

# Management control systems in logistics and supply chain management: a literature review

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**Abstract** The purpose of this article is to provide an overview of the literature covering the area of management control systems (MCS) in logistics and supply chain management (SCM). It is motivated by the increasing attention the two fields of MCS and logistics/SCM have lately attained, fueled by an augmenting competitive pressure companies are facing. For logistics and supply chain practitioners to realize the existing potentials, effective MCS are necessary. In order to facilitate future research in the field of MCS, which consequently also benefits practitioners, it is necessary to consolidate the extant literature. To do so and to identify promising avenues for future research is the purpose of this article. We provide a literature overview that covers the main aspects of MCS in context of logistics and SCM by applying content analysis. To account for quality of publication, the analysis is restricted to international top journals. The literature review shows foremost that research into the development and implementation of a holistic MCS for logistics and SCM should be intensified which could be achieved by further case studies as well as survey-based studies. More conceptual work could be necessary to enable a better practical utilization of MCS in logistics and supply chain settings. We reveal a considerable potential

for further research on MCS in logistics and SCM, from which both research and practice alike will profit.

**Keywords** Literature review ·  
Management control systems (MCS) · Logistics ·  
Supply chain management (SCM)

## 1 Introduction

Over the years, the management of logistics and supply chains has turned into a widely discussed topic, both in practice and research. This development was paralleled by the increasing attention the two fields of management control systems (MCS) and logistics/supply chain management (SCM) have lately attained, fueled by an augmenting competitive pressure companies are facing. Additionally, the understanding has grown that well-managed supply chains represent a competitive advantage and are a major lever of overall firm performance [1, 2]. For logistics and supply chain practitioners to realize the existing potentials, effective MCS are necessary to serve as the underlying basis. This is especially true today as companies are facing the aftermath of the 2008/2009 financial and economical crisis.

Yet, the application of state-of-the-art MCS in logistics and SCM still remains partially rudimentary in practice. Often, essential elements of MCS like the detailed and exhaustive consideration of cost issues when designing supply chains [3] or general supply chain orientation of existing MCS are not found in practice [4]. In fact, MCS in logistics and supply chains, in many cases, are reduced to mere operational aspects [5].

Also in research shortcomings can be observed. Logistics and SCM have been studied in depth from a performance perspective [6–11] as well as from a cost

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perspective [12, 13]. Although introduced already in the late 1980s [14] frameworks for the discussion of control in the context of logistics and supply chain are rarely applied. The control process often remains an unspecific adaptation of general MCS research which does not address any specific characteristics with regard to the management of logistics and supply chains. This is not satisfying as theory and practice demand for techniques and practices adapted to supply chain needs [15, 16]. Further, the intersection of MCS and logistics and SCM often seems to be unclear. It is characterized by a large degree of heterogeneity and decoupled theoretical view [6].

In order to facilitate future research in the field of MCS, which consequently benefits practitioners, it is necessary to consolidate the extant literature. To do so and to identify promising avenues for future research is the aim of this article.

The article is organized as follows. First, fundamental definitions for this paper are presented. Afterward, relevant literature is identified and the framework used is described. Thereafter, the literature is classified and reviewed. The manuscript closes with a discussion of the implications and directions for further research.

## 2 Conceptual basis

Regarding MCS and logistics/SCM, no commonly agreed upon definition exists. Moreover, for both areas of interest a wide variety of different schools of thought can be identified. Thus, before conducting the literature review, we will sketch the understanding of these terms which is applied in the following.

Some scholars have a very broad view of MCS that includes nearly the entire organization of a company (e.g., [17]). As these approaches include virtually everything that can be termed “management”, we chose to apply a more narrow understanding which is well expressed in Simons’ widely agreed [18–22] definition of MCS:

“Management Control System are the formal, information-based routines and procedures managers use to maintain or alter patterns in organizational activities” ([23], p. 5).

These routines and procedures have the character of controls, which have been named and categorized by scholars in different ways. Merchant/van der Stede, for example, differentiates action controls, results controls and personnel/cultural controls [24], whereas Simons refers to diagnostic controls, interactive controls, and boundary and belief systems [23].

Logistics (and logistics management) is here understood according to the definition of the Council of SCM

Professionals, which particularly highlights the aspects of coordination and integration, as also illuminated by a number of authors [4, 25–28]. Logistics is seen as

“that part of Supply Chain Management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customer requirements” [29].

For the definition of the terminus SCM, we follow the proposition of Mentzer, DeWitt et. al., who define SCM as

“the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole” [2].

Following this definition, a supply chain is seen as an entity with a certain degree of integration inside a particular company and among several companies (thus, according to Min/Mentzer extending functional integration to all firms involved in the respective supply chain [30]). As will be further elaborated in the course of the literature review, this extension makes the issues of controllability that can already be observed in classical intra-firm settings even more severe [31, 32].

## 3 Methodology

To consolidate the existing knowledge on MCS in logistics and supply chains we review the extant literature by applying content analysis. Content analysis is a well-accepted method used by numerous scholars (e.g., [33–36]). It aims at a reliable, objective, systematic as well as quantitative study of existing publications [33, 37] and allows for the investigation of implicit assumptions as well as explicit statements of texts [33]. Thus, it represents a promising method for reviewing literature [38]. In order to conduct a content analysis, two steps are required: sampling and categorization [34].

Sampling means that in an initial step articles which contribute to the domain of MCS in logistics and SCM have to be identified. Given the diversity of available publications, this search has to be directed by setting appropriate limits. These limits were operationalized through the following steps: first, only literature in English language and published in academic journals was considered, while dissertations, textbooks, and conference papers were excluded. To account for quality of publication the

analyses focus on international top journals. Selection in the field of management accounting was done by choosing the top five journals [39]. These include *The Accounting Review* (TAR), *Journal of Accounting Research* (JAR), *Accounting, Organizations and Society* (AOS), *Management Science* and *Journal of Business*. The two journals solely focusing on finance and financial accounting (*Journal of Finance*, *Journal of Financial & Quantitative Analysis*) were excluded. For the domain of logistics/SCM, also the top five international journals were included [40]: *Journal of Business Logistics* (JBL), *International Journal of Physical Distribution and Logistics Management* (IJPDLM), *International Journal of Logistics Management* (IJLM), *Journal of Operations Management* (JOM), and *Transportation Journal* (TJ). Concerning their year of publication, a timeframe from 1988 until 2008 was covered, which represents a timeframe we consider adequate because it both captures a large proportion of the development of SCM [2] and MCS while still being connected to current research.

