Supplier performance measurement system use, relationship trust, and performance improvement: a dyadic perspective

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Abstract

Purpose – Grounding on resource orchestration theory, this paper aims to study the relationship between the way buying companies use their supplier performance measurement systems and the performance improvements obtained from suppliers, with relationship trust identified as a mediator in the previous link.
Design/methodology/approach – The authors design a conceptual model and test it through structural equation modelling on a final sample of 147 buyer-supplier responses, collected by means of a dyadic survey.
Findings – Results suggest that the buyer company may achieve the most by balancing a diagnostic and interactive use of the measurement system, as they are both positively related to supplier performance improvement. Furthermore, relationship trust acts as a mediator in case of the interactive use, but not for the diagnostic. This type of use negatively affects relationship trust, due to its mechanistic use in the buyer-supplier relationship.
Originality/value – The authors' results contribute to the current academic debate about supplier performance measurement system design and use by analyzing the impact of different supplier performance measurement system uses, and highlighting their relative impact on relationship trust and supplier performance improvement. From a methodological perspective, adopting a dyadic data collection process increases the robustness of the findings.

Keywords Supplier performance measurement system, Performance, Trust, Dyad, Survey
Paper type Research paper

1. Introduction

Supply base orchestration is a key enabler for buying companies to achieve and maintain a sustainable competitive advantage (Gong *et al.*, 2018; Davis-Sramek *et al.*, 2019). Hence, supplier performance measurement systems (SPMSs) become instrumental to both relational and organizational performance. Defined as a set of metrics used to quantify the efficiency and effectiveness of suppliers' actions (Hald and Ellegaard, 2011; Maestrini *et al.* 2018a, b), SPMSs extend management's control upstream in the supply chain, allowing the

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coordination and alignment of suppliers (Simpson *et al.*, 2002; Kannan and Tan, 2002; Luzzini *et al.*, 2014; Patrucco *et al.*, 2020b).

SPMSs have recently been the subject of several studies in the supply chain management literature (e.g., Dey *et al.*, 2015; Paparoidamis *et al.*, 2017; Maestrini *et al.*, 2018a, b, c), but current research is mostly focused on the SPMS design (*what* should be measured) and implementation (*how* to collect data and measure performance). Empirical evidence about intra-company performance measurement systems (PMSs) shows that the system use (rather than its design features) profoundly affects the resource orchestration process and ultimately the organizational performance (Henri, 2006; Koufteros *et al.*, 2014). Therefore, while deciding *what* and *how* to measure is essential, this is not sufficient to predict results (Gutierrez *et al.*, 2015). In a similar vein, we argue that the way buying companies use the (inter-company) SPMS has important implications for suppliers' orchestration and alignment, ultimately influencing the buyer-supplier relationship and the associated performance.

In this study, we discuss the role of SPMSs for supplier orchestration, paying specific attention to the SPMS use, the development of buyer-supplier relationship trust, and the potential improvement of supplier performance. In particular, we conceptualize the SPMS use by distinguishing between the diagnostic and the interactive approach (Henri, 2006). We rely on resource orchestration theory (ROT; Sirmon *et al.*, 2007, 2011) as the SPMS use as a relational tool naturally fits the ROT perspective, suggesting that how resources are managed is as important as their possession. As a matter of fact, ROT has been successfully applied to performance measurement research (e.g., Koufteros *et al.*, 2014), yet mostly focusing on intra- rather than inter-organizational PMSs.

In order to account for both the buyer's (who measures) and the supplier's (who is measured) perspectives, our research design focuses on the buyer-supplier dyad as a unit of analysis. In terms of empirical data, we were able to tests our hypotheses on a final sample of 147 dyadic responses, consisting of matched buyer-supplier couples.

The remainder of the paper is organized as follows. The next section introduces our theoretical background and reviews the relevant literature about the role of SPMS in buyer-supplier relationships. In Section 3, we discuss the research hypotheses. Section 4 describes the methodology adopted for the empirical investigation. In Section 5, the main findings are reported. These results are then discussed in Section 6, while in Section 7 we present the main theoretical and managerial contributions and direction for future research.

