

Integrated Virtual Cooperation in Product Costing in the Discrete Manufacturing Industry: A Problem Identification

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Abstract

Virtual collaboration in corporations is an important factor for working efficiently without the limitations of time and place. As a business domain, product costing is characterized by a high demand for communication, coordination, and information exchange. Nevertheless, practitioners point out that product costing does not exhibit a modern tool-based collaborative practice. Thus, this paper examines the collaborative process in product costing. An exploratory study shows that, in practice, the way of collaboration is still very traditional, often relying on e-mail and lacking integrated IT support. Contributing to the overall workload with almost 90%, collaboration in product costing has a high potential for improvements in productivity and consistency. As a showcase, the study reveals that virtual cooperation has not been integrated into particular business areas and that there is a need to find ways to enable and support such specific forms of virtual cooperation.

1 Introduction

In the discrete manufacturing industry, where products like automobiles, furniture, and electronic devices are manufactured, product costing is performed to identify the costs that a product will generate. The more complex the composition of a product, the more extensive is the process of assessing the costs in advance.

Practice describes product costing as a collaborative business activity involving a high degree of information exchange and communication between many stakeholders. Nowadays, adequate IT support is essential for efficiently performing corporate work. Enterprise 2.0 has become the symbol for virtual, business related collaboration techniques. The concepts and categories of Web 2.0 have been integrated into the corporate environment. Sharing knowledge, finding contacts, and keeping information transparent have become vital activities for companies and their employees, as well as in the relationships with their customers and partners. In research, the adoption of eCollaboration in enterprises is investigated frequently due to the diverse managerial challenges that have not yet been resolved. It could be the missing user involvement, the lack of management support or the

inability to properly use eCollaboration tools (Riemer et al. 2009, Alqahtani et al. 2014, Andriole 2010). Communication is an important aspect in the product costing business domain and we want to find out whether the way it is performed and supported today has room for improvement. We see the necessity to analyze integrative approaches for collaboration support and to investigate whether respective information systems are applied in this business field. In eCollaboration, typical questions are related to knowledge, the knowledge holder and the options to get in touch with this person. Considering the product costing process these kinds of issues seem to be clear and not the center of attention. Here, the main topics are communication and information exchange. Furthermore, it appears that both need to be directly linked to the progress of the product costing process. Exactly when a particular task is finished, the exchange of data needs to be initiated to enable necessary discussions to be started. Therefore, this paper examines whether integrated computer-supported virtual cooperation exists in the domain of product costing.

In order to establish a detailed understanding in this business field, the presented paper investigates the collaborative process in product costing within the discrete manufacturing industry and addresses the following research questions:

- Q1: What are the characteristics of collaboration in product costing and which tools are used for it?
- Q2: What are the current deficits of the technological support regarding the collaborative process in product costing?

To answer these questions, the paper is structured as follows: The next section describes product costing in the discrete manufacturing industry and the eCollaboration research field to provide insight into the background of this paper. Section 3 presents the design of the study conducted in this research. Afterwards, the research questions stated above are answered. Sections 4.1 and 4.2 examine the first research question, while Section 4.3 discusses the findings of the second research question. This is followed by a discussion and the paper terminates with a conclusion regarding the relevant findings.

2 Background

2.1 Product costing in the discrete manufacturing industry

Adequate instruments and methodologies are required for the process of corporate management, which includes leading, administrating, and directing a company. Managerial accounting is a practice used to establish the foundations for decisions with the help of financial and non-financial information (Warren et al. 2014). Product costing is a part of managerial accounting that enables companies to calculate the costs that a product generates. Since 70% of the costs of goods sold are already set during product development, preliminary costing is crucial, revealing a high potential to influence costs (Saaksvuori and Immonen 2004).