Second, analyzed literature was limited to the area of MCS in logistics and SCM by keyword definition. To ensure the reference to logistics or SCM the keyword search always included one of the three words “logistics”, “supply chain”, and “supplier”. In addition, the titles, abstracts and author supplied keywords also had to contain one of the following phrases to belong to the domain of MCS: “strategy implementation”, “plan implementation”, “strategic planning”, “target setting”, “management control”, “managerial control”, “accounting”, “performance management”, “performance measurement”, “cost management”, “cost control”, “behavioral control”, “cultural control”, “informal control”, “task control”, “control system”, “budget”, “reward”, “incentive”, “compensation”, “metrics”.

Our search resulted in a total number of 101 articles in the selected ten journals. The majority of these stem from the logistics and SCM journals. Within this group of journal almost all articles were published in the two

journals IJPDLM and JBL with a total number of 64 articles (Fig. 1). Within the management accounting journals we see a similar pattern, where almost all articles were published in only two journals: AOS and *Management Science*, which provide a total of 23 articles. All the other journals only provide a very limited number of contributions (*Journal of Business* without a single article, *Journal of Operations Management*, *The Accounting Review*, *Transportation Journal* and *Journal of Accounting Research* with between two and four articles each over the 20-year period).

Considering *Management Science* not to be a pure management accounting journal, but with an equal focus on operations and SCM, the distribution of articles gives the impression that MCS in logistics and supply chains is mainly a topic of supply-chain oriented journals.

Regarding occurrence of articles only a slight increase in number of articles can be observed from 1988 to 2008 (please note that the last bar only refers to 1 year, while the other bars refer to a 2-year span) (Fig. 2). This might be seen as an indicator for a slight increase in attention over the course of time. However, the total amount of articles is still low, when considering that every journal provides less than one relevant article per year on average.

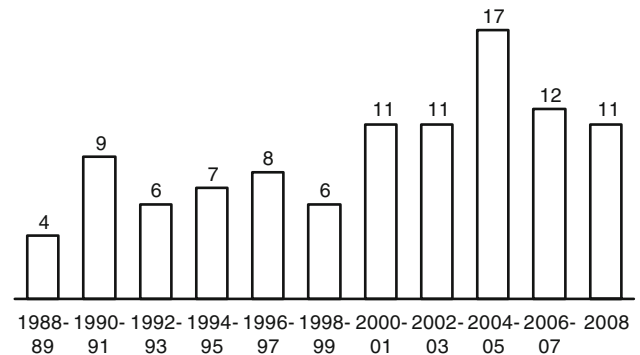
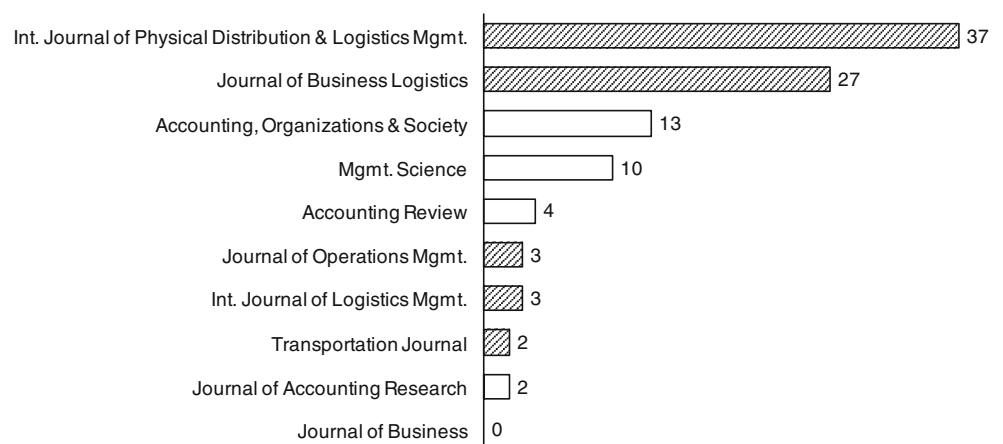


Fig. 2 Distribution of relevant articles over time

Fig. 1 Distribution of reviewed articles across the journals (shaded logistics/SCM journals)



### 3.1 Framework

In order to categorize the articles and their content, an appropriate framework is necessary. As the focus of our study is on MCS in a certain area of application, the framework has to consider a management accounting and control perspective. A well-established framework [41, 42] that fulfills this requirement to be used for the purpose of this review was developed by Otley [18]. Its character is rather descriptive than normative [43], and aims at providing a holistic view about the existing practices in the field of management accounting and control systems.

The framework provided by Otley addresses five key areas of management: (1) definition and evaluation of key organizational objectives, (2) process of strategy implementation, (3) target setting as well as performance measurement, (4) rewards and incentive structure used, and (5) flow of information.

Using a contingency theory approach, Otley deduces the general objectives of the company at the top level as his first area. These objectives form the foundation for the company-specific MCS and are subsequently translated into strategies, followed by an implementation process in the subdivisions. This connection of objectives and strategy is examined in the second area. It links the company level with a more operational level. The third part focuses on effectiveness and efficiency. It aims to describe and analyze techniques of goal setting and goal attainment, performance measurement as well as behavioral aspects. Bearing these performance targets in mind, the fourth question deals with both incentives and rewards to achieve defined targets. It considers not only financial rewards but also intangible factors. Information flow, as fifth area, refers to feed-back and feed-forward information. It enables ex-ante preventive action, ex-post corrective action, and learning.