2. Theoretical background

2.1 Theoretical lens of the study: Resource-based view and resource orchestration theory

This study aims to offer a specific contribution to the SPMS literature. However, resource-based view (rbv) and resource orchestration theory (ROT) provide some important theoretical underpinnings to understand the use of SPMSs and their potential performance outcomes. Supply chain literature largely supports the application of RBV to buyer-supplier relationships (Barney, 2012). Similarly to firm-owned resources, suppliers can become a source of competitive advantage when buyer-supplier relationships characterize as valuable, rare, inimitable and non-substitutable. However, while RBV establishes the necessary conditions for competitive advantage, it does not explain *how* resources come to generate value. As such, ROT complements RBV by focusing on the processes through which resources are transformed into capabilities and ultimately generate a sustained competitive advantage (Sirmon *et al.*, 2007, 2011). Indeed, one of the main tenets of ROT is that the effective use of resources is as important as the possession of such resources. ROT extends the RBV and articulates the processes of accumulating, bundling, and leveraging resources, which lead to competitive advantage. This view is not new in general management and operations management literature. On the one hand, Sirmon *et al.* (2011, p. 1391) clearly argue

that RBV, although robustly tested, requires additional specifications: "possessing resources alone does not guarantee the development of competitive advantage; instead, resources must be accumulated, bundled, and leveraged, meaning that the full value of resources for creating competitive advantages is realized only when resources are managed effectively." On the other hand, Hitt *et al.* (2016, p. 82) analyze the use of RBV in operations management and argue ROT to be "*particularly helpful for explaining various operational capabilities and the capabilities needed for effectively managing a firm's supply chain and the broader value chain.*" Yet, when considering buyer-supplier relationships, which are the essence of supply chain research, the application of ROT remains limited. Some authors adopt the ROT lens to investigate collaboration and integration with suppliers (e.g. Liu *et al.*, 2016; Gong *et al.*, 2018) or supply chain disruptions (e.g. Ketchen *et al.*, 2014); however, to the best of our knowledge, no study provides a ROT perspective regarding SPMSs to increase the effectiveness of suppliers' management.

We believe that our study fits in this theoretical stream in that SPMS is an important tool that enables resource orchestration across buyer-supplier relationships. As a matter of fact, previous studies clearly show that performance measurement systems (PMSs) are a key mechanism for resource orchestration, establishing an explicit connection with ROT (Koufteros *et al.*, 2014). PMSs bring essential information regarding the functioning of the resource portfolio and the outcomes that can be obtained with bundles of capabilities (Hitt *et al.*, 2011; Bourne *et al.*, 2013). These systems are responsible for alignment and coordination and are "*essential links between strategy, execution, and ultimate value creation*" (Melnyk *et al.*, 2004, p. 209). Koufteros *et al.* (2014) represent a valuable example of how ROT can be applied to study internal PMSs, showing how they can synchronize the internal resources orchestration process that, in turn, positively affects the development of organizational capabilities.

Although we do not intend to contribute to ROT by revising its core principles, we do argue that the strategic view of resource orchestration and the role of performance measurement can be extended to buyer-supplier relationships. Again, just like company-owned resources, the typical processes of resource orchestration seems naturally applicable to the supply chain context, where SPMSs become crucial to align and generate value across buyer-supplier relationships. In line with recent studies, we consider the SPMS as a tool the buying company designs and implements to manage and coordinate the supplier orchestration process (Bourne *et al.*, 2018; Maestrini *et al.*, 2018a); so, the main objective of this paper is to analyze the role SPMSs play in the suppliers' orchestration process, with the ultimate goal of improving suppliers' performance.

2.2 Performance measurement in buyer-supplier relationships

The literature about performance measurement and management identifies the so-called *PMS lifecycle* as made of four subsequent phases (Bourne *et al.*, 2000; Nudurupati *et al.*, 2011; Maestrini *et al.*, 2018a): (1) design (i.e. *what to measure*), (2) implementation (i.e. *how to put the system in action*), (3) use (i.e. *how to use the system*), and (4) review (i.e. *what to change in the system*). However, most of the existing PMSs are designed for organizations' internal purposes, having only limited capabilities to support inter-organizational information exchange and management. Performance measurement extending beyond organizational boundaries has become increasingly relevant in connection to advances in information systems (Franco-Santos *et al.*, 2012). For example, cloud services and new analytical solutions have been used to support inter-organizational performance information exchange (Jääskeläinen, 2021). Secondly, while internal PMS literature has progressively shifted from performance measurement to performance management (Gutierrez *et al.*, 2015), with an increased focus on the PMS lifecycle use and review phases, SPMS literature has not yet

undergone this evolution. Most contributions are still focused on how to design the SPMS (e.g., Luzzini *et al.*, 2014; Maestrini *et al.*, 2018c; Patrucco *et al.*, 2020b), or how to select metrics and adopt specific measurement frameworks (e.g., Muralidharan *et al.*, 2002; Humphreys *et al.*, 2007; Huang and Keskar, 2007; Nair *et al.*, 2015). Hence, it is increasingly important to understand how performance information can support management and performance advancements in buyer-supplier relationships and, in particular, how buying companies should use their SPMSs to effectively orchestrate their suppliers (Morgan, 2007; Cousins *et al.*, 2008; Bourne *et al.*, 2018).

