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Process Modelling as Serious Game: Design of a Role-Playing Game for a Corporate Training

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***Abstract*—This paper presents findings of a field study into the design and initial evaluation of a role-playing game based on a model of a complex tendering process at a German manufacturing company. Conceived as part of an inhouse training for 1,000 employees by the process management unit, the role-playing game aims to familiarize the participants with the intricacies of the manufacturer's tendering process—by instructing them to properly interpret a BPMN (Business Process Model & Notation) representation of the process presented to the participants in a modelling tool. Rather than presenting the participants with a syntactically correct and semantically adequate process model, the process model is reduced to a simplified representation of the control flow and to placeholders for activities, events, roles, documents and information systems. In the role-playing game, teams of four employees from different business functions perform the group task of understanding the meaning of predefined model elements in the context of the tendering process, and of assigning these elements to the correct placeholder under time pressure and in competition with other teams in the room. As an original game element, video interviews with experts on a particular aspect of the tendering process are attached to the respective model elements and are required by the participants to solve the group task. The game design is tested and developed in three pilot trainings. We report on the design of the role-playing game, its initial evaluation, and conclude with a discussion of our findings.**

I. Introduction

Serious games have received attention among researchers and practitioners as a potential means for promoting professional development by stimulating an active learning process. While interest and investment in serious games have been on the rise, business process models and business process modelling have, to date, only rarely been studied as part of a serious game intended for professional training. In this work, we report on findings of an ongoing field study into the design of a cooperative, computer-supported role-playing game based on a business process model. The field research is conducted at a German manufacturing company which engineers, builds and installs large-scale filling and packaging systems tailored to the needs of industrial customers. With a staff of 5,000, production facilities in Germany, the USA, Mexico, Brasil, and India, and a 2015 turnover of about 1,1 billion Euros, the manufacturer represents a medium-sized enterprise typical for the German industrial sector. The main rationale for choosing the site for this field research was the unique opportunity to study the design and design process of the role-playing game and its application to a professional training. Designed and developed by the manufacturer's process management unit, the role-playing game is part of a one-day inhouse training on the company's complex tendering and order management process which is initiated by a customer request for quotation triggering more than 20 mostly complex activities involving staff from areas such as mechanical and construction engineering as well as sales and accounting, among others. The resulting final tender is represented by an extensive set of documents often consisting of several hundred pages of specifications including constructional drawings, comprehensive calculations and cost estimates. The role-playing game constitutes the centerpiece of the inhouse training, and is scheduled to take up to four hours in the afternoon of each training day. In the morning of a training day, a preparatory business game is scheduled which is not subject to this field research.

The primary research objective of the field study is to understand the design and design process of the role-playing game—including design objectives, design challenges, and design decisions. The study is in part motivated by our initial conjecture that the task of assigning predefined elements to prearranged placeholders in the process model template, i. e. the simplified representation of the process model, is too simple a task to warrant a professional training. After all, the control flow is predefined and we assumed a straightforward solution space. However, findings reported in this work indicate that the degree of difficulty induced by the task is sufficient to address the training objectives, and that the role-playing game positively contributes to achieving these objectives.

In the present work, we focus on the design of the process model template and role-playing game, and their initial evaluation in the pilot trainings. Section II reviews related work. Methodological considerations informing the field study are outlined in Sect. III. Section IV reports on the design and design process of the role-playing game. Findings are discussed in the concluding Sect. V.

II. Related Work

The application of games used for serious purposes ('serious games') has been discussed in various fields for long [1]. Application areas are i. a., in education and industrial trainings [1, p. 10] [2, p. 30f]. The use of digital serious games in teaching

and professional trainings extended in the last decades and emerged as an intensely studied field [3, p. 10] [4, p. 16]. Very broadly, a serious game is characterized as a game used for non-entertainment purposes, e. g., for education or training [1], [5], [6]. Several approaches to classify serious games have been suggested [7, p. 16]. A typical classification is according to so-called markets, i. e. corporate games, educational games, government games, healthcare games, military games, as well as political, religious, and art games [5]. Initial approaches of this categorization can already be noticed in [1]. The present serious game falls into the category of corporate games. Another elaborate classification of digital serious games used for learning purposes based on four dimensions is suggested in [8]. The first dimension *primary educational content* is specified as academic education, health, marketing, military, occupation or social change—similar to the classification according to markets. For the dimension *primary learning principle*, the concepts cognitive problem solving, knowledge gain through exploration, practising skills, and social problem solving are suggested. The third dimension is the *target age group* with the levels preschool and below, elementary school, middle school and high school, as well as college, adult, and senior. In the fourth dimension *platform*, computer-based games and games designed for other platforms are distinguished. With respect to this classification, the role-playing game considered here can be characterised as a game with primarily occupational content and with the primary learning principle of cognitive problem solving as it is aimed at conveying knowledge with regard to the manufacturer's tendering process by instructing the participants to work on the process model template in a modelling tool. The target age group is the group of adults and the game is run computer-supported. Various game elements are incorporated into serious games, i. a., competition, roles, rules, groups/teams, three-dimensional environments, and time pressure [1, p. 5, 16f] [3, p. 11]. Game elements can broadly be described as elements being characteristic to games [3, p. 12]. In the present case, different game elements being incorporated into the training can be identified, i. a., rules, roles, and time pressure.

