

# Supply chain management and activity-based costing

## Current status and directions for the future

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### Abstract

**Purpose** – The purpose of this paper is to summarize and analyze what is known regarding activity-based costing (ABC) applications in the context of supply chain management (SCM). The authors present a reference framework for practical implications and areas for future research in intra-firm and inter-organizational environments.

**Design/methodology/approach** – The findings underlie a systematic review methodology. Research gaps and guidance for further publications are derived from the reference framework based on ABC and SCM literature.

**Findings** – The review illustrates four main areas for further research: determination of the role of management accounting in SCM (including supply chain finance), integration of time-driven ABC with radio frequency identification (RFID) technology and automatic data collection, analysis of inter-organizational management tools in supply chains in multiple negotiation rounds, and standardization of cost accounting data in supply chains.

**Practical implications** – The review provides practitioners with three main recommendations: ABC applications require a solid data basis, organizational readiness, commitment from senior management, and an ABC management philosophy; open book accounting for inter-organizational cost information-sharing purposes needs institutional arrangements and economic incentive systems; and sharing costs and benefits among supply chain members requires a change of managers' mind-set.

**Originality/value** – This paper reveals practical implications and provides new directions for research based on the reference framework. The paper contributes to the interdisciplinary topic between SCM and management accounting by providing a structured overview of 87 peer-reviewed articles from 1992 to 2016.

**Keywords** Supply chain finance, Systematic literature review, Inter-organizational cost management, Supply chain costing

**Paper type** Literature review

### Introduction

Increasing transactions between firms, such as the exchange of materials and information, are the reason for the “hidden factory,” meaning high manufacturing overhead costs (Miller and Vollmann, 1985). Traditional cost accounting practices (e.g. volume-based costing) have been unable to allocate these costs to products accordingly (Dickinson and Lere, 2003; Thyssen *et al.*, 2006; Uskonen and Tenhiälä, 2012). Yet accurate cost data are crucial for decision making and have been seen as a source of competitive advantage (Gupta and Galloway, 2003; Berling, 2008; Lin *et al.*, 2012; Maiga *et al.*, 2014). Cooper and Kaplan (1988) presented activity-based costing (ABC) as an alternative cost accounting approach. Initially, ABC was intended to be implemented for intra-firm purposes only (La Londe and Pohlen, 1996). However, the reduction of a company's own contribution to a product's value due to outsourcing (McCarthy and Anagnostou, 2004; Schulze *et al.*, 2012) resulted in more transactions at the inter-organizational level (Weber *et al.*, 2010). Furthermore, global competition has increased and puts pressure on firms and their supply chains (Khataie *et al.*, 2011; Askarany *et al.*, 2010). Today, not only individual firms but also whole supply chains compete against each other. Consequently, the need for coordinated activities, as well as information sharing, within and



across supply chains has arisen (Schulze *et al.*, 2012). Supply chain management (SCM) supports firms to manage inter-company material, information, and financial flows to collectively enhance productivity, performance, and profitability (Gunasekaran *et al.*, 2004; Templar *et al.*, 2016). Efforts today to improve competitiveness include suppliers and customers. Cost transparency across the supply chain, in addition to appropriate customer service levels, is seen as a crucial success factor (Hoffjan *et al.*, 2011).

ABC has been the subject of general reviews that describe its evolution (e.g. Innes *et al.*, 2000; Bjørnenak and Mitchell, 2002), discuss its organizational aspects (Shields, 1995; Krumwiede, 1998), or examine its communication patterns (Lukka and Granlund, 2002). Various attempts have been made to integrate SCM and ABC (Lin *et al.*, 2001), while the inter-organizational nature and the relational context represent the main characteristics (Cooper and Slagmulder, 2004). Thus far, the intersecting literature of SCM and ABC has not been reviewed. So, the contribution of this paper is to provide the current status and future directions of ABC in SCM. As the concept of ABC remains stable, whereas the terms “supply chain” and “SCM” still experience confusion regarding their meaning (Mentzer *et al.*, 2001; Carter *et al.*, 2015), this paper focuses on different ABC adoption levels within various “understandings” of the supply chain and SCM, respectively.

The remainder of this paper is organized as follows: after this introduction, the following section provides the background for the research question by presenting the methodology for the literature review. The third section focuses on the research framework in which the SCM and management accounting disciplines are integrated in a two-dimensional matrix (the ABC adoption level and the supply chain view). The fourth section presents the current state of knowledge. This section is structured according to the supply chain views (intra-firm, supply chain orientation (SCO), and SCM). In the fifth section, the compiled literature is discussed and managerial implications are given. In the final section, conclusions for the study are provided and areas for future work based on the reference framework are presented.

## Methodology

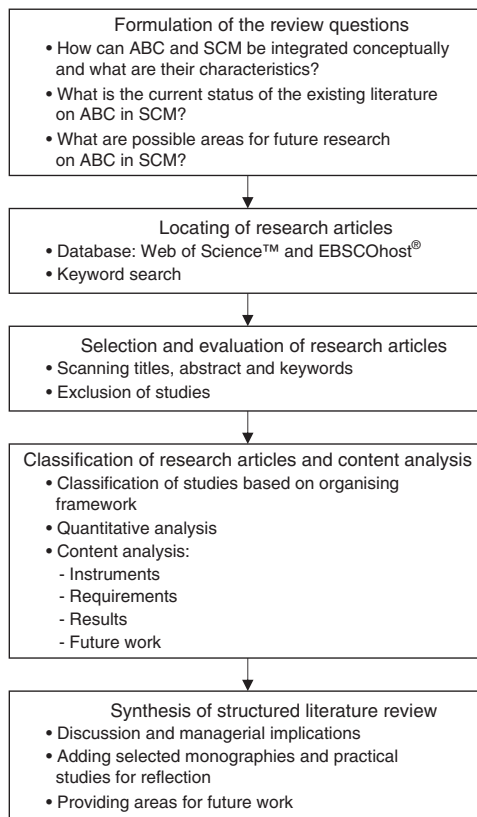
A structured literature review differs from a narrative review due to the systematic method, which implies a detailed plan of the steps taken to select, scan, and analyze the literature to reduce biases and to increase transparency (Tranfield *et al.*, 2003). Rousseau (2006) emphasizes that systematic reviews have been applied in management research to close the “research-practice gap.” A structured literature review is a method for developing propositions and discussing future research implications (Touboulic and Walker, 2015). Therefore, as shown in Figure 1 the process is split into five consecutive steps (Denyer and Tranfield, 2009): formulate review questions, locate research articles, select and evaluate articles, classify and analyze the content, and report and use the results as a synthesis.

