

# Missing performance management and measurement aspects in performance-based contracting

## A systematic process-based literature analysis of an astonishing research gap

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### Abstract

**Purpose** – Performance-based contracting (PBC) is a business model for the adaptive and innovative delivery of product-service systems. In PBC, the provider is paid according to the service performance with the aim of providing monetary incentives to safeguard possible outcomes as much as possible for the PBC customer. Performance measurement and its management are crucial for PBC success and, in particular, for the pay-for-performance link. However, the literature on PBC performance management is rather sparse, and there has been no systematic review on the topic. Thus, the purpose of this paper is to fill that gap and to present a comprehensive and systematic review of performance measurement and management in the PBC context.

**Design/methodology/approach** – The paper builds on a literature review based on a sample of 102 subject-relevant articles from academic journals. The content analysis follows a two-step procedure. First, the articles are coded following a process-based research framework. Second, the content of each process step is assessed in a qualitative text analysis.

**Findings** – The results show a surprising scarcity of papers that explicitly address performance management topics in the context of PBC. Only the topics of performance specification and performance indicators are broadly addressed, whereas in all of the other areas, e.g., strategic alignment, data capture and reporting, only limited specific findings could be found.

**Research limitations/implications** – The paper concludes that future research on performance management in PBC should expand its theoretical framework and empirical efforts in four specific proposed directions.

**Originality/value** – The paper provides an up-to-date review that is focused on performance management and measurement in the emerging context of PBC.

**Keywords** Literature review, Performance-based contracting, Performance measurement and management

**Paper type** Literature review

### 1. Introduction

Many companies in the business-to-consumer sector offer their clients access to and the usage of products but not ownership of such products (“use not own”). Typical examples are modern car sharing, couch surfing or music- or video-streaming offerings. Moreover, manufacturing companies in the industrial business-to-business sector offer more than physical products – they sell the performance of their products (Holmbom *et al.*, 2014). The academic discourse addresses that phenomenon and discusses it under the term “performance-based contracting” (PBC) (Essig *et al.*, 2016; Selviaridis and Norrman, 2014; Kim *et al.*, 2007).

Interest in PBC has significantly increased in the last two decades (Selviaridis and Wynstra, 2015); however, the focus has been on clarifying the concept (Hypko *et al.*, 2010) or analyzing its content, e.g., contract design (Datta and Roy, 2013). Although an increase in published PBC research papers has recently been observed (Selviaridis and Wynstra, 2015), the literature on PBC with a specific focus on performance measurement and management (PMM) is scarce, and there has been no systematic review that considers both aspects.



This situation is surprising with regard to two aspects. First, PBC explicitly addresses performance as a key element of its contract approach (Holmbom *et al.*, 2014; Glas *et al.*, 2013; Randall *et al.*, 2011). It is important to have accurate PMM in place (Sols *et al.*, 2007). There are numerous challenges to selecting, measuring and managing appropriate performance indicators (Holmbom *et al.*, 2014; Tukker, 2004; Spring and Araujo, 2009). Typical key performance indicators (KPIs) in the context of PBC are, for example, availability, reliability, maintainability, supportability, logistics response time, logistic footprint and cost of use (Sols *et al.*, 2007). Nevertheless, despite its high relevance, discussion of PMM is rare in PBC contributions. Furthermore, even the understanding of performance remains unsettled and the discussion of KPIs and their measurement is ongoing, recent reviews of the PBC literature have recommended placing PMM on the agenda for future research (Selviaridis and Wynstra, 2015; Mouzas, 2016).

Second, there is a need to further develop PMM given the dynamic change in environmental contexts and the emerging of new practices (Melnyk *et al.*, 2014). PBC is not only considered to be a phenomenon of new and changed business practices but also an approach that represents the application of new and emerging theoretical methods such as service-dominant logic theory (Randall *et al.*, 2010). In addition, contemporary supply settings make the PMM of suppliers and service providers essential for industrial customers (Gottschalk and Solli-Sæther, 2005). Nevertheless, the research on how source providers can set up and operate PMM is thus far generally lacking (Weimer and Seuring, 2009).

It thus appears that the research streams of PBC and PMM can profit from each other to further develop PMM in the context of service-oriented industrial business models and to apply state-of-the-art PMM knowledge in the emerging PBC field. Thus, the guiding research question is how the PMM literature can contribute to PBC and vice versa.

For this purpose, it is necessary to take stock of the existing literature, to assess how the field of PBC and PMM could effectively build on the existing literature and to identify which areas and research questions should be addressed. Therefore, this paper reviews and synthesizes the PMM literature within the PBC field. In particular, this research aims to expand knowledge on how deeply specific PMM topic areas are addressed within the PBC literature to identify the topics that represent research gaps. The next section provides a comparative review of the previous research on PBC and its relationship to PMM. Section 3 sets the stage for further analysis and reviews the PBC and PMM areas, building a contextual analysis framework for the review. In Section 4, the applied methodology is described. A review of the findings is presented in Section 5, and the findings are divided into quantitative and qualitative content analyses. In Sections 6 and 7, the findings are discussed, suggestions for future PMM and PBC research are proposed and managerial implications are outlined. Finally, Section 8 summarizes and offers concluding remarks on the study's main contributions and limitations.

## 2. The previous research on PBC and its relationship to PMM

PBC and PMM appear to be closely related, and the relatively new concept of PBC can certainly profit from the existing research findings in the PMM literature. The field of PBC is an emerging topic for practitioners and academia, which explains the rising interest in and increase of publications on the topic of PBC (Selviaridis and Wynstra, 2015). The starting point of this research was an initial screening of the literature on PBC. On the one hand, the screening supported claims that aspects of PMM are rarely or only briefly touched upon in PBC contributions. On the other hand, the screening also identified eight literature reviews on PBC. To avoid repetitive research, this study briefly reports on these eight reviews and uses them to justify the applied methodology (Table I).

Authors	Journal	Industry focus	Main objective	Reviewed papers	Time scope	Relation to PMM
Selviaridis and Wynstra (2015)	<i>International Journal of Production Research</i>	No specific focus	Development of a PBC classification framework	241	1985-2014	PMM content is addressed to conceptualize PBC dimensions
Alyami <i>et al.</i> (2015)	<i>9th International Conference on Managing 2015</i>	Construction sector	Review of PBC performance measures for road maintenance	n.a.	n.a.	Very specific aspects are discussed (e.g. road roughness)
Holmbom <i>et al.</i> (2014)	<i>Journal of Manufacturing Technology Management</i>	Aerospace and defense	Review of benefits and drawbacks of PBL	101	1988-2013	PMM aspects are crucial implementation factors of PBC
Sultana <i>et al.</i> (2013)	<i>International Journal of Productivity and Performance Management</i>	Construction sector	Review on practices in PBC with focus on benefits and potential	62	n.a.	Very specific aspects are discussed (e.g. road roughness)
Selviaridis (2011)	<i>Proceedings of the 20th Annual IPSERA Conference</i>	No specific focus	General review within the operations and supply management research field	87	1985-2010	Investments in PMM within a PBC are seen as a research gap
Hypko <i>et al.</i> (2010)	<i>Journal of Service Management</i>	Manufacturing	Clarification of the PBC concept	39	2001-2010	PMM is hardly mentioned. Focus on PBC business model
Carlson <i>et al.</i> (2010)	<i>Health Policy</i>	Healthcare and welfare	Review of PBC schemes in healthcare	n.a.	1998-2009	Classification of schemes in terms of, e.g., health outcomes
Eldridge and Palmer (2009)	<i>Health Policy and Planning</i>	Healthcare and welfare	Review of PBC payment /donor schemes in health systems	17	1990-2008	Discussion of four models of finance/donor and organization

**Table I.**  
Overview of  
previous literature  
reviews on PBC

The oldest considered review is from Eldridge and Palmer (2009). The most recent reviews are from Alyami *et al.* (2015) and Selviaridis and Wynstra (2015). Although some reviews appear to be comprehensive, with more than 100 analyzed contributions (Holmbom *et al.*, 2014; Selviaridis and Wynstra, 2015), other reviews only provide a narrow literature sample (e.g. 17 in the review of Eldridge and Palmer, 2009). Six reviews focus on one particular industry branch: two on construction, two on healthcare, one on aerospace in defense and one on manufacturing. Two reviews, which are partially based upon each other, focus on the functional aspects of operations and supply management (Selviaridis, 2011; Selviaridis and Wynstra, 2015).

The main objectives of the reviews are to define and classify PBC (Selviaridis and Wynstra, 2015; Hypko *et al.*, 2010), to analyze benefits or drawbacks (Holmbom *et al.*, 2014; Sultana *et al.*, 2013; Selviaridis, 2011) and to report payment schemes (Carlson *et al.*, 2010; Eldridge and Palmer, 2009). Only one review focused on performance measures (Alyami *et al.*, 2015), and it reported highly specific findings, e.g., road roughness.

Overall, the previous content analysis in the context of PBC lacks a distinct focus on PMM. Even when aspects of PMM are reported (e.g. Alyami *et al.*, 2015; Carlson *et al.*, 2010),

the findings are industry specific, have little relationship to operations and supply management and thus are limited. The work of Selviaridis and Wynstra (2015) is the exception and addresses aspects of PMM in the supply management context; however, it does not review these aspects in detail. Instead, it uses them to conceptualize the authors' understanding of PBC. They report in their appendix that 89 studies address or at least mention PMM aspects in their sample of 241 contributions (Selviaridis and Wynstra, 2015). Selviaridis and Wynstra (2015) is the starting point of this study because an in-depth analysis of PBC- and PMM-related literature has yet to be performed. This omission calls for a comprehensive review that links PBC with aspects of PMM.

### 3. Development of the analysis framework

This section describes the development of the framework that is used to further structure the topic and the review analysis. In recent years, a large number of academic papers have addressed PMM (Taticchi *et al.*, 2010; Choong, 2014); thus, it is first necessary to discuss the understanding of performance and PMM. Then, the PMM process steps are presented as a basis for an analysis framework (Section 3.1). Next, the concept of PBC is defined and presented in more detail (Section 3.2). Finally, the analysis framework is developed (Section 3.3).