The impact of serious games on learning effects is discussed in literature and referred to as uncertain [9]. However, the active role of participants is commonly assumed to result in traceable incentive effects, a more easily acquisition of knowledge, and longer lasting retention of knowledge—in comparison to rather inactive learning approaches [10]. In addition, the application of serious games for training purposes is accompanied by the promises of increased motivation and engagement–controversially discussed in literature [1], [6], [11] [3, p. 9] [4, p. 14].

We know of only the following few contributions applying process models or elements of process modelling as part of serious games (in particular [12]–[17]). A process modelling approach in a virtual environment aimed at conveying business process modelling practises is suggested in [12]. The approach primarily focusses on collaborative modelling and modelling in distributed environments. Similar to the game considered in the present research, the presented approach focusses on the representation of a business process in a BPMN variant. However, the approach in [12] suggests a three-dimensional environment for process modelling in which users are represented as virtual world avatars. Collaborative modelling is fostered by offering the opportunity to jointly model with users in the same modelling environment, i. e. the same virtual world. The authors introduce tools for collaborative process modelling they developed and incorporated into the virtual environment, e. g., the so-called Process Modeller allowing to create business process models represented in a BPMN variant. The approach can be seen as a computer-based serious game incorporating i. a., the game elements of a three-dimensional environment and the opportunity to build teams.

A computer-based serious game also incorporating the game element of a three-dimensional environment is proposed in [13]. The game called *ImPROVE* is based on the implementation of a triage system in a hospital emergency unit. The task of the participants is to model the underlying business processes which also can be simulated. The provided real-time feedback during the game is emphasised. It is the aim of *ImProve* to foster organisational learning. Further incorporated game elements are i. a., competition and rules.

Another approach related to the topic of the present paper is suggested in [14]. The author reports on the design of an ERP simulation game called *ERPsim* aimed at conveying concepts and competencies concerning Enterprise Resource Planning (ERP) systems. The participants are instructed to run a business with an ERP system in business cycles, i. e. the game is turn-based. Each cycle includes the business processes of procurement and production as well as the sales process. Similar to the serious game in this case, the participants are divided into groups (five to six participants) and perform the group task in competition with other teams under time pressure. Besides enhancing the understanding of concepts and developing competencies related to ERP systems, another objective of the suggested game is to convey the benefits accompanying enterprise integration [14, p. 442]. *ERPsim* can be seen as a serious simulation game which is computer-based and incorporates i. a., the game elements of competition, groups, rules, and time pressure. The simulation game has been used in academic context, in research, and commercially [18]. A remotely related approach is suggested in [15].

A serious game aimed at conveying collaborative modelling competencies is the training game *Innov8* developed by IBM [16]. *Innov8* is a business process management simulation game in a three-dimensional environment in which the user is represented as a virtual avatar engaged in a fictional call center agency. The game task is to improve business processes in the virtual company by gathering information related to these processes, modelling business processes, and redesigning processes. The intended learning effects refer to fundamentals of business process management, i. a., process modelling competencies. Similar to the serious game considered here, participants are introduced to process models represented in a BPMN variant. *Innov8* can be seen as a computer-

based simulation game incorporating i. a., the game elements of roles and a three-dimensional environment. In [17], an evaluation of the application of *Innov8* in Information Systems teaching is presented. The authors report on an experiment conducted at a business school investigating the impact of the application of *Innov8* on business process management learning. In the considered case, the evaluation of applying *Innov8* in a business process management course by the students is rather positive, especially with respect to educational aspects. However, deficiencies in conveying theoretical knowledge are reported. The authors conclude that applying *Innov8* complements business process management learning in the presented case, in particular with regard to active learning and developing practical skills.

Different from this prior work, the design and development of the role-playing game reported at hand is studied at the manufacturer's site who intends to apply business process models as part of this serious game for corporate training purposes.

III. Research Process

The research process does not follow a singular prescription (e. g. [19]) but rests upon a pluralistic conception of scientific research and corresponding considerations towards research methods [20]—a conception particularly suited for field research on technical artifacts in social action systems as it allows for accounting for the particularities of the research subject (e. g. contingencies of the action system and of the artifact), see, for example, Morgan's thoughts on studying such settings [21] and Ciborra's 'alternative views' [22].

The conception of the field research presented in this paper is informed by Hermeneutics [23]–[25] and is aimed at providing an *understanding of the design and design process* under investigation through interpretations of the researchers [20, p. 25, 27]. The research approach is thus based on "understanding as a method [...] a form of *empathy* (in German *Einfühlung*) or re-creation in the mind of the scholar of the mental atmosphere" [23, p. 6].

Any attempt to *understand* involves the researchers' personal experiences and perceptions, and, thus, implies the methodological challenge of providing scientific justifications for the presented interpretations which are both traceable and convincing with respect to the postulates of justifying scientific knowledge [20, p. 27–28, 52]. To address this challenge, the present work aims at making the intentionality in understanding traceable by reconstructing the purposes and objectives of the actors involved in the design and design process, by describing the artifacts in a way comprehensible to others, and by presenting an adequate justification of the developed interpretations [26, p. 79].

Following this path, a convincing justification is not guaranteed. However, it contributes to an iterative justification and allows for a critical evaluation of the developed interpretations [20]. This particular research approach is regarded as suitable for studying the design and design process of the role-playing game in the field as, to date, there has been no systematic examination or theory development on that particular research subject [27, p. 370, 372]. Hence, a field study provides the opportunity for developing a first, exploratory understanding of the design and its process at hand [20, p. 27].