Within the literature review the focus will be on the last four areas of MCS. This is due to the fact that the formulation of a dedicated logistics and supply chain strategy is commonly considered as a part of the overall company

strategy [44, 45]. This means that the formulation of logistics and supply chain objectives is not a specific application of MCS in the special field of logistics and SCM, but rather part of the general MCS. Thus, the review of the extant literature will start with the examination of the process of strategy implementation. In the next step, we will review the literature regarding performance management in logistics and supply chain, and consider target setting and behavioral aspects. The subsequent step is the topic of rewards and incentives. Finally, we consider the aspect of information flows including information processing.

## 4 Findings

### 4.1 Literature classification

Prior to analyzing the content of the articles, this section gives an overview regarding the methodologies and approaches used. This is done based upon the suggestion of Sachan/Datta by differentiating the research design into a quantitative (e.g., construct validity tests, math models) and a qualitative (e.g., case study, action research) design [11]. Further, the articles are distinguished into empirical (survey based) and desk research (e.g., conceptual).

Based on these two dimensions, four main types of article design can be identified: empirical quantitative, empirical qualitative, desk quantitative, and desk qualitative. Articles may also apply a multi-method approach by combining more than one of the four main types. This, for example, is the case when a survey is accompanied by case-study interviews to gain in-depth insights into the quantitative results (for an overview of the usage of case studies in logistics research, see [46]).

Remarkable differences between the two selected groups of journals can be observed. As displayed in Fig. 3, the articles from the management accounting journals mainly focus on desk research with emphasis on quantitative methods, while the articles in the logistics and supply chain journals are almost evenly distributed among quantitative

**Fig. 3** Use of research methods for accounting and logistics journals

		Articles from accounting journals		Articles from logistics journals	
		Qualitative	Quantitative	Qualitative	Quantitative
Method	Empirical	24%	9%	22%	36%
	Desk	21%	46%	31%	11%

and qualitative work, with an emphasis on qualitative desk work and quantitative empirical work.

Within the group of management accounting, the two main contributing journals AOS and *Management Science* show very different styles. While most of the articles in *Management Science* are desk quantitative and use mathematical modeling, articles in AOS are more empirically oriented and often utilize qualitative case-based research. The two main contributing journals in the field of logistics and SCM, JBL and IJPDLM, are quite similar with respect to the employed research designs. The main difference is that IJPDLM employs slightly more empirical qualitative research based on case studies, whereas JBL presents a little more quantitative empirical work.

When analyzing the selected articles more deeply, almost an even distribution across the main methods (survey, simulation/experiment, interviews, math modeling, case study, pure conceptual modeling or other, e.g., literature review [11]) can be observed (see Fig. 4). Exceptions from this are simulations, which are employed relatively seldom only, and surveys, which are used more often than other methods.

## 4.2 Categorization

After having performed the literature classification, namely the assessment of different research types used, the next step was literature categorization. It is based on Otley's framework as described earlier [18].

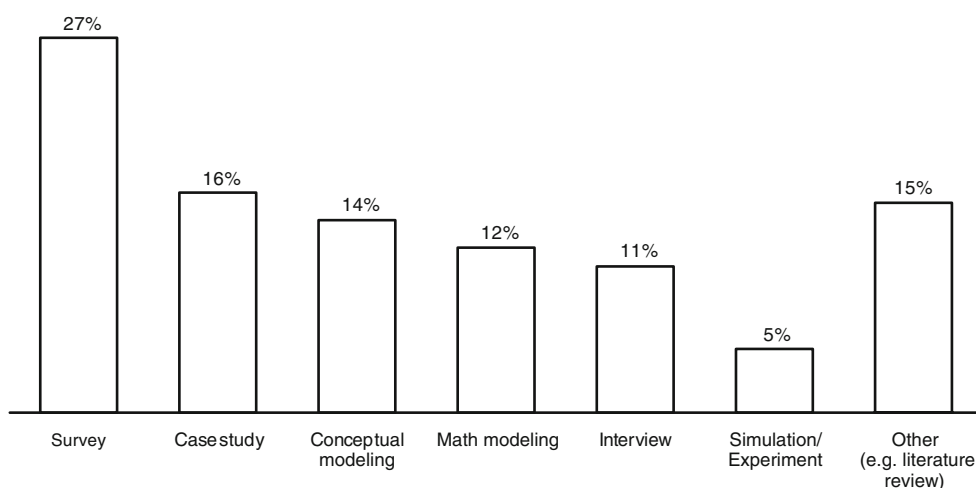
### 4.2.1 Strategy implementation

Any system that is controlled requires objectives against which it can be assessed. Without a proper logistics and supply chain strategy, or even an imperfect definition or

missing implementation of a logistics and supply chain strategy, logistics decisions are often taken with inadequate information, solely based on intuition [47]. For this reason, the selection and deduction of logistics and supply chain strategies have been discussed for several decades, and is well covered in the academic literature [1, 2, 25, 48–50]. In contrast to a mere “top-down” definition, research on the actual implementation of these functional strategies is rare. This is problematic, as deducting or selecting a strategy does not equate to a completed implementation.

In practice, terminology and benefits derived from definition and implementation of strategy in logistics and supply chain contexts seem not to be completely clear. For example, Novack speaks of standards being synonymous to general objectives the organization tries to attain [14]. This lack of an agreed definition of strategy in general and logistics and supply chain strategy specifically can lead to a certain degree of disappointment, which can be observed when it comes to translating strategy into action and deducing corresponding plans [51].

However, there are also several cases, where in practice, a development toward supply chain strategies (so called “functional strategies”) can be observed, which are well defined [44] and implemented. The observations made can be interpreted as the result of the intention to increase logistical performance through appropriate supply chain strategies [45] and, in conjunction with other functional strategies, also enhance overall firm performance [52, 53]. The implementation and transfer of a (howsoever formulated) strategy into operation is answered in several different ways in literature. Morash illuminates how an overall business strategy (or “competitive strategy” [54]) and the corresponding specific supply chain strategy may be transformed into defined supply chain capabilities and an increased supply chain performance [45].



