

Measuring supply chain performance: a lifecycle framework and a case study

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ABSTRACT

Purpose:

(1) providing a conceptual framework of the supply chain performance measurement system (SCPMS) lifecycle (highlighting key activities of the design, implementation, use, and review phases); (2) investigating how the different actors involved in the SCPMS perceive the system and can act to allow for an effective adoption.

Design/methodology/approach:

the SCPMS lifecycle framework is developed grounding on performance measurement and supply chain management literature. To answer the two theory building research questions, an in depth case study involving seven firms across three tiers of the mass retail supply chain has been conducted.

Findings:

the empirical evidence highlighted potential SCPMS benefits (including operational performance improvement, higher control, lower information overloading, higher supply chain integration) and criticalities/barriers to an effective adoption (lack of industry standards, lack of trust regarding data reliability, SCPMS as a tool of power, lack of interest in the system and the performance metrics). Several elements characterizing the SCPMS lifecycle could increase its effective adoption: engaging SC partners in the design phase; relying on a rigorous primary data collection and performance measures calculation; actively exploiting the tool through a systematic discussion on performance and establishing incentive/disincentives plans.

Originality/value:

the paper contributes to the conceptualization of SCPMSs and to clarify how to ensure an effective SCPMS adoption: apart from relationship specific attributes, SCPMS lifecycle phases are suggested to have a key role.

Keywords: Supply chain; performance measurement system; lifecycle; case study

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1. Introduction

A performance measurement system (PMS) is defined as “a set of metrics used to quantify both the efficiency and effectiveness of actions” aimed at supporting the strategy implementation (Neely et al., 1995). Several studies have focused on various aspects of the PMS lifecycle – i.e., the design phase (Neely et al., 1995), the implementation and use phase (Bourne et al., 2000; Bourne et al., 2002; Henri, 2006), the review phase (Braz et al., 2011) – and its relationship with performance improvement. While most of these works investigate intra-organizational PMSs (i.e., systems that focus on a single company performance), there is an increasing interest on inter-organizational PMSs. Such systems, often referred to as supply chain performance measurement systems – SCPMS (Van Hoek, 1998; Beamon, 1999; Angerhofer and Angelides, 2006), entail several challenges considering – for example – how hard is to collect and integrate data coming from different firms and to manage an inter-firm reporting (Gunasekaran et al. 2004; Hald and Ellegaard, 2011; Luzzini et al., 2014).

Extant literature still offers limited insights on how to ensure the effective adoption of SCPMSs. To the best of our knowledge, previous studies mainly focus on the system design (addressing which performance dimensions to tackle and how to select relevant metrics), neglecting the other phases of the SCPMS lifecycle (i.e., implementation, use and review), even though they crucially affect the SCPMS success or failure (Gutierrez et al., 2015). Moreover, most empirical studies consider the perspective of a single company in the supply chain (SC), thus neglecting the view of other actors involved. Eventually, SCPMSs are still considered a promising research stream (e.g., Melnyk et al., 2014; Franco-Santos et al., 2012).

Within this study, we pursue three goals: first, we aim to develop a comprehensive SCPMS lifecycle framework, which can serve both scholars and managers; secondly, we investigate the SCPMS effective adoption focusing on possible alignments and misalignments in the perception of different SC partners involved; finally, we investigate how the different SCPMS lifecycle phases can affect the system effectiveness, thus properly supporting SC orchestration.

To fulfil previous goals, we firstly review relevant literature and develop a conceptual framework on the SCPMS lifecycle. Next, we define the research questions and illustrate the research method (i.e. the SC case study). As a result, we report the findings and discuss the empirical evidence, which leads to elaborate a set of four research propositions. Conclusions, limitations and future developments of the paper.

2. Research background

2.1 Overview of SCPMS literature

We conceive the SCPMS as “a set of metrics used to quantify the efficiency and effectiveness of supply chain processes and relationships, spanning across multiple firms and enabling supply chain orchestration” (Neely et al., 2005; Hald and Ellegaard, 2011; Gunasekaran et al., 2001-2004). Different disciplines, such as operations and supply chain management (e.g., Beamon, 1999; Cousins et al., 2008), performance measurement and accounting (e.g., Mahama, 2006), and information management (e.g., Angerhofer and Angelides, 2006) have approached the topic, using different labels and focusing on different units of analysis. Rather than covering the SC, the scope of the measurement process has been limited to: vendor evaluation systems (e.g., Luzzini et al., 2014), buyer-supplier relationship performance (e.g., Giannakis 2007), process performance (e.g., Chan and Qi, 2003).

All these streams of literature mostly focus on the SCPMS design, discussing which performance dimensions should be selected (Maestrini et al., 2017). On this behalf, several consolidated frameworks have been proposed, including: the SC balanced scorecard (Brewer and Speh, 2000; Bhagwat and Sharma, 2007); the SCOR model (Gunasekaran et al., 2004); the resource-output flexibility model (Beamon, 1999); and process-based SCPMSs (Chan and Qi., 2003).

These studies acknowledge that the SCPMS, while leading to certain benefits, uncovers some criticalities. Reported benefits include: SC strategy control and communication (Gunasekaran et al., 2004; Bhagwat and Sharma, 2007); more efficient decision-making, avoiding information

overloading (Kocaoglu et al., 2011; Moreira and Tjahjono, 2016); continuous improvement of SC processes and SCM practices (Mondragon et al., 2011). Criticalities include: complex data collection, integration and analysis (Luzzini et al., 2014; Hald and Ellegaard, 2011); defining the unit of analysis (Bhagwat and Sharma, 2007); high investments in management information system (MIS) (Kocaoglu et al., 2011). Nevertheless, empirical evidence regarding benefits and criticalities is limited: SCPMS outcomes are either discussed theoretically or extremely framework specific (e.g. Van Hoek, 1998; Beamon, 1999; Brewer and Speh, 2000).

Therefore, we can identify two main limitations of extant SCPMS literature. On the one hand, a truly SC-wide scope has yet to emerge, as the only adopted perspective normally is the buyer's (i.e., the evaluator), ignoring how other involved actors (e.g., suppliers and third parties) perceive the SCPMS. On the other hand, while picking the right set of measures is essential, it certainly is not the only factor ensuring an effective SCPMS adoption. Just like any other PMS (Bourne et al., 2000; Gutierrez et al., 2015), scholars should adopt a lifecycle view and go beyond the design phase to assess the system effectiveness.

In order to overcome such limitations, we ground on some seminal studies from the PMS literature (Neely et al., 1995; Bourne et al., 2000; Bourne et al., 2002; Henri, 2006; Lohman et al., 2004; Braz et al., 2011) and define the main phases of the SCPMS lifecycle (i.e., design, implementation, use and review), identifying the key steps that should lead to an effective SCPMS adoption, from the perspective of all parties involved.

2.2 Introducing the SCPMS lifecycle framework

The PMS design entails the process of developing the measurement framework, identifying the limited set of metrics that really matters to execute strategy at various levels (Melnyk et al., 2004; Micheli and Mura, 2017). The SCPMS should support the SC strategy implementation and the unit of analysis could range from SC processes to SC relationships and SC partners' status information

(Kannan and Tan, 2002; Giannakis, 2007; Koh et al. 2016). Moreover, the degree of involvement of different actors or functions must be determined: previous studies show that actively involving a cross-functional and cross-firm team into the SCPMS can ensure greater benefits but, at the same time, requires greater skills in terms of relationship management, team-working and negotiation (Luzzini et al., 2014; Hald and Ellegaard, 2011). Once developed the metrics set, firms can eventually set performance-based contracts that formally regulate the relationships and/or apply incentives/disincentives plans (see Figure 1).