Different from the methodological tenet of the researcher as an 'uninvolved observer' [28], the role of the first author has not been strictly confined in that sense: When the process management unit faced design decisions pertaining to the process model template and to the incentives provided to the participants during the game, the first author was asked to provide his views on the issues, and to participate in design discussions on two occasions. Hence, the present work does not strictly follow the methodological convention of the uninvolved observer, although the researchers primarily and almost exclusively have been in that role. The reasons for this specific setup lie in the timing of this research. At the time, when the research process began in December 2014, the process management unit already had designed a first version of the process model template, and had the chosen modelling tool vendor implement that design in the modelling tool. The design of the corresponding role-playing game, however, matured afterwards, required changes to the template, and was tested and further developed in three pilot trainings at the manufacturer's site (in January and February of 2015). The present work refers to the game design as of March 2016.

Data for the field study were collected in unstructured interviews, artifact and document reviews, and observations (e. g. during pilot studies) to obtain multiple perspectives on an issue. As part of the data collection, the process management unit explains the design of the role-playing game in various stages of the design process, and gives demonstrations of the modelling tool, process model template, and interactions with the tool during the role-playing game. The design of the role-playing game is further made available via written documentation and video recordings on the setup, rules, and used support material (e. g. instructions provided to participants). The modelling software tool and the process model template are also accessed as are the documents and video material (i. e. expert interviews) incorporated in the template. In the January 2015 and the February 2015 pilot training, one researcher attended as observer. A third pilot training, i. e. the first one in December 2014, is made available to the researchers as video recording. An additional demonstration of the role-playing game intended for members of the manufacturer's management in February 2015 is attended by the first author but not recorded. Further information on the pilot trainings is provided in Sec. IV-D.

IV. Research Results

A. Training objectives and subsequent goals

The primary objective set by senior management is reconstructed as to achieve a consistent and comprehensive understanding of the tendering process by the trained staff. This objective is motivated by internal studies suggesting that employees' process knowledge beyond immediate process involvement, i. e., across business functions, should be improved

to avoid unnecessary friction and costly redundant work. A secondary objective set by senior management is reconstructed as to obtain suggestions for process improvement from the training, i. e., staff participating in the training should be incentivized to formulate own ideas for improvement, and to submit their ideas during the training.

For the game design, the process management unit operationalizes these two high-level objectives by establishing the following interdependent subgoals: (1) The participants are familiar with the intricacies of the tendering process, and have obtained knowledge of important activities, events, roles, responsibilities, documents, information systems, and technical terminology. (2) The participants are able to adequately interpret a process model in the chosen graphical notation (a slightly modified BPMN variant), and to purposefully use business process models for performing their work. (3) The participants are able to communicate about business processes using process models, and to jointly develop a common understanding of (process-related) organisational issues based on process models. (4) The participants are able to recognize potential for organisational (process) improvement based on process models, and to formulate suggestions for process improvement based on process models.

In our reconstruction, it is, thus, *not* an objective of the training to develop the participating staff to be able to *construct* process models but to be able to properly interpret process models in the chosen and slightly modified BPMN variant, and to be able to purposefully use existing process models for the range of tasks described.

B. Design of the process model template

The process model template functions as key game element in the role-playing game in that the game design builds on the template. An excerpt of the graphical representation of the process model template is shown in Fig. 1 and in Fig. 2 as presented to the training participants in the modelling software tool. Note that both figures show illustrative excerpts shortened compared to the considerably more complex template used in the training which comprises 22 tasks and 12 milestones, 17 roles, 29 documents and 6 information systems, and covers the tendering *and* order management process whereas in the pilot trainings only the tendering process is represented by the template. Also note that the labels and textual descriptions in the figures shown in the present work are translated from German to English by the authors. As mentioned afore, the template was designed by the manufacturer's process management unit.

Rather than presenting the participants with a syntactically correct and semantically adequate process model, the process model is reduced to a simplified representation of the control flow and to placeholders for 'milestones' (or 'MS' in the template), activities (denoted as 'tasks' in the template), roles, information systems and documents (upper third of Fig. 1). The control flow shows solely sequences on a high level of aggregation. Branching and concurrencies, i. e. gateways, are omitted. Symbols of the type 'circle with triangle' have an idiosyncratic meaning and represent 'milestones' in the manufacturer's tendering process, i. e. events specific to the tendering process and important to its understanding by training participants. Placeholders for information systems are depicted in Fig. 1 as symbols inspired by the graphical symbol for 'magnetic storage' in flow diagrams (flowcharts). Placeholders for documents use the common graphical representation of a dog-eared sheet of paper, and responsibilities of roles are marked by a circled 'R' symbol below a task symbol. Hence, the graphical notation follows the BPMN 2.0 notation [29] as suggested by its specification [30] but is modified by the process management unit to accomodate for specifics of the firm's requirements towards business process models.