#### 3.1 Review of PMM

**3.1.1 Performance understanding.** The term “performance” is not easy to define (Otley, 1999), and it has not been consistently defined in the management research (Krause, 2006; Lebas and Euske, 2007). The diverse character of performance definitions is summarized by Lebas and Euske (2007) who stated, “Performance per se may not be definable in the absolute. It is [...] contextual both in terms of users and in terms of purpose.”

Specifically, performance is considered to be the degree of target achievement for the relevant stakeholders (Krause, 2006); however, performance is also about deploying and managing the components of the causal model(s) that lead to the timely attainment of stated objectives within constraints that are specific to the firm and to the situation (Lebas, 1995). Several authors define performance by referring to “efficiency and effective dimensions” and highlight the multidimensionality of performance (Lebas, 1995; Neely *et al.*, 1995; Karrer, 2006; Lebas and Euske, 2007).

To obtain an understanding of performance in the context of PBC, in addition to the concepts of multidimensionality and the context dependency of performance, PBC's relationship to processes must be included. Entchelmeier (2008) defined performance according to four process dimensions: input oriented, process oriented, output oriented and potential oriented. A similar definition of performance is described by Karrer (2006), who only replaced the “potential-oriented” dimension with an “outcome-oriented” one – in other words, the availability of a system or the number units that are produced or sold. The definition of performance as being output or outcome oriented will be of especial interest in the context of the analysis of PBC.

**3.1.2 PMM.** There is also no cohesive view within the research community with regard to the definition of performance measurement (Choong, 2013). Tonchia and Quagini (2010) stated, “if we want to manage performance, we have to be able to measure it. [...] That is, if you can't measure it, you can't manage it!” A definition is postulated by Franco-Santos *et al.* (2012) in which the emphasis is on the use of different performance measures and the link to strategy: “contemporary performance measurement comprises the use of financial and non-financial performance measures linked to the organization's business strategy.” Neely *et al.* (2005) note that performance measurement is literally “the process of quantifying efficiency and effectiveness of action [...]” As a summary of 27 definitions, Choong (2014) prescribed

performance measurement “as meeting set targets (goals) with a view for improvement.” Performance measurement cannot be considered separately from performance management; they are interrelated and form an iterative process because an effective performance measurement system is designed around KPIs, considers variance analysis and cause-and-effect relationships and fosters decision making (Lebas, 1995; Choong, 2014). Following this integrated understanding, the term PMM is used for the remainder of the paper.

A comprehensive view of the content of PMM encompasses “formal and informal mechanisms, processes, systems, and networks used by organizations for conveying the key objectives and goals elicited by management, for assisting the strategic process and ongoing management through analysis, planning, measurement, control, rewarding, and broadly managing performance [...]” (Ferreira and Otley, 2009). Due to this content heterogeneity, PMM is often identified as a system to which several interdependent factors contribute. The main features of a PMM system are briefly described following Franco-Santos *et al.* (2007) and Choong (2013). These features are data (variables), measuring attributes and supporting infrastructure.

Data are often differentiated in quantitative and qualitative form in terms of their use for financial and non-financial purposes (Otley, 1999; Bourne *et al.*, 2003). Neely *et al.* (1995) highlight the integration of different data into a “[...]set of metrics used to quantify both the efficiency and effectiveness of actions.” Measuring attributes are linked to strategic objectives and are used to generate the information that is necessary for decision making (Marshall *et al.*, 1999). Many authors do not differentiate between measure, metric and indicator (Neely *et al.*, 1995; Bourne *et al.*, 2003; Choong, 2013) and use the terms interchangeably. The term supporting infrastructure incorporates not only the organizational setting and information systems but also methods of data collection and data analysis. In addition, a PMM system exhibits other characteristics. It must be easy to understand, retain a long-term character and be linked to a reward system (Gomes *et al.*, 2004). Moreover, it must be flexible to adapt to strategic changes (Kennerley *et al.*, 2003). These characteristics are used below in the discussion about PMM in the context of PBC.

*3.1.3 PMM process.* The process of PMM has been extensively analyzed in the literature (Kennerley *et al.*, 2003). A simple PMM process consists of three phases: the design of measures, the implementation of measures and the use of measures (Bourne *et al.*, 2000; Forslund and Jonsson, 2007). Neely *et al.* (1995) extended this perception and included not only the performance target setting but the need for feedback loops and a connection to reward functions. In line with this notion, Franco-Santos *et al.* (2007) identified five process categories, which include “selection and design of measures, collection and manipulation of data, information management, performance evaluation and rewards and system review.” In addition, Otley (1999) referred to the definition of strategic objectives and the assessment of strategy implementation, target setting, the design of an incentive system and finally the design of an informational system. An additional process step called the “refreshing” of the PMM system is justified by the organizational or environmental changes over time and their effect on the PMM design (Bourne *et al.*, 2005). In this process step, a constant re-evaluation of the appropriateness of existing performance measures on the one hand and of the PMM system as a whole on the other is performed (Bourne *et al.*, 2005).

The above-mentioned issues can also be used to assess a PMM process following the aggregated process view that is provided by Bourne *et al.* (2005) in which they distinguish seven main processes: linkage to strategic objectives, data capture, data analysis, interpretation of data, communication and information provision, decision making and taking action and refreshing.

Summarizing the literature on PMM and on the PMM process, this review defines performance as a multidimensional and context-dependent construct along input,

throughputs, outputs and outcomes. It also connects to the perspective that PMM is a system to which several factors contribute, such as measures, data or a supporting infrastructure. Finally, the literature on the PMM process is reviewed, and seven main process steps are identified that will be the basis for the analysis framework.

### 3.2 Review of PBC

This section provides a brief understanding of why there is a need for a new contract approach and how PBC is defined. It also provides initial indications that PMM is highly important for the execution of a PBC. Furthermore, a three-step contract process is presented.

First, academic interest in PBC has recently increased (Hypko *et al.*, 2010; Sultana *et al.*, 2013; Selviaridis and Wynstra, 2015; Nullmeier *et al.*, 2016) because PBC addresses specific, contemporary challenges in buyer-supplier relationships and provides a solution mechanism for these challenges by aligning the goals of the supplier and the buyer by defining, measuring and rewarding outcomes (Selviaridis and Wynstra, 2015). However, the PBC literature remains heterogenous due to specific applications of the approach in various industries, for example, manufacturing (Hypko *et al.*, 2010), defense (Glas *et al.*, 2013), infrastructure (Schoenmaker and de Bruijn, 2016), energy (Hufen and de Bruijn, 2016) and transportation (Stanley and Hensher, 2008).

More specifically, the challenge is that customer companies no longer purchase products and services (separately) but rather seek integrated service bundles and products, which are often called “solutions” or “product-service systems” (Kleemann and Essig, 2013). The described shift from products to service bundles forces suppliers to continuously extend their service offerings and to develop toward a specific service provider. The contribution of suppliers and service providers is significant for the success of their customer companies and increases long-term dependencies (Hypko *et al.*, 2010; Kleemann and Essig, 2013). This situation calls for new approaches to contracting (Baines *et al.*, 2009). In addressing this challenge, PBC plays a major role (Guajardo *et al.*, 2012).

The underlying idea of PBC is first that companies buy the outcome of a service solution and not a physical product with attached services (Datta and Roy, 2011; Randall *et al.*, 2010; Kleemann and Essig, 2013). Second, the PBC provider in return is compensated (at least partially) based on a successfully achieved outcome (Doerr *et al.*, 2005), for example, when an engine manufacturer is paid in relation to the usage hours, which depend upon engine uptime and reflect the customer value (Guajardo *et al.*, 2012). Thus, a PBC provider is not tied to the detailed technical specifications of the customer; instead, the provider accepts full responsibility for how to achieve the desired outcome (Sols *et al.*, 2007; Glas and Essig, 2008). This approach implies a transfer of risks to the PBC provider (Doerr *et al.*, 2005) but, conversely, encourages the provider to improve performance during the contract period according to the implemented incentives and sanctions (Randall *et al.*, 2014).

A PBC uses KPIs and incentives to improve outcome performance, which requires procedures to measure, report and manage the performance during the complete contract period (Datta and Roy, 2011). Thus, PMM is a vital aspect of each PBC and must be considered in all phases of the contracting process. However, there are many major challenges to PMM because poorly specified KPIs and incentives can lead to unintended consequences and foster provider opportunism (Kim *et al.*, 2007; Neely, 2008; Selviaridis and Wynstra, 2015; McDonald and Roland, 2009). Moreover, a need for further research in the PMM area has been identified by various authors in the PBC field (Dean and Kiu, 2002; Weimer and Seuring, 2009; Sultana *et al.*, 2013; Alyami *et al.*, 2015; Selviaridis and Wynstra, 2015).

For the aims of this research, it is necessary to structure the PBC topic. PBC is basically a contracting approach. Therefore, the contracting process is used to divide PBC management into three phases: the design phase of PBC, the management and execution phase of PBC



and the post-PBC phase (Lazzarotto *et al.*, 2014; Selviaridis and Norrman, 2015; Selviaridis and Wynstra, 2015). Each contracting phase can be linked to different PMM process steps, as is shown in the analysis framework (Section 3.3).

### 3.3 Analysis framework

To develop PMM in the emerging context of PBC, a deeper understanding of the relevant PMM aspects is required. There are existing frameworks for the analysis of PBC; however, they refer to risk management (Selviaridis and Wynstra, 2015), address the cooperation mode with supplier and life cycle costs (Glas *et al.*, 2013) or solely focus on performance indicators (Sols *et al.*, 2007). Thus, an analysis framework is developed in this section to structure and focus the content analysis of this study on all of the PMM aspects of a PBC.

For this purpose, the insights from PMM (Section 3.1) are merged with those from PBC (Section 3.2) into a process-oriented analysis framework. The framework is based on the seven steps of the PMM process (Bourne *et al.*, 2005) but separates the design of the incentive system from the design of KPIs to highlight that important issue. Then, the three contract phases, design, management and post-contract (Lazzarotto *et al.*, 2014), are connected with the eight PMM process steps.

Four PMM process steps are related to the design phase of the contract, which are as follows: (1) strategy alignment (2) performance specification (3) KPI design and performance targets and (4) design of the incentive system. The next three PMM process steps are then related to the management phase of the contract: (5) data capture (6) performance assessment and (7) performance reporting. The last PMM process step (8) taking action and refreshing, is of interest not only for the execution and management phase of a contract but also for the post-contract phase. Therefore, it is connected with both contract phases (Figure 1).