In the implementation phase, data are collected and processed on a regular basis through systems and procedures (Bourne et al., 2002). In a SC context, these steps get complicate: primary data collection addresses both internal sources (e.g., vendor rating conducted by the purchasing department) and external sources (e.g., firm's financial performance by information providers). Furthermore, performance reporting requires to account for the needs of different parties in terms of content, frequency, and transparency. To this regard, the use of MISs might dramatically affect the SCPMS adoption, ensuring data reliability and timeliness, task automation and better decision-making (Bititci et al., 2006).

Once routinely implemented, the PMS use greatly affects the resource orchestration process. Using a PMS implies managing feedbacks and discussion on performance reported, implementing the actions leading to designed targets and applying contractual arrangements (including incentive/disincentive mechanisms). Accordingly, a firm can decide to use the SCPMS mainly for internal purposes, or to proactively feed the relationship with external parties (i.e. diagnostic vs interactive use – Henri, 2006). When a diagnostic use is preferred, measures are used one-way and serve to track progress towards goals, monitor results, compare outcomes and expectations, and drive rewards mechanisms. The interactive use, instead, reflects a bi-directional role of the SCPMS, which enables discussion on results and fosters continuous improvement and collaboration.

The last step of the PMS lifecycle entails the review of metrics, in order to keep it aligned with the firm strategy (Lohman et al., 2004). Similarly, the SCPMS review should embed any change in

the SC strategy (considering both endogenous and exogenous factors) through new/revised metrics and targets (Braz et al., 2011).

The SCPMS is generally designed by the focal company or by a third party (like an industry association) but then is supposed to be used by all the actors involved, both upstream (suppliers) and downstream (distributors, customers).

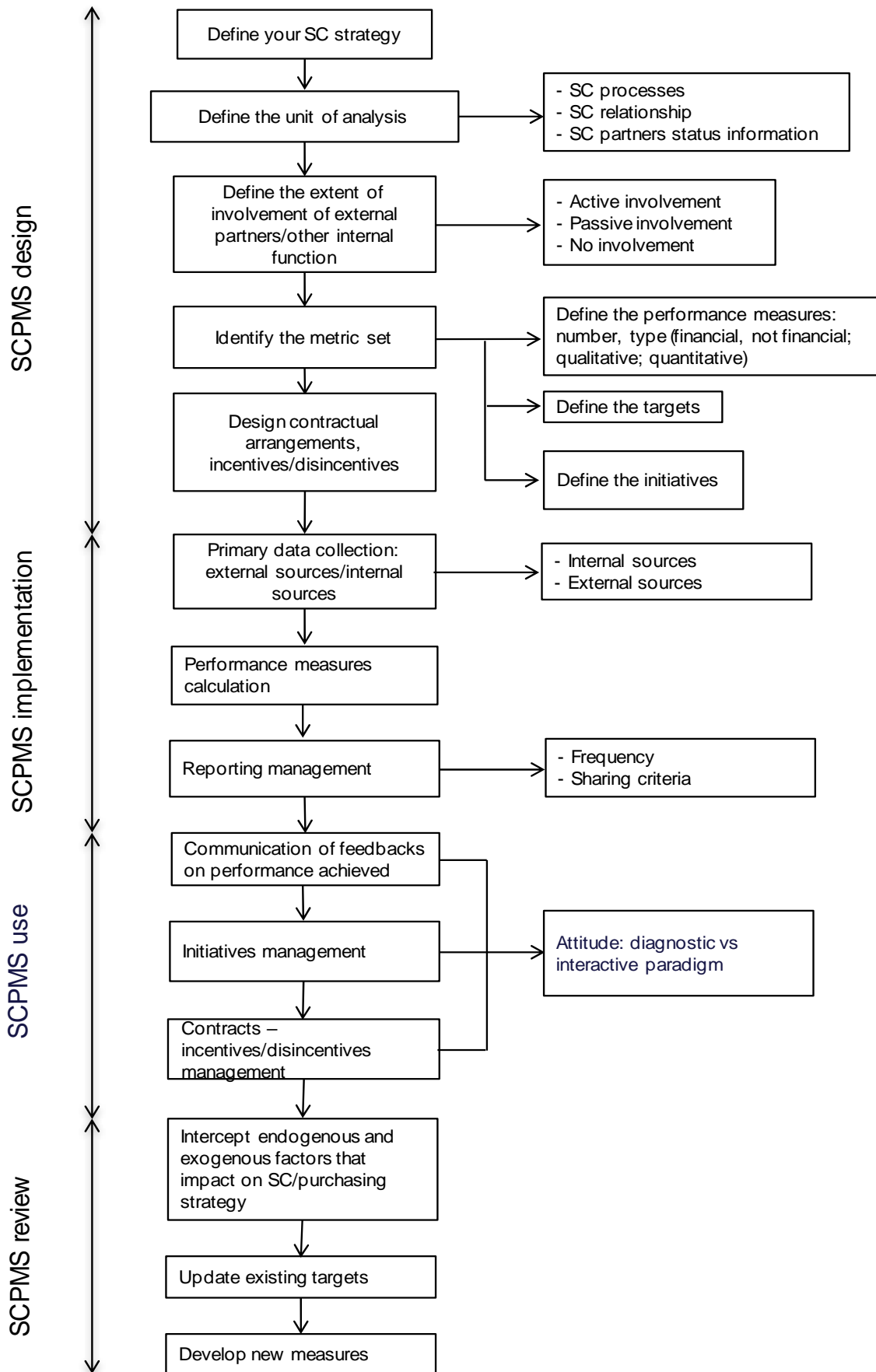


Figure 1: SCPMS lifecycle

3. Research questions

The benefits and criticalities associated to the SCPMS adoption have been only partially explored through empirical studies. Also, extant studies usually collect evidence from the SCPMS sponsor and neglect the point of view of other actors involved. Furthermore, the major focus has been on the design stage rather than the SCPMS lifecycle.

Our empirical analysis aims at overcoming such limitations. On the one hand, we wonder what are the benefits and criticalities connected to the SCPMS adoption as experienced by different SC players. For example, how is the system useful to the buyer as opposed to the supplier? We argue that encompassing a multi-actor perspective on the SCPMS is key to ensure its effective adoption; therefore, we formulate the first research question as follows:

RQ1: *How do the different actors in the supply chain perceive the SCPMS, in terms of benefits and criticalities?*

On the other hand, we wonder what are the key choices ensuring an effective SCPMS adoption throughout its lifecycle, i.e. beyond the design phase. Indeed, previous (internal) PMS studies suggest that the implementation, use and review phases can greatly affect the outcomes of the system adoption. Therefore, we formulate the following research question:

RQ2: *How do the SCPMS lifecycle phases influence the system effectiveness from the perspective of the actors involved?*

4. Methodology

4.1 Rationale

An inductive case study approach (Eisenhardt and Graebner, 2007; Yin, 2003) seemed to be the most suitable methodology to answer our research questions. Firstly, case study research is particularly suitable in the early stage of theory development (Eisenhardt, 1989), where the aim is to

formulate new insights (Voss et al., 2002). SCPMSs are still in their early stage of development and it is worth to investigate the matter in-depth before formulating testable hypotheses. Secondly, case studies let us effectively triangulate opinions from different actors in the SC, which is especially relevant to answer our first research question.