**Fig. 4** Use of research methods aggregated



The actual degree of implementation of logistics and supply chain strategy has been shown to depend especially on the stage of logistics development [53, 55], which may range from mere “distribution logistics” over “integrated logistics” to “logistics and supply chain management” representing strategic capabilities of the overall firm. According to Kent and Flint [56], several distinct levels of development can be observed (these include logistics as a pure transportation function, the beginning inclusion of inter-firm information flows as well as integrated and strategic applications of logistics on advanced levels).

Many authors state the importance of sequential capability building and logistics development. Whenever certain stages or levels have not been fully operationalized, the subsequent development stages will suffer from a disconnection of strategy and measurements [31].

Within a certain organization, operative budgets can be seen as the simplest way to transform a logistics and supply chain strategy into practice. According to Novack [14], budgets are the instrument most easily recognized as well as analyzed from a research perspective within this domain. They are acknowledged as being a tool that helps to communicate plans and to coordinate a company’s activities. Even simple budgets can cover total cost aspects of logistics [57, 58] (and supply chains, when broadened to inter-organizational settings). Strategy, thus, becomes translated into action by planning, monitoring, and reporting. At the same time, it forms an important prerequisite for rewarding and incentivizing employees. The planning activities also include related areas like forecasting and estimation [9, 51].

The field of logistics and SCM to a large degree involves joint and common costs. Therefore, in practice, it can in most cases only be insufficiently addressed by standard costing systems [47].

A broader approach for practice is consequently proposed by Novack/Dunn, who introduce the concept of ‘Logistics Optimizing’ and ‘Operational Plans and Systems (Loops)’, which implies a broader view that tries to address specific characteristics of logistics and supply chains [44]. The tool aims to facilitate the communication and interaction between corporate planners and logistics planners and thus contributes to the company’s strategy implementation. Accordingly, strategy implementation via operational plans and systems loops follows a stringent practice-oriented pattern: a six-step logic is applied. Step one and two consider the actual formulation of the logistics strategy, step three analyzes the capabilities of the company with regards to logistics and supply chains, step four elaborates on necessary efforts to further increase performance, and steps five and six establish actual performance goals. This approach may serve as a general method to analyze own strengths and weaknesses as well as external factors that influence the logistics performance of the company.

Across organizations, the topic of coordination between companies as a strategic enabler has been one of the central issues for research [59]. The simplest form to implement a strategy in this context is via market- and cooperation-mechanisms. In this respect, a large amount of research focuses on pricing and contracting as primary source of coordination and thus neglects the explicit need for MCS [59]. The corresponding articles not only deny the need for explicit coordination mechanisms, but also the logistics and supply chain strategies need to be translated into action through means and measures.

Additionally, the links and interfaces have to be considered when analyzing and preparing strategy implementation. Free [60] (as one of the few scholars published in AOS that deals with supply chains) focuses on MCS specifically with respect to inter-organizational aspects. Such aspects inevitably arise with, for example, logistics outsourcing [61] or generally within supply chains and are addressed by different authors [53, 60]. The literature shows that the general idea of trust in this context has a severe impact in supply chains [62, 63]. The concept of trust (see [64] for an overview) represents an emerging body of accounting research. This assertion is supported by the fact that a number of areas exist in which logistics and supply chains are not a mere field of application of MCS but are directly involved in the progress of MCS research [65–67].

Some authors derive the need for special MCS in logistics and supply chain contexts from observations they were able to make in companies, especially regarding existing interdependencies. Dechow and Mouritsen [68] describe the large interdependencies of logistics and accounting in context of enterprise resource planning systems. This comparatively recent article also shows that theoretically well-settled ideas of MCS have diffused into logistics and SCM research, but not to the same extent into logistics and SCM practice. In practice, focus is mostly on issues of cost accounting, described by a number of authors with more or less specific techniques for cost accounting in logistics and supply chains [12, 69]. However, this does not imply that no need for the specific design of MCS exists. In fact, extraordinary efforts into MCS can be translated into obvious competitive advantages and visible success [70].

#### 4.2.2 Target setting and performance measurement

Having described the process of (high level) strategy implementation, the next step in both analyzing and establishing a coherent MCS in logistics and supply chains consists of appropriate target setting and subsequent performance measurement. The literature agrees on the importance of both [10, 30, 71, 72].

Target setting and performance measurement may be seen as part of a “logistics performance audit” [51].

It includes first identifying the performance measures to be used and the service levels to be met and afterward comparing the degree to which the targets were met. This part of MCS is the logical consequence of strategy implementation.

Several studies point out how difficult it is to measure logistics performance [6, 14, 47]. This particularly affects and complicates the definition of accurate standards and targets [14]. This difficulty is not caused by a lack of theoretical considerations.

In practice, performance is ensured with the help of systems for performance measurement [5, 73], and within these measurement systems, both financial and non-financial measures are applied [7]. Forslund [74] states “high performance logistics require the discipline of measurements”. Especially, because goals positively reinforce employees and can help to motivate them [14]. To ensure this, performance measurement should incorporate at least three aspects: (1) the systematic collection of data, (2) consistency in reporting, and (3) consistency in interpretation [75].

The literature offers different, competing classifications for performance measures. Kleinsorge et al. [75] differentiate between the evaluation of quality and the evaluation of operational efficiency, dividing both domains further into investment-oriented, transaction-oriented, and relationship-oriented measures. They further highlight the last two types of measures to be comparably difficult to collect and report. Since, this classification has been widened from a non-logistics context which differentiates market-based, hierarchical, and alternative controls (see e.g., [62, 76, 77], for a comparative view or [78] for the differentiation between coordination via price mechanisms and coordination that incorporates non-price mechanisms).

