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Boundary subjects and boundary objects in accounting fact construction and communication

Abstract

Purpose: This article elaborates the concepts of boundary subjects and boundary objects in constructing and communicating relevant accounting facts for managing product development (PD). Boundary subjects and objects benefit effective accounting enactment, by building a shared understanding about different actors' roles and information needs, and by helping to respond to these needs.

Design/methodology/approach: The article uses a longitudinal interventionist case study of a machinery manufacturer. The focus of this case study was the production ramp-up phase at the end of a PD program. Different actors' needs were first collected and elaborated by interventionist researchers (boundary subjects). Then accounting prototypes (boundary objects) provided new means of communication.

Findings: The findings show that dealing with boundaries is crucial in accounting development. The role of boundary subjects was fundamental in the process of choosing, constructing, elaborating, and communicating accounting facts. During this process, accounting prototypes integrated new accounting facts, the boundary subjects mitigated the boundaries, and the boundary objects focused and restricted communication about accounting facts.

Research limitations/implications: The interventionist case study tests the pragmatic constructivism approach by examining accounting enactment under uncertainty and ambiguity. The study refines pragmatic constructivism in terms of boundaries, boundary subjects and boundary objects.

Practical implications: The intentional use of boundary subjects and objects as communication platform could push a more active inclusion of business controllers as active business partners.

Originality/value: The paper contributes to the literature on accounting development by highlighting the use of boundary subjects and boundary objects as fundamental mechanisms in constructing and communicating accounting facts.

Introduction

Organizations can be understood as systems with several interfaces or boundaries that restrict, guide and channel the interaction, which is elemental for the functioning of the organization. Accounting information provision outlines the reporting structure of an organization, and thus defines the boundaries between business units and functions (Burchell *et al.*, 1980). At the same time, suitable accounting information can help managerial actors identify their role within the organization and foster interplay across the boundaries (Wouters and Roijmans, 2011). Managerial actors' needs for accounting information, however, are not limited to their immediate work domains; instead, accounting information should cover the wider business context and related business units, processes, or functional activities to a sufficient degree (Hall, 2010; Wouters and Verdaansdonk, 2002). The following fundamental questions remain: How do organizations deal with different boundaries in their organizational realities? More specifically, how can accounting help actors to deal with those boundaries?

Product development (PD) activities feature several boundaries, as typical PD projects involve different business functions and different-level actors ranging from functional managers to individual engineers. In PD, actors often face uncertainty regarding the task outcomes (Jørgensen and Messner, 2010), insufficient processes with which to integrate the uncertain knowledge of different actors (Kraaijenbrink, 2012), and difficulties in actually utilizing accounting information for decision-making (Nixon, 1998). In all, product development provides a rich context for examining the organizational boundaries, different actors' information needs and the means to overcome managerial challenges under uncertainty and ambiguity.

This article elaborates the concepts of *boundary subjects* (Huzzard *et al.*, 2010) and *boundary objects* (Carlile, 2002; Briers and Chua, 2001) in the context of constructing accounting facts for PD management[1]. In organizations with several boundaries, as in PD, there is a need for boundary objects that will help integrate different accounting viewpoints and communicate accounting facts among stakeholders. In addition to technical solutions, boundary subjects, that is,

people in different interfaces, are also required for a similar role within the organizational boundaries. In the context of PD, boundary subjects (such as internal mediators or external researchers, see, e.g., Huzzard *et al.*, 2010) and boundary objects (such as product cost estimation spreadsheets or information systems for profitability management under development, see, e.g., Earl, 1978; 1982; Wouters and Roijmans, 2011) contribute to developing accounting and control that support managerial work (Hall, 2010; Wouters and Verdaansdonk, 2002).

To grasp the organizational realities at individual actors' levels and to understand the roles of boundary objects and boundary subjects in constructing and communicating accounting facts, the viewpoints of different actors (Nørreklit *et al.*, 2010), driven also by values and valuations, should be included in the inquiry and elaborated upon[2]. Even if the values of different actors cannot be easily identified, a detailed analysis of the choice of and further elaboration upon accounting facts is clearly influenced by values and valuations. The individual actors' values are not the focus of this paper. However, the value of creating trustworthy accounting facts drives the processes of accounting fact construction and communication. The involved actors have to subscribe to this value. Accounting development would indeed lead to what Ahrens and Chapman (2007, p. 23) highlighted: "The key to understanding practices lies in the careful tracing of their constitutive activities." In order to understand how different accounting facts are constructed, researchers must address the very practice of how PD actors "act" in constructing and communicating accounting facts. Thus, the article is guided by the following two research questions:

- 1) How do PD actors choose, construct and elaborate relevant accounting facts and related possibilities in the accounting development process?
- 2) What are the roles of boundary objects and boundary subjects in constructing and communicating accounting facts in PD activities?

The article is based on an interventionist case study (Suomala and Lyly-Yrjänäinen, 2011; Suomala *et al.*, 2014) of a Finnish machinery manufacturer's PD management. Through this case study, the article reports and reflects upon a longitudinal process of accounting development

facilitated by the interventionist researchers. The research project had access to the company in 2012–2013; during this period, the interventionist researchers were involved with a large PD program. The elaboration of two accounting prototypes paved the way to enhanced accounting support for managing PD. These accounting prototypes supported the production ramp-up at the end of the PD project, which featured boundaries between different managers (e.g., PD, sales, production, and finance). Data were gathered from 30 meetings with 27 stakeholders. The data from the meetings were thematically coded and cross-tabulated with Atlas.ti software to scrutinize how PD actors constructed and communicated accounting facts.

Theoretically, the article contributes to our understanding of the process of choosing, constructing, and elaborating accounting facts and related possibilities in the PD context. The article adds particularly to the body of knowledge on constructing and communicating accounting facts among several actors and actor groups across organizational boundaries (Jakobsen *et al.*, 2011; Nørreklit *et al.*, 2010). The article suggests that accounting development in the PD context requires coherence between the company *topos* and individual PD managers' *topoi* (Jakobsen *et al.*, 2011) and linkages between different functional managers' *topoi* with each other. More particularly, the article contributes to the accounting literature by elaborating the process of accounting development facilitated by boundary subjects and boundary objects as fundamental mechanisms in interactive accounting development. The article shows that the boundary subjects mitigate the boundaries, and the boundary objects focus and restrict construction of accounting facts. Together, this results in effective accounting enactment.

The structure of the paper is as follows. The literature review synthesizes actors' requirements for constructing accounting facts in the PD context and introduces boundary subjects, boundary objects, and the pragmatic constructivism in responding to those requirements. The empirical section begins with an overview of the empirical setting and the data collection. The empirical findings focus on the production ramp-up stage, reflections on the role of the PD actors as boundary subjects in the process of constructing and communicating accounting facts, and the

design and early use of the accounting prototypes as boundary objects in such a process. The discussion section focuses on the two research questions, before the conclusions.

Literature review

The literature review consists of two sections. First, it outlines the needs for accounting development by synthesizing actors' requirements for accounting fact construction in the PD context. Second, it introduces and elaborates upon the concepts of boundary subjects and boundary objects in relation to the pragmatic constructivism in responding to those requirements.

Actors' requirements for accounting information in product development

Supportive accounting information could help managerial actors identify their role within the organization and foster interplay across the boundaries (Wouters and Roijmans, 2011), and thus help recognize surrounding possibilities. In this article, boundaries mean the borders and interfaces between actors or groups of actors (e.g., business functions and teams), and one actor may have several different boundaries simultaneously. Dealing with those boundaries is essential as the possibilities (and related accounting information) are rarely about single entities, but managing them requires awareness of the wider business context (company *topos*) and collaboration among actors and groups of actors (with different *topoi*; Nørreklit, 2011b; see also Hall, 2010).

The PD context features several boundaries at different levels, between actors in different business functions (PD, sales, production, finance, etc.) and between actors at different levels of the organization (business unit managers, project managers, designers). At the same time, in PD, contextual features challenge the production and use of suitable accounting information by different actors for different managerial purposes. Multiple, simultaneous objectives tend to increase the challenge and uncertainty of the accounting figures related to PD projects (Davila and Wouters, 2007) and, thus, limits the availability of accounting information related to the decision-making situations (Jørgensen and Messner, 2010). Production ramp-up, as the empirical focus area of this paper, represents one example that accounting information does not typically support. This lack of

accounting support occurs because the ramp-up phase combines the estimates given by different actors about sales/production volumes, sales prices, production costs, and the actual realization of those possibilities in terms of the first production batches.

