulting from this process for the three RQL are shown in Table 1.

Table 1. Search queries and number of hits for the RQ

Search query	AISeL	IEEE	Scopus
(participatory modelling OR participative modeling) AND (phase OR activit* OR step OR task)	2 (4)	0 (7)	18 (78)
(participatory enterprise modelling OR participative enterprise modeling) AND (phase OR activit* OR step OR task)	1 (1)	1 (2)	5 (5)
(collaborative modelling) AND (phase OR activit* OR step OR task)	(40)	2 (40)	9 (38)
(collaborative enterprise modelling) AND (phase OR activit* OR step OR task)	1 (1)	1 (1)	0

Step 4 is selecting the papers relevant for the RQL. In most cases it was sufficient to read the abstract. In case of unclear situations, we read the full text. The number of relevant papers is shown in Table 1 with the number of hits given in parentheses. Most papers considered irrelevant were addressing the modelling of collaborative (software) agents or user behaviour, software systems or components supporting CM or PEM, or the general applicability of CM in specific domains. Step 5 is extracting the relevant information to answer the RQLs. The results from this step are presented in the remainder of this section, which is at the same time result of Step 6, documenting the results.

The search results show that there is a substantial amount of work on collaborative and participatory modelling in the IS community, in computer science, business administration, sociology, decision sciences and engineering. Most of the work can be sorted into four larger groups:

- Research addressing *steps and activities of modelling sessions* independently of specific modelling purposes. Examples are recommendations for preparing and conducting sessions from [8], phases, interaction topics and rules observed by [20] or different perspectives to be considered during enterprise modelling sessions [15].
- Work addressing *specific modelling purposes, such as process or goal modelling*, with recommendations of steps or phases to be considered. Examples are business process modelling [21], structured decision making [22], the "commandments" for a socio-environmental modelling [23].
- *Aspects of group interaction or collaboration between participants* in modelling sessions, such as speech-acts and dialog games [24] or psychological ownership of models [25].
- *Abilities, behavioural aspects and cognitive processes* in collaborative/participative conceptual modelling. Examples are executive functions ([26]; see also below) and levels of participation or collaboration [27].

In the following, we summarise the results from the perspective of our RQLs. Regarding RQL 1, a line of work contributed by Hoppenbrouwers, Wilmont and Proper [26, 28] could be identified that investigates the use of *executive functions* for identifying tasks and activities. Executive function is an umbrella term for the complex cognitive processes that serve ongoing, goal-directed behaviours. In educational sciences and neuropsychology, the underlying concepts and scales have been used since many years to assess and classify behavioural and metacognitive abilities, for example by [29]:

- *Inhibit* – stop engaging in a behaviour
- *Shift* – move freely from one activity/situation to another (switch or alternate)
- *Emotional control* – regulate emotional responses appropriately
- *Initiate* – begin an activity and independently generate content or results
- *Working memory* – hold information when completing a task
- *Plan/organize* – anticipate future events; set goals; develop steps; grasp main ideas; organize and understand the main points
- *Organization of materials* – put order in work or documentation storage
- *Monitor* – check work and to assess one's own performance

In regard to RQL 1 and RQL 2, much work on activities and tasks to be performed in modelling sessions also originates from the team of Stirna, Persson and Sandkuhl with various co-authors who through all publications give consistent recommendations for PEM sessions. However, the primary focus of this work is not on single activities but the whole process of PEM and required roles and competences, which makes the work equally relevant for RQL 2. Relevant results for this question include recommendations for conducting PEM, which consists of different general steps to take such as planning and preparing a session or setting up the room. They are not specific to the content and internal structure of a session. The authors explicitly state that they do "not describe details of how a modelling session is conducted" and recommend literature for specific modelling purposes. In regard to RQL 3, the search did not return explicit recommendations for the transition between different activities in PEM. Implicitly, the work by Stirna/Persson stating the need for "creativity, consolidation, consensus, critique and new focus" phases in PEM sessions address this RQL. However, they see this as activity during preparation only. Furthermore, there were no relevant publications specifically on steps/activities/phases of collaborative enterprise modelling. As a result of the literature analysis, we conclude that fine-grained guidance is missing how to conducting a participative modelling workshop.

5 Industrial Case Studies

The two case studies described in this section were selected from different research and development projects with industrial partners conducted at Rostock University during fall 2019 and spring 2020. For all case studies, the participating researchers collected documents, minutes of meetings and interviews with company representatives, field notes taken when working with the companies, models of process, information structures and business models and other relevant information. This material concerns the situation before conducting participatory modelling sessions, the preparation of the sessions, the activities during the sessions as such and the results. It forms the basis for the case studies and is presented in a condensed way in this section. For all case studies, we will use the same structure of presentation starting with a description of the starting point, the different phases of the transformation and the final situation.