The four areas in the lower two-thirds of Fig. 1 present the participants with the milestones, tasks, roles, documents and information systems to be positioned on the placeholders above (via drag and drop). As further explained in the next section, the group task in the role-playing game is to assign the start and end event and milestones (exemplified in area 1), the tasks (area 2), roles (area 3) as well as document types and information systems (area 4) to their respective placeholder. Note that the identifiers (names) of symbols are removed for reasons of anonymity—except for roles (3) shown as examples. In the role-playing game, all model elements shown in the lower part of the figure have a descriptive identifier in the context of its tendering process. The area labelled as 'Bonus' is explained in the subsequent section.

An interview with a domain expert, a demonstration of a task conducted with software system (both as video recording) or an example of a document created and used in the tendering process (showing e. g. diagrams and calculations) is attached to each model element and available to the participants for viewing (via double-clicking on the small files symbol in the upper right corner of an element, see Fig. 1). The attached media is aimed at conveying domain knowledge regarding the meaning of the model element in the context of the tendering process. In particular, the video interviews (conducted by a member of the process management unit) deal with the specific domain terminology used for communication about the specific aspects of the tendering process represented by the respective model element. As noted before, understanding the tendering process implies understanding the respective subset of technical terminology used in the involved knowledge domains, e. g., specific terms established in the involved engineering disciplines. In the video interviews, domain experts explain the specific aspect referred to by the model element and exemplify the use and meaning of their technical vocabulary. The expert interviews constitute a key element of the role-playing game: Building on group discussions of their content, an individual and shared understanding of the aspects referred to by the model elements develops and sense-making ensues.

The design of the process model template builds on the premise that each individual participant has limited knowledge of certain aspects of the tendering process but no individual has knowledge of all aspects, and that each group in the role-

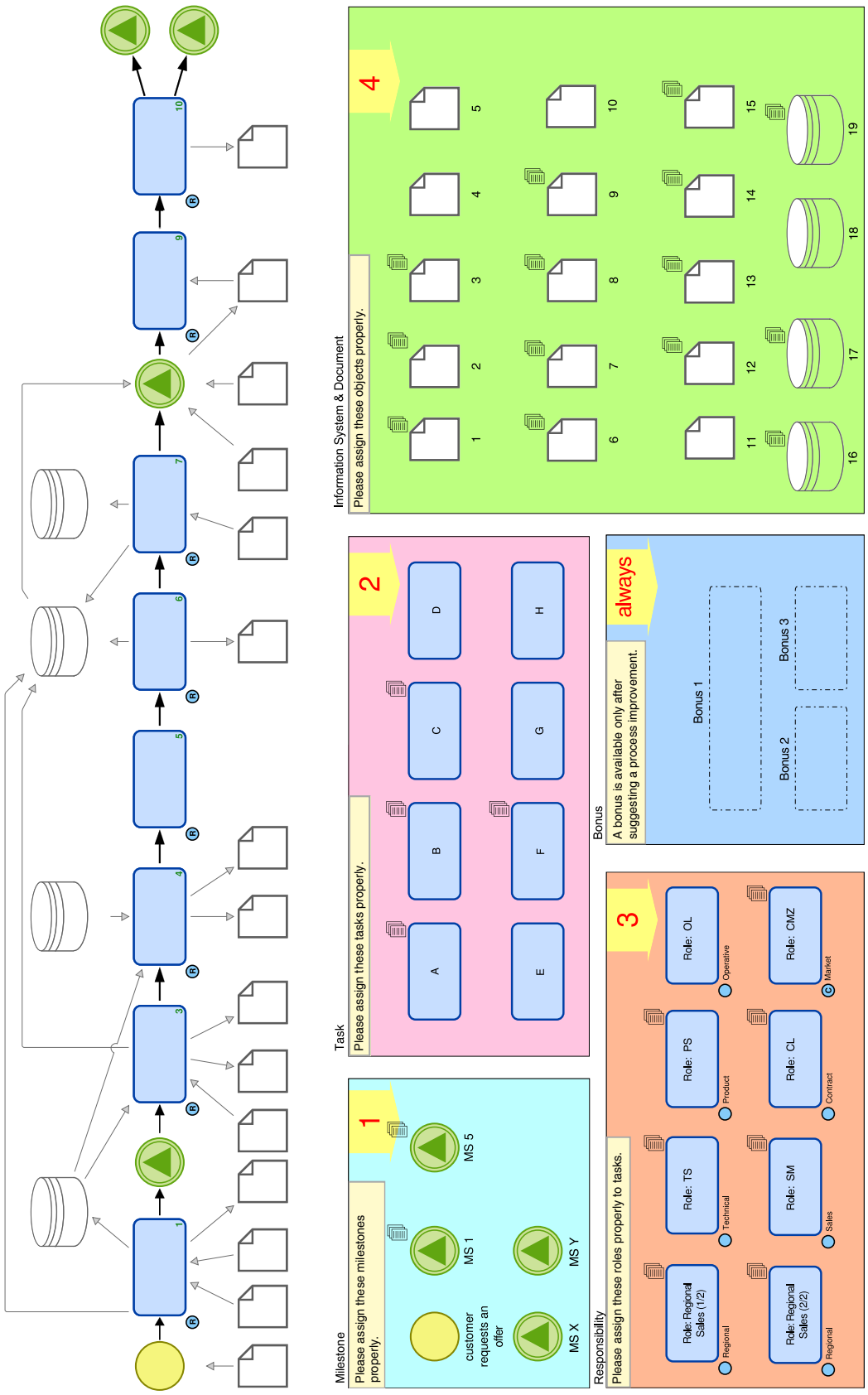

Fig. 1. Process model template (see Sec. IV-B for explanation)—used with permission. Courtesy of K. Hestert, KHS GmbH, Germany.