## 4. Methodology

### 4.1 Literature search strategy

The systematic literature review method is applied in this research (Denyer and Tranfield, 2009). A systematic literature review is a transparent process that ensures scientific rigor and replicability and outlines the audit process of the author's procedure and conclusions (Denyer and Tranfield, 2009). In preparing the review, the relevance and

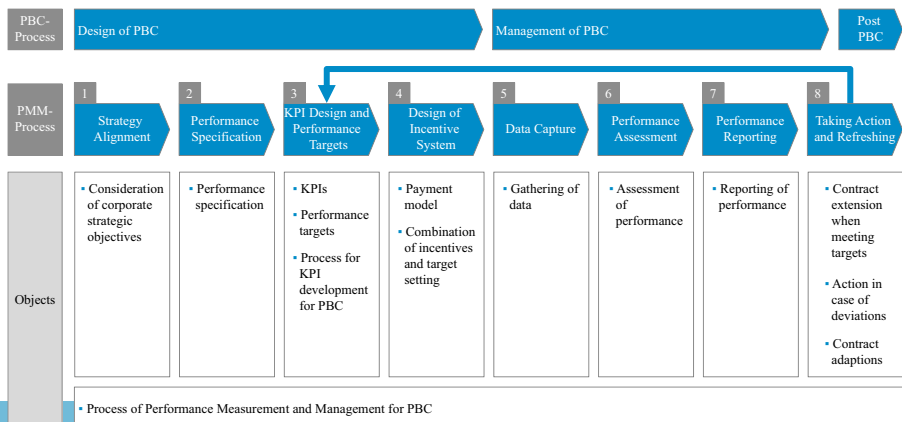


Figure 1. Analysis framework

scope of PMM within the PBC literature is determined through a scoping study (Tranfield *et al.*, 2003). The objective of the scoping study was to identify the most relevant keywords that concern PBC. The papers that are relevant for the scoping study were selected based on the author’s knowledge of the field and an initial search within academic databases.

The identified keywords included “Performance-based contract\*,” “Performance-based logistics,” “Outcome based contract\*,” “Availability contract\*” and “Performance-based payment.” Keywords such as “Servitization” or “Product service system” were not viewed as concentrating solely on PBC and thus were omitted. The review comprised articles from January 2000 to February 2017. That timeline comprises the most relevant articles that address PBC according to the previous reviews (Selviaridis and Wynstra, 2015).

The literature search employed the databases Emerald Insight, Science Direct and Ebsco Business Source Corporate Plus. The search filtered hits from academic, peer-reviewed journals. Additional papers were identified based on citations in the already found hits. Next, non-English language articles were excluded, which resulted in 482 articles in total. The abstracts of all 482 articles were read to ensure that all of the articles were actually related to the topic. Papers that concern PBC at an intra-firm level (e.g. management incentives) were eliminated. After discussions within the research team, all of the articles from journals on children or social work were excluded. These filters reduced the number of articles to 243. In a next step, the content of all 243 articles was reviewed, and articles that actually addressed PMM aspects were identified. This identification delivered the final sample for the literature review of 102 articles, which is in line with the previous findings of Selviaridis and Wynstra (2015), who found 89 hits on performance measurement within their sample of 241 PBC-related articles. Finally, the content of the articles was coded according to the analysis framework. The literature search strategy is summarized in Figure 2.

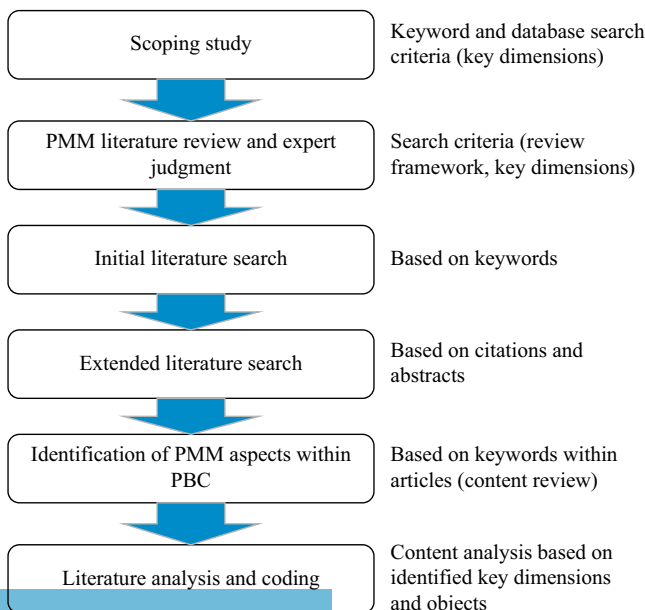


Figure 2. Methodological approach



#### 4.2 Coding and content analysis

To cope with issues around the quality assessment of articles throughout the literature review, e.g., error or bias, the content of the articles was coded using standardized data extraction forms (recommended by Tranfield *et al.*, 2003). General information (title, author and publication details), the methodologies, the industry focus of each article and content aspects that related to the analysis framework were coded. For the coding, a basic classification form was used with 8 classification categories and 32 classification objects in total. MAXQDA software and Excel coding tables were used for this task.

Generally, the authors followed the reliability and validity aspects of content analysis methodology (Krippendorff, 2012). As an example, the definition of each classification category was written into the classification form, which allowed each reviewer to understand the content of the coding in the same manner, thus increasing semantic validity. Additionally, the articles were reviewed by two researchers to prevent bias and enhance reliability. In a first step, 20 articles were coded independently by both researchers according to 32 classification objects. Agreement on 29 classification objects between the authors was reached, which indicated an inter-rater reliability of 90.6 percent, which is an acceptable percentage for further coding (Carey *et al.*, 1996). All of the disagreements were discussed to clarify the interpretation of the categories. The remaining articles were divided between the researchers to finalize the coding. This activity also included regular meetings to discuss research findings, emerging issues on the application of the categories and the general progress of the research.

### 5. Findings

#### 5.1 Sample descriptive

The literature search revealed 102 papers that address PMM in the PBC context. The distribution of the papers over time confirms the previous findings and shows a recent steep increase of published scientific papers (Selviaridis and Wynstra, 2015). The topic has clearly been increasing in academic relevance since the mid-2000s, and the hits in 2015 and 2016 indicate that this trend continues (Figure 3).

Next, the findings suggest a dominance of qualitative and conceptual approaches (Figure 4). A total of 62 papers (61 percent) report on such methods, while quantitative (18 percent) and mathematical (14 percent) contributions are underrepresented. This literature review also includes eight papers (8 percent) that conducted their own reviews. As mentioned above, these reviews clarify the PBC concept (Hypko *et al.*, 2010; Holmbom *et al.*, 2014; Selviaridis and Wynstra, 2015) or address sector-specific issues (Sultana *et al.*, 2013; Alyami *et al.*, 2015). No specific and profound review on PMM in the context of PBC was found.

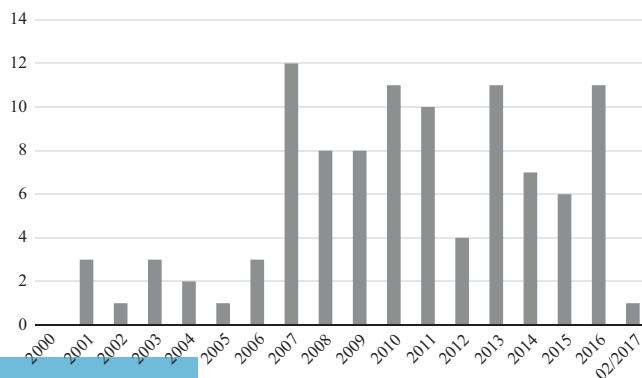
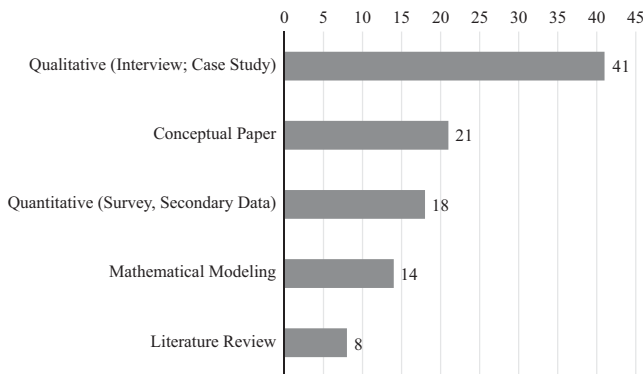


Figure 3.  
Articles over time

Figure 4. Articles per applied methodology



Sector-specific issues are often discussed in the literature, e.g., PBC in the defense context is called performance-based logistics (Glas *et al.*, 2013). The articles cover diverse industry sectors (Figure 5). Aerospace, defense, healthcare and construction are often referred to, and energy, transportation, manufacturing and the public sectors are of high relevance. The housing and the oil and gas industries play a minor role. A total of 16 papers (16 percent) discuss PBC across industries or without explicitly referring to one specific industry.

However, the findings show that the literature on PMM in the PBC context is not consolidated (Figure 6). The 102 hits are distributed across 64 different journals. The journals address different disciplines, topics and target groups, such as logistics (*Transportation Research Record*), manufacturing (*Journal of Manufacturing Technology Management*), production (*Journal of Production Management*) and a few PMM outlets (*International Journal of Productivity and Performance Management*). Only in 22 journals were two or more articles published, which is also an indicator of the scattered field.