5.1 Case A: Modelling Digital Transformation Goals at Automotive Supplier

Case study Company A is a subsidiary of a major automotive manufacturer responsible for producing tools for the metal parts of chassis production, such as roofs, doors, side panels, etc. These tools, called (press) forms, are developed individually for each car model variant in an iterative process of casting, milling and/or welding, and polishing. Company A is doing the largest share of its business with the automotive manufacturer. It also serves other automotive and truck suppliers. Due to its unique specialization on forms for a specific metal, Company A is well-positioned in the market. However, its management aims to increase efficiency and flexibility in the business model to be prepared for possible future market changes. The case study emerged when Company A

decided to investigate radical digital innovation focusing on disruptive ways of working or technologies instead of gradual optimization or increase in efficiency. A workshop was planned to investigate the potential for radical innovation concerning the possibilities for drastic and seemingly unrealistic changes, like, reduction of production time for forms to 10% of the current value, no setup time of the production system or internal logistics requiring no staff.

Preparation and execution of the workshop included several steps: the selected participants represented all relevant departments of the company (design, production, logistics, procurement, human resources, economics, service and customer care), mostly represented by the head of the unit or senior experts. All ten participants (2 female, 8 male of all age groups) were informed beforehand about purpose of the workshop, the need to think "out-of-the-box" and the importance of their participation. The workshop consisted of three major phases:

Phase 1 included the collection of proposals from the participants for the radical transformation of products and of operations. The facilitator asked the participants to write down their ideas for radical DT for the products of the company on paper cards. After 15 minutes, participant by participant were asked to briefly present their ideas and put them up on a plastic wall. Facilitator and participants started to sort the ideas into groups on the plastic wall. The same procedure was repeated for ideas to radically transform operations. The facilitators had own ideas available which were derived from analysing DT in related industries. These ideas were meant to inspire the discussion in case there was a lack of new ideas, but this was not needed.

Phase 2 aimed at joint clustering the collected options and definition of priorities. The purpose was, essentially, to agree on a joint understanding and a clear separation of all clusters. The initial sorting of the participants` ideas turned out to be fine-grained and sometimes too fuzzy. The facilitators walked the participants through all initial groups of ideas and initiated a discussion about naming and boundaries of these groups. The clusters the participants agreed on were put on the plastic wall with paper cards of a different color. The definition of priorities was done using a voting approach. Each participant received a number of votes (sticky paper marks). All voted simultaneously by putting the marks on their prioritized clusters.

Phase 3; Based on the priorities, an initial evaluation of the top three options for radical transformation of products and the top three transformations in operations was done. For this purpose, the workshop switched from a joint session with all participants to parallel sessions in two groups. Each group started with one option and had the task to elaborate the essentials of the option using five questions (what would be the exact vision/goal, what activities are required, who has to do what, what resources and partners are needed, what is the business value?). The result was documented with a canvas (paper size A0). After 30 minutes, the next option followed and the groups often changed membership. After having completed all options all participants gathered and for each group one member presented the group's results.

The content of the workshop was documented in photo documentation of collected ideas and clusters, written documentation of the evaluation results, and notes. The workshop was conducted by two researchers: one facilitator and one note taker.

5.2 Case B: Modelling the Innovation Process at Manufacturing Company

Case study Company B is a metal processing / manufacturing company focusing on the production of lifting and pushing gearboxes. This company is faced to changing customer requirements, increasing knowledge intensification, and technical developments, which is why it is forced to create new products and services or update existing ones. This implies to constantly rethink and, if necessary, adapt processes in order to satisfy customer needs. In this context, employees are an indispensable source of new ideas due to their deep knowledge of the products, processes, and customer needs. With a large number of ideas, a systematic management becomes necessary for them, which can be supported by an IT-supported idea- and innovation management system (IMS). However, IMS and innovation processes are often developed and implemented in a top-down manner without asking the employees much about their needs. Since IMS should increase participation, Company B decided to develop the innovation process in a participatory way in a workshop to prepare for later implementation in an IMS.

The workshop was attended by 10 employees, 3 females and 7 males, of all age groups. They work in the departments production, assembly, design, sales, and IT. All participants were aware of the context, as they had previously participated in interviews regarding possible requirements for an IMS. The workshop followed a predefined structure. In a first task possible process steps should be elaborated. In task 2, data elements which may be required in different process steps should be identified. Afterwards, in task 3 roles and responsibilities should be defined for each process step and in task 4 decision points should be determined. Regarding tasks 1 and 2, the following three phases could be identified during the workshop:

Phase 1: In order to let the participants think for themselves and to support that really everyone shares their thoughts, the participants were asked to write their ideas and suggestions down on paper cards. In order to set a time limit for the participants, they were given 10 minutes for thinking and writing down. After this time, all participants had made it clear that they were ready. Otherwise they would have been given a few more minutes.