4.2 Sampling

This research is based on a qualitative design involving a single three-tiers SC case study and tackling the adoption of a shared SCPMS. The case has been selected for theoretical reasons (Eisenhardt, 1989). It involves three SC tiers in the Italian mass retail sector (see Figure 2) including: a retailer, acting as the focal company and sponsoring the SCPMS (first tier). Two logistics providers, acting as intermediaries between goods manufacturers and retailers: these players usually serve several goods manufacturers taking care of a variable range of logistics activities (from transportation to warehouse management and delivery planning); they represent the second SC tier. Then, three consumer goods manufacturers constituting the third tier of the SC under scrutiny, producing the goods showed in the retailer's shelves.

The ICT service provider has been addressed as well, being the platform owner and developer. The SC collaboration platform grounds on cloud technology, which is exploited by retailers, logistics providers and manufacturers that collaboratively manage the delivery process (see figure 3). The platform entails procedures for process data collection, algorithms for data analysis and metrics calculation as well as reporting functionalities, thus configuring a process based SCPMS (Chan and Qui, 2003). In our study, the SCPMS represents the unit of analysis: we investigate the benefits and criticalities perceived by various actors involved from the adoption as well as the different phases of the lifecycle (see Figure 1).

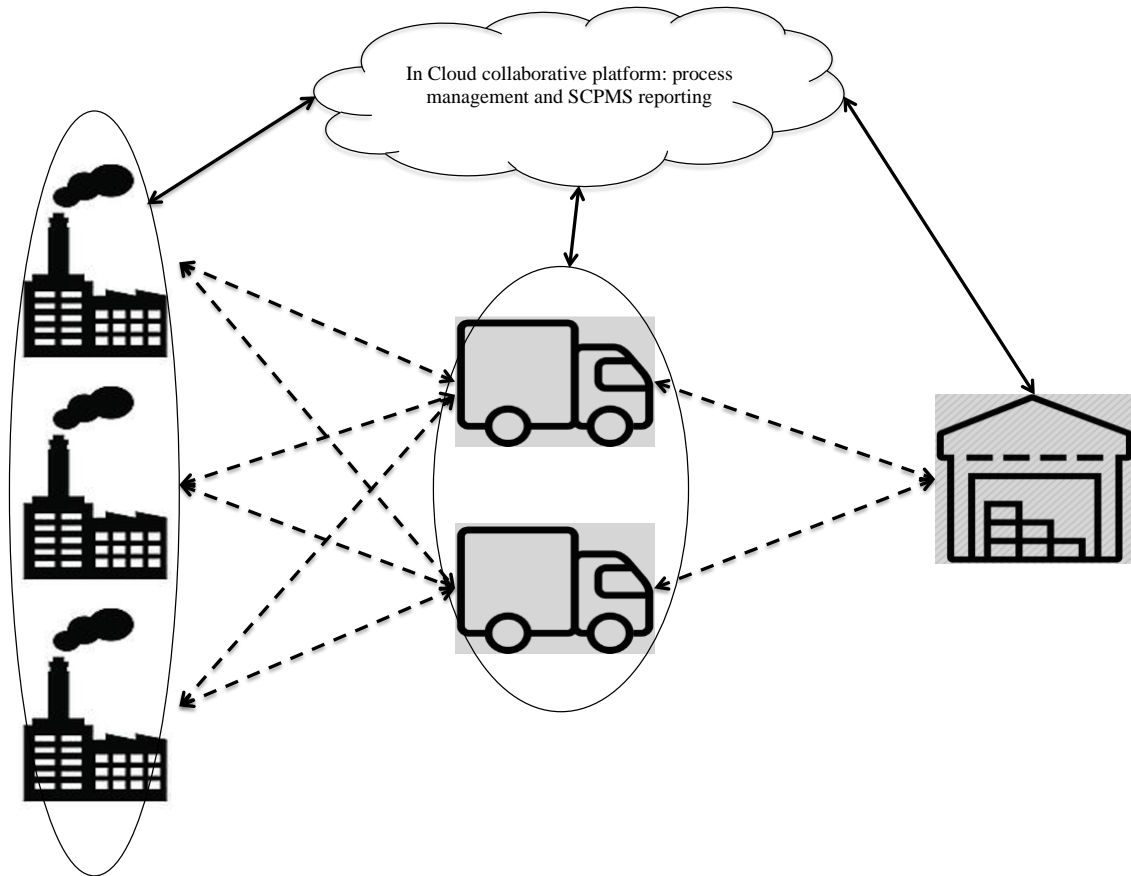


Figure 2: Mass retail SC

4.3 Data collection

Data were collected between May 2013 and December 2014, thus configuring a longitudinal empirical investigation lasting 19 months on a single SC case study. A total of 14 key informants were interviewed from the 7 companies involved (Table 1). Informants ranged from executive positions to planning and operative positions directly in touch with the system.

Table 1: Sample overview

Firm	Annual sales (mln €)	Employees	Product/services	Number of informants (number of meetings)	Job position
Retailer (RET)	6000	23000	Distributor of consumer goods	2 (3)	Country General Manager (Italy) Transportation manager
Logistics Provider 1 (LP1)	160	400	Transportation, warehousing, logistics activities outsourcer	3 (3)	Transportation Planning Manager Business analyst
Logistics Provider 2 (LP2)	226	500	Transportation, warehousing, logistics activities outsourcer	2 (2)	Transportation Manager Business analyst
Manufacturer 1 (MAN1)	1150	2500	Beverage	3 (3)	Transportation manager Transportation planning analyst Production manager
Manufacturer 2 (MAN2)	226	500	Grocery	2 (2)	Supply chain manager Supply chain planner
Manufacturer 3 (MAN3)	130	200	French dressing	1(2)	Supply chain manager
ICT system provider (ISP)	20	208	Software for B2B integration	2(2)	Business unit director Senior consultant

To enhance data triangulation (Eisenhardt and Graebner, 2007), information came primarily from three separate sources from each organization: semi-structured interviews with multiple respondents, public and internal firm-specific documentation, and observation.

The case study protocol benefited of the literature review regarding the SCPMS lifecycle characteristics and expected outcomes. Data have been collected by means of in-depth open-ended interviews, which lasted between 120 and 180 minutes. The interview questionnaire is reported in the appendix. Moreover, 22 follow-up meetings involving both practitioners and research team members, 55 briefing phone calls and a great amount of back-up mails have been collected all along the SC case study, thus achieving a rich empirical data set.

In addition to interview data, various documents regarding all the firms were used for data triangulation, ranging from annual reports to internal documents related to processes and outcomes. Besides, reports related to the SCPMS put in place were collected from the ICT provider archives. We eventually looked autonomously for further documents in the firms' corporate websites and on the web.

Finally, on-site observations improved the understanding on how the SCPMS really works. Field notes were used to triangulate observations with the interviews data and guarantee a further validation.

4.4 Data analysis

All interviews were recorded upon permission and later transcribed by researchers, enabling the inclusion of additional notes, comments and ideas. Interview data have been coded via an iterative process aimed at capturing the relevant information. The final coding is the result of an open discussion on cases results among three researchers (see Table 2). Various aspects related to the SCPMS have been investigated: the steps of the SCPMS lifecycle to achieve a complete description of the tool, the status of the relationship among the different actors involved and the benefits and criticalities perceived from the SCPMS adoption.