If a customer asks for a quote for a product that has never been produced, the costs of the product must be calculated before submitting that quote. The goal is to calculate realistic costs to provide a reliable financial assumption and run a successful business. Especially in the discrete manufacturing industry, product costing is a highly relevant task. The products in this industry consist of many parts, which can be produced in-house, in a different plant of the company, or even purchased from a supplier. Furthermore, every product needs to be assembled, often in complex procedures (Hansen

et al. 2009). In today's globalized world, new sources of procurement and sales markets emerge every day. Also, manufacturing processes change constantly due to innovative new technologies. Many diverse factors can influence the costs of a product. Especially when profit margins are low, like for automotive suppliers, cost calculations need to be exact, because even small deviations of the calculated from the future real costs per piece sum up tremendously and can easily lead to a money-losing business (Drury 2008). Hence, accurate cost calculations are essential in the discrete manufacturing industry.

In product costing it is necessary to collaborate internally, but also to work together with external partners. In a typical scenario described from practice, the sales management of a company is in direct contact with the customers. They negotiate a new product, agree on the most important specifications and the amount of the desired product. That information is communicated to the product costing department in order to get a cost quote. Product engineering can then start to design the product and give feedback on the possible composition of the product. If the product requires purchasing parts, information needs to be requested from the procurement department in order to negotiate the purchase price of these parts with various suppliers. This information also needs to be validated with the manufacturing department before the final cost quote can be sent to the customer. Thus, collaboration plays an important role in the entire process, due to the number of participants and the amount of information that must be exchanged. The exact method of collaboration also differs from company to company due to individual factors, like the production type and the length of the product development cycle.

The amount of data in management accounting is extensive, and the usage of information technology is substantial (Fiedler and Gräf 2012). In the area of classic cost accounting, the usage of standard software is very typical. In the product development phase, mainly spreadsheets are created using Microsoft Excel. This often leads to problems like the costly manual data administration, inconsistencies, missing documentation, as well as a low degree of integration (Schicker et al. 2008).

2.2 eCollaboration

Research regarding collaboration dates back to the 1980s, when a research community called "computer-supported cooperative work" started to investigate how technology can be used to support people in their work (Grudin 1994). Due to the ongoing evolution of software technology and the emergence of the Internet, new possibilities of collaboration have arisen. Web 2.0 has enabled to work together via the Internet in virtual social networks, using real-time collaboration, instant communication, and collaborative authoring tools. The trend of Web 2.0 also swept over into the business world. eCollaboration, also referred to as Enterprise 2.0 or Social Enterprise (McAfee 2006), covers collaboration within and between organizations based on information and communication technology and describes practices of communication, coordination, and collaboration between people in distributed contexts like projects, teams, or processes within and between organizations (Riemer et al. 2009).

The categories of application are diverse and their development is ongoing. Weblogs and microblogs, wikis and group authoring tools, social networks, and instant communication are just some of the tools found in the modern business environment (Koch and Riemer 2009). Furthermore, social software suites are emerging, following the trend towards integrated solutions that cover several categories of eCollaboration. The implementation of such tools can improve communication, enable collaboration, and provide more flexibility for employees to work together.

Today's work environments demand collaboration between distributed teams without location or time constraints. Accordingly, eCollaboration can benefit a company's work productivity (Alqahtani et al. 2014). Despite these possible benefits, Andriole (2010) revealed a gap between the expected and actual business impacts. Although numerous software products exploit these collaborative technologies, eCollaboration is a complex, risky, and often-ineffective undertaking in practice. The ongoing and rapid emergence of eCollaboration technologies makes it an insecure, unsteady field, both managerially and technologically (Riemer et al. 2009). Consequently, concerns about security and loss of control often arise. One challenge widely investigated in research is the adoption of eCollaboration. A low user adoption can be the result of several factors, as Alqahtani et al. (2014) discovered. The benefits a company creates by successfully adopting eCollaboration strategies can be affected by a lack of employee awareness or ability, an unsupportive corporate culture, or the length of time necessary to integrate these ideas throughout the business (Alqahtani et al. 2014).