### 5.2 Content findings

The analysis reveals the status quo of academic attention on specific PMM process steps. Overall, the 102 papers address 257 content issues that are related to the PMM process. The topic of performance specification (step 2) and KPI design and performance targets

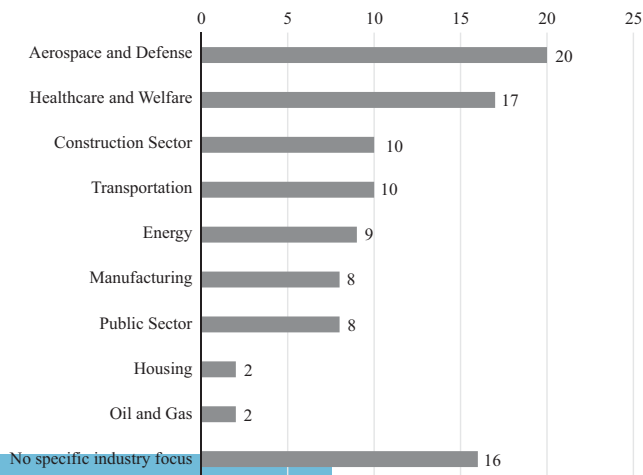


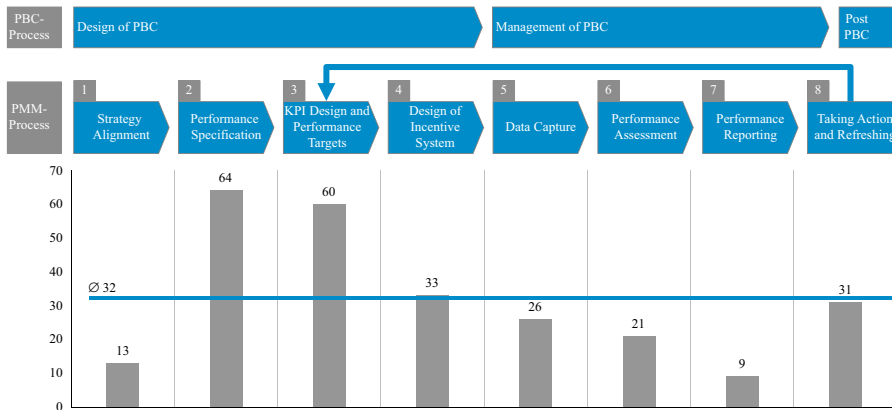
Figure 5. Articles and their industry focus



**Figure 6.**  
Articles per journal  
with two or more hits

(step 3) are the areas of highest interest, with 64 and 60 codings, respectively, which represent the number of references to these topics, and they are by far the highest number of references. Additionally, four topics (design of incentive system, data capture, performance assessment and taking action and refreshing – steps 4, 5, 6 and 8) are discussed with a number of codings (21 to 33 each). These topics are addressed, even when most of the contributions only touch on the topic. In contrast, the topics of strategy alignment (step 1) and performance reporting (step 7) are addressed by only 13 and 9 codings, respectively. Additionally, these topics are only addressed in side notes (Figure 7). The distribution of content hits by industry branch indicates no significant distribution differences across industries, even when the aerospace/defense and healthcare/welfare industries dominate the discussion by numbers, at least for the PMM process steps 2 – performance specification, 3 – KPI design and performance targets and 4 – design of incentive system (see Table AI).

**5.2.1 Strategy alignment.** An essential element in the PMM process is the definition of the strategic objectives of the company as a first step (Otley, 1999). Most authors who address PBC do not stress alignment with corporate objectives at all; only 13 codings mention that aspect. However, some authors argue that an effective PBC is aligned to the strategic goals of the customer (Buchanan and Klingner, 2007). The same understanding of the linkage of incentives with corporate goals is described in a case study by Selviaridis and Norrman (2014): “This aligns [...PBC provider’s] incentives to customer’s strategic goal of making products available at the lowest possible cost.” There is a need to align the performance and the respective KPIs to the corporate goals of the buying organization (Barber and Parsons, 2009). However, it is often a challenge in the design of a PBC to



Note: n = 257 content codings from 102 articles

Figure 7. Article hits per process step of performance management

actually link KPIs with corporate goals (Selviaridis and Wynstra, 2015). In practice, KPIs often do not represent the corporate goals of the buying organization (Datta and Roy, 2011; Selviaridis and Norrman, 2015).

The linkage of KPIs, incentives or even the whole contract to strategic targets is also mentioned in the public or transportation sector. In these industries, the PBC must be aligned with the government objectives, as is stated by Stanley and Hensher (2008): “The end result will be a set of negotiated PBCs that will reinforce the government’s strategic goals, while [...] maintaining performance pressure for cost effective service delivery.” Particularly in the public sector, authors also emphasize the importance of linking the public purpose in general to the performance specification of the contract (Sols *et al.*, 2007; Stanley and Hensher, 2008).

Overall, only 13 codings address the issue of strategy alignment. There is broad consensus that, in a PBC context, the incentives and KPIs should be aligned with strategic goals. However, there is no further information in the literature with regard to how the alignment of a PBC and strategy goals can be ensured.

**5.2.2 Performance specification.** With 64 codings, the aspect of performance specification appears to be crucial for PBC. A broad definition of performance is applied to PBC because performance is understood as a form of outcome or output, of efficiency and effectiveness and as a multidimensional construct that consists of several areas of performance (Sols *et al.*, 2007; Selviaridis and Norrman, 2014; Lu, 2016). Many authors within the field of PBC describe the focus of the customer as a performance goal that is defined as an outcome or as his expectation of the performance to be delivered (Kim *et al.*, 2007; Hypko *et al.*, 2010; Randall *et al.*, 2011; Glas *et al.*, 2013). However, in the majority of cases, a definition of the term outcome is missing (Martin, 2007; Hypko *et al.*, 2010; Deng *et al.*, 2014; Essig *et al.*, 2016).

For example, Vitasek and Manrodt (2012) only state, “[...] a service provider is paid only when it is successful in achieving the mutually agreed desired outcomes.” Moreover, Caldwell and Howard (2014) describe performance as only “the outcomes required from the contract.” However, other authors try to describe the term performance. Selviaridis and Norrman (2014) describe performance as an output or outcome; output refers to “the service functionality and level of performance (e.g. machine availability percent),” and outcome refers to “customer value derived from a given service.” In contrast to this definition, Glas *et al.* (2013) presented a broader definition of outcome. They defined an outcome as “[...] either process-related

(e.g. service time), potential-related (e.g. availability) or result-related (e.g. operating time or mission success). In this context, other authors also subsume the level of performance, for example the availability of a system, to the definition of outcome” (Caldwell and Howard, 2014; Randall *et al.*, 2014). Others do not distinguish between outputs and outcomes at all and mention both terms within the same context (Hypko *et al.*, 2010; Sultana *et al.*, 2013).

Another aspect of performance is the importance of efficiency and effectiveness because in a PBC context, both must be ensured (Dean and Kiu, 2002). In the defense sector, the military aspect requires that the system be effective, and this includes characteristics such as robustness and resilience as well as efficiency in delivery (Glas *et al.*, 2013). However, in the energy sector, performance is always defined as making investments in energy efficiency for the customer, which leads to overall improved plant and operational efficiency, and obtaining income from a proportion of the saved energy costs (Davies and Chan, 2001; Deng *et al.*, 2014).

Finally, performance is also considered from a multidimensional perspective; that is, it is necessary to consider multiple factors such as quality, cost, delivery and timeliness to evaluate supplier performance (Buchanan and Klingner, 2007; Lazzarotto *et al.*, 2014). Lu (2016) argues that it is difficult to find suitable measures that incorporate the full spectrum of human service performance, which is characterized by multidimensional and competing values. The outcome in general can be defined by several, individually determined, dimensions, for example, operational availability, logistics response time and customer satisfaction (Doerr *et al.*, 2005; Sols *et al.*, 2007).

In summary, the review showed that there is confusion about the exact definition of performance within PBC that is also dependent upon the industry sector. The terms “output” and “outcome” are occasionally used interchangeably, or at least they are not defined. As emphasized by the PMM literature, the authors within the PBC field are aware of the multidimensionality of performance and highlight the efficiency and effectiveness of the demanded outcomes.

**5.2.3 KPI design and performance targets.** The above-noted aspect of PMM is also of high importance for PBC due to the relatively high number of 60 codings. In the design phase of PBC, the objective is to encourage the contractor to optimally deliver the requested performance (Stanley and Hensher, 2008). In this respect, the KPIs that represent the requested performance (desired outcome) are a vital element to measure the achieved performance in relation to predefined performance targets (Glas *et al.*, 2013; Alyami *et al.*, 2015). The literature states that the selection of KPIs that actually represent the desired outcome is a major step in the design and management of PBC (Datta and Roy, 2011). KPI definition often represents a key challenge for the customer (de la Garza *et al.*, 2009; Caldwell and Howard, 2014; Holmbom *et al.*, 2014). For example, when system reliability is measured using the KPI “mean time between failures” (MTBF), it is often difficult to define what a failure actually is (Holmbom *et al.*, 2014). To analyze the MTBF, other low-level KPIs such as failure diagnostics time or parts delivery time must be considered (Jin and Tian, 2012).

It is possible to assess contract performance using a single KPI, which is often the case in the utilities sector (Sols *et al.*, 2008). However, in most cases, performance is measured across industries by a multidimensional set of KPIs that can incorporate quantitative and qualitative elements (McLellan *et al.*, 2008; Datta and Roy, 2011) and can be objectively or subjectively measured (Holmbom *et al.*, 2014). However, this set of KPIs should be limited to a few high-level KPIs that form the basis for incentives (Vitasek and Manrodt, 2012; Kristiansen, 2017).

With regard to the design of specific KPIs for PBC, several requirements have been identified in the literature (Alyami *et al.*, 2015; Selviaridis and Wynstra, 2015): a KPI must be clearly defined and documented, outcome oriented, linked to customer strategic objectives,

SMART (specific, measurable, achievable, result-oriented and timely), objectively measurable and the number of KPIs in use should be limited.

Furthermore, numerous articles report on PBC and the KPIs that are used in the practice, often based on case studies. According to Selviaridis and Norrman (2015), common KPIs in the service supply chain are packaging delivery precision percentage, packaging availability percentage, transport delivery precision percentage, cost savings for customers, transport delivery accuracy percentage, picking accuracy percentage and perfect order percentage. The KPIs of a logistics service provider for a military system are availability, reliability, maintainability, supportability, logistics response time, logistic footprint and cost of use (Sols *et al.*, 2007; Nowicki *et al.*, 2010). Cleaning services in public transport are assessed by the following KPIs: quality (cleanliness of trains), safety (processes and tools/materials used) and personnel (employee satisfaction) (Nullmeier *et al.*, 2016). The industry perspective indicates that multiple performance indicators are required in a PBC setting (Sols *et al.*, 2007; Nowicki *et al.*, 2008).