Within-case analysis showed how each firm is using the system and what are the benefits and criticalities associated. Cross-case analysis followed prominent examples regarding SC case study research (e.g. Bhakoo and Choi, 2013): firstly, a cross-case analysis considering firms at the same SC tier was conducted (i.e. comparing manufacturers and logistics providers); secondly, a cross-case analysis considering the different tiers of the SC was performed (i.e. comparing manufacturers to logistics providers and to the retailer). We allowed for replication logic in both analyses and we identified recurrent patterns.

Table 2: Coding adopted for the case-study

<p>SCPMS design Neely et al. (1995); Melnik et al. (2004-2014)</p>	<ul style="list-style-type: none"> • Unit of analysis • Set of metrics • Degree of involvement of various actors • Degree of involvement of various functions • Contract design 	<p>The role of the SCPMS within the organization Chenhall (2005)</p>	<ul style="list-style-type: none"> • The extent to which the SCPMS is considered and adopted in the organization, for different purposes
<p>SCPMS implementation Bourne et al. (2000-2002)</p>	<ul style="list-style-type: none"> • Primary data collection • Performance measures calculations • Reporting management 	<p>Relationship among different partners Nyaga et al. (2010); Zhao et al., (2011); Cheung et al., (2010) Botta-Genoulaz et al. 2010, Chapter 4-5-8)</p>	<ul style="list-style-type: none"> • Relationship characteristics (trust, commitment, collaboration)
<p>SCPMS use Henri (2006)</p>	<ul style="list-style-type: none"> • Diagnostic vs interactive use • Rewarding mechanisms linked to the SCPMS 	<p>Benefits related to the SCPMS adoption Neely et al. (2005); Chen and Paulraj (2004) Botta-Genoulaz et al. 2010, Chapter 2)</p>	<ul style="list-style-type: none"> • Benefits cited during interviews related to the system adoption and in particular to the sharing of metrics.
<p>SCPMS review Braz et al., (2011); Lohman et al., (2004)</p>	<ul style="list-style-type: none"> • Revision of performance measures • Revision of targets • Frequency 	<p>Criticalities related to SCPMS adoption Brewer and Speh (2000);</p>	<ul style="list-style-type: none"> • Criticalities cited during interviews related to the system adoption and in particular to the sharing of metrics.

5. Findings

In this section we present the results derived from our within- and cross-case analysis. Firstly, we describe the inter-firm process under scrutiny and the related SCPMS. Then we report findings regarding benefits and criticalities perceived by each actor as well as key variables along the SCPMS lifecycle that affect their perception.

5.1 Description of the SCPMS in place

Since 2009, the Italian mass retail industry is facing a dramatic volume reduction and a decrease in the average profitability. The need for efficiency is much stronger than ever and firms are looking for improvement opportunities throughout the SC.

In this paper we analysed the solution developed by the ICT system provider (ISP) and adopted by the retailer (RET) within its SC. It constitutes an innovative case in the SCPMS literature, since the platform enables the development of a process-based SCPMS, with a set of metrics shared among three tiers within the mass retail SC. To this regard, despite the technological platform adopted is not the focus of our analysis, we acknowledge that the ISP delivered a tool that overcomes several limitations of currently available solutions. On the one hand, the platform in place is already capable of integrating and sharing data on the Cloud across different MISs, harmonizing different standards and deploying common communication protocols. It is also one of the few that allows calculating SC-wide performance measures targeting different facets of the SC process and different units of analysis. On the other hand, the platform still suffers for the lack of automation in data collection, which could be fixed in the future by investing in tracking technologies.

The SC process managed through the platform concerns the delivery at the RET distribution centre (DC). The starting point is the RET's order publication in the ISP Cloud platform. Then the manufacturer (MAN) assigns the order to the logistics provider (LP), who takes care of the on-line booking of time slots. The dynamic booking allows the LPs to reserve their own two-hours slot within

the larger delivery interval. The reservation can happen via web, SMS or call centre. Accordingly, the RET arranges internal operations in order to receive and unload the trucks at the agreed time, favouring a considerable queue reduction and improving both LPs and RET operators' productivity. Through the system, MANs gain insights on LPs and RET performance; LPs optimize operations planning and maximize truck saturation; the RET greatly improves the resources allocation at the DC and therefore reduces operational costs. The main steps of the process are summarised in Figure 3.

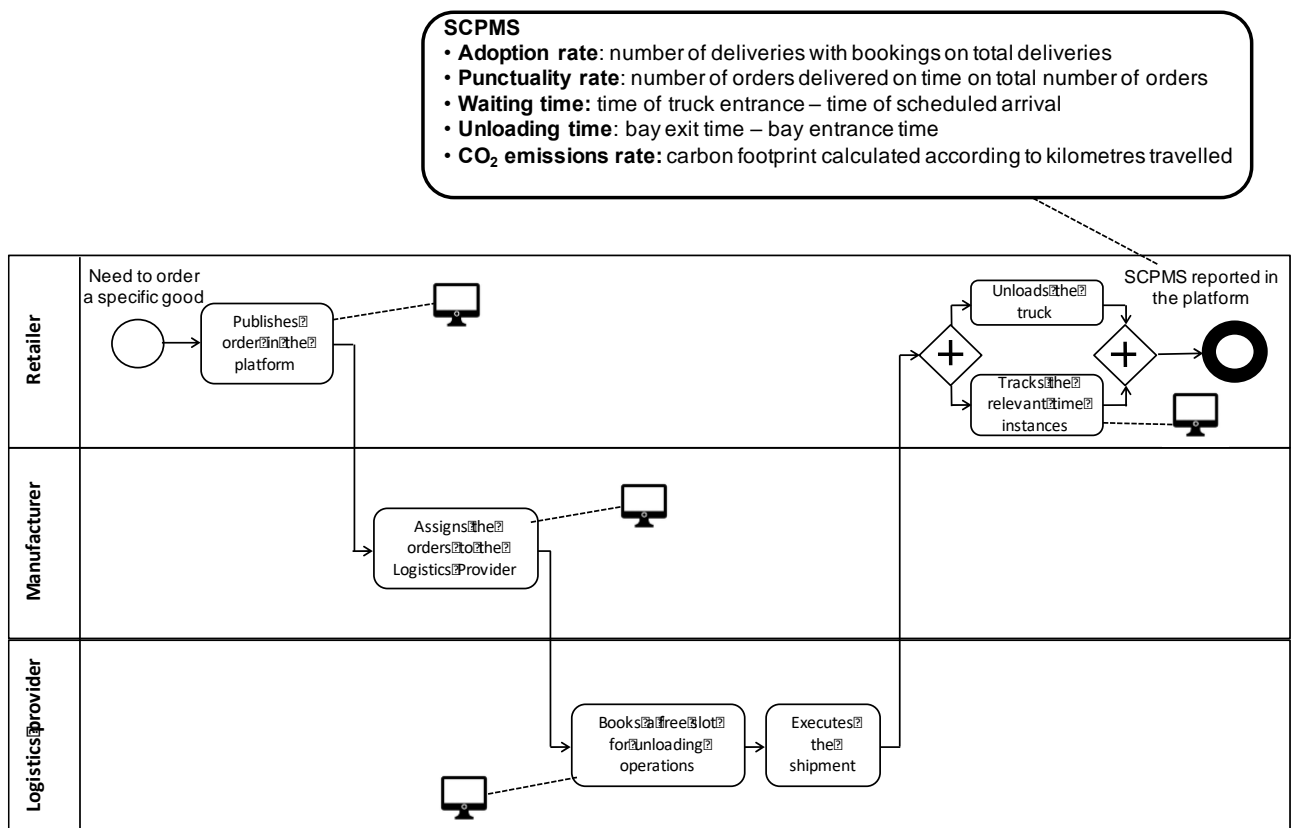


Figure 3: SC process scheme

The focus of our analysis is the SCPMS, which is a critical part of the system adopted. Indeed, a key feature of the ISP solution is the possibility to translate transactional process data into performance metrics that can be shared among the SC partners. We collected information on all the

SCPMS lifecycle phases, by triangulating interview data from each firm involved and secondary data related to the solution. Table 3 reports the most relevant SCPMS features.