The general adoption of eCollaboration has been investigated in numerous research studies (Riemer et al. 2009, Alqahtani et al. 2014). One new aspect worth examination is the business domain specific adoption. In several business domains, the level of collaboration is very high, but the usage of the typical generic eCollaboration tools is not appropriate. As explained in Section 2.1, product costing is a business domain with collaborative structures. Collaboration and the product costing process itself are highly linked, which means a specific division has to be contacted at an exact point in time, e.g. when the supplier has announced the new price for a purchasing part. Such a direct connection of collaboration and the product costing process seems to be missing. Thus, time and resources are wasted due to the inefficient collaboration process. In turn, the classic eCollaboration tools are inapplicable due to their focus on general adoption. In order to investigate this topic and to determine how the situation in product costing could be improved, an exploratory study was designed.

3 Study design

The goal of this paper is to identify whether there exists a lack of integrated cooperation support in product costing. To get a first understanding about the product costing process and its organizational IT support, we designed an online survey. Such a questionnaire is an appropriate tool to collect data very dynamically since the respondents can participate anytime and anywhere, thereby shortening and simplifying the collection process (Bethlehem and Biffignandi 2012). In order to provide a precise structuring, we divided the questionnaire into three topic areas: the collaborative process, its participants, and the IT support for collaboration. Altogether, these topic areas can form a picture about how the participants collaborate, how complex the process is, and whether the participants face problems due to inefficient IT support.

We selected an international sample of participants for the questionnaire to ensure a more robust understanding about collaboration in product costing. The discrete manufacturing industry consists of several industrial sectors. In order to generate a more complete understanding of the situation, the study included companies from different industries. The automotive industry is a key player when it comes to the production of distinct items. As a finished product, an automobile consists of numerous parts including, for example, the body, wheels and the seats. In turn, the seats are made of several parts, which need to be produced or procured, assembled, and provided to the market. Another interesting sector is the machine building industry. The main capabilities of this sector are

the production of industrial, agricultural, or construction machinery and components. This also demonstrates the necessity to compose and assemble different elements. Furthermore, the industrial sectors of consumer goods, like the furniture or high tech industry, is included in the study to ensure an objective, inter-branch picture of the current situation in product costing collaboration.

The relevance of product costing depends on the complexity of the manufacturing process of an enterprise. A high degree of complexity can often be found in big manufacturing companies. So we examined the size of enterprises from this industry to find suitable companies for the study. We only selected international companies with more than 1000 employees. Furthermore, different divisions and business roles were considered. Since numerous participants appear to be involved in the process, the integration of the different perspectives is crucial to provide an overall understanding of the process. This covers managerial accounting, product controlling, marketing, sales and procurement, as well as engineering and information technology.

Based on these requirements, we contacted companies from which we knew (due to our background) that they have a potential interest in research regarding product costing. Here, we could win 26 cooperation partners, which signaled their will to participate in our study: seven companies from Germany and 19 companies from the USA were invited to the study, from which 26 German employees and 55 US employees were contacted. The study was conducted in April 2015. Altogether, 15 companies took part: six from Germany and nine from the USA. From the 81 invitees 28 people participated in the study, evenly split among employees from American and German companies.

4 Findings

4.1 Unsatisfactory collaboration in product costing

The study results underline the importance of product costing in the discrete manufacturing industry. Of the participants, 96.4% see product costing as relevant for running their business successfully, and 25 out of 28 participants stated that it plays an important role for their companies to achieve their strategic goals. For 82.1%, product costing is a topic that is relevant to management. For 28.6%, even the top management is involved in the process.