This article focuses on two aspects. First, the article focuses on uncertainty of accounting information (*facts* and related *possibilities*, also guided by actors' *values* see, e.g., Nørreklit *et al.*, 2010), which is due to the time–space distance between PD activities and the business impacts resulting from those activities (Jørgensen and Messner, 2010). Second, the article focuses on the insufficient processes that integrate the uncertain knowledge that different individuals and actor groups possess (Kraaijenbrink, 2012). This is because PD activities involve a number of different functional/managerial actors working together to effectively anticipate and manage the business consequences (*possibilities* and their *communication*, see, e.g., Nørreklit *et al.*, 2010). These two aspects together imply the need for different types of boundary objects and boundary subjects in facilitating or mediating PD management at different levels.

Regarding the first aspect of the uncertainty of PD activities and related accounting information (*facts*), Nixon (1998) suggested that during an early phase of a PD project, qualitative information tends to dominate the decision-making; accounting should focus on rough estimates of business impacts (*possibilities*). However, during the execution of PD projects, the relative uncertainty decreases, the view of the business impacts sharpens, and more quantitative information is available (information about factual possibilities). Jørgensen and Messner (2010) conclude that in a PD project context with high uncertainty, only some of the decisions can actually be made based on accounting information, and the lack of accounting information, together with significant ambiguity related to the business consequences, leads to strategizing, that is, decision-making without clear support from accounting facts. Davila and Wouters (2007) divide the units of analysis of accounting in PD into *ex ante* and *ex post* calculations. The former refers to the business impact analyses, cost estimations (according to the cost targets), and cost budgeting of PD activities (*possibilities*). The latter refers typically to the measurement of the PD projects (and more

generally, PD activities) according to budgets, and to measuring the actual costs of the early prototypes and the production batches of new products (facts). One challenge of accounting in supporting PD lies in the fact that although business impacts are estimated beforehand, these estimates are only rarely revisited by relevant actor groups after the project has been executed (when asking “Were the possibilities factual?” or “Were they an illusion?”, see, e.g., Jakobsen *et al.*, 2011).

Regarding the second aspect of knowledge integration and communication, PD activities combine information and knowledge from a number of individual actors and actor groups. This knowledge integration drives the performance of PD activities. Clark and Fujimoto (1991) suggest that personnel become increasingly specialized and, thus, are capable of producing new knowledge about such specializations and enhancing performance. D’Adderio (2001) defines knowledge integration as the extent to which people communicate and cooperate with each other. In this paper, the notion of knowledge integration is part of the process of constructing accounting facts. This construction of accounting facts takes place collectively via reflection upon and elaboration on the evolving requirements of the business environment and the changes that are required from accounting practices and systems (Korhonen, 2014).

According to Ditillo (2012), management control systems represent important mechanisms in knowledge-sharing and communication. In knowledge-intensive organizations (such as PD organizations), the visibility of rules and routines, the scalability of estimates and decisions, and the flexibility of individuals’ roles and responsibilities are desired characteristics. Obviously, supporting and facilitating communication is a senior managers’ task. The organization should support the building of shared values and identities (i.e., company *topos*, Nørreklit, 2011b), thus enabling knowledge-sharing (Hansen, 1999).

Despite the focus on calculations, numbers, and factual economic possibilities, Nørreklit *et al.* (2010) see accounting and control as a paradigm that is more closely related to social sciences than to natural sciences. Therefore, in addition to providing the possibility for assessing and

analyzing economic facts, an accounting tool should primarily help individuals better understand and communicate their shared and individual values regarding their economic possibilities. Although accounting numbers may themselves be subject to optimization, it is how the numbers are socially constructed and used in organizational communication that makes accounting a social discipline (for an example of cost calculations in intra-organizational communication, see Korhonen *et al.*, 2016).

Goffin *et al.* (2010) have studied organizational learning based on earlier PD projects. Among the central learning areas, Goffin *et al.* identify budgets and costs, organizational complexities, problem-solving capabilities, product features, resources and schedules, and the application of the learning outcomes. Much expertise is required to recognize, choose, and exploit the knowledge and capabilities of different actors and the learning outcomes of the prior projects. A complex organization results in fragmented knowledge about PD activities and, thus, makes PD management ineffective. In addition to learning between projects, changes during projects might require actions. Quite often, the scope and the content are changed, or the targets set for the projects in terms of product features, costs, or time appear to be too ambitious (Goffin *et al.*, 2010; Korhonen, 2014). This ambition poses challenges for accounting and control tools as well.

There is a clear need for enhanced theoretical understanding of the social process of choosing, constructing, elaborating, and communicating accounting facts in the PD context because of the limited understanding of current PD accounting and control practice and the contextual requirements of PD for interaction between different actors and actor groups. As PD activities remarkably involve different actors and actor groups with many boundaries, this article focuses on the role of boundary objects and boundary subjects in facilitating such a process of choosing, constructing, elaborating, and communicating accounting facts. In this article, more specifically, we are interested in the antecedents and catalysts of the interaction across boundaries (such as boundary objects and boundary subjects between actors and actor groups), which may have a role in the process of constructing and communicating accounting facts.

Pragmatic constructivism, boundary objects, and boundary subjects in PD

PD activities involve several actors and actor groups that work together to meet the objectives set for individual but often interlinked PD projects. PD activities, essentially, deal with possibilities, that is, future business impacts, and accounting facts provide the basis for dealing with and examining those possibilities. The process of choosing, constructing, elaborating, and communicating accounting facts is supposed to help managers in managing those possibilities. This setting offers a natural starting point for employing pragmatic constructivism (Nørreklit *et al.*, 2010; 2012; Nørreklit, 2011a; Jakobsen *et al.*, 2011), which focuses on examining actor realities to better understand and enhance accounting practices, for example. Nørreklit *et al.* (2012, p. 506) recently summarized pragmatic constructivism as follows:

For endeavors to be fulfilled, i.e. causally effect the desired outcome, there must be an integration of four dimensions involved in the endeavor: a factual observational basis; a set of possibilities that are integrated with the facts, i.e. factual possibilities not speculative ones; values and goals that express the subjective values that motivate people involved and are within the range of the factual possibilities; finally, communication must convey this integrated structure of facts, possibilities and values to the people involved.

If communication is understood only as one dimension of the actor's reality, such as delivering a ready-made package, then communication is not understood as comprehensively as is required by the PD context. "To integrate the factual possibilities across the various employees involved in a given stage, interactive communication must take place" (Nørreklit *et al.*, 2012, p. 507). The process of constructing accounting facts is required and intertwined with the process of accounting fact communication.

There is an ongoing discussion on the boundary objects that serve various purposes of interaction in organizations (Star and Giesemer, 1989; Carlile, 2002; Bechky, 2003). The term boundary object refers to the means, models, and platforms through which different individual actors' viewpoints can be more easily understood and communicated to others; boundary objects

help communication among actors (Briers and Chua, 2001, p. 238). As described by Nørreklit *et al.* (2012), actors and actor groups from different (professional, social, and functional) backgrounds requires bridges to enable interaction. In the PD context, different actors may have joint and individual values and objectives; boundary objects, as platforms of interaction, need to consider them. As different actors need objects upon which to build conversations (Star and Gieseemer, 1989), accounting reports and calculations could serve the purposes of integration and gaining focus.

