Enabling Business Domain-Specific eCollaboration
How to Integrate Virtual Cooperation in Product Costing

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Abstract: Due to digitalization and the rising relevance of knowledge work, virtual cooperation in enterprises is increasingly important. Product costing is an example of a business domain that is characterized by a high demand for communication, coordination, and information exchange. Time and location-based restrictions underline the necessity of computer-assisted support in collaboration. However, an approach to integrate IT-support for virtual cooperation directly into the core process of business domains like product costing is still missing. To overcome this challenge, we show how to enable Business Domain-Specific eCollaboration based on the design principles for integrated virtual cooperation in product costing. This paper presents how to combine collaboration support directly with the process of this particular business domain.

1 INTRODUCTION

Virtual cooperation enables working efficiently around the limitations of time and place. In enterprises, this empowers teams to collaborate even though they are situated in different locations and time zones. The relevance of corporate structures that support virtual collaboration are found to increase, especially in business domains characterized by a high demand for information exchange and communication (Riemer et al., 2009; Alqahtani et al., 2014; Andriole, 2010).

Product costing is one such example of a highly collaborative business domain due to the numerous participants involved in the costing process. Dealing with cost estimations of manufactured goods is very typical in the discrete manufacturing industry, which includes products like automobiles, electronic devices, and technical equipment. Because 70% of the costs of goods sold are already set during product development, early product costing has a high potential to influence costs. In particular, when the costs of a new product whose development cycle has just begun are determined, collaboration is a significant factor in success due to the diverse sources of information that are necessary and essential in the process (Drury, 2008; Saaksvuori and Immonen, 2004). A prior study of ours showed that, in collaborating, primarily traditional methods like physical meetings and telephone calls and generic tools such as emails and online conferences are used. However, in the exploratory survey that we organized with business experts the majority of participants also reported an unsatisfying level of IT support for collaboration in product costing, and problems related to that (Lück and Leyh, 2016a). Therefore, we introduced the approach of Business Domain-Specific eCollaboration in order to tackle the challenge of integrating virtual cooperation support directly into the core process of particular business domains. Based on strong feedback on the topic from practice, we continued with the business domain of product costing as a showcase. We conducted interviews with experts from practice who pointed out that there is a high demand for integrated virtual cooperation support in product costing and we determined the requirements for such an IT support system (Lück and Leyh, 2016b).

In this paper, we aim to develop a concept for a sociotechnical collaboration system for product costing. To analyse how to connect the support for collaboration with the systems used to solve tasks in daily business, we address the following research question:

• RQ1: According to the requirements derived from the collaborative processes in product costing, how can virtual cooperation be integrated into the

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domain by enabling Business Domain-Specific eCollaboration?

To answer this question, we have structured our paper as follows. After we explain the background of this paper in section 2, we describe the requirements-based design principles for Business Domain-Specific eCollaboration in the context of product costing in section 3. In section 4, we present our approach for integrated virtual cooperation before concluding the paper with a summary and outlook in section 5.

2 BACKGROUND

The costing process of goods in the discrete manufacturing industry is an example of a business domain involving a multitude of departments with a high degree of collaboration. Typically, managerial accounting keeps an eye on the financial aspects, engineering contributes construction-related information, and the sales team negotiates with customers and reflects the feedback from the market. In addition, the procurement department contacts suppliers in cases where a part of the product should not be produced in-house, but purchased. Further interaction partners are common in product costing, illustrating the high complexity of the collaborative process (Drury, 2008; Warren, 2014).

Therefore, we initiated a research project about virtual cooperation in product costing. The first step was the investigation of the current collaboration support (Lück and Leyh, 2016a). We discovered that the usage of common eCollaboration tools is insufficient and remains unsatisfying with room for improvement. Nearly 90% of the total product costing workload consist of collaborative work, which makes the support of these activities essential to ensuring efficiency throughout the costing process. The complexity of the process needs to be reduced by clarifying who the participants are and what their tasks are as well as showing the progress of the costing process (Lück and Leyh, 2016a). Data management is often detached from the cooperation process, since using spreadsheet programs such as Microsoft Excel remains highly common (Fiedler and Gräf, 2012; Hansen et al., 2009; Schicker et al., 2008). Thus, an integrated support concept could provide further benefits, such as increasing data consistency, speeding up the business process, and raising productivity (Alqahtani et al., 2014; Back et al., 2012; Lück and Leyh, 2016a).