Grounding on the seminal work of Simons (1994, 1995, 2000), the literature identifies and compares two distinct approaches to PMS use, namely *diagnostic* and *interactive* use (Koufteros *et al.*, 2014; Su *et al.*, 2015; De Harlez and Malagueno, 2016). The *diagnostic* use represents the traditional control mechanism associated with PMS (Henri, 2006), aimed primarily at monitoring the degree of achievement of univocally determined targets. It includes activities such as applying procedures for formal evaluation, implementing performance improvement plans, and defining conditions for penalties or incentives (Micheli and Manzoni, 2010; Koufteros *et al.*, 2014). The *interactive* use, instead, includes the development of learning mechanisms within the measurement process. It represents the positive force that promotes the identification of improvement opportunities through an ongoing dialogue between the measuring and measured counterparts (Bisbe and Otley, 2004; Grafton *et al.*, 2010). It includes performance data sharing, and joint interpretation and discussion of results, in order to stimulate a shared approach towards continuous improvement and the implementation of agreed action plans (Widener, 2007). These two approaches to PMS use are interdependent and complement each other (Mundy, 2010). The diagnostic use enables control over pre-defined goals, while the interactive use allows searching for new opportunities, solving potential conflicts, and fostering collaboration. According to Henri (2006), these approaches represent complementary forces, which should coexist and work simultaneously with different purposes.

For the purpose of this study, we extend the diagnostic and interactive approach to the buyer-supplier relationship scenario and relate it to the SPMS architecture. On the one hand, a diagnostic SPMS use allows monitoring supplier's activities coherently with the performance measures and targets set by the buyer. In this sense, the SPMS becomes a "relationship regulator" (Maestrini *et al.*, 2018b), with the objective to align the supplier behavior to the buyer purchasing strategy. On the other hand, the interactive SPMS use enables an active supplier involvement throughout the measurement process, emphasizing the bi-directional nature of the relationship. In this sense, the SPMS also plays the role of "relationship stimulator," facilitating the dialogue and the open debate about mutual performance, enabling continuous improvement and win-win solutions (Prahinski and Benton, 2004). In line with the case of internal PMSs, the diagnostic and the interactive use of SPMSs might clash with each other, leading to a dynamic tension arising from their co-presence. While the diagnostic use emphasizes a constant pressure on target achievement through a formal tracking of performance, the interactive use enables a proactive engagement of the two parts, exchanging opinions and establishing joint improvement plans in a positive, yet challenging climate. Although theoretically relevant, the implications of a diagnostic and interactive use of SPMS are still empirically unexplored. Therefore, analyzing their impact on performance outcomes is an interesting and relevant development. As ROT suggests, studying how performance measurement is used can help understanding how inter-organizational resources can generate value. Grounding on extant studies investigating internal PMSs (e.g., Koufteros *et al.*, 2014), we extend this perspective to buyer-supplier relationships.

Furthermore, we are interested in studying the relevant intervening mechanisms that can explain the performance effect of SPSM uses. Previous studies in the context of internal performance measurement show that the PMS use can stimulate an array of organizational

capabilities, leading to performance improvement (e.g., Henri, 2006; Koufteros *et al.*, 2014). In the context of buyer-supplier relationships, previous studies analyzed the mediation effect of socialization mechanisms (e.g., Cousins *et al.*, 2008), cooperation (e.g., Mahama, 2006), and commitment (e.g., Prahinski and Fan, 2007; Glas, 2017). We also focus our attention on *trust*, a key relational construct (Nyaga *et al.*, 2010; Fawcett *et al.*, 2017), which is rather neglected in SPMS literature. In fact, we expect that different approaches to the SPSM use will affect the trust between parties and ultimately determine relationship performance.

3. Hypotheses development

3.1 SPMS use and supplier performance

What managers expect from the use of PMSs is an improvement in performance (Neely, 2005). Nevertheless, the relationship between the PMS adoption and performance improvement is far from straightforward. Considering internal PMSs, empirical evidence reports mixed results on the impact on organizational performance (e.g., Chenhall, 2005; Widener, 2007; Micheli and Manzoni, 2010; Nixon and Burns, 2012; De Harlez and Malagueno, 2016), and the debate is still open (Melnyk *et al.*, 2014; Cappelli and Tavis, 2016).