Table 3: Results on the SCPMS lifecycle

SCPMS design variables Neely et al. (1995); Melnyk et al. (2004-2014)	Unit of analysis: the SC process of DC bays online booking and related unloading operations.
	Degree of involvement of different internal functions: the SC process under scrutiny is perceived as crucial for the firm. There is a high commitment from the top management, who is fully aware of the SCPMS but did not actively participate to design it. The RET's SCM function designed the system with the ISP.
	Degree of involvement of external actors: apart from the ISP, no LP or MAN have been involved in designing the system.
	Set of metrics <ul style="list-style-type: none"> • <i>Adoption rate:</i> number of deliveries with booking on total deliveries (LP-MAN performance) • <i>Punctuality rate:</i> number of orders delivered on time on total number of orders (LP performance) • <i>Waiting time:</i> time of truck entrance – time of scheduled arrival (RET performance) • <i>Unloading time:</i> bay exit time – bay entrance time (RET performance) • <i>Co2 emission:</i> carbon footprint calculated according to kilometres travelled (LP-MAN performance)
	Contractual arrangements, incentives/disincentives: not present
SCPMS implementation variables Bourne et al. (2000-2002)	Primary data collection: critical time instances related to the SC process considered (truck arrival, truck entrance, truck exit), are manually inserted in the platform by the distributor operators. The booking number is tracked automatically.
	Performance measures calculation: performance measures are automatically calculated through job benches installed in the platform.
	Reporting management: <ul style="list-style-type: none"> • <i>Frequency of reporting:</i> the performance measures in the platform are constantly updated at each delivery. The platform enables a highly flexible indicators configuration. Each company involved could easily customize the metrics of interest by different aggregation levels: year, month, week on a temporal basis; retailer or single DC perspective. • <i>Sharing criteria:</i> manufacturers have visibility on the performances of all their logistics providers; the retailers have visibility on his performance and on the performance of each logistics providers; each logistics provider has visibility on his performance on every DC served and on the retailer performance. Finally, the ISP has a complete visibility on the performance related to the specific SC process at an industry level
SCPMS use variables Henri (2006)	Communication of feedbacks on performance achieved: there is no systematic and structured communication among the SC partners on performance reported. Each actor can analyse data but feedbacks are not formalized.
	Initiatives management: mainly internal with no active involvement of SC partners
	Contracts - incentive/disincentive management: no contractual defined consequences applied
SCPMS review variables Braz et al. (2011); Lohman et al. (2004)	Changes in SC strategy <ul style="list-style-type: none"> • The need to comply with new regulations that limit the trucks waiting time at RET's DCs requires to improve efficiency and effectiveness of unloading operations. The SCPMS enables a formal monitoring of these performance metrics • The increasing importance of the environmental dimension led to introduce CO₂ footprint tracking for each truck travel
	Updating of metric targets: not done during the inquiry period. Targets are not even clearly defined.
	Development of new measures: the RET (in partnership with the ISP) is willing to monitor other SC processes (e.g. order cycle and order confirmation; replenishment; reminders) through the existing platform. New performance measures are going to be developed once other SC process will be included in the system.

5.2 Benefits and criticalities

A first output of the empirical investigation is to gain insights on the benefits and criticalities that SC actors perceive as resulting from the SCPMS adoption. In doing so, we account for different views. The system owner (the ISP) and the system promoter (the RET) are satisfied with the shared SCPMS. The following benefits emerge (see Table 4): (1) internal and (2) external operational performance improvement; (3) higher control on SC processes; (4) avoidance of information overloading, thanks to synthetic reporting that includes a limited set of metrics; (5) higher SC integration as the SCPMS allows to launch joint performance improvement plans. The only complaint is the lack of an industry standard in terms of delivery process activities, ICT platform, and key performance indicators. MANs and LPs perceive the lack of an industry standard, too. Working with different customers, they are subject to different types of delivery process and they are potentially exposed to different SCPMSs, including different sets of performance metrics. This situation leads to face several performance trade-offs, preventing the definition of a clear and homogeneous SC strategy.

The reasons explaining the SCPMS adoption fuel the debate among suppliers. MAN1, MAN2 and LP2 display a negative attitude towards the system and its usage: they think the RET is adopting the SCPMS in a top-down fashion, to further exploit its bargaining power. Instead, MAN3 and LP1 welcome the SCPMS as enabling mutual benefits. As a further proof, they acknowledge that some metrics are put in place to measure the RET performance (i.e. waiting time, loading time). However, all suppliers seem doubtful about the reliability and objectivity of the SCPMS, given that DC operators (employed by RET) manually track the primary data used for the calculation of performance metrics.

Finally, both MANs and LPs own an internal PMS targeting SC processes. MAN1 and MAN2 in particular are more engaged with the LPs than with the RE. Consequently, when assessing their delivery performance, they are usually more confident on data reported by their LPs than the ones

present in the SCPMS. For this reason, the system is perceived as a redundant source of information due to pre-existing proprietary PMSs. MAN3 and LP1, instead, cultivate an integrated relationship with RET and consider the SCPMS as a useful source of information.

Table 4 and 5 summarize results of cross-case analysis, providing each actor's perception on benefits and criticalities. We selected some exemplar quotations emerged during the coding process. The ISP has been addressed as well as source of information and reported in the cross-case analysis. Within the specific case, the ISP plays a critical role in enabling the SCPMS, thus allowing SC partners at each tier to exchange information and collaborate on the SC process under scrutiny. Thus, the ISP perspective on the system may be of some interest to gain insights on its role and relationship with various actors within the SC. It must be clear though that the ISP perspective might be biased (being the platform provider) and that its role (i.e. enabler) is different compared to the SC partners using the platform and the related SCPMS.