### *Formulation of the review questions*

The contribution of this paper can be derived by answering the following three questions:

- R1. How can ABC and SCM be integrated conceptually, and what are their characteristics?
- R2. What is the current status of the existing literature on ABC in SCM?
- R3. What are possible areas for future research on ABC in SCM?

The first research question enables practitioners to receive a nuanced view of various supply chain costing tools. In addition, by developing three concepts of ABC application in intra- and inter-organizational environments, academics can improve their understanding of the topic. The second research question is dedicated to the accumulated literature by analyzing the instruments, requirements, results, and possible areas for future work.



**Figure 1.**  
Systematic literature  
review procedure

Therefore, researchers might benefit from an aggregated view of the topic and the identification of existing knowledge gaps from a supply chain perspective. The third research question addresses academics foremost. Based on the state of knowledge, areas for future research are described opening up new possibilities for research in the disciplines of SCM and management accounting.

#### *Locating of research articles*

The approach was applied to minimize bias and to cover a wide range of sources. Therefore, two online databases were used. The main database was Web of Science™ because it is one of the leading research databases worldwide. Further research was conducted in the Business Source® Complete database via the EBSCOhost® research database service. Both databases provide full text access from the publisher which makes the entire research process more efficient. The choice of journals is essential to ensure a high-quality data basis. No limitations on the field of research were applied because the review should refer to a broad area of intersecting topics of SCM and ABC literature. Although a trend toward a higher publication rate of literature in recent years regarding perception and knowledge gaps is evident, the body of knowledge is not yet overwhelming enough to justify a periodical constraint for gaining a manageable list of published articles. Therefore, the relevant period of this review is from 1992 to 2016. As shown in Table I, various research phrases were used.

Management accounting	Relationship	Supply chain management
activity based costing	network	supply chain management
activity-based costing	dyadic	supply chain
activity based-costing	inter-firm	value chain
ABC	intra-firm	sourcing
	collaboration	purchasing
	cooperation	operations
	integrating	production
		manufacturing
		transport
		supply
		logistics

**Table I.**  
Keywords used in the  
literature research

**Note:** Keywords are listed in order of their respective discipline or relationship character

Both authors developed a list of keywords independently. The set of keywords was discussed critically in order to enhance the adequateness of the keywords used. To link the two disciplines, the search operator “AND” was used, ensuring that only articles related to ABC and SCM appeared. Another technical aspect of the research process was the use of the wild card character “\*” at the end of search phrases. Thus, for instance, the keyword “purchas\*” was entered to ensure articles related to both terms “purchasing” and “purchase” would be found.

#### *Selection and evaluation of research articles*

Two researchers were involved in the selection and evaluation process so that no decisive article was missed. The selection process was conducted independently to reduce subjective bias and enhance validity. Overall, 3,725 articles and conference proceedings were found due to a broad range of keywords and different search techniques (see Table II). First, both researchers scanned the journal names and the article titles of 3,725 papers; 3,266 papers were excluded, because the content has no relation to the analyzed topic (e.g. medical paper). Next, the researchers read the abstract and the author keywords to determine the article’s relevance to SCM and ABC; 459 items corresponded to the research questions. To ensure the high quality of this paper, only peer-reviewed papers are included (Denyer and Tranfield, 2009). Therefore, 152 proceedings articles were excluded from the literature review because these documents are not peer-reviewed. In addition, 150 articles are not accessible due to restricted license and access rights, and 68 (42 plus 26) articles are not related to the topics of this literature review (e.g. a paper refers to ABC but does not

Reason for exclusion	Number of exclusions
Articles found based on keywords	3,725
Matching items	459
Proceedings	-152
Restricted or no access	-150
No ABC relation	-42
No supply chain relation	-26
Patents	-2
Total number of articles	87

**Table II.**  
Paper search results

**Note:** The research was conducted in June 2016

involve SCM). Finally, two patents were excluded. Overall, the following literature review is based on 87 peer-reviewed articles over a period of 25 years. All papers correspond to 19 percent of all matching items (459) found in Web of Science™ and EBSCOhost®.

*Classification of research articles and content analysis*

In step 4, both researchers classified the articles simultaneously and autonomously according to the organizing framework by reading the 87 papers in their entirety. Additionally, every article was further tagged with up to 30 distinctive variables (see Table III). Relevant content was then summarized and collected in a Microsoft Excel spreadsheet.

*Synthesis of structured literature review*

The review provides a snapshot of the multifaceted topic of ABC and SCM. Although the ideal review should be thorough, including all relevant scholarly and empirical outlets (Short, 2009), this paper does not pretend to cover the entirety of the literature. As demanded by Rousseau *et al.* (2008), this paper is a systematic accumulation, analysis, and reflective interpretation of the literature that addresses specific research questions. The review represents a holistic view by comprising the essence of the body of literature. The systematic process increases transparency and enhances scientific validity and reliability but does not create a complete picture of ABC and SCM.

Category	Variable description
Author	Authorship
Title	Title of article
Journal	Journal publishing the article
Year of publication	Year when the article was published
Country	The country codes are the three-letter codes defined in ISO 3166-1; it is the intended country of the corresponding main author's affiliation
Journal ranking	The journals are divided into five categories: A+, A, B, C and D according to the VHB-JOURQUAL journal rating ( <a href="http://vhbonline.org/en/service/jourqual/">http://vhbonline.org/en/service/jourqual/</a> ) and quantitative citation analysis ( <i>Journal Citation Report 2015</i> )
Disciplines	Classification of disciplines is based on the <i>Journal Citation Report 2015</i> of the online database InCites™ <i>Journal Citation Reports</i> ® (Thomson Reuters, 2016)
JCI ranking	Calculation of the 2015 Journal Impact Factor = no. of citations to all items published in 2013 and 2014 "divided by" no. of articles and reviews published in 2013 and 2014 (Thomson Reuters, 2016)
Methodology	Methodology types include empirical or conceptual studies (a study was categorized as empirical if a case study was conducted)
Case study	Description of the case study topic and industry
Organizational framework	Classification of the articles according to the organizational framework criteria: specific, generic, intra-firm ABC, SCO-ABC, SCM-ABC
SCOR classification	A firm's activities can be classified in the SCOR model: "PLAN, SOURCE, MAKE, DELIVER and RETURN." If a paper does not address a specific SCOR variable, the paper is considered generic
Cost level	Description on which level the cost objects are measured, e.g. business unit level, batch level, order level, component level, supplier level
Cost driver	Cost drivers addressed by the ABC approach
Instruments	Description of the method, model, or concept of ABC application in various supply chain environments
Requirements	Preconditions for ABC implementation that needs to be given in order to implement ABC
Results	Outcomes of the paper and description of the value added
Future work	Research gaps for future investigations