Phase 2: In the next step, one participant after the other presented and explained each of their ideas and pinned the paper cards on a wall in chronological order. The other participants listened and discussed some points if there was any uncertainty. This phase ended when all participants have presented all of their thoughts and pinned the paper cards on the wall.

Phase 3: Having all paper cards pinned on the wall, there was a final discussion with all participants where suggested process steps and data elements were aggregated and clustered. (This was gathering and bundling of ideas and suggestions -> task 3 and 4 also gathering but with a more decisive character)

Task 3 and 4 should not be limited to suggestions. Since a company-wide process cannot look different for every employee, decisions had to be made, for example, who should be involved in which process step or at which points decisions had to be made. Therefore, a moderated discussion was conducted in which the participants were asked for each step of the process who should be involved and whether a decision should be made on this point.

As a final task the participants were asked to name success factors for the long-term use of IMS that are relevant for them. Phase 1 to 3 was conducted in the same way as done before in task 1 and 2. Since it may not be possible to fulfil all the factors mentioned, it was relevant to find out which are the most important success factors for the participants. Therefore, a further phase was carried out in which the participants were asked to mark with dot stickers which factor is important for them. Each participant received three stickers which could be placed as desired. This allowed to identify the most important factors by the highest number of stickers received.

6 Case Study Analysis

6.1 Coding Scheme for Case Study Analysis

To answer our research question and to finally derive the generic process model for PEM, we analyse our case data in a three step approach. In the first step documented in this section, we develop a coding scheme used to interpret the case data. In the second step, we apply this coding scheme to enrich an abstract, tabular-based reconstruction of our case data (cf. Section 6.2). In a third step, we use this enriched reconstruction to answer the overall research question and derive the generic process model for PEM (cf. Section 6.3). Answering this question in turn implies to answer three sub-questions. First, "what are the central *activities* in a workshop and how are they composed?" The answer should provide the process structure of the workshop. Second, "what are *ending conditions* for activities?" The answer should provide criteria useful to decide when the next activity should start. Third, "which *skills* are needed in the different phases of a workshop?" The answer should enrich the process structure with abilities. Taken together, these answers to all three sub-questions provide insights in regard to our general RQ "How should modelling sessions be structured and conducted?" (cf. Section 2).

In the following, we derive a coding scheme by following these three sub-questions. In doing so, we identify codes for (i) each *phase* of the workshop, (ii) the *ending conditions* that triggered the next activity during the workshop and (iii) the *skills* that were required in each phase. In the following, we introduce our codes.

Phases. For identifying relevant codes, we use the moderation cycle from Seifert [30], originally released in the 1980s. It comprises the phases *Begin*, *Collect*, *Select*, *Elaborate*, *Plan*, and *Finalize*. In the beginning, participants are e.g. welcomed and the goals are explained. In the following collection phase, items are elicited. They form the input for the subsequent elaboration phase in which they are worked on e.g. in small groups. In the subsequent planning phase, further actions are determined based on the results achieved so far. In the last phase, the workshop is closed thereby critically reflecting the achieved results and possible next steps. We add to this cycle a preparation phase (in line with the literature in Section 4). We furthermore rename "collect" into "elicit" in order to emphasize the active role of the moderator. We further replace "select" with "structure & prioritize" to reflect that elicited concepts or thoughts should be integrated or put into a common perspective, which of course may also involve selections. We also rename "plan" to "reflect" since the development of more detailed plans

can be decided in the workshop but must not necessarily be carried out during the workshop, so "reflect" is more neutral and at the same time does not exclude making plans. We furthermore rename "elaborate" to "design" in order to accommodate the domain of enterprise modelling. We finally use the codes *Prepare* (PREP), *Elicit* (ELCI), *Structure & Prioritize* (SPRIO), *Design* (DSGN), *Reflect* (RFLC), and *Finalize* (FINA).