Table 4: Benefits perceived

	Internal operational performance improvement	Partners' operational performance improvement	Higher control over SC processes	Lower information overload	Higher SC integration
RET	HIGH "The efficiency and productivity of operations at the DC has greatly improved. Time slot booking has greatly improved the operators' work planning. Besides, the use of metrics boosted their sense of responsibility and productivity."	HIGH "In our opinion, manufacturers can't but be happy of the SCPMS. They can monitor the LPs' performance in each DC in Italy. I think this is an extremely powerful information for them to make the delivery process lean and efficient."	HIGH "The system tracks time instances and calculates critical performance metrics. Information is stored in the platform and never over-written. This allows us to keep under control process performance of each supplier and analyse historical trends."	HIGH "The platform is user friendly and the SCPMS reports can be customized at your preference. Metrics calculation is automatic and, though some data cleaning could be necessary, the information is synthetic and highly insightful."	MEDIUM "We still use the SCPMS mainly internally. Only with a few partners we have experienced a more systematic discussion on mutual performance, aimed at coordinating efforts for improvement."
MAN1	Not significant/ not mentioned	MEDIUM "I guess the RET is the only player, who benefit from this new system"	Not significant/ not mentioned	Not significant/ not mentioned	Not significant/ not mentioned
MAN2	Not significant/ not mentioned	HIGH "Sure the RET has increased its performance. Part of the SCPMS is oriented to their operators at the DCs."	Not significant/ not mentioned	MEDIUM "In our business we really deal with big data. I have to admit that the SCPMS is effective in extrapolating only critical information."	Not significant/ not mentioned
MAN3	HIGH "The platform has improved our delivery planning and contributed to stimulate performance of LPs. We have real time visibility and this supports our decision making."	HIGH "RET certainly takes the most from this application... but it has to be said that their performance are our performance when dealing with on-shelf availability."	HIGH "Before the SCPMS, the information on downstream delivery performance was poor and fragmented. Problems were managed in a reactive way, often leading to penalties."	HIGH "The synthesis of the information is a key feature of the system. The reporting is highly flexible and automatized."	MEDIUM "In a couple of occasions, we organized meetings with RET to discuss about the SCPMS and performance. Hopefully, this will occur more frequently in the future."
LP1	MEDIUM "The SCPMS keeps sub-contractors under a positive pressure, thus positively affecting their performance, which are eventually our performance."	HIGH "RET is by far the winner of this SC process reengineering. The SCPMS implicitly forces us to be more performant (with no reward) and its operators to be more productive."	MEDIUM "The system is a good support to control our private carriers."	HIGH "The platform is easy to use and the SCPMS is dynamic and flexible. Technologically it is a well done package."	MEDIUM "When our own carriers register performance that differs from the SCPMS, we sit around a table and discuss. Generally things get better afterwards."
LP2	Not significant/ not mentioned	HIGH "This system is perfectly tailored to the RET needs. The SCPMS is unilateral"	Not significant/ not mentioned	Not significant/ not mentioned	Not significant/ not mentioned
ISP	HIGH "Retailers can dramatically increase their performance. First, the slot booking improves the inbound logistics. Second, the SCPMS allows for performance measurement of its own performance as well as suppliers'."	HIGH "Anything measured improves. Metrics address both RET and LPs-manufacturers performance. Operators at the DCs will have to increase their productivity. Suppliers will have to better plan their deliveries."	HIGH "Manufacturers have real time visibility on logistics providers' performance. Logistics providers have visibility on their subcontractors when present. Retailers have visibility on the whole upstream SC performance"	HIGH "We definitely deal with big data. Our platform turn this huge amount of rough time data into a SCPMS, which can be tailored according to the user needs, in terms of reporting"	HIGH "The platform with the SCPMS is aimed at fostering collaboration among users and continuous improvement on SC process performance. In doing this, unique performance data are shared at different SC levels too."

Table 5: Criticalities perceived

	Lack of industry standard	Lack of trust in data reliability	Tool of power (RET's opportunism)	Lack of interest in performance metrics
RET	MEDIUM "The lack of an industry standard is a problem we are seriously addressing with industry associations and other retailers. However, it's difficult to impose a way to follow in such a competitive market."	<i>Not significant/ not mentioned</i>	<i>Not significant/ not mentioned</i>	<i>Not significant /not mentioned</i>
MAN1	HIGH "Different players manage delivery process differently in terms of activities, ICT systems to be used and even critical performance that matters. This creates a big entropy to face for us."	HIGH "If you want to set a SCPMS, that's fine for us. Yet it has to be rigorous... a manual data entry is simply not acceptable."	HIGH "Moreover we think the RET is mainly using the SCPMS in a highly top-down fashion, just to keep pressure high and not to foster collaboration."	HIGH "We have our own SCPMS as well as performance information coming from the LPs. We honestly do not look at the SCPMS under scrutiny."
MAN2	MEDIUM "Within the broad concept of delivery performance, customers are interested in diverse dimensions (punctuality, flexibility, lead time) and always use different metrics. It's hard to follow them all."	HIGH "If you want to really use a SCPMS to manage relationship with SC partners, data reliability has to be guaranteed... pure and simple!"	HIGH "My opinion is they just want to put us under pressure indirectly, since no explicit penalties is related to poor performance."	MEDIUM "We receive performance reports from almost all our customers, both retailers and bigger logistics providers. Moreover, of course we measure our own delivery performance. In the end we just triangulate our data with the ones of partner customers."
MAN3	HIGH "This system, which is a best practice according to us, is applied only by three retailers. Some use another platform, while others simply don't use the slot booking procedures. This creates more complexity to deal with in the planning phase."	MEDIUM "Primary data, so time instances, are inserted manually by the RET operator. As far as no penalties or service level agreement are linked with the platform SCPMS, this is not such a great issue."	<i>Not significant/ not mentioned</i>	<i>Not significant/ not mentioned</i>
LP1	HIGH "We have done a lot with industry associations to form standards to follow... but delivery is still a mess. This platform within the SCPMS is interesting per se, yet we can not forget other customers asking for different systems, procedures and performance."	MEDIUM "The retailer itself acknowledges the manual data collection to be a major limitation of the SCPMS reported. That's why its use is still mainly internal."	<i>Not significant/ not mentioned</i>	<i>Not significant/ not mentioned</i>
LP2	HIGH "We are in-between producers and retailers. Not only there are no standards within the industry. It happens that requests from one side and the other differ from each other. It's a hard business."	HIGH "The manual data entry, totally owned by the RET, is a clear limitation of the system. No reliable and rigour data collection is present."	MEDIUM "Our customers are the producers and we primarily have to account to them. The SCPMS is another external source of pressure"	MEDIUM "Honestly we look at the SCPMS, only in case the RET ask to do so. We do measure our own performance measures and when some failures happen, we are the first to apologize and give proper explanation to our customers"
ISP	MEDIUM "We strongly believe in the goodness of our offer for the whole retail SC. We are struggling to make it become the standard, both by involving new customers and by involving industry associations. We are constantly increasing our market share, still a lot needs to be done."	<i>Not significant/ not mentioned</i>	<i>Not significant/ not mentioned</i>	<i>Not significant/ not mentioned</i>

5.3 Managing the SCPMS lifecycle

The second research question explores how the SCPMS lifecycle phases (i.e., design, implementation, use and review) affect the SCPMS effective adoption. Through semi-structured interviews focused on the SCPMS in place, interviewees freely pointed out some associations between the SCPMS lifecycle and both benefits and criticalities discussed above.

Regarding the design phase, the SCPMS put in place lacks precise targets as well as pre-defined consequences related to being above or below the targets. Besides, RET autonomously selects the metrics to be used with the ISP, with no direct involvement of SC partners. Indeed, suppliers were informed about the SC process reengineering, but they were not aligned, nor involved from the beginning in the SCPMS design. This lack of integration in the early stage of development has led to the perception of a top-down, “coercive” adoption of the SCPMS in some cases.

MAN2 Supply Chain Planner: *“We were aware of the new system in place, yet have no clue about the SCPMS. After a couple of months from the adoption, reports of metrics started to arrive [...]; we were a bit upset I have to admit... for not being informed earlier.”*

LP2 Business Analysts: *“We had just started using the platform to manage the booking. Then one of our customers forwarded us some sorts of RET reports highlighting poor performance from us. We couldn’t even understand metrics applied at the beginning...”*

Regarding the implementation phase, several SCPMS characteristics emerged as enablers of a routinely and effective adoption. The shared platform is equipped with algorithms and job benches that guarantee an automatic calculation of each performance measure. In addition, reporting is very flexible: each actor joining the platform can easily configure several types of metrics at different levels of analysis (e.g., time interval, DC, orders, and so on). Such functionalities represent a recognized advantage of the system.