Another research stream classifies performance indicators with regard to their perceived practical usefulness. Depending on the author different foci can be observed. Whereas several authors recommend the use of very practical variables including lead time, percentage of on-time delivery or inventory availability [45, 51, 74], others include broader meta-valuation (e.g., overall supplier performance, consistency of quality) [51, 79] or “value-based” ones [80].

Theoretically, these “value-based” considerations directly link to the approach of total cost of ownership, which is not completely well established in logistics and supply chain [81, 82]. The advantage of total cost of ownership considerations is that these concepts cover the overall value chain and thereby all steps, starting from a potential supplier selection up to an ongoing management of logistics activities and helps to cover aspects including general performance measurement as well as target setting [81].

In practice, this manifests itself in an arbitrary situation: although a general overview with regard to commonly used performance measures exists (e.g., [72]) companies often refrain from an extended usage. In many cases, companies restrain on traditional performance measures (i.e., non-cash oriented and non-value oriented ones) with a focus on minimizing direct costs [73]. Therefore, performance evaluation is often done by applying classical measures only. This is particularly severe as, e.g., Cavinato [83] shows: information needs are much higher than the data provided by classical budgetary systems. This is problematic as Mentzer and Konrad [84] mention the importance of accurate data as a basis for an efficient performance measurement. The literature only offers little advice how these information needs should best be fulfilled as the corresponding articles often are either very broad or very technically and narrowly defined (for example, Kleinsorge et al. [47] and Clarke Gourdin [85] with the example of (fractional) linear programming techniques or Novack [14] explaining statistical process control).

Coherently, not only inside the single company, but also across several companies and along the supply chain, a lack of implementation can be observed. Empirically seen, here many of the elaborated measurement techniques developed in the literature lack practical relevance—so far only few successful applications can be found in practice [81]. Instead, companies most often apply tools and measures known from classical managerial accounting (e.g., matrices with individual weights for different involved factors, see [75]).

For example, qualitative measures and targets are rarely used. Often, cost efficiency is the primary driver of measures and target setting [75]. Especially in early stages of the logistics and supply chain evolution the focus of measurement is often placed on production and transportation costs, and not on capturing the whole scope of activities and an exhaustive fulfillment of the strategy [55]. One reason for this can be seen in the fact that financial data is easy to report [10, 75] and comparable across different companies.

These empirical observations come along with the phenomenon of aggregating measures too much [47]. By doing so, companies neglect internal impacts of individual decisions within the supply chain system.

A further problem when considering inter-company settings stems from the fact that different understandings of the term performance prevail [6, 79]. Further, logistics often involve inter-firm relationships, which creates various problems [62], starting with different companies within a relationship having a different idea of what constitutes logistics performance [47] and ending with conflicting views about how high-specific targets should be set [74].

As stated, research about performance evaluation and target setting with regard to broader aspects of MCS is rarely found. Literature only in a limited number of articles deals with aspects of logistics dyads covering both parties involved in the relationship. There are few exceptions, showing the application of agency theory [86, 87], collaborative network theory [88] or transaction cost and resource-based theory [89] for example. This is especially problematic, because performance measurement systems for logistics and supply chains become incomplete whenever strategic performance measures are disaggregated into several performance dimensions, organizational units, and different periods of time without a proper reflection [90].

In practice, this issue is not solved either: the practical implementation of targets and measures often lacks appropriate foundation. This seems to be somehow contradictory, as supply chains can be seen as systems that are influenced by the threat of instability and contradictory norms [91]. This per se calls for effective MCS.

Mentzer and Konrad (see [84], p. 39) state that performance measures have to “be consistent with the management reward system” in order to be effective—a practical suggestion that links to the Sect. 4.2.3.

#### 4.2.3 Rewards and incentives

Target setting and performance measurement are connected with the implementation of an adequate incentive system. This connection is observable for example in the research of Simatupang and Sridharan [92], who show that decision synchronization in connection with incentive alignment leads to an improvement in fulfillment performance. In contrast to this view of incentive alignment as a means to achieve performance, Lee and Whang [93] regard performance measurement as a means for incentive alignment. These different views show the interacting relationship of both incentives and performance measurement.

Rewards and incentives not only refer to financial aspects but also include intangible factors as reputation or appreciation [18] of employees. Yet, this is not reflected in the literature on rewards and incentives. Only one article [94] exists that covers logistics- and employee-centered aspects. The empirical results indicate that non-financial factors (socialization opportunities and sense of community) have a stronger impact on employee turnover than financial rewards have [94].

A significant number of articles cover coordination-related aspects in inter-company settings. The emphasis on this field can be explained by the importance the availability of information has in enhancing supply chain performance [95] and consequently by the necessity to provide adequate incentives for sharing information [96]. Commonly, in this research stream mathematical modeling is

applied and a game-theoretical view used. One important practical topic is the aspect of confidentiality and incentives for them [97] as well as the type of contract and the included incentives for information sharing [98].

Li [99] especially examines incentives to companies for information sharing in vertical relationships. In contrast to this, Lee and Whang [93] refer to decentralized supply chains in focusing on the misalignment of incentives and the development of a performance measurement scheme to avoid this misalignment in order to achieve overall supply chain efficiency. For this they recommend transfer pricing, consignment costs, penalties, and shortage reimbursement [93]. Further, incentive problems are discussed that arise in buyer–supplier relationships based on incomplete contracts. Possible solutions to these problems are seen in trust enhancement, through contract design, asset ownership or organizational effects (e.g., number of suppliers and monitoring [96]).

Rewards and incentives is the only part of Otley’s framework where a commensurable proportion of research from new institutional economics can be observed. Dekker [63], for example, addresses opportunistic behavior and how this may be avoided. He proposes a financial incentive system, based on a mutual fund for necessary investments, with the aim to align the partners’ objectives with the alliance’s goals. Further, benefit sharing may also be used as an incentive tool [63]. Simatupang and Sridharan [92] regard incentive alignment as a central aspect of collaboration and use it as one of three factors to measure supply chain collaboration. For them “incentive alignment refers to the degree to which chain members share costs, risks, and benefits” ([92], p. 46). Within incentive alignment they focus on financial rewards and only integrate one non-financial factor, i.e., delivery guarantee.