The KPIs were grouped to structure the content of the reviewed articles. Some articles only report on generic KPIs, e.g., “availability” or “mobility,” whereas other articles explicitly mention specific KPIs, e.g., “shipments volume per pallet” or “MTBF.” Therefore, the findings are presented in generic KPI categories (Table II) and specific KPI measuring specifications (Table III).

Focus area	Key performance indicator categories	Author(s)
Logistics in defense and aerospace	Availability, reliability, maintainability, supportability, logistics response time, logistic footprint and cost of use	Sols <i>et al.</i> (2007), Barber and Parsons (2009), Nowicki <i>et al.</i> (2010)
Logistics in defense and aerospace	Utilization, productivity, effectiveness, transactions	Doerr <i>et al.</i> (2005)
Logistics in defense and aerospace	Second-tier metrics for system effectiveness, operational availability, availability, degraded availability, mission availability and degraded mission availability, operational reliability, mission reliability, mission dependability, degraded mission reliability and degraded mission dependability, logistics footprint; response time	Sols <i>et al.</i> (2008)
Construction works	Mobility (traffic flow), safety (residents, construction workers), accessibility (duration of construction on site) and environment (noise, dust, waste, reused materials, total use of materials)	Sebastian <i>et al.</i> (2013)
Train manufacturing	Operational availability (trains are to be ready for departure at specified times), mission reliability (the trains should arrive at their destination stations on time, provided they departed from the origin stations on time)	Sols <i>et al.</i> (2007)
Industrial maintenance	Quality performance, cost, delivery time	Lazzarotto <i>et al.</i> (2014)
Cleaning services in transportation	Quality (cleanliness of trains), safety (processes and tools/materials used), personnel (education provided and employee satisfaction)	Nullmeier <i>et al.</i> (2016)
Road maintenance	Level-of-service effectiveness, cost efficiency, timeliness of response (response time of the contractor to service requests), response to complaints, response to emergencies and snow removal, safety procedures, quality of services (assesses the customer perceptions with respect to the condition of the assets and contractor performance)	de la Garza <i>et al.</i> (2009), Ozbek <i>et al.</i> (2010), Sultana <i>et al.</i> (2013)
Road maintenance (pavement)	Pavement evaluation indices, e.g., pavement condition index (PCI), mathematical equations of which the inputs are values of different performance measures such as rutting and cracking	Alyami <i>et al.</i> (2015)

**Table II.**  
KPI categories in PBC



Focus area	Key performance indicator	Author(s)
Logistics service provider	Physical KPIs (e.g. shipments volume/EUR pro pallet, geographical coverage); monetary KPIs (trade spending/value in use, capital investments/return on assets); informational KPIs (electronic data exchange/units, category data/value)	Mouzas (2016)
Logistics service provider	Labor hour used/labor hours budgeted; area of warehouse occupied/total area; hours machine used/machine capacity; ton-miles delivered/costs incurred; orders processed/hours of labor; pallets unloaded/hour of dock time; items filled/items requested; shipments on time/shipments sent; error/total transactions	Doerr <i>et al.</i> (2005)
Road maintenance (pavement)	Flexible pavement: cracking, rutting, raveling, flushing, potholing; rigid pavement: transverse cracking, faulting, longitudinal meander cracking, joint failure, joint cracking or spalling; granular shoulder: cross-fall, edge drop-off, ponding, rutting	Alyami <i>et al.</i> (2015)
Road maintenance (pavement)	Pavement sound intensity testing; pavement smoothness; concrete thickness; concrete spread rates	Molenaar and Navarro (2011)
Service supply chain	Packaging delivery precision percentage, packaging availability percentage, transport delivery precision percentage, product damages (max incidents per month), cost savings for customers, transport delivery accuracy percentage, picking accuracy percentage, product damages percentage and perfect orders percentage	Selviaridis and Norrman (2015)
Maintenance for real estate management	Jammed windows and doors; presence of wood rot; presence of cracking paint; discolored paint; loss of gloss paint; functioning of double glazing; presence of glass damage	Straub (2007)
Maintenance defense and aerospace	Mean time between unscheduled repairs; availability of spares and engines within 72 hours	Glas <i>et al.</i> (2013)
Maintenance defense and aerospace	Available flying hours; available days at sea	Caldwell and Howard (2014)
Maintenance defense and aerospace	Number of aircrafts available; flight hours; spares available; number of non-functional days	Datta and Roy (2011)
Human service	Employment results; time to employment; job retention and wage	Lu (2016)
Human service	Entered employment; job retention, full and appropriate engagement, customer satisfaction	Heinrich and Choi (2007)
Healthcare	Immunization and antenatal care coverage, patient satisfaction and health worker satisfaction	Soeters <i>et al.</i> (2011)
Property management	Energy saving, air temperature, water quality, air quality, water temperature	Hufen and de Bruijn (2016)
Train operator	Train delay time; technical errors measured as discrete errors	Stenbeck (2008)

**Table III.**  
KPIs in PBC

Once the relevant KPIs are selected and defined, baseline values and required performance targets must be established (Sols *et al.*, 2008; de la Garza *et al.*, 2009). Baseline each KPI could already be a challenging task in a PBC. The baseline can be based on historical performance data; however, even that might not be reliable when the measurement of the data has been done differently or the system is now used differently (Sols *et al.*, 2008; Holmbom *et al.*, 2014). For newly developed systems or service bundles with no historic experience, baselining is even more challenging because the baseline must be defined based on predictions of future performance (Kim *et al.*, 2007).

After setting the baseline – the “normal” performance of a system – the next step is to define the desired performance target (Holmbom *et al.*, 2014). This target is connected with financial incentives in a PBC and is often a topic of negotiations and discussions between the PBC provider and the contractor, particularly when the performance targets have been set too high (Selviaridis and Norrman, 2015). However, setting the performance targets too low is also risky because both sides are satisfied by good reported performance, but no one challenges the indicators in terms of whether an even better

performance is possible (Alyami *et al.*, 2015; Schoenmaker and de Bruijn, 2016). As Holmbom *et al.* (2014) stated, "Performance target values must represent the customer's needs and form a realistic challenge for the supplier." In addition to the described performance targets, defining and setting minimum performance levels below which the customer is allowed to drastically penalize the contractor or even terminate the contract is also recommended (Sols *et al.*, 2008).

Several sources address the issue of how to implement PBC as a business model (e.g. Kumar and Markeset, 2007; Jin and Wang, 2012; Freund and Stölzle, 2016); however, few sources address the more detailed aspects of the implementation of a PBC KPI measurement system. There are empirical findings, e.g., the need for investments (Selviaridis and Norrman, 2014); however, the topic of KPI implementation in PBC is clearly a gap in the literature.

Overall, KPI design and performance targets are broadly discussed in the PBC literature, compared with other PMM process steps. There are different opinions with regard to how to measure performance (single KPI vs several KPIs); however, the literature broadly agrees on KPI requirements and the procedure to define KPI baseline or target values. A multitude of KPIs are mentioned in the literature, whereas there is only limited discussion of implementation aspects.

*5.2.4 Design of an incentive system.* The design of a PBC payment system determines the degree of incentive alignment by defining the extent and intensity of bonuses and penalties (Kim *et al.*, 2007; Sols *et al.*, 2007). The objective is to balance several KPIs and transform the results into a reasonable payment (Sols *et al.*, 2008), although it is a challenge to find a performance incentive with the necessary but reasonable intensity (Selviaridis and Norrman, 2015). A PBC incentive system requires a financial performance payment component (Doerr *et al.*, 2005; Glas *et al.*, 2013). This financial incentive is linked to KPIs to motivate the contractor to perform in the interest of the customer (Hünerberg and Hüttmann, 2003; Selviaridis, 2016). The extent of the variable component of the payment and incentive system is highly project specific. A payment that is directly linked to KPIs is in fact conceivable; however, in practice, partially tied payment systems dominate (McLellan *et al.*, 2008; Glas *et al.*, 2013; Selviaridis and Wynstra, 2015).

For the manufacturing industry, Hypko *et al.* (2010) distinguish the pay-on-availability (provided performance), pay-on-production (demanded performance) and pay-per-use (demanded performance) PBC payment approaches. The pay-on-availability approach ensures the customer the availability of a specified system or machinery. Following the pay-on-production approach, contractor compensation is tied to the manufactured output, whereas the pay-per-use approach focuses on how often a system is used or on the volume of manufactured products (Hypko *et al.*, 2010).

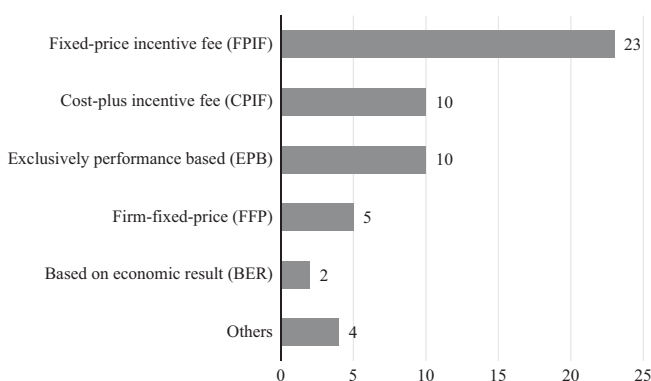
There are essentially five payment models that are described in the PBC literature (Figure 8): fixed-price incentive fee (FPIF), cost-plus incentive fee (CPIF), firm-fixed-price (FFP), exclusively performance-based (EPB) and based on economic result (BER).

The most common payment model is the FPIF, which provides a fixed price for a defined performance (e.g. system availability) based on a defined level of use (e.g. hours in use) and adds an incentive component when performance targets are achieved or surpassed (Kim *et al.*, 2007; Nowicki *et al.*, 2010; Caldwell and Howard, 2014).

A CPIF is determined by reimbursed costs for the service with an additional incentive component to foster performance improvements or cost reductions (Nowicki *et al.*, 2010; Datta and Roy, 2011; Glas *et al.*, 2013). These types of contracts can also be used as a first step to a FPIF payment model (Kim *et al.*, 2007).