With regard to the research question Q1, Figure 1 shows which collaboration resources are used during the product costing process. Both internal and external, e-mail was the most frequently used instrument. Every participant mentioned that they used e-mail for internal collaboration. Meetings (96.4%) and telephone usage (89.3%) were also overwhelmingly common methods of collaboration. Behind these predominant methods, in fourth place, was the usage of the calculation software. This means that the tool most central for the accomplishment of product calculation only sometimes serves as a collaboration platform at the same time. Surprisingly, less than half of the companies use workflow support to manage product costing tasks. Looking at the results for external collaboration, it becomes apparent that the support for collaborative work is mostly limited to e-mail (92.9%), telephone calls (82.1%), meetings (53.6%), and telephone conferences (50.0%). A lack of integrated collaboration support both for internal and external cooperation appears to be present.

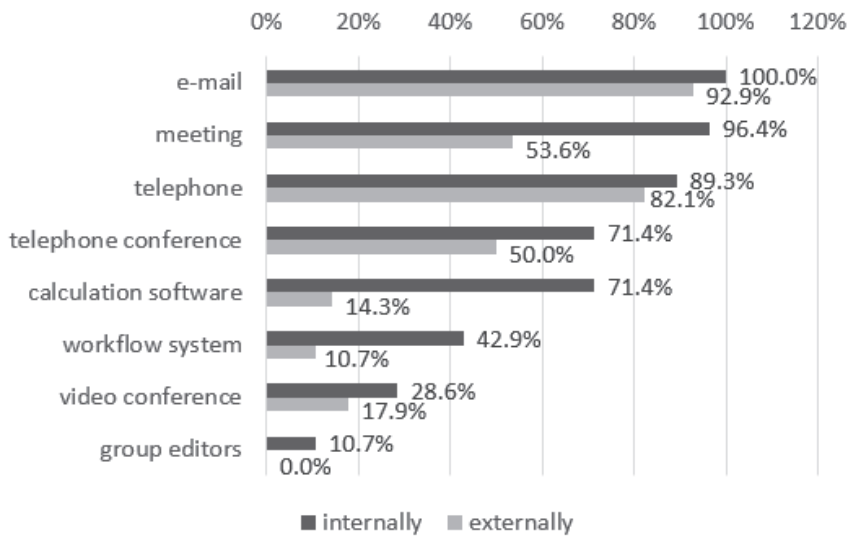


Figure 1: Collaboration tools in use (n=28, multiple answers possible)

Overall satisfaction with IT support in product costing demonstrates the need for action to improve the current situation. As shown in Figure 2, only one in four participants responded that they had satisfying IT support, but every second participant was discontented with it. No correlation between the utilization of a particular IT tool and the satisfaction can be found in the study. Thus the overall traditional way of collaboration could be the reason for the rating, indicating that further investigation is necessary.

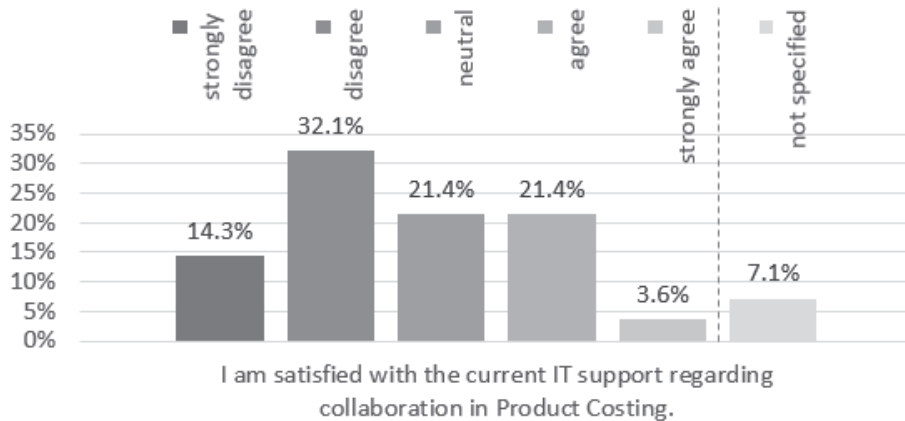


Figure 2: Satisfaction with IT support (n=28)

4.2 High collaboration complexity in product costing

In product costing, working both with stakeholders within the company and with external partners is necessary. Consequently, the study participants were asked about the percentage of time they spend on collaboration compared to their overall workload.