Another stream of research is based on agency theory—sometimes described as economic theory of incentives [100]—in the context of supply transactions. Apart from incentive contracts, objective performance measurement, formal (ex ante) contracts, subjective assessment, and relational contracts can also be used as incentives. Gibbons [100] highlights that also career concerns, i.e., belief of the worker’s abilities based on observable performance and by this future compensation, as well as the promise of promotion and future supplier value form possible incentives. Another agency-theory based article addresses incentive contracting like those based on game-theory. It is shown that product architecture decisions and the occurrence of product failure are connected with incentive efficiency [101].

There is a strong connection between incentive systems on the one hand and information flow and information sharing on the other hand (as documented especially in several articles published in *Management Science*).



It can be concluded, that the existing literature mainly considers financial incentives as a means of coordination and goal alignment, while non-financial incentives rarely are researched. This may be attributed to a problem already faced for performance measurement and target setting: the general difficulty in modeling and measuring soft factors as opposed to hard monetary incentives. Logistic-specific questions are addressed only to a minor degree; often an application of incentive considerations from other areas is done more or less without reflection [94]. Most articles research buyer–supplier and other supply chain relationships. Possible reasons for this may lie in the fact that incentive misalignment causes greater problems in inter-organizational settings than internally and that the need for coordination often is higher between companies than within [26].

#### 4.2.4 Information flows

Information flows can be seen as the overarching basis of MCS. This is also reflected in the large number of articles which can be found in the academic literature in logistics and SCM. Almost half of the articles finally considered deal with information and its flow, which is a clear indication for the importance of this area of MCS.

Within the logistics journals, several research streams can be identified. They consider design and implementation of information systems in general, their connection with the organizational or supply chain structure, and the effect on coordination and cooperation including performance measurement.

Novack [14] states that information plays a major role for effective control, and emphasizes the importance of current and adequately detailed data for decision-making and control. The basis for an efficient information flow lies in the implementation of information technology and information systems.

The information needs mentioned by Novack as the justification and motivation for research on information flows are addressed by a number of other authors as well. Tomkins [65] examines differences in information requirements that depend on the type of alliance or network the parties are engaged in and shows that the extent to which information is needed is determined by trust: the more the relationship is based on trust, the less formal information processing is necessary. However, contrary ideas exist in research. Dekker [63] categorizes information sharing explicitly as a form of formal control. He, therefore, sees information sharing and transparency as an essential basis for trusting relationships. In dyadic relationships, information precision and reliability are relevant for the implementation of vendor managed inventory and for enhancing supply chain profitability [102]. With regard

to organizational design and control in inter-organizational relationships, on the one hand informal meetings and communication, on the other hand formal information processing, e.g., shared forecasting, are relevant to achieve coordination and enhance value.

As information flows represent the overarching basis for effective and efficient MCS in logistics and supply chains, many of the reviewed *Management Science* articles not only cover the topic of incentives (as highlighted in the previous section), but also information aspects and refer to the effects that follow from information sharing [95, 97–99]. Li [99] points out that information sharing should not be considered isolated, because for example the reaction of other firms (e.g., competitors) has to be examined at the same time. Other authors in contrast refer to the concept of decentralized information to avoid the problems connected with information sharing (e.g., inventory levels, coordination problems, and hidden information) [93]. Additionally, information flow in connection with the operating policies of demand monitoring and ordering is considered to achieve cost reduction and higher efficiency through improved information utilization [103].

Formalized information flows are often supported by IT systems. This fact is considered by a number of authors. These systems and their capabilities as well as special information tools (e.g., electronic data interchange, EDI) are a first area of research. Information systems and current and comprehensive information are seen as a means for effective coordination, within a company as well as along the supply chain [31, 83, 104–107].

Within this research stream, the use of EDI is often discussed. EDI is seen as a tool to facilitate data sharing across company boundaries [104]. Furthermore, EDI is seen as an enabler for value-adding partnerships and the coordination of inter-organizational processes, and by this as an essential for high logistics performance [108].

For just-in-time (JIT) manufacturers, reliable and up-to-date data is very important. Here, EDI is seen as a possibility for efficient information handling. Empirical data indicates that “JIT firms realize more benefits using EDI than non-JIT firms” ([109], p. 31). Overall, customer satisfaction is enhanced by improved communication and integrated use of information technologies based on EDI. In connection with strategic supply chain planning the use and design of decision support systems (DSS) is discussed. Koutsoukis et al. [110] highlight how the process from data generation to knowledge creation is integrated into a DSS.

Information is considered in several ways. First, with regard to forecasting and the hardware and software used, furthermore the information flow connected to order processing [51].

Also warehouse and distribution information systems are seen as relevant [14]. In this context, the kind of

warehouse information systems used (standard vs. tailor-made) and the relationship of warehouse complexity with the planning and control structure is researched [111]. Especially software and non-financial informational control are said to be important [112]. Additionally, forecasting processes and systems are dependent on the information technology used [113, 114].

This research stream also makes reference to the implementation of boundary-spanning collaborative planning, forecasting and replenishment systems, data generation, and by this, the need for software usage [113]. Moreover, information and communication technologies are regarded as a success factor for an efficient SCM [115].

In this context, establishing communication channels, as well as web-based IT tools, decision support systems, and the security of information transmission are relevant. However, practical implementation of enterprise resource planning systems cannot be found very often, whereas simple, non-integrated forms of communication like emails and faxes are commonly used. Standard databases, uniform coding schemes, and order placements, for example, are similarly seldom used, even though these technologies would provide the possibility to coordinate and align operations across the supply chain. Especially in context of reverse logistics, the necessity of information systems support is stated, but is found to be not sufficient and has to be linked with behavioral aspects [116].