Some authors actually do not consider a FFP to be a PBC payment model (Kim *et al.*, 2007; Hypko *et al.*, 2010); however, when the fixed price is tied to minimum performance targets

**Figure 8.**  
No. of articles dealing  
with payment models



that must be achieved, it can also be considered to be an alternative PBC payment model (Randall *et al.*, 2011; Glas *et al.*, 2013).

To integrate the KPIs with the described payment models, Sols *et al.* (2007) suggested the concept of penalty, dead and reward zones. Only when the performance reaches the reward zone does the contractor realize a superior profit. In the dead zone, he/she is reimbursed according to the agreed price, and in the penalty zone, the price is cut (Sols *et al.*, 2007).

In addition to the described payment models, which are partially tied to performance, there are also payment models that are discussed that fully tie performance to payment (EPB). This model best fits the core concept of PBC because it focuses the contractor solely on achieving the defined performance. An EPB is often neglected by contractors due to the high-risk transfer (McLellan *et al.*, 2008; Glas *et al.*, 2013).

The last discussed model in the PBC literature is a payment model in which the fee is based on customer economic result (BER). In this model, performance is tied to defined KPIs that reflect the customer economic result, for example generated revenues, saved costs or contribution to customer margin (Hünerberg and Hüttmann, 2003; Hypko *et al.*, 2010).

In summary, the analyzed literature essentially agrees that the design of an incentive system is important for PBC. However, several payment schemes are presented, and the schemes are named differently (e.g. pay-per-use vs incentive fee payment). There is also no consensus with regard to which payment schemes are actually PBC. Overall, the PMM topic is not yet consolidated for PBC.

**5.2.5 Data capture.** The next step in the PMM process is to check whether and how the data for a KPI can be measured and whether the data are precise, accurate and reliable (Choong, 2014). Such issues are often an obstacle in designing an effective PMM system in a PBC context (Selviaridis and Norrman, 2015). The review shows that in most of the articles, data capture does not play a role because it is hardly mentioned. Only 26 codings (out of 257) mention the topic of data capture.

In these articles, several means of data capture are described. Nullmeier *et al.* (2016) identified two main approaches to gather contractor performance data, including contractor audits and customer satisfaction surveys; however, they acknowledge that additional methods are occasionally used to verify the same performance category to increase credibility for the contractor. In road maintenance or construction, the data are primarily gathered through field inspections (de la Garza *et al.*, 2009; Mouzas, 2016). In addition to audits, surveys and field inspections, conducting meetings to gather data directly from the responsible persons is also suggested (Kumar *et al.*, 2006); however, the credibility of the data with regard to the influence on incentives is questionable. If performance cannot be objectively verified by auditors, contractors might encounter audit exceptions, questioned costs and demands for

repayment (Martin, 2007). Conversely, the customer then must ensure that the PBC contractor is not gaming the system, e.g., when a bus driver does not stop at all of the bus stops because he/she is late, which is directly related to financial bonuses (Greiling, 2006).

Another interesting question is related to the responsible party performing the data gathering. It might be assumed that in a PBC, the data gathering is performed by the customer due to the link with payment; however, this approach is not always used (Alyami *et al.*, 2015; Nullmeier *et al.*, 2016). In addition, contractors can be held responsible for periodically collecting performance data (Martin, 2007). Then, the reliability of the data gathering must be ensured, e.g., by randomly joining the contractor during data gathering or performing additional quality audits (Alyami *et al.*, 2015). Another approach is third-party data collection, which is often assumed to be more objective; however, additional costs are incurred with that approach (Stenbeck, 2008).

When measuring performance, the most important element is the underlying IT infrastructure, which can determine a reliable, accurate, effective and efficient data collection process (Randall *et al.*, 2010; Selviaridis and Norrman, 2015; Mouzas, 2016). Particularly in PBC contexts that include complex and expensive product-service bundles, real-time data collection that is supported by IT is necessary (Forslund, 2012). Moreover, in the field of energy service contracts, high investment in IT infrastructure for data gathering and auditing is compulsory, often requiring specialized tools and equipment (Sorrell, 2007). In this context, the additional investments in data collection and measurement systems can outweigh the benefits that can be gained by extra rewards and must be thoroughly considered (Greiling, 2006; Kumar *et al.*, 2006).

Overall, it is surprising that data capture is hardly mentioned in the reviewed literature because this PMM process step is considered to be a possible obstacle to designing effective PBC. The literature sources agree that there are multiple approaches to gathering data, e.g., audits, surveys, field inspections or systems that are fully automated by IT. There is no clear consensus or recommendation with regard to data gathering responsibilities. Discussed alternatives include data gathering that is performed by the customer, by the provider or by a third party. Furthermore, studies broadly agree that an underlying IT infrastructure is helpful for PMM in PBC. However, the names of the IT systems that are in use are not mentioned, nor are the requirements or functionalities of such systems discussed. Altogether, the literature on data capture is consistent on general aspects (e.g. the need for IT infrastructure and the need for the clarification of responsibilities); however, further guidance (e.g. evaluation or even case descriptions of PMM IT systems) remains missing.

*5.2.6 Performance assessment.* After the performance data are gathered, they must be analyzed to provide feedback to the contractor and report results to respective stakeholders (Sols *et al.*, 2008; Molenaar and Navarro, 2011). This PMM process step has received surprisingly little notice (21 codings), even when it is necessary to develop and implement monitoring methodologies, procedures and tools (Alyami *et al.*, 2015) that are structured systematically (Kumar *et al.*, 2006). Performance monitoring and assessment procedures are aimed at the evaluation and definition of service success, assigning failures to specific actions of the contractor or the customer and investigating whether the contractor is accountable for these failures (Selviaridis and Norrman, 2014). In regular assessment meetings, the achievement of performance targets and deviations from targets are discussed, and corrective actions are jointly planned (Kumar *et al.*, 2006; Buchanan and Klingner, 2007). In preparation for these meetings, data assessment can be structured in three phases (Larbi, 2001; Sols *et al.*, 2008; de la Garza *et al.*, 2009), which are as follows:

- (1) calculation of actual and target values of the respective KPIs;
- (2) performing a comparison of actual values and target performance values; and

- (3) performing a comparison between different areas of service, different years (also trend analysis) and in relation to budget with the objective of deriving further actions.

The aim of these steps is to transform the gathered data into information (Sols *et al.*, 2008). The assessment of the information in meetings is of high importance, and it is considered to be a critical success factor (Selviaridis and Norrman, 2015). Overall, performance assessment is a necessary step within the PMM process, and the extent of data analysis must be considered in the context of the required investments of time, effort and money (Ozbek *et al.*, 2010). Some sources provide further insights into performance assessment, e.g., the execution of performance assessment meetings.

*5.2.7 Performance reporting.* Overall, only nine codings address performance reporting. Some of them explicitly address the issue and identify several aspects (Greiling, 2006; de la Garza *et al.*, 2009) while other sources only mention some aspects. First, several authors identify the need to report performance (Greiling, 2006). Selviaridis and Wynstra (2015) and Molenaar and Navarro (2011) measure and report performance; however, only Greiling (2006) notes the high importance of reporting as an “important driver for the introduction of performance measurement.” Greiling (2006) also weighs the efficiency and effectiveness of reporting. Ineffectiveness is mentioned, for example, the production of reports that do not influence the decision-making process or increase efficiency generate high costs for gathering information that outweigh the benefits of the data.

Another aspect is reporting frequency. In the articles, there are four comments on the frequency of performance reporting: Larbi (2001), Vitasek and Manrodt (2012), Selviaridis and Wynstra (2015) and Kumar *et al.* (2006) simply state that reporting should occur regularly. However, it is not clear what “regular reporting” actually means; a whole range, from real-time to daily, monthly, quarterly or annual reporting, is conceivable.

Additional information is given with respect to the design and/or formatting of reporting. de la Garza *et al.* (2009) distinguish three alternative report designs: report card with a simple presentation of KPIs; report of effectiveness, with a detailed analysis of the PBC performance; and report of deficiencies with critical issues addressed to the PBC provider. Ozbek *et al.* (2010) also refer to the report card as a meaningful reporting design and provide deeper insights into the reporting formatting by proposing the use of as many visuals as possible. Reporting should produce appropriate and user-friendly reports that can effectively communicate the results to stakeholders (Ozbek *et al.*, 2010).

Finally, there are several comments on the content of performance reporting in PBC. Greiling (2006) indicates that the reporting of multidimensional KPIs would enhance transparency. de la Garza *et al.* (2009) note the reporting of KPIs on effectiveness and on performance deficiencies.

Overall, this section showed that the academic discussion of the performance reporting of PBC remains in its infancy because the included aspects of reporting (need for reporting, efficiency and effectiveness, frequency, organization, design and/or formatting and content) are only slightly touched upon. Most statements are based on generic or plausible clues that concern how to report management content. A broader discussion on how performance should be reported in PBC is missing.

*5.2.8 Taking action and refreshing.* Issues that concern the PMM process, step-taking action and refreshing are limited to the following aspects. First, the issue of contract extension or termination is supposed to be relevant (Lazzarotto *et al.*, 2014). In PBC, the opportunity for an early contract extension can provide additional incentives for the contractor (Geary *et al.*, 2010). This type of incentive can also raise the issue that once the contract extension is granted, it loses its power. To cope with that problem, multiple contract extensions are suggested (Schoemaker and de Bruijn, 2016). Conversely, an early

contract termination can also be considered when the contractor repeatedly misses the minimum performance targets, dependent on how this alternative is defined in the contract (Sols *et al.*, 2008).