**Table III.** Categories and variables for classification and content analysis

**Notes:** Overall the articles are described and classified according to 30 variables. This table presents "umbrella terms" only

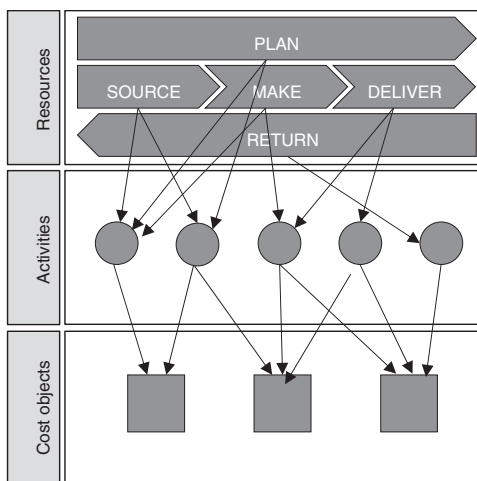
**Conceptual integration of ABC and SCM**

In the following section, the first research question is addressed by clarifying the concepts of ABC and SCM. This presentation provides the basis for the organizing framework that integrates both approaches. Moreover, the conceptual development creates the main classification criteria for the analyzed papers.

*ABC adoption level: specific vs generic*

During the 1980s, product costs experienced a shift from raw materials and direct manufacturing to manufacturing overhead costs (Miller and Vollmann, 1985). Traditional volume-based costing did not give detailed cost driver information, and therefore, decision making was unfocused and more random (Maiga, 2012; Drake and Haka, 2008). This issue was addressed by academics in 1988. Cooper and Kaplan (1988) coined the term “ABC.” Their intention was to give accountants a new instrument to measure costs accurately. Thus, ABC has its historical roots in manufacturing. But, ABC adoption is not only restricted to a production environment. Applications cover additional function levels, such as logistics, sourcing, distribution, research and development (R&D), and marketing. To consider this evolutionary step, the review of these articles is classified as “specific” in terms of the ABC adoption level. This classification can be divided into the Supply Chain Operations Reference (SCOR) model: “PLAN, SOURCE, MAKE, DELIVER and RETURN” (Lockamy and McCormack, 2004).

As shown in Figure 2, the ABC method consists of a two-step procedure. In the first step, resource costs are allocated to activities in order to form activity cost pools (circular shapes). In the second step, the costs are allocated to cost objects (rectangular shapes) by cost drivers (McKenzie, 1999; Thyssen *et al.*, 2006). Tsai *et al.* (2011) state that resource drivers (arrows linking resources with activity cost pools) approximate the resource consumption by activities. Each activity done for a cost object is reflected by a cost driver. Some articles do not necessarily address single company functions but follow a holistic approach without explicitly referring to a specific organizational department or function. For example, when the authors address decision-making processes, a topic typically dealt with at the corporate level, the article is classified as “generic.” The dichotomous designation of articles helps readers to find their respective field of interest.



Source: Adapted from Tsai *et al.* (2011)

**Figure 2.**  
Cost assignment method of ABC

As the final step in the development of ABC, academics focused on inter-organizational cost accounting tools. La Londe and Pohlen (1996) were the first to point out that supply chain costs are not measured explicitly. Traditional accounting systems are function oriented, not process oriented. These systems capture costs at a level of aggregation too high to identify the true costs of products (Themido *et al.*, 2000). General ledger manufacturing cost-oriented systems do not yield precise enough cost results for effective decision making. La Londe and Pohlen (1996) also state there is enormous potential gain in the supply chain, rather than simply focusing within the four walls of the firm itself. They declared traditional cost systems are inadequate and introduced for the first time an inter-organizational perspective to management accounting in the scientific literature[1].

#### *Supply chain view: intra-firm vs inter-organizational ABC*

When Cooper and Kaplan (1988) introduced ABC as a new cost accounting method, they addressed intra-firm issues. To implement ABC, business processes must be mapped to identify the resources and activities involved (e.g. Pirttilä and Hautaniemi, 1995; Cooper and Kaplan, 1988; Ben-Arieh and Qian, 2003; Uskonen and Tenhialä, 2012). To produce a good or to provide a service, several activities performed by various functions or departments are associated with these processes. Therefore, the implementation of ABC implies that the internal supply chain is part of the method. This category is labeled “intra-firm ABC[2].”

When scholars such as La Londe and Pohlen (1996) or Cooper and Slagmulder (2004) suggested expanding the horizon of cost accounting, they introduced an inter-organizational management perspective. Leaving the internal view leads to SCM aspects, whereas ABC operates as a cross-company management accounting tool. This view is depicted by the second category of the supply chain perspective labeled “inter-organizational view.”

To lay the groundwork for SCM, Carter *et al.* (2015) developed six foundational premises of the supply chain; the ones that affect this review will be discussed. The authors define the supply chain as a network, consisting of nodes and links, which is bounded by a fuzzy horizon. By referring to the network, the authors emphasize the chain length which is not just dyadic. It consists of triads as the smallest unit of a network (Mena *et al.*, 2013). A node is defined as an agent that has the ability to make decisions and maximize its own gain within the parameters in which the agent operates (Carter *et al.*, 2015). In this research work, ABC represents the link consisting of information between different decision-making units (agents). To be manageable, the supply chain must be limited. Thus, the supply chain is bounded by the visible horizon of the focal agent whereas the agent is aware of the physical nodes and links (Carter *et al.*, 2015).

Now that the term “supply chain” has been defined, SCM must be specified. Mentzer *et al.* (2001) use a compatible approach of awareness to define SCM. They introduced a dichotomous comprehension of the term: SCO and SCM. SCO is defined “as the recognition by an organization of the systemic, strategic implications of the tactical activities involved in managing the various flows in a supply chain” (p. 11). This means that the firm’s management understands that adopting ABC has upstream and downstream implications. Managers are aware of their role within the supply chain. If a firm sees only the systemic (supply chain) and strategic (coordination) implications in one direction, then the firm does not have SCO. In this paper, firms’ concept of SCO is limited because a considerable number of the articles deal with buyer-supplier dyads. Accordingly, applying ABC within this relationship would not be considered SCO, but neither could it be categorized as “intra-firm ABC.” In addition, dyadic ABC actions do not implicate SCM because it is not coordinated across the supply chain. As these articles have an inter-organizational characteristic but do not intend a holistic perception, they are categorized as “SCO-ABC.”