Baiman and Rajan [96] point out that the accounting information systems represent only one of several inter-organizational design instruments, which are influenced by various contingency factors. Integrative information, i.e., information on cause–effect linkages within the supply chain, is essential for strategic performance measurement systems. Furthermore, it is highlighted that these systems form the basis for learning which is linked with strategic outcome [19].

This leads to the next important research stream which considers links and interfaces (especially in an inter-organizational setting); efficient SCM and coordination of partners is not possible without adequate information. There is a certain focus on special technologies or settings observable, for example, logistics coordination, and the usage of EDI [108], or information sharing in vendor-managed inventory with special focus on the problem of information availability and reliability is researched [117, 118]. Spekman et al. [119] see the information flow as a basis of interaction, along with Germain Iyer [107], who refer to information systems as a basic enabler for integration and additionally highlight the importance of behavioral aspects.

Information exchange between supply chain partners not only has a positive effect on time efficiency and demand transparency (both together referred to as “responsiveness”)

when implemented well, but it is a clear hindrance and influences performance negatively when missing [120]. An improvement in information exchange leads to a higher responsiveness. As aforementioned, Simatupang and Sridharan [92] develop an instrument for supply chain collaboration measurement, of which information sharing is one of three parts. While inventory and fulfillment are strongly affected by information sharing in a positive way, responsiveness is only improved slightly.

With regards to performance, a high level of commitment leads to a high value of information systems support [116]. Dysfunctional ERP systems and data processing are one problem of the integration of performance management in buyer–supplier dyads. Additionally, the necessity of performance feedback for corrective actions is pointed out [121]. Varila et al. [12] highlight the aspect of data collection and information systems in connection with the development of a highly accurate cost accounting system for warehouse logistics.

In the early 1990s, a general need for workflow and process redesign is proclaimed to sustain lasting benefits from EDI [108]. However, literature does not give a clear answer whether this goal has been reached almost 20 years later.

Information systems as one of the supporting factors for JIT manufacturing have been identified quite early, too [122]. The development of an integrated supply chain is found to be highly influenced and enabled by information technology and information sharing. Even though a reluctance toward information sharing is present in practice, this could be overcome through similar values and visions [119]. Due to information technology, centralized operations are not seen as necessary anymore to achieve control. Additionally, central strategic planning and fulfillment on a decentralized level are facilitated by information technology [105]. Information systems and computer technology, by this the link between supply chain partners, along with the organizational structure, are also seen as crucial for the implementation of integrated distribution concepts [123]. Referring to a basic logistics function, it was identified that a warehouse information system “plays a crucial role in the planning and control structure to achieve the desired high warehouse performance” ([111], p. 392).

From an overall MCS perspective, interdependence between information and performance is often proclaimed. This connection between information and performance is explicitly stressed quite early in the literature [84, 124] and until today articles directly broach this issue [121]. Information, especially in case of information sharing and contracts, is either seen as system integrated and contract relevant, or as an enabling factor. Performance measurement delivers information for decision-making [31]; information sharing and implemented information technologies

lead to inventory reduction, improved decision-making, order and delivery time flexibility as well as higher responsiveness [125]. Furthermore, it is hypothesized that information connectivity mediates the relationship between flexible logistics and performance [126].

Unfortunately, even on these basic ideas of use and effects of information systems literature does not agree. Daugherty et al. [116], for example, especially refer to the connection of reverse logistics performance and information systems support. In their research, a linkage between information systems support and operating/financial performance could not be detected. With regard to the relationship commitment between the buyer and the supplier the performance is enhanced. They could also not establish a link between information systems support and satisfaction.

Overall, the main focus of the literature lies on “linear” supply chains, i.e., buyer–supplier relationships. A broader, network-based view is rarely taken [63]. Only few articles refer to logistics and information in a comprehensive way [12, 51, 112]. Here, a trend along with the general change of focus from logistics to SCM can be seen. Over time another change can also be noted. Of the earlier papers many have high interest in technology and systems possibilities [51, 104, 127]. Later on, trust, behavioral and organizational aspects as well as the process of information sharing become additionally relevant [83, 92, 96, 107]. Despite this, information availability and ways of information exchange are still important today [106, 117].

## 5 Conclusion and suggestions for further research

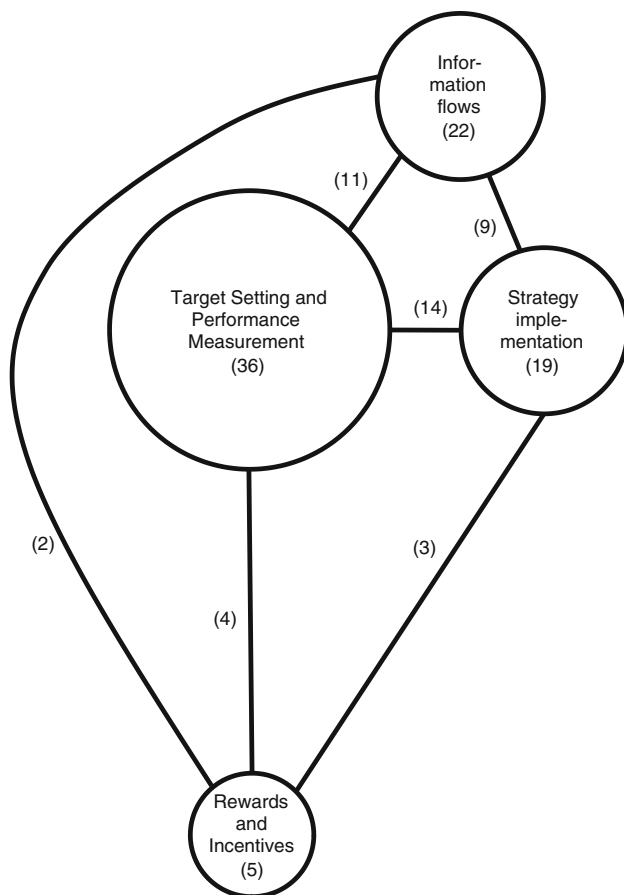
Generally speaking, management accounting journals only rarely address specific issues associated with logistics and SCM; this includes both, theoretical and practical aspects. Although logistics and supply chains in some cases serve as a specific example for the application of dedicated accounting and control tools [128, 129] or the description of general management control issues in inter-firm contexts, only a small number of articles explicitly focus on this field. The majority of research published in management accounting journals has a rather general approach [102, 130, 131]. One interpretation for this could be that management accounting scholars do not see any need for the development of new and more specific accounting techniques [65]. Instead, various authors elaborate known methods and apply them to logistics and supply chain contexts [132]. This would correspond to the view of Dechow and Mouritsen [68], who cite arguments for a coexistence of both the physical, business-process oriented logistics and the formal, information-oriented accounting—a view which would explicitly deny the need for dedicated MCS in logistics and supply chains.