In addition to boundary objects as platforms for communication, more recently, the idea of active boundary subjects has been brought up in the context of action research for organizational development (Huzzard *et al.*, 2010). Building on the analysis by Huzzard *et al.* (2010, p. 17), boundary subjects, such as action researchers, could act “at the boundaries ... and [by] making the connections happen, in particular through conversations.” The idea of boundary subjects extends the common view on communication through accounting figures. Boundary subjects as actors could facilitate the process of constructing and communicating accounting facts in contexts with uncertainty and ambiguity. Briers and Chua (2001) identify five means for overcoming the communication challenges in accounting development: databases, visions regarding the future, idealistic objectives, boundary objects, and standardized procedures. As a prerequisite for using standardized boundary objects, the intentional use of boundary subjects could facilitate the creation of a common language among actors in their collective choice and construction of accounting facts (Carlile, 2002; Bechky, 2003). Boundary subjects could especially facilitate the pragmatic use of common knowledge (see knowledge transformation in Huzzard *et al.*, 2010) and “make communication happen” in organizations, in the form of constructing and communicating accounting facts.

In this article, accounting development and related accounting fact construction and communication are not a top-down process but a dialogue between different PD actors (R&D

stakeholders in Figure 1), who work as designers, experts, project managers, or functional managers (Nørreklit, 2011b, p. 9):

The leader-actor communication aims at creating a topos with which to enact employees so that they become powerful and committed actors realizing the strategy of the company... Through the shared activity of reflection, innovation, judgment, and decision making the organization is bound together.

The shared activity for organizational development described by Nørreklit (2011b) is described here as accounting development through the process of constructing and communicating accounting facts.

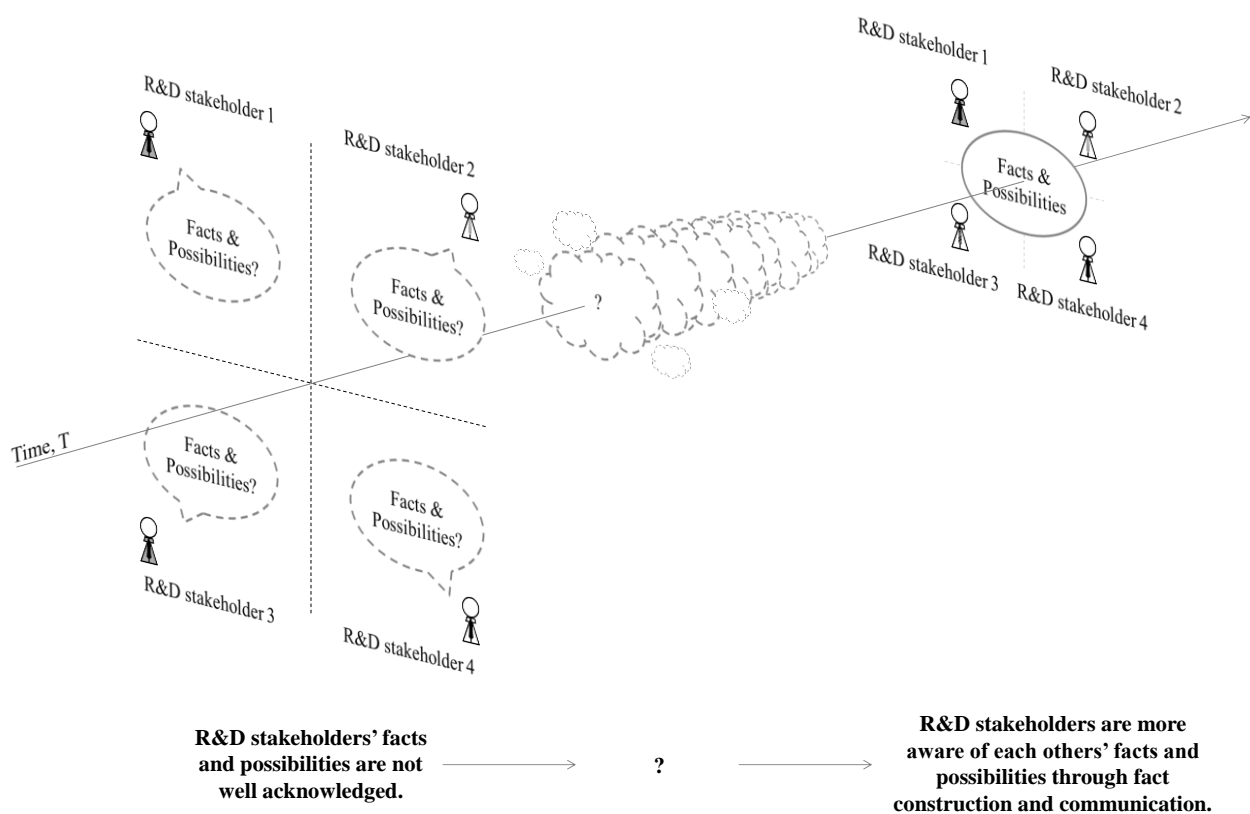


Figure 1. A better understanding of how actors' accounting facts and possibilities are constructed and communicated is needed

The basis for practical and meaningful work is an available set of facts, that outlines factual possibilities. Boundary objects and boundary subjects can serve as the means for choosing, constructing, and elaborating on accounting issues that become facts through the wider process of

accounting development in PD. As conveyed in Figure 1, employing accounting as a boundary element could increase the awareness of relevant accounting facts and possibilities, construct accounting facts and enhance communication among the actors. Through the process of constructing and communicating accounting facts, the coherence between different actors' *topoi* may be increased and linkages between the different *topoi* may be established. One way to integrate different actors' *topoi* is to use certain accounting prototypes in organizational boundaries.

Accounting prototypes represent one example of boundary objects that are potentially helpful in constructing and communicating accounting facts. Accounting prototypes are jointly and iteratively created preliminary tools, for example, cost accounting spreadsheets or accounting information systems under development. Accounting development through prototypes combines the ideas of using objects as bridges between the boundaries and facilitating social interaction between the actors involved in the development process.

Earl (1978, 1982) proposed that prototype thinking aids learning within accounting and control system development. Similarly, Wouters and Roijmans (2011) proposed only recently that prototypes could be beneficial in accounting development. A process with trial-and-error phases involves many alternatives and integrates different viewpoints during the process. Experimenting in accounting development responds to the challenge of the availability of relevant accounting facts information as well as to the challenge of dealing with organizational boundaries (Wouters and Roijmans, 2011). Wouters and Roijmans (2011) build on Carlile's (2002) work and suggest that experiment-based accounting development enhances interaction between different functions, different viewpoints, and different alternatives. Instead of serving primarily as a control tool, the accounting prototypes in the present article supported the people, individual actors influenced by the centralized control systems. We examine the accounting prototypes as boundary objects in the process of constructing and communicating accounting facts that aim at better supporting PD managers, PD project participants, and the production ramp-up at the end of the PD project. There may also be challenges in accounting development with prototypes. As integrating different

viewpoints is challenging (Wouters and Roijmans, 2011; see also Earl, 1978), boundary subjects may be needed to facilitate the interactive processes (Huzzard *et al.*, 2010).

Empirical findings

In this section, we provide evidence of the real-life process of recognizing, constructing and elaborating accounting facts and related possibilities. The section includes an overview of the empirical setting and the data collection in a large-scale PD program that focuses on the production ramp-up stage. We present findings regarding the recognition and construction of the relevant accounting facts in the ramp-up, the role of the researchers as boundary subjects in building a shared understanding of the ramp-up, and the design and early use of the accounting prototypes as boundary objects.

Overview of the case

The paper is based on a qualitative, interventionist research project (Jönsson and Lukka, 2007; Suomala *et al.*, 2014; Suomala and Lyly-Yrjänäinen, 2011). The research project took place in 2012–2013 in a Finnish machinery manufacturing company that produces production machinery and related services for its customers. The company is a highly innovative original equipment manufacturer, is a technology leader within the industry, and has significant PD activities involving hundreds of people. The company has implemented a management control system for selecting and steering PD projects and has tools and techniques for estimating the initial business impacts (volumes, prices, costs, etc.) of single PD projects and wider PD programs, setting targets for PD projects, and managing cross-functional projects. At the same time, the company had only recently started to pay attention to the boundaries between different business functions (as R&D stakeholders) during the PD projects. The PD managers wanted new means for mitigating and leveraging boundaries to better support the project manager, who was responsible for executing the PD project, and to increase the collective awareness of the issues that influence the business impacts generated by PD projects.