Figure 3 reveals that, on average, 87% of the overall workload in product costing consists of communication and information exchange. More than half of the working time is spent on internal collaboration, indicating room for efficiency improvement. If the IT support enabled to perform the respective tasks faster, half of the workload in product costing could decline significantly. Another

28.5% of the working time is spent collaborating with external partners, so the product costing process also happens to a notable extent externally.

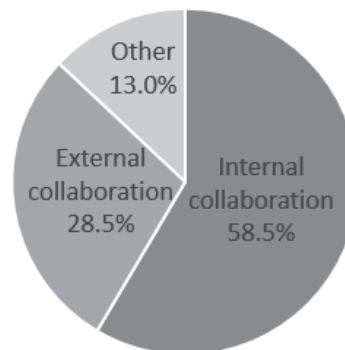


Figure 3: Proportion of workload (n=28)

As described in section 2.1 product costing affects multiple departments of a company. Hence, the roles the study participants hold in their companies were inquired. Seven different roles were included in the study: 12x manager, 9x (product) controller, 8x IT specialist, 5x engineer, 2x sales specialist, 1x marketing specialist and 1x purchaser. Multiple answers were allowed, because an employee can have responsibilities in several divisions. The diversity of roles ensures the reflection of a variety of perspectives in the study.

Furthermore, we investigated who is involved in the collaborative process of product costing (see Table 1). In 85.7% of the companies, a minimum of four employees participates in product costing. For 28.6% of these cases, there are even more than ten participants. In order to understand the interdisciplinary complexity, the number of participating divisions was analyzed. More than half of the study participants stated that up to three divisions were involved in product costing in their company. For 28.6%, four to six divisions need to work together in order to accomplish a cost calculation and 2 participants (7.1%) stated that more than ten divisions are involved. Large companies sometimes have their product development and production distributed over different locations, making face-to-face collaboration impossible which underlines the necessity for technological support. This remote work environment usually does not exceed more than three locations (75.0%).

Number	Colleagues	Divisions	Locations	External companies	People from external companies
01-03	10.7%	53.6%	75.0%	42.9%	32.1%
04-06	46.4%	28.6%	14.3%	17.9%	17.9%
07-09	10.7%	7.1%	0.0%	0.0%	3.6%
10+	28.6%	7.1%	7.1%	14.3%	14.3%
n/a	3.6%	3.6%	3.6%	25.0%	32.1%

Table 1: Product costing participants (n=28)

Beside the internal collaboration, the companies of the participants also work and collaborate with external partners. Mostly, they reported that one to three external companies participate in a product costing process, but four participants (14.3%) specified that their companies cooperate with ten or more external partners. The same applies for the number of external people. In the majority of cases,

working together included up to three persons from external organizations. Nevertheless, every seventh participant (14.3%) said that this number was ten or more. It should be considered that a notable amount of the respondents did not provide information about external participation.

The 28 participants stated that they come from the following industrial sectors: 10x automotive, 10x machine building, 6x consumer goods and 2x high-tech. Thus, the study represents a variety of industries with a slight emphasis on the automotive and machine building industries. The described complexity of the collaborative structures can be found in all of these industries, no matter whether the company was situated in Germany or the USA. Referring to the first research question, the high number of people, divisions, and locations involved demonstrates how interdependent and sophisticated the product costing process can be. Furthermore, this data shows how the topic reaches beyond the boundaries of the individual enterprises.