This literature review also shows that management accounting and logistics journals neither cover the topic of MCS in logistics and SCM in a holistic way considering the complete MCS, nor in a large number of articles. The linkage between all four of Otley’s segments is essential for an effective MCS. Until today, this is not researched in a sufficient way. Due to the relevance of logistics and supply chains with their related costs, their cost reduction and coordination possibility, a comprehensive MCS to achieve effectiveness and efficiency is important. Our review shows that there are several topics still to be researched within this field.

In order to gain a deeper understanding of the overall structure of MCS research in logistics and SCM and to make the aforementioned links more obvious, we classified the content of all selected articles based on the dimension chosen in the respective cases. As shown in the respective sections of this review, an intra-organizational and inter-organizational perspective can be chosen. Although one might expect to find by far more articles in the inter-organizational setting, this is not the case—the 101 articles are almost evenly distributed between intra-organizational (48) and inter-organizational (53) focus. However, over the years the number of inter-organizationally focused articles clearly outweighs the intra-organizationally focused ones. While the number of intra-organizational articles has been rather constant over the last 20 years at 2.5 articles per year, the number of the inter-organizational articles has steadily grown and has significantly grown after 2000 and reached levels of around 5 articles per year since then. Based on this differentiation, the depiction of a network- and interrelation chart is possible, showing the joint and reclusive occurrence of topics. The chart can be read as follows: numerals in circles show the number of articles which consider the respective part of Otley’s framework. For reason of exhaustiveness, these include all articles stating the respective part of the framework (in the other parts of this review article, only the significant ones are mentioned). All articles covering more than one area of the framework constitute the lines between the circles (numerals show number of articles considering the respective two aspects).

With respect to our classifications, target setting and performance measurement is the topic discussed most often (indicated by the size of the circles in Figs. 5 and 6). Additionally, this part of Otley’s framework has the highest number of interrelated/shared articles.

Concerning the number of articles considering intra-organizational aspects, there is neither an increase nor decrease observable from 1988 to 2008. For inter-organization aspects, however, there is an increase in number of articles, which becomes particularly observable from the year 2000 onwards (not shown in diagrams).

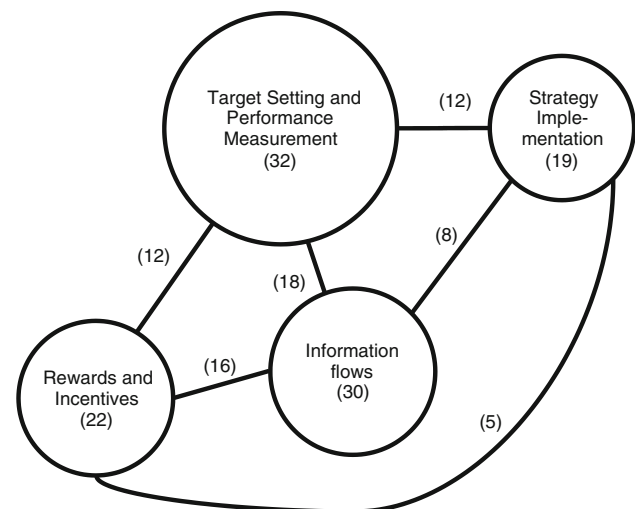


**Fig. 5** Topics covered in selected articles (intra-organizational)

For the intra-organizational perspective (see Fig. 5), the links between all circles are much weaker than for the inter-organizational perspective (see Fig. 6). Further, in the intra-organizationally focused articles the topic of rewards and incentives is often treated uncoupled from the other aspects of MCS, while the interrelation between the other three areas is at least at a medium level.

The inter-organizational perspective on the other hand (see Fig. 6) shows a more holistic pattern of research that better considers interrelations between different areas of MCS. Here, only the interface between strategy implementation and rewards/incentives is rarely considered. All other links can be considered to be medium to strong and thus represent a research perspective which is on its way to a comprehensive and interrelated view.

The literature review shows foremost that research into the development and implementation of a holistic MCS for logistics and SCM should be intensified which could be achieved by further case studies as well as survey-based studies. More conceptual work could be necessary to enable a better practical utilization of MCS in logistics and supply chain settings. Within this, the aspect of rewards and incentives should be considered in more detail, in



**Fig. 6** Topics covered in selected articles (inter-organizational)

connection with motivational/behavioral aspects. Especially on the intra-organizational level, further research is necessary, as motivated employees can raise productivity and enhance firm performance. In this context, as well as for the supply chain level, not only financial rewards but also the effect and implementation of non-monetary incentives, the optimum combination of both reward schemes and the measurement scale for incentive granting should be further examined. Regarding information flow, especially the examination of broader relationships, i.e., networks, and their information needs is relevant for the future. Connected to this is the consideration of information flows in various industries and their differences. Moreover, possibilities for an efficiency increase in information flows should be researched. Further emphasis is also encouraged toward the aspect of feedback and learning in supply chains.

The overall outlook reveals a considerable potential for further research on management control systems in logistics and SCM, from which both research and practice alike will profit.

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