The business impact analysis (BIA) of a PD program currently conducted in the company includes estimates of the volumes, prices, costs, and after-sales profits of the new products. The BIA template represents the basis for selecting and steering PD projects in the case company. In the studied PD program, the BIA of the program was based on the BIAs conducted for many new products. If something was changed at the PD program level, the single PD projects were subject to changes, accordingly. The estimates in the BIA include significant uncertainty. As different R&D stakeholders provide those estimates, that is, sales managers are responsible for estimating volume, whereas production managers estimate the material and labor costs, there was no shared understanding of the mechanisms by which the PD program and single projects contribute to the company's business.

In this context, the production ramp-up of new products was not estimated as part of the BIA, despite the potentially significant business impacts of this phase of the PD program. The production ramp-up—the phase when new products were assembled for the first time on the assembly line and when the design choices and planned business impacts are turned into action during production—was not carefully defined in the initial PD program or single PD project plans. As a project manager was primarily responsible for meeting the objectives of a new product and the production manager was responsible for its assembly, neither clear targets nor responsibilities were set for the ramp-up phase. Additional challenges for managing the ramp-up phase and its timing were set by the sales and marketing representatives, who highlighted the availability of the products, and who wished to sell old products until the ramp-up of the new products was complete. The production ramp-up represents a critical phase for assessing (actual numbers vs. targets or estimates) and managing the business impacts of new products, but the accounting practice did not previously support this phase. In response to the research questions in this article, the witnessed and facilitated process of accounting fact construction for managing the ramp-up phase involved several R&D stakeholders and required organizational boundaries be overcome. During the process, new potential forms for overcoming and leveraging the boundaries, that is, new boundary objects and

boundary subjects, were designed, utilized, and examined by the researchers. The focus of the empirical material was on understanding the realities (*topoi*) of the different actors and the boundaries between them within the PD program in the company. To mitigate the organizational boundaries, the researchers collected formal “greetings” from different actor groups to each other regarding the need for accounting development for PD. In addition, during the research process, the researchers, together with program and project management and production representatives, designed accounting prototypes that were supposed to integrate relevant functional viewpoints into the business impacts of the PD program and support the ramp-up phases of new products. Access to the design and early use of the accounting prototypes provided visibility to the processes of constructing and communicating accounting facts throughout the company.

Research process, data collection, and analysis

Participatory observations, meetings, interviews, emails, and summaries written after the phone calls comprise the empirical data. Moreover, there was extensive access to the company’s documentation regarding the PD program and the ramp-up plans. This article is based on 30 interviews and meetings with 27 individuals (9/2012–5/2013). One of the interventionist researchers also worked for one week on the case company’s production line. Table I summarizes the people involved in the interviews, meetings, and those we met on informal occasions. On some occasions, many people across the business functions were present. The researchers most often met with production managers and personnel, finance managers, and PD managers and personnel. The researchers closely cooperated with a PD project manager, who was responsible for cost estimations of the new products, which enhanced the researchers’ access to the meetings. The program and project managers initiated the process of accounting development for the ramp-up, and the production representatives were actively involved in the process. The after-sales representatives were not as actively involved in the process, despite the importance of the spare part business in the company. In addition, as the sales and marketing representatives work all over the world, the volume estimates were based on consolidated figures, whereas the production figures and estimates

were more actively updated and based on more detailed analyses. Identifying the information needs among different actor groups and designing the ramp-up scenarios to be used as accounting prototypes were tasks given to one of the researchers. This was due to the lack of resources for accounting development in the company in general and to the potential benefits of using an external actor as a boundary subject in facilitating the construction and communication of accounting facts.

Table I. People involved in the interviews and meetings

Roles present in meetings	Different people	Percentage
Production	11	41%
PD project personnel	4	15%
Another division of the company	3	11%
After sales	2	7%
Finance/Accounting	2	7%
Sourcing	2	7%
PD program management	1	4%
Product management (product line sales)	1	4%
Research personnel	1	4%
Total	27	100%

An interventionist case study requires extensive and chronological documentation of the research process and the collected empirical material. We documented the empirical data underlying this article on a daily basis and coded them with the help of Atlas.ti software to enable iterative qualitative analyses and further analyses after the research process. The codes used in the Atlas.ti analyses include the role of the actor (e.g., a business function, such as a production and manager or expert role), the need to mitigate the boundary with another actor group (wishes, concerns, questions), and the content of the accounting facts (and related possibilities) regarding the product(s) under development (volumes, price, cost, timing, learning curve, modularity, etc.). Moreover, we analyzed the findings afterward in connection with the concepts of boundary objects and boundary subjects to scrutinize how PD actors jointly and individually constructed and communicated accounting facts.

Initiating the choice and construction of the accounting facts: unveiling the information needs of different actors

Initially, different actors undertook many PD activities separately, and there were no active forums for anticipating and discussing ramp-up management. The program managers had recently established a cross-functional team for discussing timely PD issues during the design phase, but the ramp-up phase remained beyond the scope of the team. The researchers collected the different actors' "greetings" to each other regarding the needs for accounting development for managing the ramp-up. This data collection was among the first actions to share existing assumptions and concerns regarding the upcoming ramp-up phase and to shed light on the boundaries between the different actors and actor groups. At the same time, the role of the researchers was to serve as the boundary subjects in mitigating the existing boundaries, largely in line with the recent development in the company toward increased cross-functional cooperation.

As conveyed in Table II, various issues were brought up by the different actors of the company that revealed the different viewpoints of the ramp-up management and more particularly revealing the relevant viewpoints and information sources for constructing accounting facts for managing the ramp-up. Among the R&D stakeholders, representatives of R&D, sourcing, the product line, the PD project, aftersales, and accounting were identified as key actor groups related to the ramp-up phase. The issues presented in Table II are labeled "questions," "concerns," "reality checks," and "wishes" for other actors and actor groups, and responding to those issues was supposed to be beneficial to an individual actor, to many actors, or to the company more broadly. The labelling of issues unveils the collective sensemaking as examined by Laine et al. (2016). In this paper, the labelling of issues enables understanding actors' underlying values that influence how they communicate identified accounting facts.

Table II. Interventionist researchers conveyed “greetings” from R&D stakeholders to each other

Function		To whom the "greetings" are intended						
Function	R&D	Sourcing & Operative purchases	Production	Product line	Project	After sales	Accounting	
<i>R&D</i>		Concern of subcontractor's quality after the prototype machines have been built.	Concern of manufacturing "current" and "new" machine generations on the same production line.	Question about production ramp-up and ramp-down schedule. Concern of killing the "current" machine generation. Wish that there are volume options but not everything possible.	Wish that responsibilities are clarified regarding interfaces and the product family.			
<i>Sourcing & Operative purchases</i>	Wish to have a change log about which component replaces what. Wish to limit changes to make it possible for subcontractors to deliver.		Wish to get support for make-or-buy decisions regarding the prototype machine.	Wish to plan and estimate ramp-up and ramp-down. Wish to increase the volume as quickly as possible.	Wish to commit to decisions that have been made. Wish to give estimates to support sourcing work.	Wish not to offer every single component as an available spare part but as larger packages.	Question about how to quantify e.g., postponement and scale benefits in monetary terms.	
<i>Production</i>	Concern of lacking a "common language" because products are designed for manufacturing and assembly and the product structure fixes production organizing.	Wish for comprehensive cost-consciousness, not only prices.	Wish to construct prototype machines carefully and taking the time needed (internal communication between production line assembly and prototype assembly).	Reality check that estimates are the basis for production planning. Reality check that the "current" and "new" generations will not fit into the same production line, making ramp-down a must. Wish for quick ramp-up and not going back and forth.	Wish for communication about the R&D project. Wish for clear responsibilities. Wish for ramp-down decisions (not assembly three generations at the same time in production, i.e. the "previous" "current" and "new" generations.		Wish for pressuring stakeholders about costs. Concern of the cost of waiting. Wish for cost-consciousness.	
<i>Product line</i>	Wish for available engineering resources when problems with the "new" generation occur. Question about the prices for new optional features.	Wish for prices for spare part components.	Question about delivery lead times that can be promised to the customer. Question of production volumes that would be undesirable for longer periods of time.				Question of whether one can find optimal scenarios about the minimum amount of machines on a production line, the maximum amount of machines on an assembly cell, or a volume range that would be undesirable.	
<i>Project</i>				Wish for plans to kill the "current" machine generation. Question more specifically about what is ramped-down.			Wish for bringing up different viewpoints. Wish for reasoning. Wish for common language. Wish for showing the indirect costs.	
<i>After sales</i>	Wish for a controlled cycle of making design releases. Wish for preparing for faults that need to be corrected. Wish for platform thinking. Wish for not too much customer-specific designs.			Wish for software road maps. Wish for centralized product support. Wish for training for those that operate in the front line.				
<i>Accounting</i>	Question about the development of component items (in total) and structures.	Questions about the costs of component items (in total). Question about the costs of component items (in total). Question about the essential component items.	Question about learning curves. Question about scheduling changes in production.	Wish for estimates for production ramp-up and ramp-down.	Wish for a definition for production ramp-up.	Question about the possible benefits from the "new" machine generation in after sales.	Wish for product costs (self-reflection).	