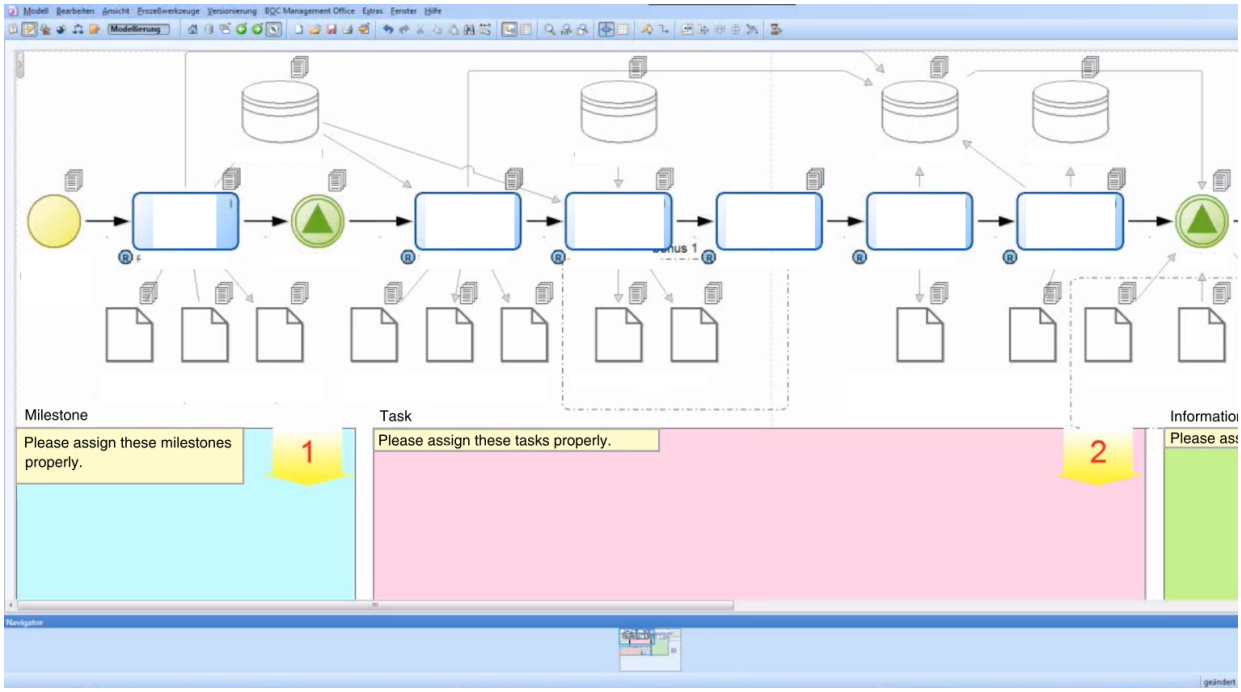

Fig. 2. Process model template as shown in the modelling tool (screenshot of the screen recording of the third pilot training, identifiers removed)—used with permission. Courtesy of K. Hestert, KHS GmbH, Germany.

playing game collectively identifies knowledge not available from within the group and fills the gaps by perusing the media attached to model elements. Thus, the individual acquisition of knowledge by participants when perusing the media is expected to differ according to the distinct state of prior knowledge.

C. Design of the role-playing game

The role-playing game is designed for a duration of about three to four hours which can be divided into three essential phases: *Introduction phase*: A moderator explains the objectives of the game, its time restriction, group task, roles and rules of the game as well as the incorporated game elements such as the process model template. In addition, the modelling software tool and the used notation are introduced. The moderator recommends to begin performing the group task with assigning milestone types to placeholders and to proceed with areas 1–4 in ascending order.

Working on the group task: The training participants work in groups of four on the group task outlined below. A group is physically situated in a room with other groups. It is planned to have at least two and at a maximum four groups in a room depending on room size and availability. The moderator periodically notes the progress of all groups in the room on a flipchart or whiteboard, so that groups are informed about the other groups' progress with the group task.

Multiple-choice test: After all groups finish the role-playing game, each participant has to take a multiple-choice test on aspects of the tendering process as conveyed by the game's group task. In the test, the participant has to demonstrate knowledge regarding the tendering process and competencies in operating software used in the manufacturer's tendering process. In the following, we outline the group task, rules and roles of the role-playing game and its further game elements.

1) Group task and basic rules: The group task is explained to the participants as to assign the model elements below the process model template to their proper placeholder in the process model template (by dragging the predefined model elements to one of the fitting placeholders above). Participants are told that each model element must be properly positioned at the one predefined placeholder without any room for interpretation, and is properly positioned only if this placeholder is chosen. Also, participants are explained that the game ends when all model elements are properly assigned to the proper placeholder, and that all model elements must be positioned. It is also emphasized that the task at hand requires the group members to work together, and to peruse the media attached to the model elements, and that group discussions on the task and media content are permitted and recommended.