RET Transportation Manager: *“I think the platform is technologically outstanding, enabling a great degree of automation and flexibility in metrics calculation and reporting.”*

MAN3 Supply Chain Manager: *“The platform is smart and user-friendly. As far as the SCPMS is concerned, it is highly flexible and customizable into different configurations. Our analysts generally make different kinds of queries, aggregating performance per distribution centers, per logistics providers etc. [...]. Then everything can be easily extracted into an excel file for further data analysis.”*

The main problem with the implementation phase is data collection, which is manual and completely performed by the RET personnel, affecting the SC partners’ confidence in the SCPMS. All suppliers agree that RET should invest in tracking technologies, in order to ensure a reliable data collection, which is the basis for an effective SCPMS. Instead, RET argues that actual errors due to manual data collection are negligible and that some suppliers are opportunistically over-emphasising this issue in order to back-up their complaints.

MAN1 Transportation Planning Analysts: *“The RET says the SCPMS is reliable, since metrics calculation is automated. There is only one problem: all metrics are based on relevant time instances manually inserted in the system by the RET operator. This is not rigorous in my opinion.”*

RET Transportation Manager: *“I honestly do think that for all of our suppliers, even the most negative about the SCPMS, the real system failure perception due to manual data entry is very low. It’s just an opportunistic move in order not to take seriously our reports and related warnings.”*

However, even the more committed partners (i.e., MAN3 and LP1) highlight the lack of rigorous data tracking as the major drawback of the system and – because of this lack – they are not willing to accept any kind of tangible consequences related to performance reported by the SCPMS, least of all any contractually defined incentive or penalty.

LP1 Transportation Planning Manager: *“As far as incentives or penalties are not related to the SCPMS put in place, manual data entry is not such a big issue according to my perspective. Reports provided are still useful and used internally, though we know data reliability is not 100% guaranteed.”*

In analysing the way each actor uses the system we find out that, apart from those who have no interest in the performance reported (MAN1), the others usually exploit the tool for internal purposes. For example, MAN2 looks at the performance reported as a secondary source of

information to gain insights on the delivery performance. LP2 analyses performance trends reported to understand what are the most critical DCs and coherently rearrange booking operations. MAN3 uses the SCPMS as the main information source regarding his downstream logistics and triangulate data with information coming from LPs.

MAN1 Transportation Manager: *“I have to say the SCPMS reported from the RET is not considered as a primary source of information at all. We have long time partnerships with most of our LPs. When measuring performance of the downstream SC, we generally take into account their own measures, which we triangulate with qualitative information and feedbacks from a few partner retailers.”*

MAN2 Supply Chain Manager: *“The SCPMS could be considered as one of the sources we take into account to measure our SC performance. We have internal SCPMS, information coming directly from LPs and PMSs reported by retailers, among which the SCPMS under scrutiny. There’s no perfect system and each source has its deficiencies. Part of our analysts’ daily job consists in aggregating and analysing this big and heterogeneous body of information”.*

Surprisingly, even the RET does not fully exploit performance metrics to actively manage external relationships. In most cases, RET just monitors SCPMS metrics internally; only when a critical LP’s performance drops, RET engages an improvement plan with the counterpart. However, RET does not use the SCPMS actively nor systematically in order to manage SC relationships. No structured performance feedback is provided and no incentive/disincentive plan is contractually defined. The manual tracking of elementary data seems to prevent RET from using the SCPMS as a formal relationship regulator. Hence, the lack of agreed consequences related to performance increase/decrease lower the interest towards the SCPMS.

RET Country General Manager: *“We would like to exploit more the SCPMS for managing our upstream SC. When you deal with such different players, spanning from micro carriers to consumer product multinational, big changes require time and effort [...]. The delivery process reengineering per se has been quite of a revolution in the business. SC partners need time to get used to it, naturally pressure on performance comes later.”*

The system review has been addressed as well, being the last phase of the SCPMS lifecycle. Grounding on a new SC process, there were no historical information about recorded performance. That is why no targets have been set from the beginning. Afterwards it soon became clear how difficult was to set unique targets, considering the big variety in terms of merchandise supplied, suppliers characteristics and DCs features. As a matter of fact, targets are still not explicitly reported within the platform. However, given the RET commitment, the current SCPMS can be easily updated according to the ISP.

ISP Senior Consultant: *“We know that the SCPMS is a key tool within the overall package. In terms of technology we have no limitation: we can introduce different targets for different suppliers’ clusters, allowing for trend analysis suggesting targets update. Obviously, we are available if the RET wants to enlarge the scope of the platform by addressing other SC processes or practices and new metrics can be added coherently.”*

6. Discussion

We clearly identify a series of benefits and criticalities acknowledged by firms involved in the SCPMS (see Table 4 and 5). Extant literature suggests that the SCPMS adoption would have a twofold positive effect: better operational performance thanks to the SCPMS motivational effect; and greater integration and collaboration with external partners (Chen and Paulraj, 2004; Gunasekaran et al., 2004; Bhagwat and Sharma, 2007; Botta-Genoulaz et al. 2010).

Our study encompasses three SC tiers, overcoming the traditional buyer-supplier focus. As a result, we discover a perceptions dichotomy between the SCPMS promoter (the RET) and the other SC partners. The SCPMS benefits reported above confirm and partially extend the literature about internal PMS (Melnik et al., 2004; Melnyk et al., 2014; Franco-Santos et al., 2012) and supplier PMS (Luzzini et al., 2014; Kannan and Tan, 2002). Furthermore, the

empirical investigation highlights some criticalities that might undermine positive outcomes. Some actors (e.g. MAN1) do not recognize much value to the SCPMS, displaying low level of interest. Others (e.g. MAN2, LP2) show a partial lack of trust in the system, which is perceived as a “tool of power” in RET’s hands (Micheli and Manzoni, 2010). These criticalities can actually damage the relationship, with a negative effect on collaboration and integration capabilities, as well as on performance. Furthermore, the lack of an industry standard in terms of process, ICT architecture, and performance metrics reported, creates additional entropy for suppliers to manage, with a perceived negative impact on operational performance. Thus, we can formulate three propositions answering the first research question:

Proposition 1. *The perception of benefits and criticalities related to the SCPMS adoption depends upon the role of each actor in the SCPMS. The system promoter tends to overemphasize benefits while its SC partners tend to exacerbate criticalities.*

Proposition 2. *Recurrent perceived benefits associated with the SCPMS adoption are: internal and external operational performance improvement; higher control on SC processes; lower information overload thanks to a structured and synthetic reporting; higher integration with SC partners, aimed at continuous improvement.*

Proposition 3. *Recurrent perceived barriers/criticalities associated with the SCPMS adoption are: lack of an industry standard regarding process monitored, ICT architecture, and performance metrics reported; lack of trust on data reliability; SCPMS perception as a tool of power; lack of interest in performance metrics.*

Our research supports previous studies on the importance of buyer-supplier relationship characteristics affecting the SCPMS effective adoption, including supplier’s commitment (Prahinsky and Benton, 2004), collaboration capabilities (Mahama, 2006); and socialization

mechanisms (Cousins et al., 2008). In the present study, firms displaying a better relationship with the RET (in terms of commitment, trust and mutual collaboration) – like MAN3 and LP1 – do display a more positive attitude towards the SCPMS.