Collaboration support has undergone an astonishing evolution since the 1980s, especially from a technological perspective (Grudin, 1994). In today's business environments, enterprise 2.0 tools such as blogs and social networks are widespread (Kemsley, 2010; Koch and Richter, 2009; McAfee, 2006). In response, research has focused on adopting eCollaboration, its success factors, or the impact of its use (Alqahtani et al., 2014; Andriole, 2010; Hasenkamp, 2001; Patel et al., 2012). However, integrated support for collaboration in the costing process is still missing, and the existing eCollaboration solutions cannot adequately support the process. In the exploratory study of our first research step experts from practice confirmed that opportunities to cooperate virtually in a way connected to the process of daily business tasks appear to be missing, and we encountered that such integral approaches have yet to evolve. The examination of prior research confirmed that collaboration support with a focus on the integration into the core process is a research gap justifying further investigation (Lück and Leyh, 2016a).

Consequently, we proceeded the research project by conducting a requirements analysis for the integration of virtual cooperation in product costing (Lück and Leyh, 2016b). In expert interviews, product costing specialists explained the collaborative costing process in their company and what IT tools they use for it. They also described the problems they currently see and the needs they have regarding a system that should support the cooperation in product costing. Based on the interviews, we derived a requirements model. How we performed the data analysis and developed the model is described in detail in our second research paper (Lück and Leyh, 2016b). We utilize the elements of the requirements model as design principles for the collaboration support system that we present in this paper. Hence, we explain the requirements-based principles in the next chapter.

3 REQUIREMENTS-BASED DESIGN PRINCIPLES FOR INTEGRATED VIRTUAL COOPERATION

To establish a substantiated foundation for our integrative cooperation approach (see chapter 4), we elaborated a requirements model in a prior research step (Lück and Leyh, 2016b). From July to September 2015, we interviewed 14 experts; half of them working in companies in Germany, the other half in companies in the United States. Because product

costing is a relevant business domain across diverse industrial sectors, we involved experts from four different industries: the automotive, consumer goods, high-tech, and machine-building industries. To understand the different perspectives on collaboration in product costing, we included IT experts, controllers, and managers in the interviews. The goal was to investigate the collaborative process in product costing and its current IT support in order to identify the requirements for virtual cooperation support. Further details are presented in the respective research paper (Lück and Leyh, 2016b).

The requirements depict the design principles for our concept of integrated virtual cooperation in product costing that we present in chapter 4 in this paper. They are aggregated in a requirements model (Lück and Leyh, 2016b), which is illustrated in Figure 1. The model consists of four requirement areas that cover 18 requirements (i.e., abbreviated R in the model) as well as three system prerequisite areas comprising six constraints necessary to enable IT-based collaboration support (i.e., represented by C in the model). The requirement area called *Product Cost Monitoring* should give experts a clear overview of the costing processes to keep the participants informed about the status of the costing process. One necessary component is the subscription in order to track an object manually or automatically. The presentation of which tasks have been completed, what has yet to be done, and whether any issues remain unaddressed enables product costing experts to understand and control the process. To make users aware of the status of the costing process, information about the exact progress is necessary. Showing information about the status, errors, and changes enables system-based monitoring, simplifies the coordination, and improves the controlling of the process. Moreover, Product Cost Monitoring should provide analytical functionality. The results of product costing analyses can influence how to collaborate in the team. Therefore, analytics also have to be embedded.

The second requirement area is the *Costing Workflow*. To collaborate virtually in product costing, every user should be able to participate in a self-initiated, ad hoc workflow. Costing Workflow has to be a flexible tool for the coordination of tasks. The presentation in form of a dashboard and via notifications helps to raise awareness of the actions each user has to perform. Consequently, the system has to inform participants about their workload and the tasks they have to complete. Furthermore, tracking functions are required in order to automate sequences of steps in the collaboration process.

The requirement area *Task Integration* allows utilizing the task concept of the Costing Workflow in all IT systems used for product costing. To obtain necessary data in the collaboration process, it is common that participants determine information from several information systems. Relevant data input has to be synchronized among the different IT systems in order to avoid inconsistencies. To coordinate tasks that are handled externally, interfaces connecting the relevant IT systems need to be realized in order to manage data from other sources automatically.