The last category of analysis is called “SCM-ABC.” Articles labeled SCM-ABC are entirely within the scope of the following SCM definition (Mentzer *et al.*, 2001): “The systemic, strategic

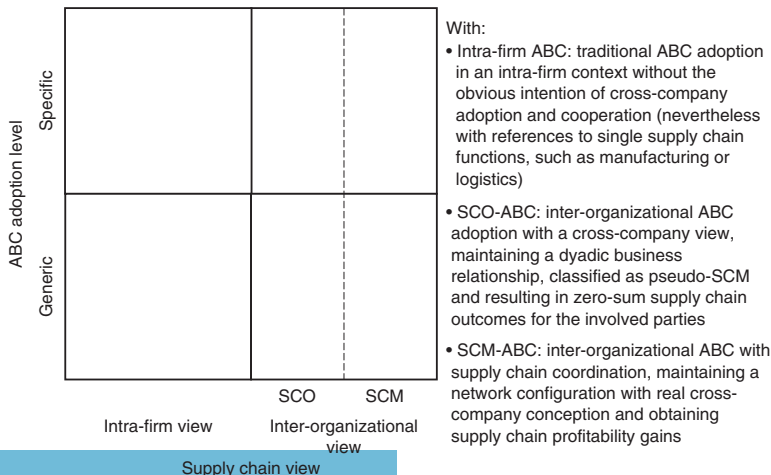


coordination of the traditional business functions and the tactics across these business functions within a particular and across businesses within the supply chain, for the purpose of improving the long-term performance of the individual companies and the supply chain as a whole” (p. 18). With the definitions presented, the conceptual basis for the literature review is prepared. To assign an article to this category, all requirements for SCM must be fulfilled. For example, the implementation of ABC must be adaptable at the supply chain level (network configuration), across different functions, based on a long-term inter-organizational relationship and with the intention of improving the performance of the supply chain (and not only for an individual firm). An ABC adoption leading to a “zero-sum” result would not be considered SCM-ABC. As the supply chain is bounded by a fuzzy horizon, the agent’s awareness of the physical nodes and links determines the supply chain. Additionally, it is important to recognize the supply chain as a relative concept because what an agent sees may depend on particular products or other agents. For that reason, an ABC implementation could be regarded as SCM-ABC in a specific supply chain configuration but would be categorized as SCO-ABC for a different inter-organizational relationship.

*Organizing framework and content analysis*

The identified literature must be classified to determine the state of knowledge regarding ABC adoption in supply chain environments and elaborating research opportunities (step 4 of the research process). The organizing framework integrates the articles into a structured scheme with the concepts above: ABC adoption level and supply chain view (Figure 3). In this way, interrelations between management accounting and SCM from an academic’s and a practitioner’s point of view are identified. Other applied classification schemes lead to a far too fragmented picture without any useful combinations and similarities of the two disciplines.

The y-axis (the ABC adoption level) categorizes the article, whether it can be assigned to a specific corporate function (e.g. manufacturing, logistics, or marketing) or has a generic quality without a precise definition of the ABC adoption level. The x-axis (the supply chain dimension) reveals mainly horizontal aspects, for example, ABC adoption in dyadic (buyer-supplier) relationships or network collaboration. In this way, a systematic categorization of both topics, SCM and ABC, is possible, indicating the similarities and individualities of all the examined research papers.



**Figure 3.** Organizing framework: the supply chain-ABC matrix



Having established a framework for classification purposes, the content aspects of the literature needs to be addressed. Table III shows the variables used in the content analysis.

Based on the variables, the current status of the existing literature, the research gaps, and future research areas can be identified. Thus, *RQ2* and *RQ3* are addressed.

### Findings and discussion

Overall, 87 articles correspond to the criteria (marked in the reference list). Of these articles, 21 address ABC generically, whereas 67 are considered specific and thus, can further be integrated in the SCOR model. In addition, 51 articles are considered intra-firm ABC applications and 36 inter-organizational papers. Of the inter-organizational view, 26 are SCO-ABC related, and ten follow a SCM-ABC view.

Figure 4 was further developed to illustrate the current status of the literature and identify possible future research fields by integrating ABC and SCM conceptually.

This step resulted in a reference framework for managerial recommendations and future work (Figure 5). The brackets next to the labels contain the quantity of articles published in the respective view. The dotted line bars at the supply chain view level are different lengths to express the additive attribute of the content variables. For example, addressing organizational concerns is also a requirement for SCO-ABC and SCM-ABC applications. The ABC adoption level shows three illustrations of the SCOR model. The generic box is added for the sake of completeness, because it is not part of the SCOR model. The SCOR model in the middle located beneath SCO-ABC emphasizes the dyadic relationship often analyzed in these articles. The SCOR model on the right side does not imply a three-echelon supply chain but depicts a section of a network-based supply chain. The content variables briefly summarize the main points. Finally, three managerial recommendations (MR1-3) are deduced based on the content analysis. Additionally, four research gaps were identified leading to relevant areas of future work (FW1-4), which are presented in the future research agenda section.

#### General trends in the literature

Most of the journals are B-rated. This is a consequence of the overrepresentation (35 percent of all articles) of two journals: the *International Journal of Production Economics* and the

ABC adoption level	Specific (67)	46	17	4
	Generic (21)	5	9	6
		Intra-firm view (51)	SCO (26) Interorganizational view (36)	SCM (10)
		Supply chain view		