A challenge of long-term PBC is to develop a PMM and incentive system that remains relevant, achievable and challenging over the entire contract period (Geary *et al.*, 2010; Hufen and de Bruijn, 2016). Therefore, several authors emphasize the importance of flexible contract configuration and the corresponding PMM system (Kumar *et al.*, 2006; Sols *et al.*, 2007; Datta and Roy, 2011; Vitasek and Manrodt, 2012). Selviaridis and Wynstra (2015) discovered that “contractual flexibility is required to adjust performance measures and financial incentives as experience accumulates.” Datta and Roy (2011), Selviaridis and Norrman (2014) and Selviaridis (2016) found that a certain flexibility of the defined performance targets results in increased system performance for the customer and general improved performance of the contractor, which leads to a win-win business relationship. Moreover, the contractor is more amenable to risk taking (Selviaridis and Norrman, 2014). In addition to these internal factors, there could be changes in the environment that influence the contract (Randall *et al.*, 2010; Batista *et al.*, 2016). In this context, Sols *et al.* (2007) argued, “[...] it is important to ensure that a system’s supportability strategy and corresponding performance-based logistics methodology are robust and agile, easily adapting to the evolving operational environments.” Due to the individual specification of each PBC and the often-missing experience at the beginning of the contractual relationship, decreasing the contract flexibility is recommended as the contract duration progresses (Hufen and de Bruijn, 2016). Although many authors stress the need for flexible contracts, an increase in contract complexity is reported (Schoenmaker and de Bruijn, 2016), which in turn underscores the importance of PMM.

In summary, the PBC literature only focuses on certain actions with regard to contract flexibility and on discussions of an early contract extension as an additional incentive instrument. These issues are identified as possible challenges for the development of PBC contracts over time. An in-depth analysis of solution mechanisms for these challenges is missing in the analyzed literature.

## 6. Discussion

The starting point of this work was the initial suspicion that the research streams of PBC and PMM are barely linked. From a quantitative point of view, this review identified 102 contributions and 257 content coding references that address PMM issues within PBC-focused articles. The sheer number might indicate that there is a broad basis of literature that connects PMM with PBC. However, the content analysis revealed that the maturity level of the PMM discussion in the context of PBC varies greatly depending upon the PMM process step.

The PMM process steps 2 – performance specification, 3 – KPI design and 4 – design of the incentive system are discussed more broadly within the PBC articles. However, these process steps only have a loose relationship with the specialized PMM literature. References to common PMM frameworks such as the balanced scorecard (Kaplan and Norton, 1992) or the performance pyramid (Cross and Lynch, 1988) cannot be reported at all within the analyzed literature. The other PMM process steps are not substantially discussed. These topics are often mentioned without any conscious reference to the PMM literature. Overall, the content findings of this review generally confirm the initial suspicion and indicate that there is only a minimal connection between the literature streams of PBC and PMM (see Table IV).

More specifically, the findings from the content analysis provide answers for the study’s guiding research questions with regard to how the PMM literature can contribute to PBC



PMM process step	PBC phase	Evaluation of overall discussion of PMM in the PBC context	Typical statements
1. Strategy alignment	Contract design	○	<p>“A potential specification challenge is a gap between the strategic mission and aims of the buying firm and the performance metrics” (Selviaridis and Wynstra, 2015)</p> <p>“An effective performance contract motivates contractors to help achieve the owner’s business goals and objectives through financial incentives” (Buchanan and Klingner, 2007)</p>
2. Performance specification		●	<p>“[...] the customer has to consider monitoring the performance of contracted services to assure the effectiveness and efficiency of the outcome” (Dean and Kiu, 2002)</p> <p>“PBL reflects contracting performance outcomes such as the availability of [...] systems” (Glas <i>et al.</i>, 2013)</p>
3. KPI design and performance targets		●	<p>“Performance measures [...] are perhaps the most important elements of performance contracting” (Alyami <i>et al.</i>, 2015)</p> <p>“Once baseline values are available for the selected metrics, the next step is to set objectively the target values for them [...]” Sols <i>et al.</i> (2008)</p> <p>“Select KPIs that reflect customer value is often difficult, since the customer’s needs often are formulated in abstract terms” (Holmbom <i>et al.</i>, 2014)</p>
4. Design of incentive system		●	<p>“PBC replaces conventional cost-plus contracts” (Kim <i>et al.</i>, 2007)</p> <p>“[...] the pay-on-availability approach constitutes the basic payment model of PBC in manufacturing industries” (Hypko <i>et al.</i>, 2010)</p> <p>“It is conceivable that all payments fully relate to the performance indicator, but parts of the payment can also form an incentive” (Glas <i>et al.</i>, 2013)</p>
5. Data capture	Contract management	●	<p>“Assessment of outcome quality [...], using three data sources: passenger satisfaction surveys, passenger as well as train conductor complaints, and quality audits” (Nullmeier <i>et al.</i>, 2016)</p> <p>“The costs for gathering performance information can outweigh the benefits [...]” (Greiling, 2006)</p>
6. Performance assessment		●	<p>“[...] the evaluation of the influencing factors was not conducted in a systematic and structured way” (Kumar <i>et al.</i>, 2006)</p> <p>“These data are analyzed and subsequently used to provide feedback to the supplier” (Nullmeier <i>et al.</i>, 2016)</p> <p>“Performance evaluation can be problematic in terms of evaluation routines” (Selviaridis and Wynstra, 2015)</p>
7. Performance reporting		●	<p>“Success is measured against the established metrics that are reported on regularly [...]” (Vitasek and Manrodt, 2012)</p>

**Table IV.**  
Evaluation of PMM topics in the PBC context

(continued)

Table IV.

PMM process step	PBC phase	Evaluation of overall discussion of PMM in the PBC context	Typical statements
8. Taking action and refreshing	Post-contract	○	<p>"[...] need to be reported and monitored so that the supplier's performance is evaluated" (Selviaridis and Wynstra, 2015)</p> <p>"Contracts should be flexible and allow for changes in the scope of to be made in the long-term" (Lazzarotto <i>et al.</i>, 2014)</p> <p>"Flexibility in performance targets leads to better system availability for the customer and better performance of the supplier" (Datta and Roy, 2011)</p> <p>"Instead of only rewarding a contractor for excellent performance with additional award fee, it rewards the contractor by extending the contract period without new competition" (Geary <i>et al.</i>, 2010)</p>

Note: Balls indicate maturity level of discussion from low ○ ◐ ◑ ◒ ◓ to high degree

and vice versa, which will be outlined and summarized in this section. The review revealed that the PMM aspects in PBC are practice driven because most PMM aspects are described based on case studies. As mentioned above, references to common PMM knowledge, such as the balanced scorecard (Kaplan and Norton, 1992), are not reported. PMM aspects are addressed and solved practically without actually using the existing PMM knowledge. This aspect is supported by the fact that only four reviewed articles were published in dedicated PMM journals, such as the *International Journal of Productivity and Performance Management*. Therefore, the PBC literature could generally profit from focused studies on the implementation of performance measurement systems in close buyer-supplier relationships (e.g. Van Camp and Braet, 2016; Ferreira *et al.*, 2012). This situation exists in particular with respect to process orientation, because the PMM literature provides several process models for PMM in contractual relationships, e.g., by Neely *et al.* (1995) and Bourne *et al.* (2005). The models can be transferred and adapted to PBC, together with other features of a PMM system (e.g. Franco-Santos *et al.*, 2007; Choong, 2013).

Conversely, expanding the PMM literature further to include emerging new practices and business models such as PBC is also required (Melnik *et al.*, 2014), although there are some examples that analyze PMM with regard to PBC or servitization (e.g. Neely, 2008). Specifically, PBC can contribute to PMM in several ways. First, PBC provides a new contingency setting for PMM, which is highly service and value oriented and aligns buyers with supplier objectives. Second, PBC focuses on outcome-oriented KPIs, which pose several challenges, e.g., how to measure, report and analyze causal relationships between inputs, outputs and outcomes. The PBC literature develops and proposes outcome-oriented KPI systems Sols *et al.* (2007). Such new and specific findings can be transferred to and cross-validated with existing KPI frameworks from the PMM literature. Third, the PBC literature analyzes incentive mechanisms (Kim *et al.*, 2007) and develops models to explain and structure compensation schemes (Sols *et al.*, 2008; Glas *et al.*, 2013) that can deliver fruitful insights for the PMM literature. Fourth, PBC can contribute to the PMM discussion with insights from new and developing theories, such as the service-dominant logic theory and its PBC implementation (Randall *et al.*, 2010).

To provide more specific guidance on how both literature streams can learn from each other, a brief description of research opportunities in each process step of our analysis framework is provided. This illustrates that a comprehensive design and implementation model for PMM in PBC is missing, as in each step, there are promising opportunities.

Process step 1, alignment with corporate objectives, has not been identified as an important aspect in the design of PBC, although the need for a link from performance measures to corporate strategic objectives is consistently agreed upon in the PMM literature (Keegan *et al.*, 1989; Otley, 1999; Bourne *et al.*, 2005; Franco-Santos *et al.*, 2007). The strategic objectives of an organization must first be considered before the performance expected from a contractor within a PBC scenario is specified (Barber and Parsons, 2009). The examination of corporate and supply relationship objectives, such as quality, innovation, cost, environment, design or even customer satisfaction, is promising, as this is the starting point for PBC design.

In step 2, performance specification, there are still ambiguities, as performance is often described as being output or outcome oriented; however, both terms are not defined in detail. Without knowing what performance really is, it is not possible to optimize the design of the PMM system in a PBC context. The definition and specification of performance in the PBC setting appears to be a promising research task, and it could link to the discourse in the PMM literature that analyzes the similarities in the definition of performance, e.g., multidimensional understanding (Lebas and Euske, 2007) or possible perspectives such as output and outcome but also input and throughput (Entchelmeier, 2008).

Next, the selection of the right KPIs in step 3 is a major topic in the PBC literature, in which KPI systems are developed and advice on how to select or implement KPIs is provided (Sols *et al.*, 2007). This is similar to approaches in the PMM literature (Keegan *et al.*, 1989). Once the relevant KPIs are defined, the required level of performance must be determined (Ferreira and Otley, 2009). Given the link between achieved performance and the compensation of a provider, the setting of performance targets is a critical task within the design of a contract (Ferreira and Otley, 2009). Because many performance-based contracts are individually designed, the ability to develop a standard set of KPIs only seems possible to a limited extent. However, in some branches, such as human services, construction and road maintenance, standard sets of KPIs have been developed.

Step 4, the payment and incentive system, was identified as an important process within the PMM context (Neely *et al.*, 1995; Franco-Santos *et al.*, 2007). The incentive component as a major governance element is a key determinant of PBC and helps to focus the contractor's attention on the defined performance expectations (Neely *et al.*, 2005). Five payment models have been identified in the reviewed literature that are suitable for PBC. The most urgent challenge in this context is to integrate the right KPIs and to set appropriate performance levels.