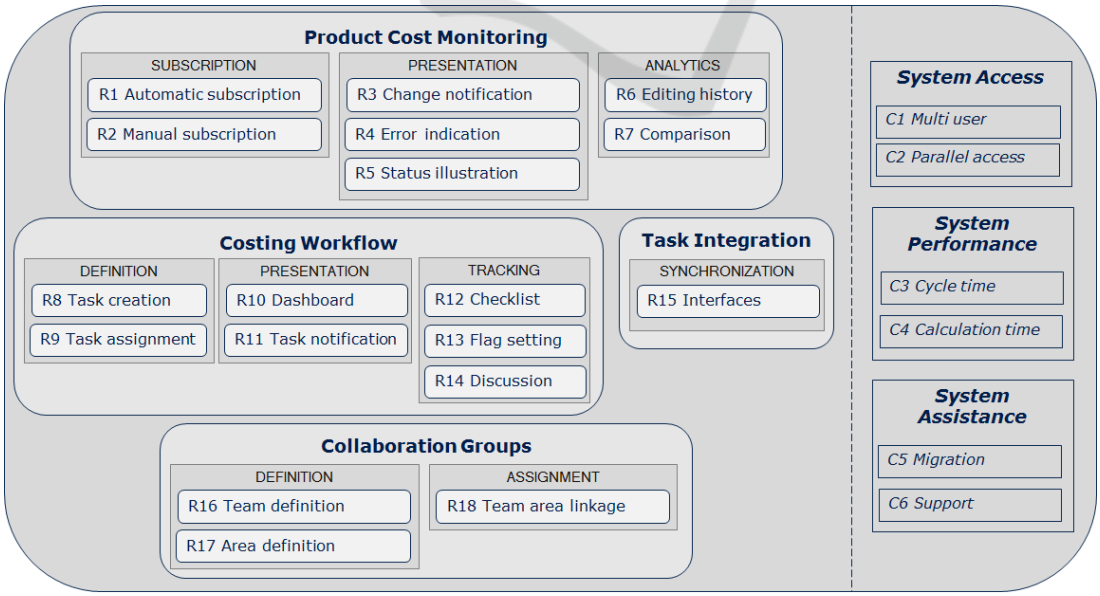

Figure 1: Requirements model.

The requirement area *Collaboration Groups* should support the definition of teams and the areas each team should be able to access. It is needed to administer the members of the collaboration teams as well as the areas the team members should be allowed to access.

Furthermore, the requirements model shows that there exist preconditions for enabling integrated virtual cooperation in product costing. *System Access* for all participants of the collaboration process is a prerequisite for using the full capabilities of the system. Another precondition is *System Performance*. Since users have to wait for results in order to proceed to the next step, when there are time restrictions in the system, the performance is critical and has to be taken into account. *System Assistance* is a major asset of standardized systems. Hence, implementation and operation knowledge from experts is a precondition for the success of the collaborative system.

As part of the prior research step, we also evaluated the requirements model in an expert session with 11 product costing specialists in December 2015 (Lück and Leyh, 2016b). None of the participants were involved in the expert interviews in order to ensure that nobody who suggested requirements in the interviews assessed them as well. All participants were from Germany. The experts from several companies in different relevant industries described the requirements model that we established for integrated virtual cooperation in product costing to be satisfactory. They agreed to the structure of the model, its requirement areas, and their subdivisions, and nobody indicated that any additional requirement area was missing. The evaluation proved that all constructs of our model have significance for integrated virtual cooperation in product costing. No changes to the model were deemed necessary, and the modular composition was evaluated to be very positive. The holistic approach to Business Domain-Specific eCollaboration received excellent feedback and participants confirmed that the requirements represented the demand for integrated virtual collaboration in product costing (Lück and Leyh, 2016b). The requirements-based design principles serve as the fundament for the collaboration system we conceptualize as follows.