**Figure 4.**  
The supply chain-ABC matrix presenting the number of analyzed papers

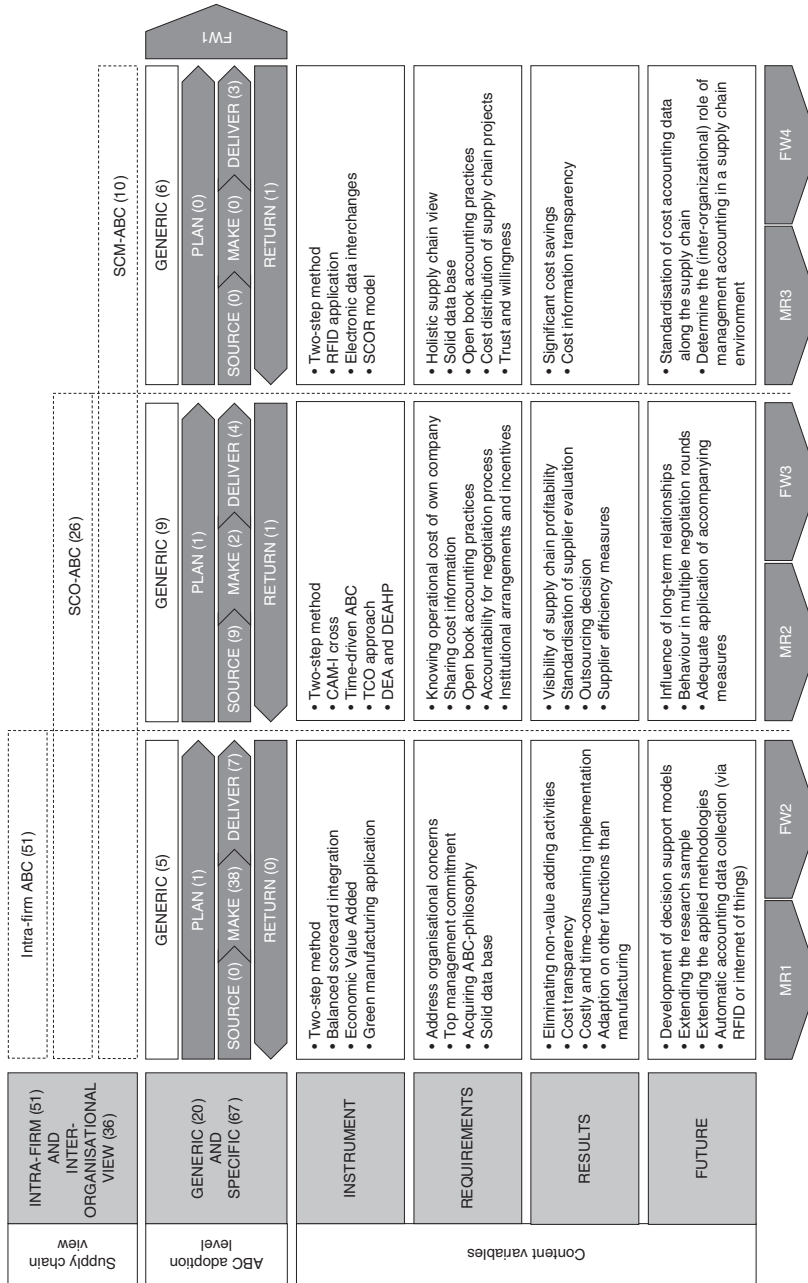


Figure 5. Reference framework for managerial recommendations and future work

*International Journal of Production Research*. Both journals are classified as engineering and industrial in terms of scientific disciplines (see Table IV). Accordingly, most articles (81 percent) are considered MAKE or DELIVER (see Table V), which are typical operational topics. In contrast, only 16 articles are finance related (management accounting is part of the generic term “finance”).

Dekker and Van Goor’s (2000) claim that the role of management accounting in SCM needs to be determined. This statement seems to still hold true today. Furthermore, 61 papers follow an empirical approach, and only 26 are classified as conceptual. One major drawback of empirical articles is that they prove a certain thesis, but the validity is limited due to the restricted scope of the unit of analysis (often case studies). Overall, 51 articles are classified as intra-firm ABC, 26 as SCO-ABC, and only ten as SCM-ABC. Therefore, little scientific work has been done for SCM-ABC.

*Insights and managerial implications of intra-firm ABC applications*

The classification according to the matrix suggests that the intra-firm articles are driven by the manufacturing side and that the outcomes are mostly based on empirical data. Until the turn of the millennium, the motivation for researchers was to provide accurate cost data for decision makers (see Zhuang and Burns, 1992; Pirttilä and Hautaniemi, 1995; Swenson, 1995; Boons, 1998; Van Damme and van der Zon, 1999). Therefore, intra-firm topics were stimulated by an internal demand. The choice of words changed afterward. Ben-Arieh and Qian (2003) emphasized that modern-day manufacturing operations face fierce global competition. To maintain competitiveness, accurate cost data are a crucial factor. Thus, the reason for implementing ABC is an external impulse (for additional examples,

**Table IV.**  
Examined ABC  
articles according to  
the journal disciplines

Discipline	Quantity	%
Engineering	43	28
Industrial	41	27
Business	19	14
Finance	16	11
Management	16	11
Computer science	5	3
Interdisciplinary applications	4	2
Operations research and management science	4	2
Multidisciplinary	2	1
Artificial Intelligence	1	1

**Note:** The classification of disciplines is based the *Journal Citation Report 2015* of the online database InCites™ *Journal Citation Reports*® (Thomson Reuters, 2016)

**Table V.**  
Examined ABC  
articles according to  
the functional  
disciplines (SCOR  
model classification)

SCOR model	Quantity	% of all specific articles
PLAN	2	2
SOURCE	9	10
MAKE	40	46
DELIVER	14	17
RETURN	2	2
Generic	20	23
Total	87	100

**Note:** Generic papers are also included

see Walker and L'abbe Wu, 2000; Thyssen *et al.*, 2006; Baykasoğlu and Kaplanoğlu, 2008; Uskonen and Tenhiälä, 2012). This change allowed ABC to develop further and to expand its areas of application either at or within different levels of aggregation (the company, function, and product levels).

Although manufacturing is the main area of ABC application, some articles are dedicated to R&D (Van Damme and van der Zon, 1999), logistics (Pirttilä and Hautaniemi, 1995; Liberatore and Miller, 1998; Varila *et al.*, 2007; Baykasoğlu and Kaplanoğlu, 2008), distribution channels (Dickinson and Lere, 2003; Shin *et al.*, 2012), or the entire company (Gunasekaran and Singh, 1999). In addition, some papers reveal interesting possibilities for ABC systems. Computer-based simulations simulate various cost scenarios (Spedding and Sun, 1999; Chan and Spedding, 2003). Green manufacturing investments could be justified because ABC incorporates intangible assets (Tsai *et al.*, 2011). ABC can also be linked to balanced scorecard applications (Liberatore and Miller, 1998) or Economic Value Added<sup>®</sup> as a management support tool as suggested by Roztocki and Needy (1999). ABC is applicable for joint products (Tsai, 1996; Tsai *et al.*, 2008). According to Tornberg *et al.* (2002), cost information is rarely available for product designers, but it could be useful in order to guarantee a cost-conscious product design. An adequate product mix can be achieved with fuzzy programming and ABC (Karakas *et al.*, 2010). Cannavacciuolo *et al.* (2012) developed an ABC model based on the analytical hierarchy process that identifies whether a new competence should be acquired internally or in the market. Moreover, Andrade *et al.* (1999) focus on the learning curve and the accompanying cost reductions. The authors found that cost reduction due to task learning is higher when ABC is employed compared to traditional costing. From a technological perspective, ABC and radio frequency identification (RFID) may initiate improvements for cost accounting (Park and Simpson, 2005; Varila *et al.*, 2007; Berling, 2008). Thus, ABC proves its multifaceted applicability. Nevertheless, every process presented can be reduced to the two-step approach (as described in Figure 3). Rezaie *et al.* (2008) advanced the method further by proposing a product cost tree for illustrating the application of ABC in a flexible manufacturing system (FMS). An FMS seems to be a constant subject of ABC solutions (Spedding and Sun, 1999; Koltai *et al.*, 2000; Özbayrak *et al.*, 2004; Dai and Lee, 2012).