4.3 Strong need for improved IT support for the collaborative process in product costing

Product costing represents a clear process structure (see Figure 4). Of the 28 participants, 18 specified that the process steps are executed in a predefined order (often: 53.6%, always: 10.7%). None of the respondents reported that the process was operated in a completely unstructured way, without a fixed sequence of tasks. This indicates that product costing is suitable for IT support to automate and accelerate the entire process. Furthermore, the respondents reported that it was common to complete the necessary steps simultaneously. More than half of the participants specified that they often (42.9%) or always (17.9%) execute the required tasks in parallel. At least occasionally, this is done by another 28.6% of participants, which underlines the potential to speed up the process. In addition, 85.7% of the participants stated that they often (57.1%) or always (28.6%) have to repeat tasks in order to finalize a cost calculation. Agreements with colleagues and external partners can lead to changed costing goals that need to be reflected in the product cost assessment. Such repetitive work could be reduced or simplified. As described by 25 of 28 participants, the product costing process is characterized by central coordination (often: 46.4%, always: 42.9%). Thus, a particular person usually manages the entire process and takes responsibility for the coordination.

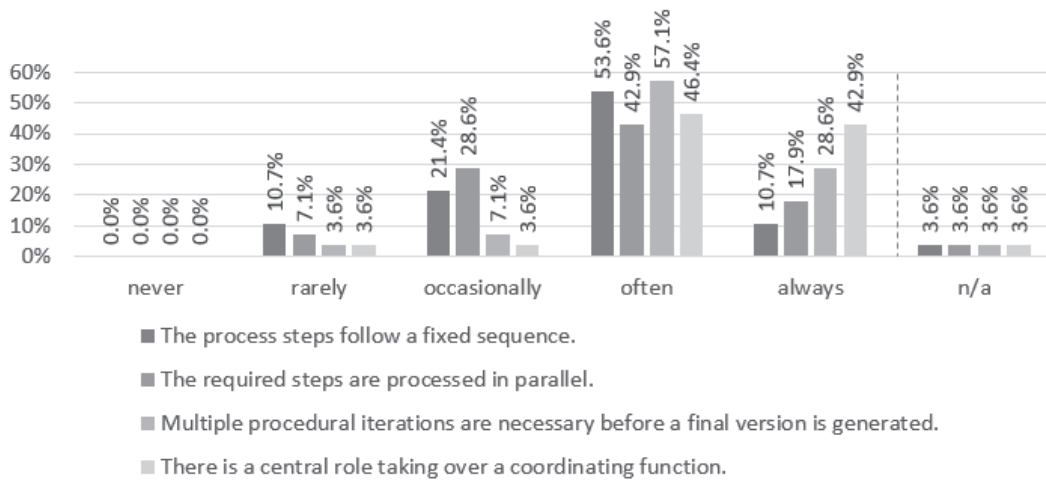


Figure 4: Process structure (n=28)

The present study also analyzed the extent to which the current use of IT supports the collaborative process, shown in Figure 5. This addresses the second research question. An important factor is employee awareness of their tasks and the status of the process. While eleven participants confirmed such an awareness (agree: 35.7%, strongly agree: 3.6%), the same number disagreed to this fact (disagree: 28.6%, strongly disagree: 10.7%). Interestingly, this evaluation does not depend on whether workflow support is used in the product costing process. Another key factor in product costing is understanding the data to be used in the process. Using obsolete prices or estimates can generate incorrect calculations, which can impede the success of a new product if the product cannot cover its own costs. Half of the study participants felt well informed about the data they need to use for a calculation (agree: 39.3%, strongly agree: 10.7%), whereas 28.6% do not get such understanding via system support (disagree: 25.0%, strongly disagree: 3.6%). Hence, the ability of IT support to integrate data effectively for this process should be compared in detail to identify the factors leading to these results. Ideally, the necessary collaboration support is directly integrated into the system used for the product cost assessment. The study results demonstrate that 46.4% of participants work with calculation tools that do not have such integrated support. For 35.7%, the integrated collaboration support is sufficient. Another IT goal is to ensure good results by supporting the prevention of misunderstandings and other miscommunication among colleagues who work together. 13 of 28 participants could not confirm that the IT support for product costing provides an adequate support to help prevent miscommunication and ensure consistency in their company process (disagree: 28.6%, strongly disagree: 17.9%). This indicates a potential to help avoiding costly errors and mistakes.