4 APPROACH FOR INTEGRATED VIRTUAL COOPERATION

To integrate virtual cooperation in product costing, we developed an approach addressing the requirements described in chapter 3. The approach is divided into three user-centric aspects: Monitoring and Initiation comprises how virtual collaboration can be coordinated and how the process can be tracked. Execution and Progression explains in what

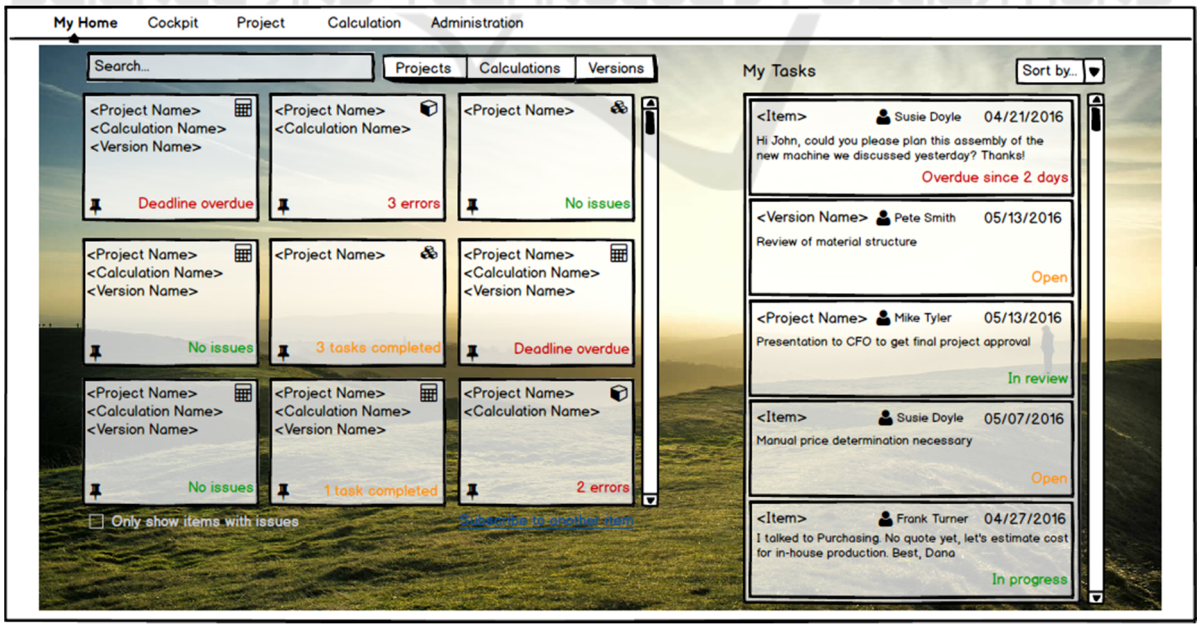

Figure 2: My Home screen.

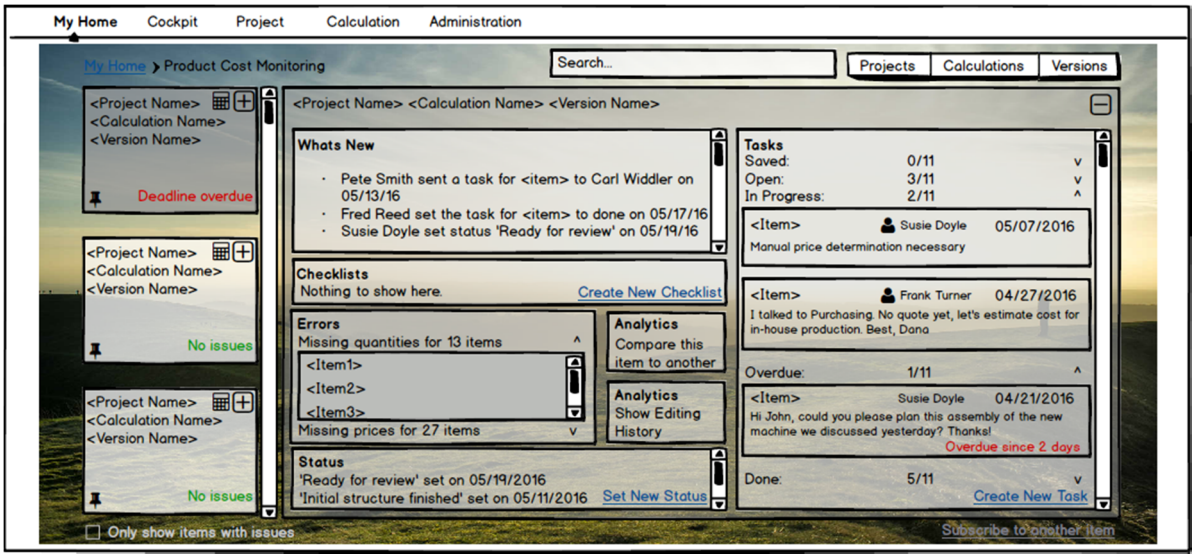

Figure 3: Product Cost Monitoring screen.

way cooperation is executed in the system. The underlying concepts regarding the enablement of those cooperation functionalities are defined in the section Permissions and Subscriptions.