Most articles mention that implementing ABC changes the entire company (e.g. Briers and Chua, 2001). Therefore, organizational issues are often stressed (Bharara and Lee, 1996; Gunasekaran and Sarhadi, 1998; Gunasekaran *et al.*, 1999; Vinodh *et al.*, 2009). Additionally, successful implementation seems to also depend on external consultants (Briers and Chua, 2001; Anderson *et al.*, 2002). ABC adaptation in an intra-firm environment is not a defined process with a clear start and end. Instead, ABC is seen as a management philosophy, whereas commitment from senior management is crucial for successful implementation (Gupta and Galloway, 2003; Vinodh *et al.*, 2009). An additional requirement lies in possessing a proper data basis (Varila *et al.*, 2007; Vinodh *et al.*, 2009; Chen *et al.*, 2014).

Having established an ABC-friendly environment, improvements at all levels of aggregation can be achieved. For example, transparent and accurate cost information can lead to the identification of non-value adding activities that help improve the efficiency and effectiveness of an organization (Gunasekaran and Sarhadi, 1998; Lea and Min, 2003; Kirche and Srivastava, 2005). Accurate cost information also leads to significant quality, cycle-time, cost improvement, and inventory reduction (Ittner *et al.*, 2002; Satoglu *et al.*, 2006; Maiga and Jacobs, 2008). On the negative side, ABC appears to be disruptive and can damage an unprepared organization (Bharara and Lee, 1996). ABC is also a costly endeavor and sometimes is inapplicable (Lere, 2001; Vinodh *et al.*, 2009). When direct costs constitute a large percentage of the total product costs (Kirche *et al.*, 2005) or the product diversity is high (Schoute, 2011), the use of ABC may not be justified. Vokurka and Lummus (2001) recommend implementing ABC at high overhead levels or at lower overhead levels but with

a wide product mix. To prevent negative outcomes when implementing ABC, the first managerial implication (MR1) is as follows:

MR1: beyond a certain level of overhead costs, ABC's versatile usability yields to transparent cost information along the supply chain that then improves efficiency and effectiveness. Practitioners need to know that a successful implementation requires a solid data basis, organizational readiness, and commitment from senior management.

#### *Insights and managerial implications of SCO-ABC applications*

In total, 26 of the 87 articles are classified as SCO-ABC. Most (17) involve specific topics, and only four use a conceptual scientific method. Logistics-related articles (DELIVER) are primarily motivated by obtaining accurate supply chain cost information (Pohlen and La Londe, 1994; Themido *et al.*, 2000; Everaert *et al.*, 2008). The Consortium for Advanced Management International (CAM-I) has provided a conceptual basis for the ABC implementation (the so called "CAM-I cross"[3]), which comes with the two-stage process (Themido *et al.*, 2000; Tsai and Hung, 2009a). Nachtmann and Needy (2001) criticize that ABC data are historically based and often estimated and therefore entailing imprecisions. Thus, time-driven ABC claims being easier and faster to install than traditional ABC (Kaplan and Anderson, 2004). Everaert *et al.* (2008) were the first to present time-driven ABC for cost modeling in a supply chain environment. Tsai and Hung (2009a) published one of the two articles that refer to the RETURN dimension. A conceptual foundation for green supply chain costing was laid by Seuring (2001) and was included in and refined for green supply chain optimization by Tsai and Hung (2009b) and Schulze *et al.* (2012).

SCO-ABC is applicable for various dyadic supply chain compositions. Sourcing decisions in particular are based on ABC outcomes (Roodhooft and Konings, 1996; Degraeve and Roodhooft, 1998; Degraeve *et al.*, 2000, 2005; Wouters *et al.*, 2005; Weber *et al.*, 2010; Zhang *et al.*, 2012; Visani *et al.*, 2016). Standardization for supplier evaluation became gradually apparent, in which several hierarchical levels of activities (the supplier, order, component, batch, or unit level) were identified as cost drivers (Degraeve and Roodhooft, 1998; Degraeve *et al.*, 2000, 2005; Hung, 2011) and linked with the total cost of ownership concept (Wouters *et al.*, 2005; Weber *et al.*, 2010; Visani *et al.*, 2016). The next step of the supplier evaluation methods was the introduction of data envelopment analysis and the data envelopment analysis hierarchy process, which combine several supplier evaluation variables with ABC, that provides a broad-based supplier assessment (Zhang *et al.*, 2012; Visani *et al.*, 2016). Moreover, Weber *et al.* (2010) state that low-cost country sourcing is a difficult endeavor for firms and ABC is supportive when it comes to outsourcing decisions regarding such countries. Aside upstream, downstream application of ABC makes the customer relationship more transparent (Niraj *et al.*, 2008). Thus, Stapleton *et al.* (2004) have described the application of ABC for logistics and marketing activities.

The inter-organizational implementation of ABC provides greater visibility of supply chain profitability and accurate cost information and leads to higher profits, as well as win-win situations for supply chain members (Pohlen and La Londe, 1994; Kulmala *et al.*, 2002; Everaert *et al.*, 2008; Anderson and Dekker, 2009; Sheu and Pan, 2009). Thus, knowing the costs of the company's operations and sharing cost information are a prerequisite (Kulmala *et al.*, 2002). This is difficult to realize, as various authors emphasize their concerns about dyadic relationships, for example, the hold-up problem in which the supplier is not willing to invest when the firm suspects that the buyer is unlikely to pay for the supplier's efforts (Drake and Haka, 2008). Another hurdle is the incentive problem, in which the supplier may not perceive the quality benefits (e.g. higher customer profitability due to higher sales price), although it is their obligation to ensure high-quality standards (Hung, 2011). Next, fixed-pie bias represents the perception of negotiators working