From whom the "greetings" are from

By interviewing different PD actors, the researchers initiated the recognition, choice, and construction of accounting facts that were relevant for managing the ramp-up from different perspectives. The researchers asked about not only the overall challenges related to the ramp-up but also the sources and forms of information that would actually help overcome those challenges and thus mitigate the boundaries.

Product management (product line sales) represents the internal customer for the PD program and individual PD projects, as the project managers will become responsible for the product's profitability after the ramp-up. Therefore, the issues brought up by the product line representative were primarily "questions," for example, regarding the delivery times of the new products that could be promised to customers (a question posed to production) and regarding the costs and desired prices of new features (a question posed to R&D). In addition, the product line representative wished for new engineering resources in case any problems emerged that could postpone the ramp-up.

Project personnel and R&D representatives brought up questions regarding the ramp-down of the existing products to better understand the content and complexity of the forthcoming product offering. In addition, actors brought up wish lists regarding the accounting support for executing the project and regarding clearer definitions of the managers' responsibilities for the new and old generations of machinery. As the responsibility for the new products would shift to sourcing and production, the R&D personnel were concerned about the capabilities of the subcontractors regarding the new products and the possibilities of assembling the new and old products at the same time in the same production system.

As the sourcing, production, and after-sales personnel were previously only indirectly involved in PD projects, the representatives of those functions primarily formulated wishes, for instance, regarding clearer responsibilities, plans for the ramp-up and ramp-down, estimates of the volumes, and increased cost-consciousness. Production representatives asked for "reality checks"

from product line representatives, for instance, regarding the volume estimates as a basis for planning production.

Accounting representatives raised several questions about other functions, such as product costs, the learning curve in terms of assembly hours, and the after-sales effects of the new products, etc. Although the BIA included the product cost estimates, for instance, they were not really revisited during program execution. Thus, other PD actors asked the accounting representatives to create scenarios and find optimal solutions once accounting information about different issues became available. In addition to the detailed issues shown in Table II, there were numerous issues regarding the timing of the production ramp-up. In discussions with product line, production, and sourcing representatives, the description of the optimal ramp-up schedule differed dramatically among the functions. For the product line sales people, selling the previous model for as long as possible and only gradually start selling the new model was important in order to prevent a situation in which customers would have to wait longer for delivery of the product due to the ramp-up. The production managers wanted a fast and strict process for the ramp-up and ramp-down, for a fast learning curve in the assembly of the new product and straightforwardly meeting the production cost targets set for the new product. The purchasing representatives wanted a gradual, yet relatively fast, shift to the new product for an easily manageable process for managing materials for the old and new product models.

Based on the discussions, the researchers created a figure that brought together these different viewpoints about the timing of the ramp-up and thus initiated discussion on the timing of the ramp-up among the different functional representatives. This is one example of when the “greetings” of one function to another were used to build and elaborate a shared understanding of the issue at hand. By combining the different functions’ viewpoints, the illusions about the production ramp-up were discussed, and development toward changing these illusions into factual possibilities advanced. In other words, the role of the researchers as external actors was to initiate

the construction of accounting facts about the ramp-up by analyzing the challenges across the boundaries of different PD actors and actor groups.

Constructing a shared understanding of the ramp-up with the help of the boundary subjects

Collecting and elaborating on the challenges of managing the ramp-up revealed that the notion of the ramp-up was neither sufficiently defined nor operationalized in the company. Formally, there was a definition for the ramp-up in the company documentation:

[From the PD viewpoint] production ramp-up means the shift of the product [responsibility] from PD to production. During the ramp-up, old models may still be produced, before a ramp-down process takes place.

However, as discussed with various functional representatives, the definition of the ramp-up required more details and elaboration of the existing accounting facts to better understand the business impacts of the alternatives. Part of the uncertainty related to managing the ramp-up seemed to be due to a lack of shared understanding of the ramp-up. Therefore, as a starting point for accounting development, there was a need for an integrative definition and operationalization of the ramp-up.

According to the interviews conducted in the case company, the following characteristics were desired in the ramp-up phase:

- Production ramp-up means meeting specific targets set for the new product (e.g., the production cost target or production volume of the new product).
- Meeting such targets requires certain sales volumes (product line) and additional ramp-up management outside the assembly line (sourcing).
- Meeting such targets seems to require more time than previously estimated in the business impact analyses (e.g., in terms of the learning curves in the assembly line).
- The ramp-down of an old product model should be included in the overall process of the ramp-up, because the ramp-down also influences the business impacts of the new product(s).

In addition to the characteristics of the ramp-up, there was also a need for defining the roles and responsibilities for different functions in the ramp-up. In Table III, the researchers put together a set of desired roles and tasks for different people. The role of management accountants or business controllers would be to support each function in their managerial work and fulfill their information needs for different planning and controlling purposes. In this vein, Table III should be read as a starting point for actually operationalizing the idea of ramp-up management in the company.

Table III. The desired roles of different functions in production ramp-up

	<i>Product line sales</i>	<i>Sourcing and purchasing</i>	<i>Production</i>	<i>R&D</i>	<i>Program management / operational management</i>
<i>Role</i>	Responsibility bearer, manager of the whole process	Problem preventer	Problem preventer	Problem preventer, responder to change needs	Process supporter, uncertainty reducer
<i>Tasks</i>	Defining the production ramp-up Mapping the readiness and means to manage production ramp-up Defining optional scenarios for ramp-up Managing risks Planning the ramp-up (volumes for the “current” and “new” generations) Managing the product portfolio Ramp-down of the “current” products Training the market areas about the “new” product generation	Planning component orders Preventing component shortages Assuring subcontractors’ quality Developing the interface between strategic sourcing and operative purchases	Supporting sales in planning production ramp-up and ramp-down Reorganizing production and assembly Planning material logistics and management Building the production facilities	Engineering product features and customer options before production starts Planning at the portfolio level Listing the replacing and to-be-replaced designs Taking care of current product engineering (product improvements)	Creating a process for the production ramp-up Determining responsibilities for the ramp-up Determining how the successfulness of the ramp-up is evaluated Supporting cross-functional communication
<i>The most important interfaces</i>	Market areas Sourcing Production R&D	Sales Production	R&D Sales	Sales Production	Sales Production Sourcing R&D

In a meeting with program and project managers and production representatives, the researchers discussed the need for a shared understanding of the ramp-up. The PD actors suggested that the overall responsibility for managing the ramp-up should be given to the product line sales personnel, who are responsible for product profitability right after a PD project has been executed.

The product line sales function has boundaries with all other functions, which should be managed to prevent possible challenges related to the ramp-up. Moreover, the product line personnel are responsible for planning the ramp-up and ramp-down of products to respond to the market needs and simultaneously to prevent problems in the company's production system. In such a ramp-up process, the sourcing and production functions are responsible for planning the ramp-up according to the guidelines and to ensure a smooth ramp-up process. As the PD project personnel were in charge of designing the new product according to the BIA and a number of requirements, the personnel should actively support the ramp-up process.

The researchers facilitated the discussion about the characteristics of the ramp-up as they collected information from different PD actors separately and facilitated discussions between the different actors. Regarding the construction of the accounting facts, the definition of the roles and responsibilities of different actors more accurately represent a basis for constructing relevant accounting facts. Therefore, elaboration of the characteristics of the ramp-up and the responsibilities of the different actors was closely related to the accounting development in this context.