4.1 Monitoring and Initiation

The first aspect of our integrative approach is how steps of the cooperation process can be triggered and how to supervise the process.

We designed the My Home screen as an entry point for all collaboration-related issues. It enables the user to get an immediate understanding regarding the status of the objects he or she is subscribed to as well as his or her assigned tasks (see Figure 2). The My Home screen is integrated in the main application to enable users to collaborate directly in the costing system preventing media breaks and reducing manual effort (Lück and Leyh, 2016a). On the left-hand side of the My Home screen one can find a tile view of all the objects the user is subscribed to with a summary of all issues (e.g., 'Deadline overdue' or '3 tasks completed').

Clicking on a tile item opens the Product Cost Monitoring screen, which provides detailed information regarding the selected object, as shown in Figure 3. Covering the requirement R5 Status illustration, this screen provides information about existing tasks and their state of completion. The same applies for checklists and flags. By summarizing recent actions in a 'What's New' area, users obtain awareness about the latest changes in the collaboration process. In addition, the screen shows existing errors, addressed as R4 Error indication. This enables the user to take immediate action on a certain issue, e.g., to request a price for a cost item that is

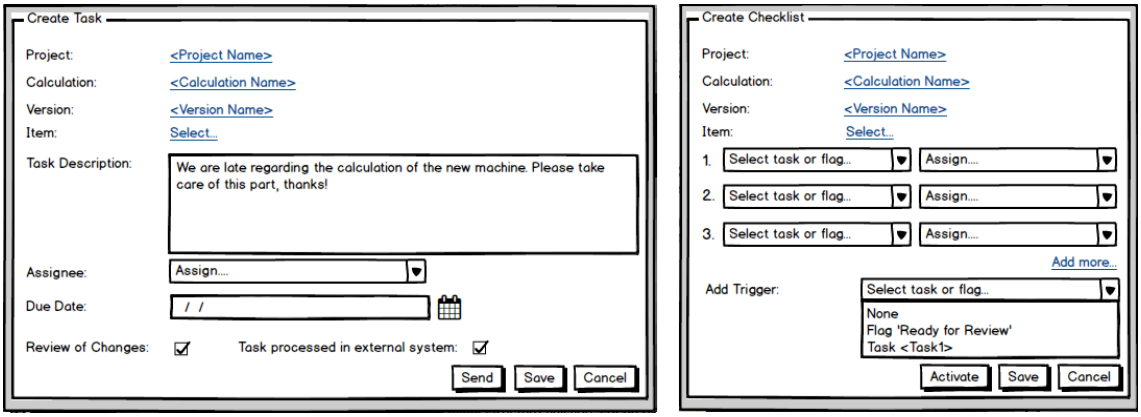

Figure 4: Dialog windows for task and checklist definitions.

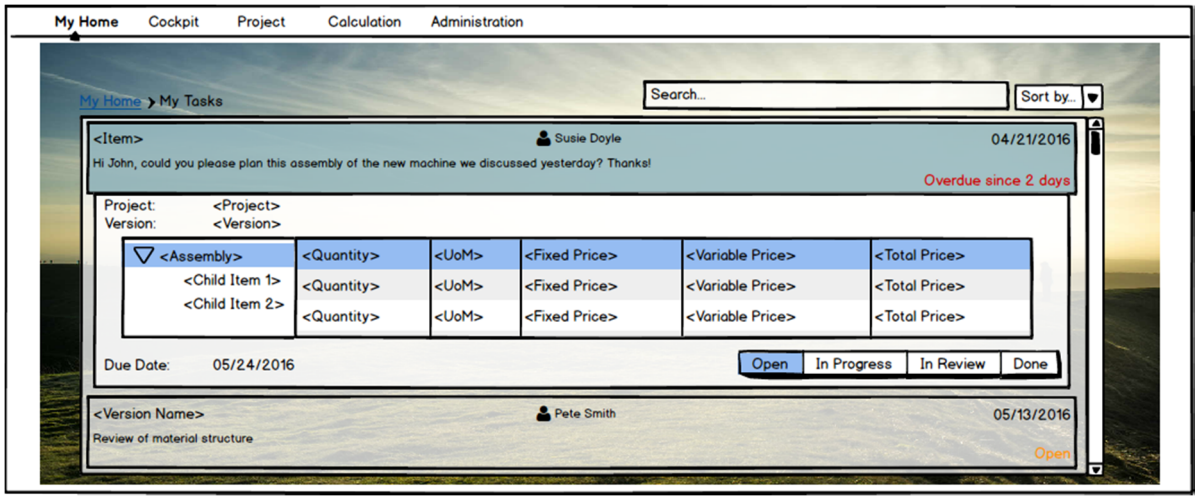

Figure 5: My Tasks screen.