Ending conditions. Codes have been collected from the workshop moderators of our case studies. We discussed and consolidated the list of codes. The final list comprises the condition of *completion* (COMP) or *timeout* (TMEO) if a phase is successfully completed due to an objective and measurable criterion or the time is over. Another condition can be *saturation* (SATU) if no new arguments are identified by the participants or *exhaustion* (EXHA) of arguments and thoughts. The latter can be the case when no criterion for completeness can be defined but it gets increasingly harder to proceed with the elicitation. Another ending condition is *quality loss* (CLOS) when ideas and arguments put forth by the participants are distractive or opposed to the workshop goals. Also, *social issues* (SOCI) can trigger the end, e.g. when suddenly conflicts pop up and dominate the discussion or participants show destructive behavior. Whereas completion, timeout, saturation, and exhaustion can be seen as normal endings of a phase, quality loss or social issues might cause an exceptional, i.e. unplanned end of a phase. Although it might be possible for the workshop moderators to apply interventions that tackle most of these conditions and then to proceed with a phase, reaching these conditions can nevertheless indicate a good opportunity for starting a new phase. This is even more so if it turns out that the interventions have a limited or no effect.

Skills. For coding the skills required in each phase as it was perceived in the real-world case studies, we considered the list of metacognitive abilities introduced in Section 4. We however group abilities that are similar into more coarse-grained categories of skills that are relevant for conducting modelling sessions. Also, we use the term of "skills" here to reflect that both knowledge and experience are relevant to complement cognitive abilities. In this way, we group *working memory*, *plan/organize*, and *organization of materials* into a group of *content structuring skills* (CSTR). They are needed to process, organize and structure content such as summarizing or grouping arguments and thoughts or draw conclusions. Furthermore, we group *initiate*, *monitor* and *shift* into *moderation skills* (MODS). They are relevant to guide the workshop participants and navigate between different activities and parts of the workshop. Finally, we group *inhibit* and *emotion control* to the category *social competence skills* (SOCS).

6.2 Reconstruction of the Case Studies

In the following, we reconstruct our case data in an abstract way by providing a table. In the rows of the table, we list major activities during the workshop. In the columns of the table, we characterize these phases in the form of a short description and by assigning the codes from our code system introduced in the previous section. Based on the reconstruction of the case data, we derived generic workshop process model (cf. next section) in the form of a process model using the Business Process This model is constructed Model and Notation (BPMN) language.

Table 2. Abstract reconstruction of the workshop activities

Workshop Activity (Short Description)	Phase	Ending Cond.	Req. Skills
CASE A – Digital Transformation Goals in Automotive Company			
Introduction to the workshop, setting workshop goals	PREP	COMP	MODS
Presentation of the company departments	PREP	COMP	MODS
Elicitation of radical transformation ideas on cards	ELCI	COMP	MODS
Presentation and clustering of the ideas on the wall	SPRIO	COMP	CSTR, MODS
Elicitation of ideas for transform. in operation on cards	ELCI	COMP	MODS
Presentation and clustering of the ideas on the wall	SPRIO	COMP	CSTR, MODS
Joint refinement of clusters until agreement reached	RFLC	SATU	MODS, SOCS
Definition of priorities of ideas within clusters	SPRIO	COMP	MODS
Detail work on three ideas for radical transformation	DSGN	TMEO	MODS, SOCS
Detail work on three ideas for operation transform	DSGN	TMEO	MODS, SOCS
Discussion of the results achieved	RFLC	SATU	MODS, SOCS
Final discussion of workshop results	FINA	COMP	MODS
CASE B – Innovation Process in Production Company			
Introduction to the workshop, setting workshop goals	PREP	COMP	MODS
Elicitation of innovation process steps on cards	ELCI	EXHA	MODS
Clustering of the steps into phases on the wall	SPRIO	COMP	CSTR, MODS
Adding a name for the identified phases	DSGN	COMP	CSTR
Discussion of the results achieved	RFLC	SATU	MODS, SOCS
Elicitation of data elements on cards	ELCI	EXHA	MODS
Clustering of the data elements on the wall	SPRIO	COMP	CSTR, MODS
Discussion of the results achieved	RFLC	SATU	MODS, SOCS
Design of process logic (flow, gates) on the wall	DSGN	COMP	CSTR
Definition of responsibilities and addition to the model	DSGN	EXHA	CSTR, SOCS
Discussion of results achieved	RFLC	SATU	CSTR, MODS
Elicitation of long-term success factors on cards	ELCI	EXHA	MODS
Clustering of the success factors on the wall	SPRIO	COMP	CSTR, MODS
Labeling of the clusters as success factor categories	DSGN	COMP	CSTR
Discussion of the results achieved	RFLC	SATU	MODS, SOCS
Final discussion of workshop results	FINA	COMP	MODS

Codes: Completion (COMP), Content structuring skills (CSTR), Design (DSGN), Elicit (ELCI), Exhaustion (EXHA), Finalize (FINA), Moderation skills (MODS), Prepare (PREP), Quality loss (QLOS), Reflect (RFLC), Saturation (SATU), Structure & Prioritize (SPRIO), Social competence skills (SOCS), Social issues (SOCI), Timeout (TMEO).