Design and early use of the accounting prototypes as boundary objects

The process of accounting development for managing the ramp-up continued naturally to designing accounting prototypes to be used as boundary objects to manage the ramp-up. The researchers again collected information from different PD actors and were in charge of designing the prototypes and facilitating discussions about them. The accounting prototypes were developed in two phases. First, an early version of the business impacts of the ramp-up was designed to show the overall profitability impacts of the ramp-up management (year 2012). Second, another prototype was built based on an enhanced understanding of the ramp-up definition and the feedback about the previous prototype (year 2013).

The first accounting prototype was built based on a discussion with program managers, project managers, and a production representative, and the prototype was based on the estimated production volumes, rough estimates of the product costs, and the challenges expected in different

ramp-up timing scenarios. The prototype calculated the best, the most realistic, and the worst case scenarios of the production ramp-up. The illustrative figure (Figure 2) conveys the evolution of the sales and production volumes in the best-case scenario, where the ramp-up results in a gradual increase in the volumes of the product categories that were examined. In this best case, the ramp-up and the ramp-down are managed so that the production and materials supply meets the market demand.

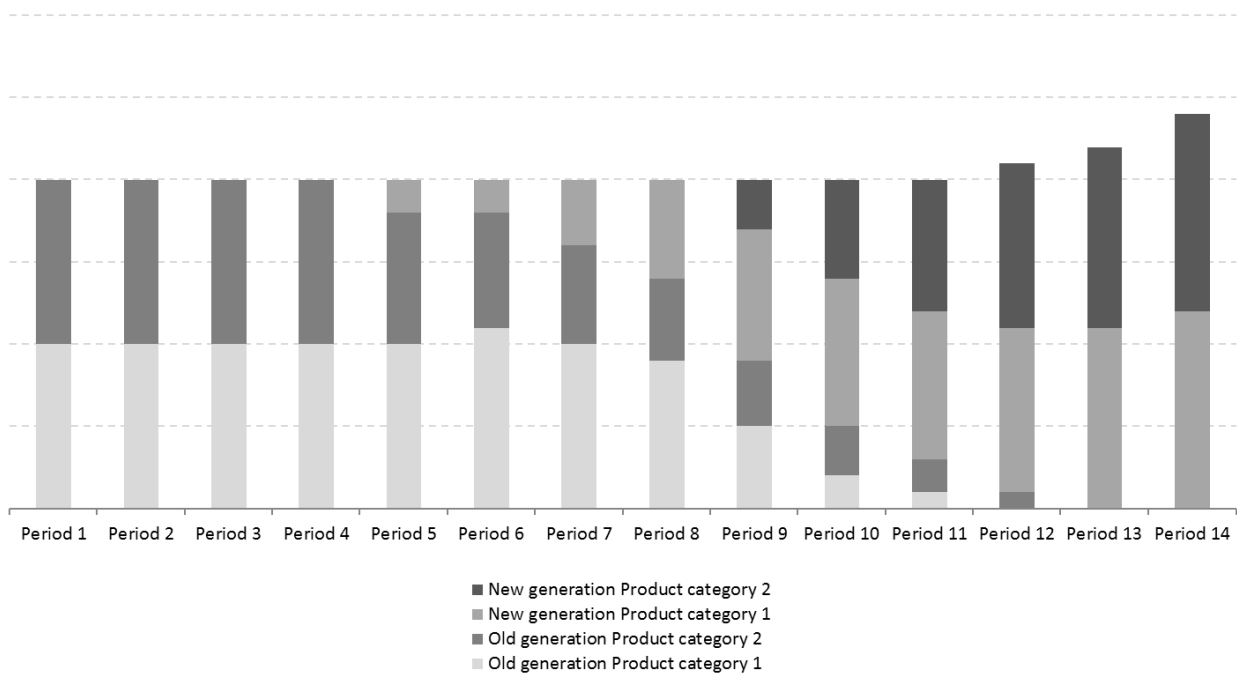


Figure 2. First accounting prototype for the profitability impacts of the ramp-up

The first accounting prototype revealed the importance of building different scenarios to show and elaborate upon the uncertainties and ambiguities in the different accounting facts. However, this prototype did not include many possibilities for analyzing the business impacts in a detailed manner, as the prototype was based on rough estimates of the volumes and costs. The PD actors could not yet draw detailed managerial implications for different PD actors to contribute to the realization of the best-case scenario. Thus, the second prototype was supposed to focus on certain details of the ramp-up phase and provide a deeper understanding of the expected profitability impacts.

The second accounting prototype focused on revisiting and elaborating values and assumptions related to the overall PD program. The following aspects were included in the ramp-up scenarios: 1) There were discussions about the impact of meeting the schedule set for designing the product, and the ramp-up tool included the possibility of postponing the ramp-up in order to analyze the impacts. 2) Another aspect, which had already been discussed with the production and sourcing representatives, was the rate at which the new product would replace the old one in production. The ramp-up tool enabled this type of analysis. 3) One target set for the new product was an enhanced modular structure, the business impacts of which were estimated based on the possibility of increasing capacity and on the lower complexity of the product structure, thus resulting in lower production management costs. 4) The learning curve on the assembly line was estimated to better understand the need for extra capacity in production during the ramp-up phase and the extra costs caused by different ramp-up scenarios. This type of information was available in the production department. The production representatives provided the researchers with actual data on the decrease in the assembly hours during the ramp-up of earlier products, and these data were integrated in the ramp-up scenarios for the new products. This information was used for the first time between the PD and production representatives.

As a result of the discussion, the researchers designed and presented the second accounting prototype to the company representatives. The central report of the tool is presented in an illustrative figure (Figure 3). By using the tool, different scenarios can be built regarding the timing and content of the ramp-up, thus resulting in different estimates of the business impact (i.e., cumulative profits in Figure 3).

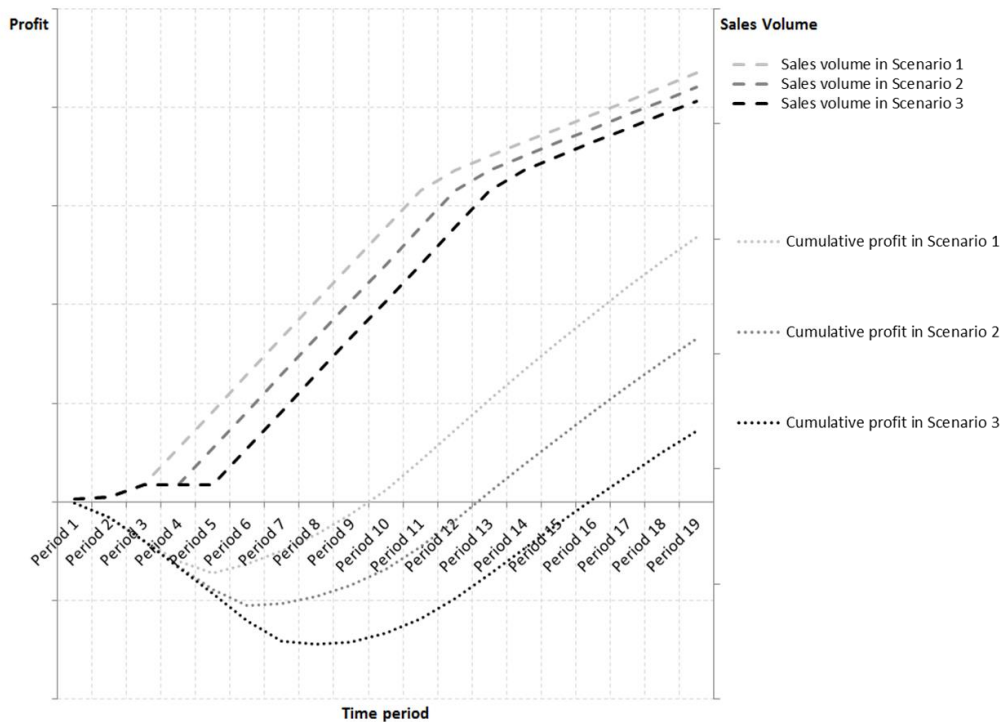


Figure 3. Refined accounting prototype based on the business impacts of the ramp-up

The use of the second accounting prototype in a meeting with different PD actors led to a reconsideration of the ramp-up execution in the company. The plan had been to execute the ramp-up much faster, but during the process, the company decided that the ramp-up would be divided more clearly into different product (sub-) ramp-ups within the PD program. The research process had revealed a number of aspects that deserve attention in the ramp-up management. The managers had recognized different economic consequences of managing the production ramp-up according to different scenarios. One may interpret, thus, that managing the launch of the new products and product categories in sub-ramp-ups was now considered a more easily manageable and safer choice. In other words, managers gave more time and attention to the individual ramp-up management of single products.