missing. The Product Cost Monitoring screen also gives central access to the analytical functions R6 Editing history and R7 Comparison. The editing history displays a chart with the chronological course of all changes made by the processors and the comparison function provides the possibility to match different objects in order to analyze potential differences. The navigation bar to the left enables switching between the objects the user is subscribed to.

In addition, the Product Cost Monitoring screen enables initiating cooperation steps by creating and assigning new tasks as well as checklists, which is addressed by the requirements R8 Task creation, R9 Task assignment, and R12 Checklist. Clicking on the link 'Create New Task' opens a dialog window in which the user can specify all necessary data. The corresponding data source that should be worked on can be selected, enabling integrated data processing (see Figure 4). Additionally, a description and due data can be entered and the task can be assigned directly to the favored processor. The option 'Review of Changes' lets the initiator decide whether he or she wants to check the changes when the task is finished before committing them to the system. At times, tasks affect other systems and data comes from those systems. In cases where the assignee works with an external system, synchronization can be activated via the corresponding checkbox. Doing so enables the processing of tasks externally, which addresses R15 Interfaces. The integration of this input has not only automation benefits, but also allows mistakes to be avoided that result from copying data manually from one system to another. The link 'Create New Checklist' provides a dialog window that enables the user to specify a consecutive sequence of tasks to be completed and/or flags that need to be set, as shown in Figure 4. Processors can be assigned to all items and a trigger can be added, e.g., to determine that a multi-level review process should be initiated if a flag called 'Ready for Review' has been set.

4.2 Execution and Progression

The central element for the collaboration execution is the My Tasks screen, displayed in Figure 5. This screen represents the requirement R10 Dashboard of the requirement area Costing Workflow. The user can navigate to this view by clicking on a task in the My Home screen (see Figure 2). It is a key instrument raising awareness and keeping each user informed about his or her workload. Here the user also sets the status of the tasks –in progress, in review, or done – which is reflected in the status illustration of the Product Cost Monitoring screen.

When the user changes the status of a task, a notification is automatically sent to every user who follows the object that the task belongs to via his or her Product Cost Monitoring screen addressing R3 Change notification. Thus, everybody who is involved is immediately informed about the progress. A similar procedure is triggered whenever a new task is sent or a new checklist is activated. In these cases, a task notification is forwarded to the assignee as required by R11 Task notification. By these means, no manual effort is necessary to keep participants informed.

Another element of the collaboration execution is the capability to set flags (R13 Flag setting). This allows to set an object to a particular state, simply by choosing the appropriate flag. Setting a flag also triggers the dispatching of a change notification in