The most relevant result of this study is that not only relationship-specific characteristics play a role on the perceived effectiveness of the SCPMS; yet also several key steps related to the SCPMS lifecycle (see Figure 1) should be taken into account in order to maximise benefits and avoid criticalities. In particular, engaging SC partners in the early stage of SCPMS design helps in improving their comprehension and in stimulating their interest. Besides, it conveys a positive attitude of the SCPMS promoter and offers the chance of improving the system. Considering the implementation phase, structured data collection entails the use of technology to ensure reliable and objective data tracking and metrics calculation. In the case analysed, the manual data collection performed by RET's operators dramatically affects the confidence in the system. A rigorous implementation seems a "conditio sine qua non" for an effective adoption. Furthermore, an active use of the SCPMS is important as well. On this behalf, we can refer to informal activities like feedbacks, meetings, discussions on performance reported and joint improvement plans, as well as to formal activities related to contract management and incentives/disincentives application. The unintended consequences deriving from a passive use of the system is that each company will use the SCPMS internally for its own purpose, leading to local optimization. Instead, our results suggest that an externally oriented use of the SCPMS would foster an open and transparent discussion among SC partners, possibly leading to joint planning and decision-making; the final aim would be to improve the outcomes for single firms and for the SC as a whole. Despite we collected some information regarding the review phase, we cannot draw any clear conclusion about the consequences on the SCPMS effective adoption due to the relative novelty of the system. Indeed, both the RET and the ISP acknowledged the

importance of periodically reviewing the performance measures, but such review has not yet occurred so far.

Thus, we propose the following proposition answering to the second research question:

Proposition 4. *The SCPMS lifecycle management critically affects the perceived effectiveness associated to the SCPMS adoption.*

Proposition 4a. *Design phase: the active involvement of supply chain partners in designing performance metrics positively affects the SCPMS perceived effectiveness, by improving the attitude towards the system and the possibility to implement continuous improvement plans.*

Proposition 4b. *Implementation phase: an objective, rigorous and faultless primary data collection and performance measures calculation positively affects the SCPMS perceived effectiveness, by increasing the confidence on metrics and on the system in general.*

Proposition 4c. *Use phase: a structured and systematic discussion on performance reported (possibly associated with an incentive/disincentive mechanisms) positively affects the SCPMS perceived effectiveness, empowering its capabilities in orchestrating SC partners.*

7. Conclusions, limitations and future developments

In the first part of the study, we develop a comprehensive framework of SCPMS lifecycle: coherently with the necessity to collect data from external sources and interacting with SC partners, we shaped the constituent elements of designing, implementing, using and reviewing the SCPMS. The framework is the theoretical basis for the subsequent empirical analysis of a process-based SCPMS. Building on a single SC case study that spans across seven firms, we formulate three propositions about the perceived SCPMS benefits and criticalities from a multi-

actor perspective and one proposition linking the SCPMS lifecycle phases to its effective adoption.

We consider this study relevant for scholars for several reasons. First, we introduce an integrated theoretical framework on the SCPMS lifecycle. Second, we expand the investigation of benefits and criticalities associated to traditional PMSs to the broader context of a process-based SCPMS, providing the empirical evidence that the literature often lacks and accounting for a SC-wide perspective, while previous studies generally investigate the perspective of one firm. Third, we show that the SCPMS lifecycle deeply affects the perceived effectiveness of the SCPMS adoption.

We deem our results relevant for managers too, because we shed some light on the key decisions regarding SC performance measurement and the drivers for the SCPMS effective adoption. The SCPMS lifecycle framework (cf. Figure 3) highlights key steps to follow when designing, implementing, using and reviewing a SCPMS and may represent a reference point for managers willing to do so. As far as benefits and criticalities are concerned, two main evidence can inspire managers' actions: first, the highly different perception upon the SCPMS that may arise addressing the SCPMS sponsor and the counterparts (cf. Table 4); second, acknowledging that this perception can be affected by the goodness of the SC relationship but also by the SCPMS lifecycle management (e.g. the involvement of SC partners in the design phase, the rigorous data collection process, the proactive use of the system for SC orchestration, cf. section 6). However, it is not the purpose of this paper (based on a single theory building SC case study) to generalize the benefits and criticalities that may arise from a SCPMS adoption, which may depend upon several other elements such as the SC structure, the SC fragmentation, the number of actors involved as well as from the industry.

The major limitation of this research is that findings depend upon one case from a single industry. Since we adopted a theory building approach, we privileged an in-depth analysis of

multiple SC tiers at the expense of a higher number of cases. Although several relevant dynamics emerged, more can be found – for example – comparing different SCs and/or different industries. Future research could investigate more complex and articulated SCPMS, hopefully leading to deeper insights on relational dynamics among SC partners involved. A second limitation is inherent to the targeted research questions: we were mostly interested to determine how the SCPMS effectiveness can be ensured, contributing to SC orchestration and alignment. Further research might assess the extent to which the presence of a SCPMS improves the performance of each tier and/or the SC overall. Finally, we do not discuss all phases of the SCPMS lifecycle with the same level of detail, also depending upon the evidence deriving from the case study. More knowledge is needed on the link between SCPMS specific features and the impact on performance and relationship capabilities; as an example, the SCPMS review phase can be studied, analysing how it affects the system effectiveness.

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A – Interview questionnaire

General information and overview

- Organization background-history, number of employees, annual sales, products. Interviewees' roles and responsibilities.

SCPMS lifecycle information

- How is the system designed? What is the unit of analysis? What is the metric set (performance measures, targets, consequences)?
- Which are the company functions involved in designing the system? How are they involved?
- Which are the external actors involved in designing the system? How are they involved?
- Are there some contractual arrangements related to the SCPMS in place?
- How is the system implemented? What is the data collection method?
- How is calculated the set of metrics?
- How are metrics reported to measured actors?
- What is the information system architecture needed to implement the SCPMS?
- How is the system used? Are there feedbacks on performance achieved? Are incentives/disincentives present? Is there a debate on performance reported?
- Has the system been reviewed? What has been added and why? Are targets controlled and reviewed constantly?

The role of the SCPMS within the organization

- What is your general opinion of the SCPMS?
- What is the general perception of the SCPMS in your organization?
- How much do you use the SCPMS in your organization? By who?
- Does the SCPMS support you in planning operations?
- Is there any aspect you would like to change regarding the SCPMS?
- Are you satisfied with the type of performance reported?
- Are you satisfied with the way the system is implemented?

Relationship specific attributes

- Are you highly committed towards the relationship with this specific SC partner?
- Do you think there is a high level of mutual trust in the relationship with this specific SC partner?
- Do you often collaborate on common issues with this specific SC partner?
- *For suppliers only*: what is your actual relationship with the RET? What was the relationship with the RET? How does the SCPMS adoption influence your opinion towards the RET?
- *For ret only*: what is your actual relationship with suppliers (logistics providers and goods manufacturer? What was the relationship with your suppliers? How does the SCPMS adoption influence your opinion towards the RET?

Benefits and criticalities

- In what ways did the SCPMS improve your operational performance?
- How does the SCPMS affect your relationship with external partners?
- What are the potential benefits achievable from the SCPMS adoption? What are the benefits that you obtained from this specific SCPMS?
- What is the perceived usefulness of the information shared?
- Are there any criticalities or disadvantages in adopting the SCPMS?
- For suppliers: are you satisfied with the SCPMS use from the RET?