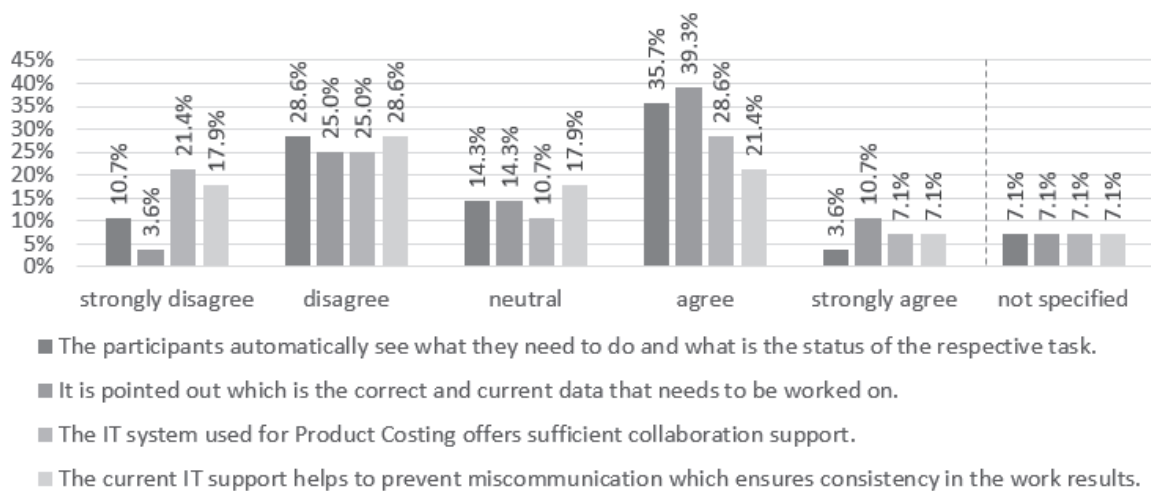


Figure 5: IT support (n=28)

5 Discussion

The study results demonstrate room for improvement in the collaborative process of product costing in the discrete manufacturing industry. Almost 90% of the overall product costing workload consists of collaborative work. The support of collaborative activities is essential to ensure efficiency throughout the entire process. In several companies, more than ten employees participate in product costing, working in up to six different divisions and usually spreading out over up to three locations. Such a separation makes face-to-face teamwork impossible, which underlines the necessity for virtual cooperation. In addition, the need for cooperation with numerous external companies

contributes to the complexity of the collaboration process. Since the ratio of collaborative work in product costing is that high, these core capabilities need to be supported efficiently and necessary prerequisites have to be established. Here, all eCollaboration categories are matters of interest in product costing: Communication, coordination as well as collaboration. Consequently, integrated collaboration platforms, also identified as unified communications (Riemer et al. 2009), seem to be suitable, since they offer bundled features from these three categories. Nevertheless, the concrete combination of the business activities, the workflow and the collaborative functions appear to be missing. Eikemeyer and Lechner created a tool to enable domain specific ad-hoc collaboration, but concentrated on the challenge of the high effort to establish the necessary infrastructure (Eikemeier and Lechner 2003). They enabled virtual ad-hoc collaboration in an easy manner instead of focusing on how business domain specificity can be accomplished through process integration. An integrated IT support system could contribute to the clarification who the participants in the process are, their tasks and the progress by representing these structures of the product costing process and enabling virtual collaboration on this basis. Hence, creating more transparency could reduce the complexity.