Naturally, decisions made by the company were not made clearly based on the scenarios with the help of the accounting prototype, but the process of constructing and communicating the accounting facts drew attention to the central business impacts related to (or observed during) the ramp-up phase. The role of the researchers in the process was to initiate construction of accounting

facts and facilitate construction and communication of the accounting facts directly as boundary subjects and indirectly through the design of the accounting prototypes as boundary objects.

Discussion

How do the PD actors choose, construct, and elaborate relevant accounting facts and related possibilities in the accounting development process?

Highlighting the illusions: The study results suggest that there can be considerable disagreement among actors in PD regarding central issues, such as the definition and the content of the ramp-up right after the PD project. The facilitating effort of the researchers—or other possible boundary subjects—is beneficial in collecting relevant accounting facts emphasized by the different PD actors and putting together the different viewpoints regarding the ramp-up. This case study suggests that actors formulate accounting facts through the mechanisms of construction, communication, and defining. Construction in this case study focused on highlighting illusions and turning them into possibilities. Communication took the form of questioning, expressing concern, giving reality checks, and making wish lists. Defining consisted of assigning roles and responsibilities related to the ramp-up. The researchers took the role of reflective and interactive actors, who aimed to integrate factual possibilities in the studied context. Thus embedded in the researchers' interventionist approach is an actor-based approach.

The findings of the case highlight the risk of different actors having substantially different *topoi* (Nørreklit, 2011b) and that these *topoi* can easily hinder defining and managing an issue, such as a production ramp-up in this case. In the early phase of the process, much attention was paid to collecting and integrating the facts and possibilities (Nørreklit *et al.*, 2010; 2012; Jakobsen *et al.*, 2011) related to the PD program in the company and the subsequent ramp-up to better understand the business impacts and the dynamics underlying the impacts. Then, the design of the accounting prototypes provided a platform for constructing, elaborating, and communicating the new accounting facts regarding the ramp-up. The “greetings” of different actors to other actors and actor

groups, once explicitly formulated, were easily understandable by the parties involved in the PD program, and they all then sought consensus. However, much communication was required in order to define the unit of analysis (i.e., the ramp-up process) and derive sufficient roles and responsibilities for it.

Turning illusions into possibilities: The use of the external boundary subjects provided a neutral and extensive viewpoint for the process of constructing accounting facts. Moreover, in addition to using new boundary subjects, using new boundary objects (i.e., accounting prototypes) that deal with the boundaries between PD actors can help in the negotiations between the actors by visualizing the concerns and possible tensions and by eventually guiding the way toward consensus.

Figure 4 illustrates the process of recognizing and choosing relevant accounting facts and building a shared understanding among different actors (people) and actor groups (business functions) regarding the ramp-up. During the process, the viewpoints and values of different actors became visible and could be taken into consideration in developing accounting prototypes. The early accounting prototypes had the role of visualizing different stakeholders' contradictory perceptions of the ramp-up and led to drawing their attention to issues that were subject to further development. Further, elaborating on the accounting facts through the accounting prototypes with different actors made the calculations more reliable and reduced the level of uncertainty and ambiguity in the PD process.

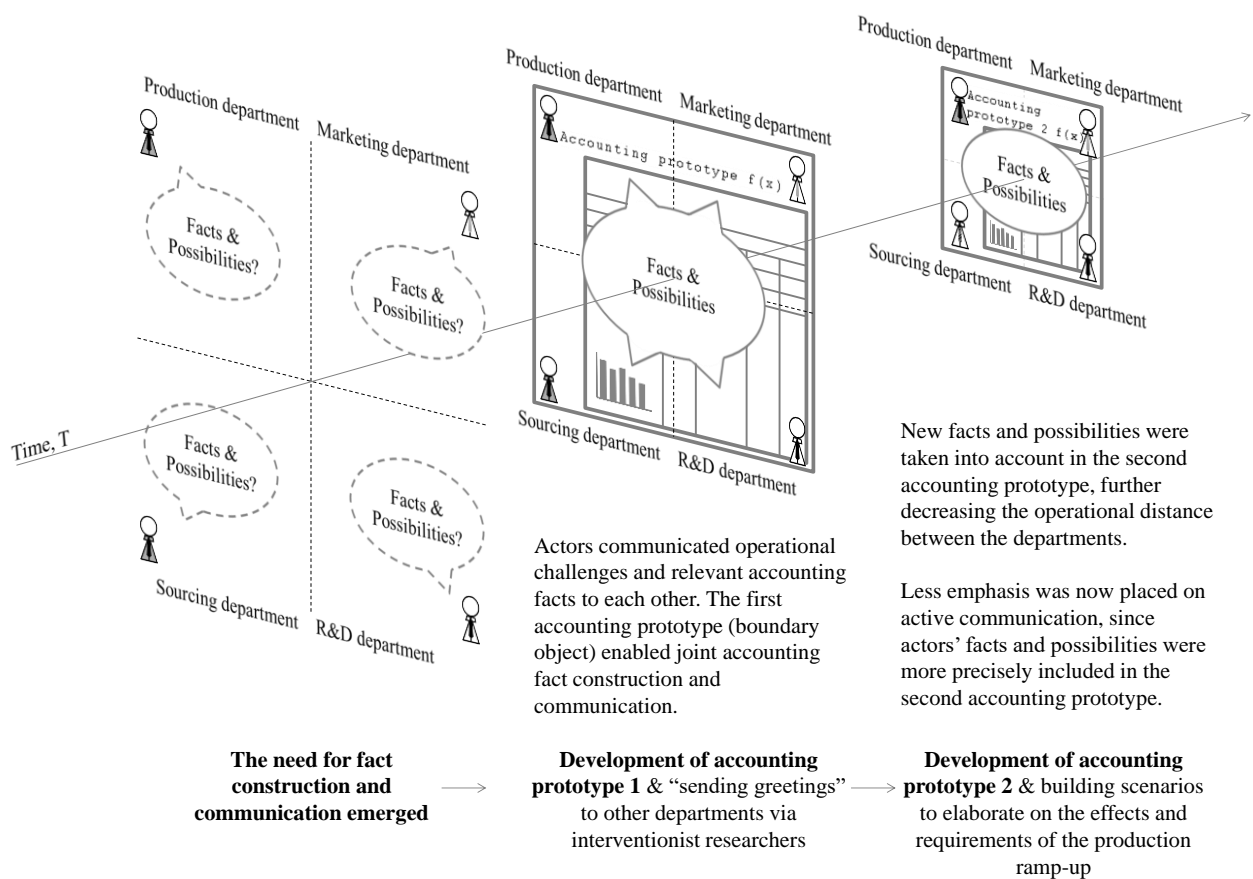


Figure 4. Knowledge integration has been enabled by accounting prototypes and research interventions

The role of the different accounting facts regarding the possibilities in the PD context evolve over time during the process of accounting development. During the early phases, the focus of development was to increase understanding of different actors' and actor groups' *topoi* and to collect and construct information regarding relevant managerial issues. Then, the recognized, chosen, and constructed facts were put together in the form of the first accounting prototype, and much communication took place.