collaboratively on a “fixed pie” (or zero-sum game) and therefore, precludes the other party from achieving their goals (Chang *et al.*, 2013). Then, performance disadvantages for less powerful buyers are less pronounced when the buyer possesses detailed ABC cost information compared to powerful buyers who do not seem to profit from cost information (Van den Abbeele *et al.*, 2009). Finally, joint profit in the supply chain can be achieved only when the buyer causes the inefficiency and not if the supplier is accused by the buyer (Masschelein *et al.*, 2012). Countermeasures are institutional arrangements (e.g. public quality information report; Drake and Haka, 2008), economic incentive systems (Hung, 2011), different cost-sharing mechanisms (Jiang *et al.*, 2016), or open book accounting practices (Kulmala *et al.*, 2002; Kajüter and Kulmala, 2005). Moreover, to reduce fixed-pie bias, negotiators are obliged to be responsible not only for the outcome of the bargaining but also for the process (Chang *et al.*, 2013). Contrary to this view, expansive open book accounting and regular surveillance do little to promote trust between organizational actors (Free, 2008). But Windolph and Moeller (2012) stress that open book accounting and regular surveillance represent a potential risk to cooperation. Nevertheless, they are used to manage interdependencies in different inter-organizational settings (Alenius *et al.*, 2015).

From an SCO-ABC perspective, practitioners would be well advised to consider the second recommendation (MR2) as follows:

MR2: to unlock competitive advantages at an inter-organizational level with ABC, decision makers should share cost information along the supply chain via open book accounting practices. Institutional arrangements and economic incentive systems are accompanying approaches to mitigate inter-firm negotiation hazards and other affiliated risks.

#### *Insights and managerial implications of SCM-ABC applications*

Ten of the 87 articles are considered SCM-ABC. As SCM tools are adapted at a different level, a more sophisticated ABC method is expected. Again, this seems not to be the case. The ABC implementation process remains the same two-step process discussed (Dekker and Van Goor, 2000; Goldsby and Closs, 2000; Dekker, 2003; Askarany *et al.*, 2010). Nevertheless, the entire procedure needs to be extended at the supply chain level (La Londe and Pohlen, 1996; Lin *et al.*, 2001). These articles imply normative ideas without providing specific instructions or proving their concepts by conducting a case study. For instance, Shapiro (1999) and Khataie *et al.* (2010) suggest linking the ABC method with mathematical or multi-objective mixed-integer programming. Miragliotta *et al.* (2009) propose to model supply chain processes using RFID. Walton (1996) points out that ABC can be used to evaluate electronic data interchanges in supply chains. Comelli *et al.* (2008) and Schulze *et al.* (2012) propose mapping the supply chain using the SCOR model. First, they suggest configuring the supply chain and second, determining the operating collaboration with ABC. However, their approach is inconsistent. They refer to the “formation of the production network” but include only upstream supplier selection. Nevertheless, of all authors, Schulze *et al.* (2012) provide the most convincing SCM-ABC concept thus far.

La Londe and Pohlen (1996) emphasize sharing cost information. As with intra-firm ABC and SCO-ABC, a solid data basis is imperative. However, a lack of perfect cost data is very common; thus, decision makers should always be aware of poor data quality when making decisions (Lin *et al.*, 2001). This issue is related to the role of management accounting in supply chains. Kulmala *et al.* (2002) emphasize the poor state of management accounting in a supply chain environment. Thus, some papers promote open book accounting (Kulmala *et al.*, 2002; Dekker, 2003; Kajüter and Kulmala, 2005; Schulze *et al.*, 2012) and claim to standardize accounting data (La Londe and Pohlen, 1996; Kulmala *et al.*, 2002; Schulze *et al.*, 2012). As with intra-firm ABC, cost savings are significant due to economies of scale (Goldsby and Closs, 2000), and cost information transparency will be improved (Lin *et al.*, 2001; Comelli *et al.*, 2008; Khataie *et al.*, 2010).



To achieve these improvements, costs and benefits should be distributed symmetrically between supply chain members (Dekker, 2003). A suitable solution is an investment proposal for the focal firm (Dekker, 2003). Furthermore, La Londe and Pohlen (1996) claim that firms must stop focusing within the four walls of the firm itself, shift from a “zero-sum” mentality, and show trust, willingness, integration, and involvement by all relevant partners in the supply chain (Goldsby and Closs, 2000; Lin *et al.*, 2001; Schulze *et al.*, 2012). Therefore, the third managerial recommendation (MR3) is:

MR3: collecting cost information along the supply chain and being aware of poor data quality is crucial for adequate decision making. As a consequence of SCM-ABC, costs and benefits should be distributed among the involved supply chain members appropriately (according to the costs' and benefits' origin and reason). Therefore, managers are required to change their mental image of their – more or less – bounded firm and recognize the accountability of the company in the supply chain.

### Conclusion and future research agenda

This study provides an overview of how ABC has been applied in various intra-firm and inter-organizational contexts. Although several reviews of ABC have been performed, none has analyzed the integration of ABC and SCM. The shift in competition from single firms to supply chains emphasizes the relevance of inter-organizational cost management approaches. To achieve supply chain competitiveness, having accurate cost data is a crucial factor. This paper thus aims at advancing the understanding of various supply chain views to build awareness of the ABC benefits in SCM. Therefore, intra-firm ABC, SCO-ABC, and SCM-ABC were defined. First, traditional ABC demonstrates the effectiveness of this management accounting tool. Then, often disguised as SCM articles, SCO-ABC papers reveal expected improvement in supply chain competitiveness. However, these articles provide the conceptual starting point for further inter-organizational research in this area. Finally, the results of the SCM-ABC articles show a network-based supply chain view, disclosing ABC cost data for supply chain members to achieve goals across company borders.

The analysis of the current body of knowledge leads to three recommendations for practitioners. First, establishing organizational readiness ensures a higher success rate when implementing the ABC two-step method. Therefore, senior management support and an ABC philosophy are necessary. Second, gathering cost information and sharing it via open book accounting practices, as well as simultaneously designing accompanying institutional arrangements or economic incentive systems, is imperative for inter-organizational collaboration. For this reason, relevant accounting data must be available to all the supply chain members involved (Seal *et al.*, 1999). The obstacle of differences in accounting systems and standards must be overcome (McIvor, 2001), and the inter-organizational cost models used in practice should not be too complex (Tomkins, 2001). Finally, to achieve supply chain improvements, cost and benefits must be shared appropriately according to their origin and reason (Cooper and Slagmulder, 2004). Therefore, decision makers must change their mental image of firms in networks.

In addition to the recommendations for practitioners, there are areas of future research.