Half of the study participants stated that they are unsatisfied with the current IT support of their company's product costing process. E-mail programs are still the most common communication tool when it comes to collaborative work support in product costing. With meetings and telephone calls following, the results clearly show that the classic communication tools are still in wide use, but do not offer sufficient support. The integration of workflows and collaboration in the calculation systems is not common and the current IT support does not consistently establish awareness about the process status and the necessary tasks for participants. Another issue is the missing data and system integration. Spreadsheets programs like Microsoft Excel are widely used, resulting in data inconsistencies and errors. By preventing media breaks, time can be saved, errors can be avoided, and more transparency can be provided regarding the collaborative process. Such an integrated system could also ensure data consistency. Furthermore, when the participants understand the benefits such a tool provides, it is likely that the classic, traditional ways of communication and collaboration will be abandoned. Additionally, improved quality of the collaboration support could also result in enhanced user satisfaction, which would be another positive effect. Therefore, further investigation is recommended.

Moreover, the study showed that product costing is a structured process. Due to the high number of iterations, adequate IT support could significantly reduce the repetition of tasks and the resulting workload in this business domain, but it is not available yet. Since parallel execution is very common, proper IT support also has the potential to speed up the entire process. The findings regarding the product costing process lead to the conclusion that the focus of future research needs to be the fusion of virtual collaboration and the specific business process with its activities, tasks and workflows. Generic eCollaboration is not specifically designed to integrate the collaboration support into the work process. A few research projects have been undertaken regarding the idea of bringing business processes and eCollaboration together, but always with a different goal. Working more collaboratively in business process management systems (Kemsley 2010) or creating cross-domain collaborative business processes (Capodieci et al. 2014) were approaches investigating eCollaboration and the process topic, but focusing on completely different issues. Hence, we see a strong need for the investigation of Business Domain Specific eCollaboration.

eCollaboration support that is specifically designed for the adoption in business domains has the potential to support the involved employees exactly where and when a particular support is needed in the collaborative product costing process. Consequently, using resources more efficiently,

increasing productivity, and saving time and money are potentials of Business Domain Specific eCollaboration that require further investigation.

Another issue in product costing is the central coordination of the process. When a particular person coordinates all process steps and verifies the respective results, a dependency is generated. Thus, the central coordination of the product costing process can create a workload bottleneck, which is a risky undertaking. From a technological point of view, the coordination of manual steps like informing other employees about tasks or including the necessary data should be supported or possibly automated by means of IT. In addition, the organizational optimization of the process is an interesting field for further investigation. Letting the group take responsibility for the necessary tasks with less restrictions and supervision can lead to quality improvements and a lower error rate. For example, this was shown by Raymond (2001) describing how the bottom up approach noticeably increased the efficiency in the open source development process. Bottom up designs can also be found in the organizational and managerial environment. Consequently, sociotechnical factors should be reflected in further investigation of Business Domain Specific eCollaboration.

6 Conclusion

Enabled by the Web 2.0 evolution, virtual collaboration has become an inherent part for teamwork within and between companies. Nevertheless, research as well as practitioners describe numerous managerial challenges related to the use of collaboration tools in business. We conducted an exploratory study to investigate collaboration in product costing and its current state of integrated virtual cooperation. Participants from different industrial sectors and with varying business roles took part in the present study, creating an objective picture of the characteristics of the product costing process.

The findings of our study demonstrate the current situation regarding collaboration in product costing. The structured process exhibits complex collaboration requirements with a direct dependency on the process steps and its progress. Despite the progress of eCollaboration technology, the IT support of the collaborative product costing process has significant room for improvement. The results of the study show that current IT support is unsatisfactory and that the usage of common eCollaboration tools is insufficient. The missing connection between the concrete product costing process and the collaboration support raises the idea of Business Domain Specific eCollaboration to improve the entire workflow, the transparency of responsibilities, and the productivity of workers involved in this process. Some research work has already been done, but the focus has never been to specifically break down eCollaboration into business domains and its processes.

Future analysis should specify how Business Domain Specific eCollaboration could improve the product costing process and draft a corresponding concept with regard to the investigated issues. Another aspect of further research could be the investigation whether the potential of Business Domain Specific eCollaboration is only a particular need in the product costing process or whether it can also be identified as an issue in other business fields.

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