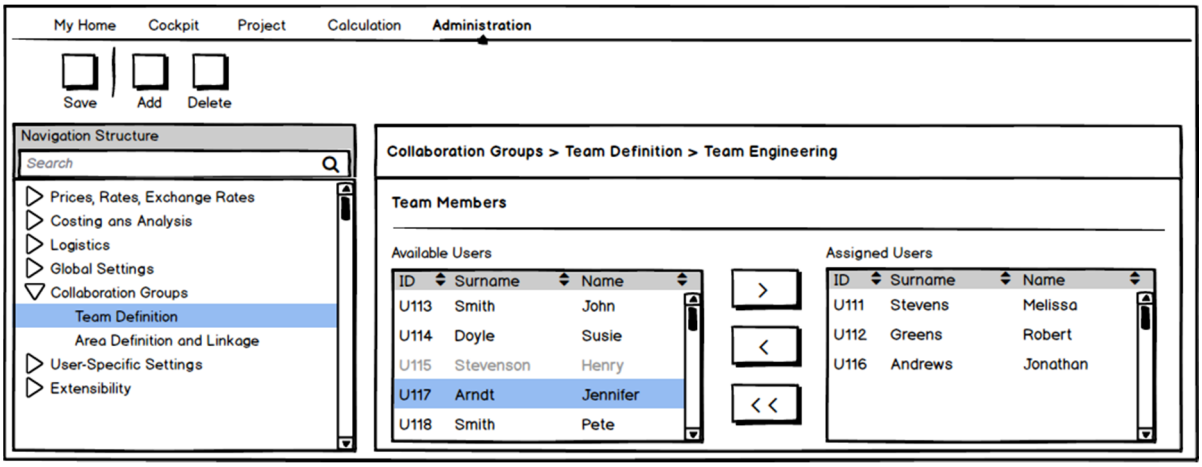

Figure 6: Team definition screen.

order to keep participants up-to-date on the latest state. Furthermore, users can leave comments and notes in order to discuss issues in the system. This addresses requirement R14 Discussion.

4.3 Permissions and Subscriptions

The fundamentals of the collaboration system are realized via permissions and subscriptions. The permissions handle the authorization in the collaboration system represented by the requirement area Collaboration Groups with the requirements R16 Team definition, R17 Area definition, and R18 Team area linkage. A Team Definition screen was designed in order to give the administrator the opportunity to specify teams and their members. After creating a team, specified by a team name, the members can be selected from a list of the available users in the system (see Figure 6). This assignment can also be reversed by deselecting the users that should not be part of the team anymore. In an Area Definition and Linkage screen, the areas of access can be specified and linked to the defined teams. For each access area, a description and a reference have to be defined. The reference specifies which object(s) should be accessible by the respective area. For linking a team to an access area, the team has to be chosen from a drop down displaying all teams from the Team Definition screen.

Subscriptions enable users to choose the objects that they want to follow. This functionality is divided into automatic and manual subscription, as requested by requirement R1 Automatic subscription and R2 Manual subscription. When a user creates a new object, he or she is automatically subscribed to it, sees all relevant information in his or her Product Cost Monitoring screen, and receives change notifications. The user can manually unfollow this object, but also follow any other object that is part of his or her access area. A pin visualizes the subscriptions. Wherever objects appear in the screens, the user has the opportunity to click on the pin in order to (un-)follow the item, providing a high level of integration (see Figure 2 and Figure 3).

5 SUMMARY AND OUTLOOK

In this paper, we presented an approach to enable Business Domain-Specific eCollaboration by integrating virtual cooperation directly into the core processes of a business area. As a showcase, we chose the business domain of product costing due to its high demand for communication and information exchange as well as the necessity of an integrated solution. In our initial study, we discovered that particularly because the collaboration support is detached from the systems in use, the process suffers from data inconsistency, missing integration and a lack of transparency (Lück and Leyh, 2016a). As a next step in our research project, we derived a comprehensive requirements model for integrated virtual cooperation in product costing. The requirements serve as design principles for the cooperation support system (Lück and Leyh, 2016b).

In the research step presented in this paper, we developed an integrative approach for Business Domain-Specific eCollaboration. It enables virtual collaboration in product costing based on connections among daily work routines, data sources, and the collaborative needs of the specific business domain. A monitoring screen summarizes the status of all relevant elements, providing insight into the progress of the costing process. By enabling the initiation of

virtual cooperation directly in the system, collaboration is accelerated and manual effort is reduced. Moreover, data consistency can be increased as the necessity for manual data input is decreased. In addition, the task dashboard screen aims at establishing awareness about the workload for each participant in the costing process. Notifications automatically inform users whenever there are new tasks or changes. Automating the collaboration process aims at increasing productivity and avoiding mistakes resulting from manual efforts. Our approach gives full flexibility for integrated virtual cooperation by providing a subscription concept that allows each user to decide which costing objects are of interest to him or her. Likewise, the permissions concept enables an easily adaptable authorization management in order to define who should participate in the collaborative process and which system areas they should be able to access. In conclusion, the approach for Business Domain-Specific eCollaboration covers all identified requirements for integrated virtual cooperation in product costing. Nonetheless, the design principles also depict system constraints that need to be fulfilled. We excluded them from our investigations, as those are external limits given by the costing systems in use.

The next step in our research project is the evaluation of our approach for integrated virtual cooperation in product costing. The validation should help to further improve the concept for the collaboration system that we later intent to test in a real-world setting. Subsequent research could also cover the investigation of further business domains with relevance to this research topic.

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