Step 5, data capture, is a necessary requirement for calculating KPI values. It appears to be an underestimated task. This is surprising, as in a PBC context, the provider's performance is at least partially tied to the achievement of performance goals (Selvaridis and Wynstra, 2015), so the gathered data must be precise, accurate and reliable (Choong, 2014). Therefore, real-time data capture that is supported by IT is recommended. Particularly when KPIs and the respective data are part of a contractual relationship, investments in information technology foster reliability, accuracy and trust in the determined KPIs (Forslund, 2012). In the design phase of the contract, the issue of how to measure the selected KPIs must be determined. Only when the data have been gathered as objectively as possible will the contractor be willing to tie a portion of the compensation to the defined KPIs. In summary, the reviewed PBC literature lacks deeper insights into approaches for reliable data gathering.

Next, data must be assessed (step 6). Performance assessment procedures aim to evaluate service success, assign failures to specific actions and investigate who is accountable for failures. The question of how to gather data is almost never discussed in the PBC literature; however, the PMM literature, of course, addresses that step in detail and, e.g., divides

performance assessment into basic and extensive data analysis (Bourne *et al.*, 2005). Basic analysis is performed by an IT system and provides deviations against target, often with a traffic light symbol, and automatically calculated figures are presented as, for example, month-to-date figures. Extensive data analysis is also often provided by the IT system; however, it is time consuming and supported by enhanced analytical IT tools, e.g., data enquiry tools and opportunities for a drill-down of KPIs (Bourne *et al.*, 2005). The PMM literature also suggests initiating regular meetings between contractor and customer to assess and interpret the collected data to foster improvements (Mortensen and Lemoine, 2008). It appears that there is great potential for knowledge transfer from PMM to PBC in that step.

The discussion of process step 7, performance reporting, is still in its infancy. Reporting frequency, report content and design are only rarely mentioned in the PBC literature. In contrast, performance reporting is a powerful instrument for communicating the measured performance, targets and priorities, motivating people, providing a basis for decision making and ensuring that the project is aligned to its objectives (Otley, 1999; Choong, 2014). The PMM literature addresses that issue in detail, which indicates opportunities for future research.

Process step 8, taking action and refreshing, is discussed in the PBC literature only when referring to issues of contract extension and contract flexibility. Other actions are barely addressed, whereas the PMM literature suggests that specific actions might be required in the course of the contract, e.g., actions to ensure that KPIs and performance targets remain relevant, achievable and challenging over the whole contract period (Kennerley and Neely, 2002). Further issues that are discussed in the PMM literature – such as PMM issues that concern who may act and which events require action taking, e.g., dramatically declined performance measures (Bourne *et al.*, 2005) – are not examined. In addition, a periodic re-evaluation of the whole PMM system is recommended in the PMM literature (Bourne *et al.*, 2005; Franco-Santos *et al.*, 2007; Pinheiro de Lima *et al.*, 2013); however, it is not a topic in the examined PBC literature.

After summarizing and discussing the answers of the guiding research question and presenting further insights from the PMM literature for each process step of the analysis framework, aggregated theoretical and managerial implications can be outlined in the next section.

## 7. Implications

The findings from the literature review and the comparison with insights from other PMM studies in the discussion section indicate several fits and gaps between the two research areas. Both feature performance as a key concept but differ in the profoundness of their analysis and discussion. Referring to the analysis framework of this paper, the contract design phase is addressed quite often, and the level of the discussion within the PBC literature is high in some aspects, even when there remains room for further analyses of some issues. Fewer contributions address PMM aspects in the contract management phase or the post-contract phase. The topics are only briefly or simply mentioned. Thus far, the level of academic discussion in these contract phases is relatively low.

The interpretation of the review findings has a number of implications for researchers in the PMM and PBC fields. The implications are presented in the form of four major future research opportunities. These research opportunities show pathways to extend PMM theory in the emerging practical field of PBC.

### 7.1 Research opportunity 1: strategy alignment

Although the alignment with corporate goals is identified as a major issue in the PMM literature, it is only slightly touched upon in the context of PBC. This finding is astonishing because PBC performance is outcome oriented and thus should be of strategic interest.

It appears that there is conceptual uncertainty with regard to how strategic goals and business outcomes are aligned between the PBC provider and its PBC customer. It is recommended that future research perform explorative and conceptual work on that issue to identify how and why corporate strategic goals, relationship strategic goals and the design of PBC are connected.

#### *7.2 Research opportunity 2: taking action and refreshing*

This topic is only addressed marginally, whereas the PMM literature addresses triggers for actions and the causes-effects of actions and improved performance. Therefore, future research can focus on triggers for actions that are required from PBC managers to ensure ongoing performance improvements. Because this topic has hardly been addressed to date, examining the issue exploratively and empirically (e.g. through case studies) is recommended to determine whether there are specific and conceptual differences in the execution of that PMM phase when conducting business in a PBC.

#### *7.3 Research opportunity 3: performance measurement*

A detailed discussion of performance monitoring and reporting issues (data capture, performance assessment and performance reporting) is missing in the PBC context; in particular, the approaches for data analysis and cost/benefit issues of automated data gathering should be considered. Due to the numerous publications that concern this topic in the PMM literature, a conceptual study is not suggested; rather, an empirical assessment is suggested that addresses whether a transfer of related topics from the PMM to the PBC field is appropriate. This assessment would include further research on the necessary IT infrastructure and systems that support PBC performance measurement.

#### *7.4 Research opportunity 4: specific aspects of PMM design*

The last research opportunity is related to individual aspects of PMM design for PBC because the design of KPIs or incentives is already broadly addressed; however, several challenges remain open for discussion. One of these challenges is the selection of appropriate KPIs that reflect the desired outcome in a PBC. A process description to develop KPIs for a PBC is missing, and further research could examine this specific topic. Another challenge is clarification of the definition of performance. Currently, most articles refer to outcome-oriented performance, while some refer to output-oriented performance. PMM widely acknowledges a multidimensional definition of performance. Therefore, the conceptual refinement of the understanding of performance is suggested. The third specific aspect focuses on the link between PBC KPIs and their integration into the (corporate) PMM indicator system. For that issue, empirical research is recommended.

In addition to the implications for research, this review also proposes managerial implications. More specifically, the process-oriented understanding of PMM aspects helps practitioners to structure their measurement and management activities in accordance with the eight process steps. Furthermore, the content that is presented in each process step is helpful to crosscheck and validate PBC efforts in practice with the state-of-the-art. For example, PBC practitioners are now able to compare their KPIs with the indicators that are listed in the tables of this paper. Thus, the analysis framework can direct management's attention to crucial process steps, but it also provides initial help for operations management within single process steps. However, some PMM aspects, e.g., the important issue of IT support systems for data capture and reporting, are so new that practice should cooperate with researchers to allow case analysis or best-practice identification studies.

## 8. Conclusion

This contribution sheds light on the emerging business concept of PBC, which is explicitly concerned with performance and its measurement, because payments are directly linked to KPIs. This review synthesized two literature streams and revealed that, surprisingly, only some aspects of PMM are discussed in the context of PBC, whereas many aspects are only marginally addressed. Of the eight PMM process steps in the analysis framework, only two are discussed in more detail.

The first main contribution lies in the synthesis of PMM and PBC literature and the creation of a combined and cross-understanding that enables researchers and practitioners in both areas to learn from each other. The second main contribution lies in the literature-based identification of future research opportunities. Four opportunities are highlighted, each of which provides inspiration for the PMM and PBC research streams. The findings provide evidence that the PMM and PBC research streams can profit from each other. PMM could further develop in the direction of service-oriented businesses such as PBC. The examination of whether and what knowledge can be transferred to PBC, e.g., in the field of performance reporting, is another recommendation. In a broader sense, this research also contributes to the literature on supply chain integration (e.g. Fawcett and Magnan, 2002; Flynn *et al.*, 2010) because PMM connects the PBC customer with its provider.

This investigation has made efforts to base its findings on robust and rigorous research, i.e., using coding software, involving different researchers in the coding process and assessing inter-rater reliability. However, there are research limitations that must be considered. First, this research work faces all of the limitations of literature reviews in general, such as the need to focus on specific keywords and employ a filter system to reduce the literature hits to a manageable number. Second, content analysis always faces the risk of coding bias and subjectivity. Finally, the interpretation of the findings into future research opportunities involves the aggregating of information.

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### Further reading

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(The Appendix follows overleaf.)



**Table A1.**  
PMM aspects in  
PBC literature by  
industry branch

Industry	Strategy alignment				KPI design and performance targets				PMM process step				Taking action and refreshing			Sum/100%	
	3	5.6%	18	33.3%	12	22.2%	11	20.4%	1	1.9%	3	8.1%	0	0.0%	6		11.1%
Aerospace/defense	0	0.0%	12	32.4%	10	27.0%	7	18.9%	3	8.1%	0	0.0%	1	2.7%	4	10.8%	37
Healthcare/welfare	0	0.0%	5	19.2%	8	30.8%	1	3.8%	5	19.2%	3	11.5%	2	7.7%	2	7.7%	26
Construction	3	13.6%	4	18.2%	6	27.3%	2	9.1%	1	4.5%	1	4.5%	1	4.5%	4	18.2%	22
Transportation	1	6.7%	4	26.7%	3	20.0%	0	0.0%	1	6.7%	3	20.0%	0	0.0%	3	20.0%	15
Energy	1	7.7%	4	30.8%	4	30.8%	3	23.1%	0	0.0%	1	7.7%	0	0.0%	0	0.0%	13
Manufacturing	0	0.0%	4	19.0%	6	28.6%	3	14.3%	4	19.0%	1	4.8%	2	9.5%	1	4.8%	21
Public sector	0	0.0%	0	0.0%	1	25.0%	0	0.0%	1	25.0%	1	25.0%	0	0.0%	1	25.0%	4
Housing	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	25.0%	1	25.0%	1	25.0%	1	25.0%	4
Oil and Gas	5	8.2%	13	21.3%	10	16.4%	6	9.8%	9	14.8%	7	11.5%	2	3.3%	9	14.8%	61
Other	13	5.1%	64	24.9%	60	23.3%	33	12.8%	26	10.1%	21	8.2%	9	3.5%	31	12.1%	257

### About the authors

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