6.3 Derivation of the Generic Workshop Process Model

The tasks represented in the model (cf. Figure 1) correspond to the phases of our coding scheme (cf. Section 6.1). The transition between the tasks has been derived by inspecting the sequence of codes in Table 1. Moreover, tasks have been grouped under a headline according to major phases of each workshop (*preparation*, *execution*, and *finalization*) and the skill profile of tasks has been indicated below these phases.

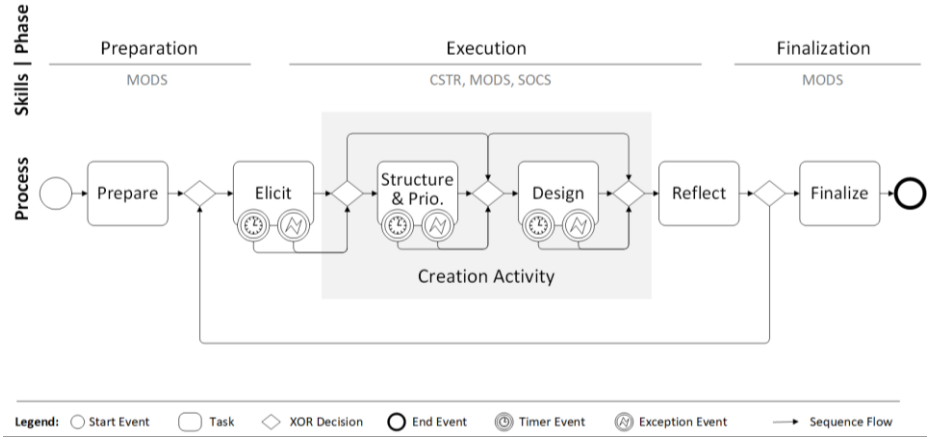

Fig. 1. Process model of participative modelling workshops

Regarding the ending conditions of tasks, they have been modelled with standard sequence flow notation for completeness, exhaustion or saturation ending conditions. In case when time is exceeded, a timer symbol attached to the activity boundary can activate the sequence flow leading to the next task. Likewise, in case of quality losses or social issues, an exception symbol is used to handle this situation and to trigger the next phase before the regular end. Furthermore, the skill profile of tasks has been indicated near the phase labels. Regarding sequence flow, the two central activities *Structuring & Priotizing* and *Design* that together form the *Creation Activity* can be skipped. This gives the flexibility that after elicitation, only reflection takes place.

A drawback of the visualization as a generic process model is that the "specifics" of participatory modelling within the six tasks are not visible because they form a refinement level of integrated practices and sub-tasks that implement participatory modelling. In particular the tasks *Elicit*, *Structure & Prioritize*, *Design* and *Reflect* have to ensure that the modelling workshop is conducted and perceived as a joint, collaborative activity of users, enterprise stakeholders and modelling experts. Depending on the situation at hand, the facilitator might need to activate participants, start additional discussions, encourage certain stakeholders to establish equal opportunities to contribute, try to reach consensus among the participants, allow for different opinions and reflection, ensure commitment to jointly defined solutions, etc. (cf. Section 3.1). The modelling experts or at least the facilitator needs well-developed behavioural and metacognitive abilities (cf. Section 4) to decide which of these sub-tasks is required in what situation.

7 Concluding Remarks and Future Work

Since knowledge about modelling phases and their interaction in modelling workshops is largely missing in the current literature, we address this knowledge gap. To do so, we analysed material from two different case studies in a systematic way. The coding scheme and its application is our first contribution.

The second contribution is our generic process model for PEM answering the questions: (i) “What are the central activities in a workshop and how are they composed?”, (ii) “What are the ending conditions of activities?”, and (iii) “Which skills are needed in different workshop phases?”. To the best of our knowledge, no such model exists up to now. The model reflects the flexible and dynamic nature of workshops via an extensive use of control flow and event handling mechanisms. We hope that our contribution serves both to better understand modelling sessions from a theoretical point of view and supports (novice) practitioners or workshop moderators to plan and execute modelling workshops. Finally, as a limitation, our model is still preliminary. Our existing case data still holds further valuable details leaving room for future work. Moreover, more case data is needed for complete justification of the model. These cases should add more diversity to the pool of collected experiences, e.g. in regard to industries. Also, modelling workshops with different purposes could be considered. Another option that we actively consider for our future work is to conduct lab experiments.

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