2) Setup of the role-playing game: In the role-playing game, trained staff participates in groups of four with each group member selected from a different business function at the same site, i. e., staff has to work together on the group task who is not in close collaboration during day-to-day business. This design decision has two main motivations: It should foster communication across business functions and aims at speeding up the work on the group task, since prior knowledge of the tendering process by group members is assumed to cover a wider range of aspects of the process than a homogeneous group from the same site. The group formation

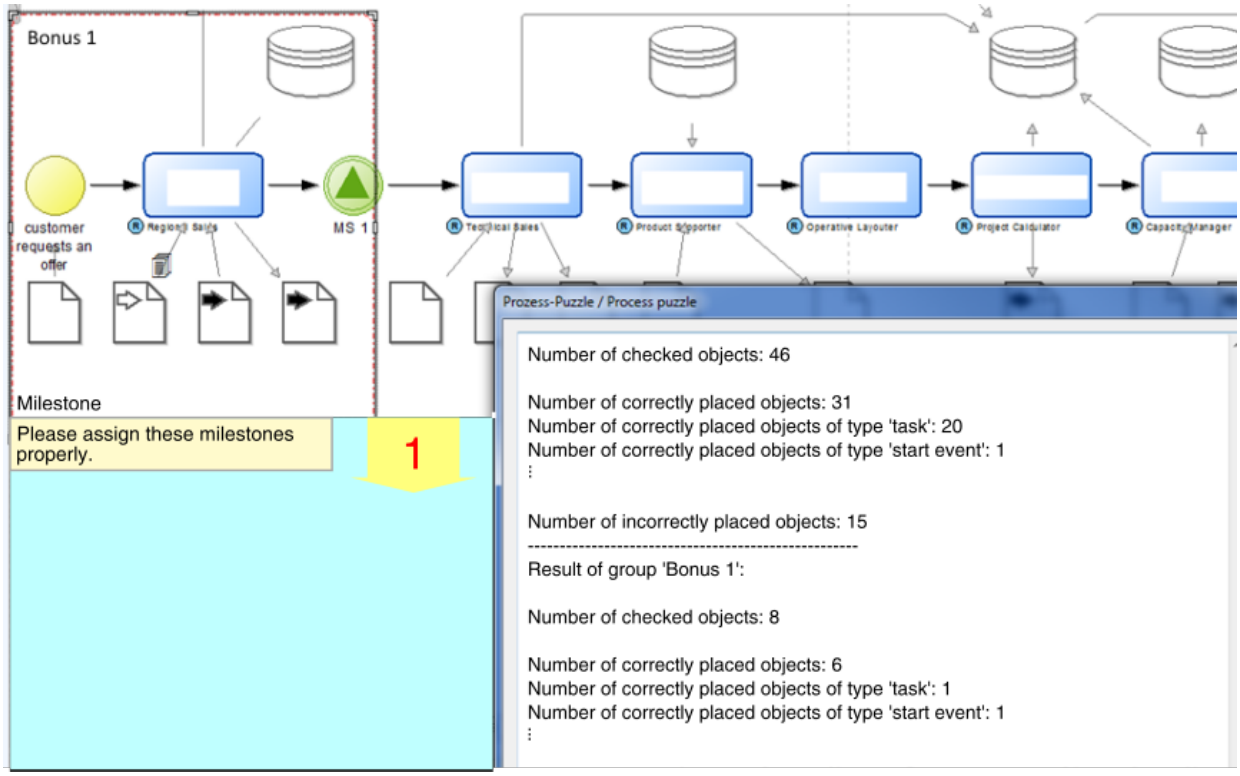

Fig. 3. Validation of proper positioning (showing a bonus as example)—used with permission. Courtesy of K. Hestert, KHS GmbH, Germany.

is, thence, predetermined and group members are preselected according to the participants' work function and affiliation to an organizational unit.

As part of the pre-training preparations, the moderator sets up one laptop computer per group and starts the modelling tool with the process model template preloaded for immediate access by each group. A printout of the rules of the game is provided to every group. During the introduction phase, the participants in the room are shown a brief video tutorial explaining the term 'process model' and the graphical notation used in the training (using a projector) including the additional overlay symbols, e. g. for accessing the attached media. The tutorial also shows how to operate the modelling tool, e. g., how to move the model elements to placeholders.

3) Game element 'validation': The role-playing game incorporates a game element we denote as 'validation of the proper positioning of a model element to its placeholder'. More specifically, every 10 minutes, each group is permitted access to a special function in the modelling tool to perform such a validation for all model elements positioned on placeholders so far. Fig. 3 illustrates the result of a validation as displayed in the modelling tool by an example. The number of properly placed model elements is displayed but it is *not shown which model elements are placed incorrectly.* In the example (see Fig. 3), 31 of a total of 46 model elements have been assigned to the proper placeholder. Consequently, the remaining 15 model elements have been assigned incorrectly or have not been assigned at all yet. Thus, any time a validation is performed, members of a group obtain feedback on their progress in the role-playing game, and, hence, on completing the group task.

A subsequent task following a validation is to identify incorrectly positioned model elements, and to discuss alternative positions, and to decide on another placeholder. Hence, the group members have to consider and question all of the already assigned model elements if there is a discrepancy between the number of already assigned model elements and the number of properly assigned model elements. The validation function is introduced to the game design to speed up the groups' work on the group task. However, the result of a validation is not precise as the number of properly respectively incorrectly assigned model elements refers to the entire process model template, and it is not indicated which model elements are assigned incorrectly or in which part of the process model template model elements are assigned incorrectly. Whenever a validation is executed, the result and, thus, the progress of the respective group is displayed to all participants in the room. The latter design decision to introduce the visual display of group progress is aimed at fostering competition between groups.