As a contribution to the existing literature on pragmatic constructivism in accounting (Nørreklit *et al.*, 2010; 2012; Jakobsen *et al.*, 2011), communication evolves and is focused alongside the longitudinal process of accounting development. However, this requires recognition of different actors' values, together with construction and elaboration of the relevant accounting facts (and factual possibilities). In this case, knowledge integration made it possible to bring up different actors' illusions about the ramp-up and then collectively seek a shared and more factual

understanding of what a product ramp-up was in the company: who is involved, what roles different actors or groups have, and the schedule for transitioning from the current product generation to the new one.

Due to the significant uncertainty of PD activities and the immaturity of accounting support in the PD context, longitudinal accounting development is elemental for redirecting decision-making with the help of new accounting information. One of the key implications possibly provided by the accounting prototypes in PD is the possibility of enhancing learning within and across PD projects (the challenge was identified by Goffin *et al.*, 2010). According to Kraaijenbrink (2012), successful PD projects are driven by successfully integrating knowledge in the project. Using accounting prototypes for establishing new ways of integrating knowledge and redirecting communication is a clear way forward in managing PD projects and subsequent ramp-ups in companies.

What is the role of boundary objects and boundary subjects in constructing and communicating accounting facts in PD activities?

Boundary objects: Our findings suggest that boundary objects play a key role in focusing on the most critical aspects of complex, uncertain, and ambiguous phenomena, providing understanding that significantly influences the business impacts. The role of boundary objects was to reveal uncertainties and ambiguities and to draw attention to central business impacts. The use of boundary subjects/objects in accounting development should not only lead to a more holistic and integrative understanding about different actors' viewpoints, but it should also enable a focused and more effective accounting enactment.

The present study considered accounting prototypes (Earl, 1978; 1982; Wouters and Roijmans, 2011) as boundary objects that intend to overcome the organizational boundaries and thus support individual actors, actor groups, and the company as a whole in their managerial work. This viewpoint elaborates on the ideas of Wouters and Roijmans (2011) regarding accounting prototypes and applies them in the context of managing PD. From the pragmatic constructivism

point of view (e.g., Nørreklit *et al.*, 2010; Jakobsen *et al.*, 2011; Nørreklit, 2011b; Cinquini *et al.*, 2013), different boundary subjects and boundary objects, such as accounting prototypes, represent the means with which one can better understand different actors' *topoi*. This understanding contributes to more effectively constructing and elaborating new accounting facts and to fostering informal communication among different actors with the aid of accounting practice under development (Nørreklit *et al.*, 2010).

In the previous literature, boundary objects have been introduced and examined in the PD context (Carlile, 2002; Bechky, 2003), and accounting prototypes have been seen as communication platforms that could help create a common language and standardized procedures for communication among the parties involved (Wouters and Roijmans, 2011; see also Briers and Chua, 2001). As examined in this article, the systematic use of boundary subjects and objects together enables such an evolutionary process toward enhanced communication and accounting enactment. As the accounting prototypes were further developed based on the process of communication, the second prototype included several relevant accounting facts, thus reducing the need for communication about fundamental assumptions and at the same time enabling more detailed managerial discussions of the dynamics of the business impacts. The second prototype took advantage of the new relationships and forms of discussion enabled by the previous phases of accounting development and provided an integrative view of the business impacts. The second prototype included detailed analyses of the different aspects of the ramp-up (timing, learning curves, etc.) brought up by different actors, which made the calculations more credible and less illusionary (Jakobsen *et al.*, 2011).

Boundary subjects: As a key finding, this article shows how boundary subjects mitigate existing boundaries and bridge subjects at the boundaries to each other. The article reports the evolution of choosing, constructing, elaborating upon, and communicating new accounting facts during accounting development. In such an evolutionary process, the role of boundary subjects was initially fundamental in collecting and assessing relevant accounting facts, revealing illusions

through discussions, and identifying factual possibilities by integrating facts received from multiple sources (Jakobsen *et al.*, 2011; Nørreklit *et al.*, 2010, 2012). In a complex development task (Hussard *et al.*, 2010), such as the case of accounting development for PD examined in this article, the use of boundary subjects quite naturally precedes the design and use of boundary objects in facilitating and focusing the communication. In the first accounting prototype, an overview of the situation (i.e., the PD program ramp-up with its business impacts) was illustrated as a result of the integrative work undertaken by the boundary subject.

The role given to (or taken by) the researcher(s) was largely in line with Huzzard *et al.*'s (2010) idea of collecting and systematizing actors' reflections regarding the practice. The idea of a boundary subject systematizing different actors' reflections is a further development in the present case study, where the actors' and actor groups' "greetings to each other" were further translated into accounting prototypes. These visualizations facilitated and focused the discussion on accounting facts and related factual possibilities by explicating various operative scenarios. As described by Huzzard *et al.* (2010), boundary subjects can help build relationships with new actors. This case study shows that in the context of accounting development, these relationships can be established, defined, and turned into action through accounting prototypes. In the PD context, this means new relationships and new forms of communication among the functional representatives, thus enabling a shared viewpoint on the business impacts and their management in the PD project or program context.

Conclusion

The article contributes to the literature on accounting development by examining the use of boundary subjects and boundary objects as fundamental mechanisms in interactive accounting development. More particularly, the paper contributes to our understanding of the process of constructing and communicating accounting facts among actors with different viewpoints, facilitated and focused by knowledgeable boundary subjects and accounting prototypes as

communication platforms. Based on the case study evidence, pragmatic constructivism turned out to be a fruitful starting point for examining the process of choosing, constructing, and elaborating relevant accounting facts and developing the accounting enactment toward the production and use of more integrative, more focused, and, at the same time, more factual accounting information.

As an implication, pragmatic constructivism could benefit from the use of boundary objects and boundary subjects, thus enabling a detailed examination of the evolutionary process that aims to connect the viewpoints of different actors. The boundary subjects could help actors, that is, subjects at the boundaries, mitigate the existing boundaries and bring subjects at the boundaries closer to each other. The boundary objects, in turn, could draw attention to the central business impacts and help actors recognize and elaborate upon the uncertainties and ambiguities in the different accounting facts.

In practice, boundary subjects and boundary objects are supplementary. Their role in the process of constructing and communicating accounting facts may change. In the case study, the lessons learned from the use of the boundary subjects in an initial phase clearly influenced the design and use of the accounting prototypes as boundary objects. Despite integrative and well-functioning boundary objects, the need remains for boundary subjects for different purposes. As a practical implication, the intentional (or at least conscious) use of boundary subjects and boundary objects in accounting development also holds significant managerial implications in PD management and in other contexts with uncertainties and ambiguities. Indeed, the findings of the paper suggest that using boundary subjects and boundary objects benefit effective accounting enactment by building a shared understanding about different actors' roles and information needs, and by helping responding to them. If business controllers (or accountants) were actively involved in designing and utilizing organizational boundaries, they could more easily take the role of an active business partner (Järvenpää, 2007) especially regarding the desired communication in solving complex business problems (Kennedy and Sorensen, 2006). In addition to providing new accounting facts, this requires, however, a more active and conscious elaboration upon the involved

actors' values and valuation. If research interventions are used, the actor-based approach is embedded in the interventionist work that seeks to integrate factual possibilities.

Finally, the interventionist case study tested the pragmatic constructivism approach in examining accounting enactment under uncertainty and ambiguity and refined the approach in relation to boundaries, boundary objects, and boundary subjects. As the boundaries represent the fundamental feature of any organizations, resulting in a lack of coherence among the different actors and actor groups, the results open up avenues for further research on subjects at the boundaries, boundary subjects, and boundary objects in practice, in different contexts, essentially outside PD management.

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Notes

1. A boundary object refers to the means, models, and platforms through which different viewpoints can be more easily understood and communicated to others through a common language (Briers and Chua, 2001, p. 238; Carlile 2002). Boundary subjects, as people, act “at the boundaries ... and [make] the connections happen, in particular through conversations.” (Huzzard et al., 2010, p. 17).
2. The article employs and refines the pragmatic constructivism approach to elaborate upon the terms of boundaries, boundary objects and boundary subjects. In pragmatic constructivism, the focus is on the social construction of reality within organization, enabled by people as actors (Jakobsen et al., 2011). The realities of the individual actors and actors groups within organizations are understood through four dimensions, facts, possibilities, value and

communication that altogether constitute the actor realities as examined in this paper (Nørreklit et al., 2010).

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