Our review shows that only 16 articles are finance related (assuming management accounting as part of “finance”). Accordingly, Dekker and Van Goor (2000) claim that the role of management accounting in SCM needs to be determined. This statement seems to still hold true today, especially while widening the perspective to other inter-organizational financial issues, such as joint fixed-assets investments and supply chain finance (Templar *et al.*, 2016). Furthermore, 61 papers follow an empirical approach, and only 26 are classified as conceptual. One major drawback of empirical articles is that they prove a certain working thesis, but the validity is limited due to the restricted scope of the unit of analysis (often case studies).



Overall, 51 articles are classified as intra-firm ABC, 26 as SCO-ABC, and only ten as SCM-ABC. Therefore, little scientific work has been conducted for real SCM-ABC. In conclusion, the current research gaps are the result of an overrepresentation of empirical and operations-related articles in combination with an underrepresentation of management accounting and finance topics in SCM. Thus, the first recommendation for future work (FW1) is as follows:

FW1: academics should lay the theoretical basis for the determination of the role of management accounting in an inter-organizational SCM environment. In addition to ABC and supply chain costing, this should include other relevant financial issues, especially supply chain finance solutions.

For most resources, time drives costs (Varila *et al.*, 2007). Thus, Kaplan and Anderson (2004) emphasize the advantages of time-driven ABC over traditional ABC. Some scientific work with ABC and time variables has been done for operations (Walker and L'abbe Wu, 2000; Berling, 2008). Moreover, automatic data collection with bar codes and RFID technology seem to be still under-recognized IT assets (Smith and Offodile, 2002; Varila *et al.*, 2007; Everaert *et al.*, 2008). But this situation is changing. In addition to the "digitalization" of the supply chain (e.g. the internet of things), the amount and the availability of cost-relevant data will substantially increase. The analysis of this (big) data and its inclusion in ABC approaches will open the door for supply chain improvements, as well as new business opportunities. Therefore, the second area for future work (FW2) refers to technological aspects:

FW2: conceptual and empirical research with information systems (e.g. RFID technology) and automatic data collection (e.g. the internet of things) in conjunction with time-driven ABC applications are relevant areas for future investigations.

SCO-ABC articles often claim to be associated with SCM although they must be classified as SCO because of their dyadic buyer-supplier research subject. The outcomes are often limited due to their single period approach and their experimentally sterile environment (Drake and Haka, 2008; Van den Abbeele *et al.*, 2009; Masschelein *et al.*, 2012; Chang *et al.*, 2013). The authors often suggest tools (e.g. open book accounting, economic incentive systems, or investment proposals) for managing inter-company relationships (Dekker, 2003; Kajüter and Kulmala, 2005; Hung, 2011), although these approaches inherit particular risks (Free, 2008; Windolph and Moeller, 2012). The third area of future work (FW3) largely relates to collaborative aspects:

FW3: the analysis of the impact of inter-organizational management tools on supply chain relationships for multiple negotiation rounds (and long-term relationships) is a promising area for future research at the intersection of management accounting (such as ABC and other cost management approaches) and SCM.

Peer-reviewed SCM-ABC articles are scarce. Only ten papers were considered for this supply chain perspective. The absence of "real" SCM-ABC literature shows that the term "SCM" is often used without stressing inter-organizational issues. Some authors claim that academics and practitioners must apply ABC to the "entire" supply chain (La Londe and Pohlen, 1996; Kulmala *et al.*, 2002; Comelli *et al.*, 2008; Weber *et al.*, 2010; Pettersson and Segerstedt, 2013). This recommendation does not seem pragmatic and could lead to further confusion about the meaning of SCM. A consistent use of the SCM concept could also support determination of the role of management accounting in a supply chain environment. Therefore, some authors suggest standardizing cost accounting data in supply chains (Dekker and Van Goor, 2000; Schulze *et al.*, 2012). Indeed, this would be a milestone for inter-organizational collaboration. The SCOR model and the "CAM-I cross" (Themido *et al.*, 2000) provide a conceptual basis for this challenging endeavor. Some research has been conducted

on this topic based on controlling supply chain costs (Chaoyang and Ying, 2010). However, no generic approach has been presented. Thus, the fourth area for future research (FW4) stresses standardization issues:

FW4: future work could focus on the development of approaches for standardizing and exchanging cost accounting data in supply chains. Therefore, it is essential to incorporate common inter-organizational network aspects to ensure the coherent adoption of affiliated SCM principles within cost management practices such as ABC.

Our review shows that management accounting in supply chains is still at a poor conceptual stage. Therefore, academics and practitioners of the multifaceted management accounting discipline are urged to play a stronger role in the future of SCM. Otherwise, cost accounting in supply chains will continue to struggle and eventually lose its *raison d'être* in inter-organizational settings. Doing so represents a major challenge, because it requires consensus on an interdisciplinary topic. Developing a framework for cross-company cost accounting standardization is a possible starting point. Another relevant implication for future research is the integration of time-driven ABC and real-time information systems (such as RFID technology or the internet of things applications), which automates the SCM-ABC process via the systematic inclusion of timestamps. However, the theoretical foundation for inter-organizational cost management practices must be developed in advance before empirical evidence can be collected. Thus, issues not well covered in the established literature must also be taken into account: the intentional exchange of manipulated data across the members of supply chain (Caglio and Ditillo, 2008; Lamming *et al.*, 2005) and the self-oriented usage of cost information for price negotiations (Hoffjan *et al.*, 2011). Beyond these obstacles, real (time) cost transparency in supply chains can be improved for all participating parties including the (voluntarily or enforced) distribution of costs and benefits between supply chain members. In this spirit, we would like to encourage scholars to conduct more conceptual and empirical studies with special focus on "financial issues" in inter-organizational settings.

### Notes

1. Aside from ABC, La Londe and Pohlen (1996) introduced several approaches to increase the visibility of supply chain costs: direct product profitability, total cost of ownership, and efficient consumer response. Additional inter-organizational costing tools are total landed cost, life cycle costing (Cavinato, 1992; Norman, 1990), zero-based pricing, and cost-based supplier performance evaluation (Ellram, 1995). These approaches are not discussed further in this paper.
2. At this point, it has to be stated that in this paper "pure" ABC adaptations (without links to the supply chain) are not analyzed. Otherwise, this review would be considered an ABC (managerial accounting) literature review. This is not the case. However, to draw further insights into this topic, the intra-firm perspective at the internal supply chain level is also considered. This supplementary division is important to categorize the literature in greater detail and subsequently obtain implications of fruitful insights, especially with respect to inter-organizational aspects.
3. The "CAM-I cross" integrates a business process view reflecting the question "why things cost?" with a cost assignment view reflecting the question "what things cost?" (Themido *et al.*, 2000).

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**Note:** The 87 papers analyzed in the structured literature review are marked by an \*.

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