4) Game element 'bonus': In addition to the game element of regular validation every 10 minutes, a further, more effective kind of validation is introduced as game element named a 'bonus'. The precondition to obtaining a bonus is for each group to submit a suggestion for improving the tendering process to the moderator. Similar to the game element of

validation previously described, a bonus enables the validation of placement of model elements (see the area labelled 'always' in Fig. 1) but different from a regular validation, a bonus allows to validate model elements in a specific region of the process model template which can be defined by adjusting the graphical element associated with the bonus (e. g., see area 'Bonus 1' in Fig. 3). Thus, the result of applying a bonus is considerably more precise than a regular validation of placement of model elements in the entire process model template. The rationale for the design decision of introducing the game element of a bonus is twofold: A bonus can reduce the time to identify incorrectly assigned model elements and, thereby, the time to solve the group task substantially. As the time period between two validations has to be at least ten minutes and as results of a validation are much less precise, the game element of a bonus introduces an incentive for the groups to receive a bonus, and, hence, to think about ideas of improvement for the tendering process.

5) Game element 'roles': The role-playing game specifies four roles with accompanying tasks and responsibilities for the group member in a role. For each group, each of the following four roles is assigned to a group member:

Team leader: The role of 'team leader' is given the objective to make sure that the group is working on the group task as effectively and efficiently as possible. It is also the task of a team leader to ensure that all group members work on the group task purposefully, participate in discussions and placement decisions, and are prepared for taking the subsequent multiple-choice test. A further task of a team leader is to summarize the content of the expert interviews and other media, and to initiate corresponding discussions on the group members' understanding of the aspect of the tendering process. Based on three control questions per interview, the team leader has the possibility to recommend not to watch a video recording if the group agrees that its explanatory content is already known by the group members and that consensus can be achieved on the decision where to place the respective model element.

Logician: The role of 'logician' is responsible for seeing that the number of model elements properly assigned to a placeholder is as high as possible. A further task assigned to this role is to periodically check for applying a bonus, i. e., whether and in which region of the process model template the group is able to benefit most from applying a bonus. A subsequent task is then to suggest to the group to discuss ideas for process improvement, and to submit an idea to the moderator.

Application operator: The main responsibility of this role is to operate the modelling tool, i. e., to position model elements on placeholders, and to activate the validation function, and to arrange the bonus areas for validation purposes.

Time keeper: The role of 'time keeper' is responsible for seeing that the overall time constraints are respected, e. g., by keeping track of time spent for discussing a single model element and by remembering the group to make a decision and to proceed to another model element. The time keeper also makes sure that the time intervals between regular validations are kept.

6) Game element 'multiple-choice test': It is known to the participants from the outset that the role-playing game concludes with a multiple-choice test taken individually and that the test questions refer to specifics of the tendering process covered in the role-playing game as well as to software operations demonstrated in video recordings. The test is comprised of 65 multiple-choice questions and tasks referring to hands-on software system operations. The questions ask i. a., for the meaning of concepts in the context of the tendering process ("What does ... mean?"), for roles (e. g., "What are the main activities of ...?"), and for tools used in the context of the tendering process (e. g., "Which tool is used for ...?"). As part of the test, each participant also has to execute tasks using software systems introduced in the role-playing game, e. g., the task of creating a contact person in the manufacturer's customer-relationship management system.

The design decision to conclude the role-playing game with a test is aimed at creating incentives for every participant to acquire further knowledge regarding the tendering process, and to get familiar with the software systems deployed in the process. The test is not passed if more than four questions are answered incorrectly. If the examination is not passed, it has to be repeated one week later. The superior of an employee who has failed the test is then made responsible for seeing that the employee acquires the required domain knowledge in the week following the failed test, and that the employee passes the test. The design decision to have the test repeated if it is failed and to involve the superior in this case is seen as an attempt to set further incentives for an employee to purposefully participate in the role-playing game, and to acquire the required knowledge.

D. Design process and initial evaluation in pilot trainings

The initial evaluation of the design of the role-playing game centers on three pilot trainings in which the then present design stage is tried and tested with test persons followed by a discussion on potential design changes first with the test persons and later within the process management unit. Design decisions are then made by the process management unit with regard to conceptual and organizational aspects. Hence, the overall design process is interpreted as to follow the general problem-solving strategy of trial-and-error with selected design stages put up for experimenting by way of trial. Note that our assessment of the design process is preliminary at present; we intend to further study the design process at a later phase of this field research.

The general setting of the pilot studies is such that staff without previous experience in process modelling is asked to participate. The test persons are recruited from the same site in Germany but from different business functions—with two notable exceptions in the first pilot training in which two members of the process management unit participated (see below for further specifics of the first pilot training). The member of process management unit responsible for the game

design functions as moderator in the three pilot trainings, and records the pilot trainings on video including screen recordings of the laptop computer in use.

The first pilot training in December 2014 focuses on testing the handling of the process model template in the used modelling tool and on watching the video recordings on the laptop computer. At this point in time, the design of the role-playing game is in a relatively early stage of development. Besides the role of the Application Operator, no further roles are communicated explicitly. Not divided into groups, the nine participants work together on the group task, i. a., by viewing videos and assigning model elements to placeholders in the process model template. In contrast to the process model template in Fig. 1, areas 1–4 and, thus, the recommended order of assigning model elements to the placeholders have not yet been build into the design. The textual descriptions attached to respective model elements are available in the modelling tool but not yet implemented as an element of the role-playing game. Creating incentives by the game element of a bonus is tested, but the corresponding rules have not yet been defined. In the introduction phase of the role-playing game, the group task and the rules of the game are explained by the moderator. In addition, the modelling tool and the used notation are introduced to the test persons. Moreover, it is established that the moderator notes the game progress of a group visible for all participants whenever a validation is executed.

Similar to the first pilot training, in the second pilot training nine employees work together on the group task. In contrast to the first pilot training, the participants are primarily recruited from middle management and not from line functions. The second pilot training incorporates the numerous design changes after the first pilot study but is not yet based on the set of explicit rules described in the previous section. Rather, the rules of the role-playing game remain vague and, thus, the subsequently added incentives to participate and to submit suggestions for process improvements have not been established. The final discussion with test persons is marked by a skeptical outlook on part of the test persons with respect to achieving the training objectives. As a result of the discussions, the design of the role-playing game is further refined and many details are precisely specified. For example, the four introduced roles, the game element of a bonus, and the group size of four are introduced to the design. Moreover, it is specified that the groups should be heterogeneous, i. e. consist of members from different business functions and with different professional backgrounds. This requirement is interpreted as an essential result of the first two pilot trainings and refers to the training goals of fostering an understanding of the tendering process and communication about the tendering process—both across business functions.

Preparing for the third pilot training, the introduced roles and corresponding tasks and responsibilities are further specified. Moreover, creating incentives by the game element of a bonus is tried as well as attaching documents (i. e. textual descriptions) to model elements. The design of the role-playing game is modified in various respects and tested in the third pilot training. Among the design changes, a particularly visible change is the introduction of a large poster showing the entire process model template which is visible to all participants during the pilot training. This refinement is based on observations of participants that focusing on parts of the process model template increases the risk of loosing the overview. As an additional help, a printout of the rules of the game, the roles and their tasks etc. is handed out to every group at the beginning of the role-playing game.

It is decided to extend the time frame for the introduction phase to allow for a more detailed introduction to the role-playing game by the moderator. Now, the moderator explains the objectives of the training and the role-playing game and its time constraints, the group task, rules and roles as well as all game elements in detail. Moreover, it is decided to add an explicit recommendation by the moderator to start working on the group task by first working on the milestones and then to to proceed with along the numbered boxes in an ascending order. As an additional organizational change, it is established that the moderator has to monitor compliance with the rules of the game and with the time constraints.

The final discussion with test persons is marked by a clearly less skeptical outlook on part of the test persons with respect to the conduct of the role-playing game. It seems that a consensus is established by the test persons that the game is likely to be accepted by the trained staff (i. e. purposefully played), and that the game positively contributes to achieving the training objectives. More specifically, the test persons emphasize the learning effect of the game with regard to a better understanding of the tendering process, and underline, in particular, that the game positively contributes to understanding the interrelations of tasks, roles, information systems and documents constituting the tendering and order management process.

V. Discussion

Contrary to our initial conjecture, the present results indicate that the degree of difficulty induced by the group task challenges the test persons to accept the task, and to purposefully and constructively perform as a group. The group task is, contrary to our expectations, *not* predominantly performed in an erratic or speculative fashion but goal-oriented and appropriate following the rules of the game. In this regard, two observations relate to our initial conjecture: Firstly, observing the test persons in the pilot studies, it becomes apparent that the group task is, again contrary to our initial conjecture, *not* too simple but rather perceived by most participants as a challenge with regard to the intricacies of the tendering process. This conclusion is indicated by the observation that the observed groups needed to view almost all attached media, and were required to discuss their understanding of the media content to purposefully solve the group task. Secondly, a further observation suggests that a deeper understanding of the manufacturer's tendering process is particularly fostered by explanations of technical terminology of a domain in the

expert interviews. This observation extends to the documents, calculations and other artifacts presented, demonstrated and explained in the video recordings.

With regard to the subgoals set by the process management unit, our findings suggest that the game design positively contributes to achieving these objectives. In particular, observations in the group discussions and final discussions in the pilot trainings indicate that the design of the role-playing game fosters an understanding of the intricacies of the tendering process by the test persons (cf. subgoal 1). Given that almost all test persons are faced with a graphically represented process model for the first time, it is striking that the test subjects themselves point out that the business process model facilitates understanding of and communication about the tendering process across business functions (cf. subgoal 3). This presupposes that the test persons were able to interpret the graphical representation which in turn implies that the subjects gained sufficient insight into the chosen modelling language and its graphical notation (cf. subgoal 2). Our observations in the pilot trainings do not allow for interpretations with regard to learning effects regarding the participants ability to formulate process improvements (cf. subgoal 4).

The present work is, to our knowledge, the first to report on serious gaming based on business process modelling and its application as part of a professional training. The field study is focused on the specific role-playing game as design artifact, and present findings are intermediary in that they are based on the early design phases up to an initial evaluation in three pilot trainings—the upcoming application to train a staff of 1,000 will provide much more reliable data for this field research. At present, our findings require careful (re-)interpretation in the light of these first, exploratory insights, and cannot and do not claim to generalize.

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