In this regard, some authors argue that the way the PMS is used – more than how it is designed – has a critical impact on performance. Through an in-depth analysis of PMSs used in different business units, Bourne (2005) concludes that the over-performing business units are those using the PMS more interactively than the others. Henri (2006) finds that a purely diagnostic PMS leads to an incremental performance improvement, as opposed to a more radical effect of an interactive approach. More recently, Koufteros *et al.* (2014) rehabilitate the diagnostic PMS use, showing that it can increase the attention towards targets and empower the company resource orchestration capabilities. However, the greatest effect on performance improvement is obtained through the combination of diagnostic and interactive approaches. Several other studies confirm this crucial takeaway: scholars agree that a more mature PMS includes both diagnostic and interactive approaches (Mundy, 2010) and that these can improve performance even under uncertain environments (Simons, 1994, 1995). Widener (2007) analyze the relationship between PMS characteristics, behavioral responses and performance, and find that diagnostic and interactive approaches are both drivers of organizational learning and attention that, ultimately, lead to better performance.

Inspired by these results – referring to the internal PMS literature – we consider similar arguments as valid in the context of buyer-supplier relationships, and we apply them to the relationship between the SPMS and supplier performance.

In line with the strategic perspective of ROT, the SPMS can be considered a managerial tool that supports supplier orchestration and enables buyer-supplier alignment in performance terms. In this regard, the diagnostic SPMS use can reflect the top-down control exercised by the buyer, with the aim to stimulate supplier attention towards target achievement constantly. On the other hand, an interactive use of PMS is instrumental in establishing a dialogue and an open discussion between the buyer and the supplier, which is helpful to guarantee a sustainable performance improvement in the long-term. Overall, the SPMS system may affect supplier performance by increasing communication between buyer and supplier and encourage them to analyze how resources should be combined to solve problems or exploit opportunities. The achievement of better results is linked to various orchestrating activities enabled by the SPMS at both the strategic and operational levels.

On the one hand, the SPMS allows prioritizing strategic goals and actions, obtaining information and feedback regarding present and future strategies. As such, inter-organizational processes and budget allocation can be aligned with the intended strategy. On the other hand, the day-by-day monitoring and management of supplier activities and performance as registered by the buyer can count on a structured dashboard that becomes a

precious support for decision making and continuous improvement. At multiple organizational levels (from key accounts to top managers), these activities rely on data and feedback obtained from diagnostic systems as well as from interactions of buyer's and supplier's employees who exchange information, challenge each other, and debate courses of action. Without the function of SPMSs, both buyers and suppliers cannot assess their current performance vis-à-vis their intended strategy, and this might obstacle the identification of appropriate ways forward. As Koufteros *et al.* (2014) clearly point out, both diagnostic and interactive approaches are necessary to balance the needs for control and renewal. Therefore, we expect that both these approaches should increase the company's ability to orchestrate the suppliers, being able to achieve a greater positive effect across target performance dimensions. Thus, the following hypotheses are formulated:

H1. The SPMS use positively impacts supplier performance improvement.

H1a. The SPMS diagnostic use positively impacts supplier performance improvement.

H1b. The SPMS interactive use positively impacts supplier performance improvement.

3.2 The mediating role of trust

In their theoretical paper on the effects of performance measurement on performance, Pavlov and Bourne (2011) claim that the dynamics connected to the use of PMS in supply chains, and their impact on performance, are only marginally explored, and that the common view is that the power of a PMS can be perceived as significant but rather opaque. Grounding on theories such as RBV, ROT and dynamic capabilities, some authors suggested that the use of the PMS does not simply improve performance. Still, it contributes to developing further capabilities and skills that go beyond the simple performance impact. Widener (2007) confirms that the combination of a diagnostic and interactive control can stimulate organizational learning and attention towards target achievement, leading to improved performance. Similarly, Grafton *et al.* (2010) find that while a "feedback control" (diagnostic) helps to strengthen current capabilities, a "feedforward control" (interactive) allows the development of new capabilities. Finally, Koufteros *et al.* (2014) highlight that both diagnostic and interactive PMS uses are positively associated with strategic management, operational and external stakeholder capabilities, which eventually positively impact organizational performance.

Shifting the attention to buyer-supplier relationships, scholars suggest that the SPMS can play the important role of relationships regulator (Maestrini *et al.*, 2018b). This is relevant because many studies about buyer-supplier relationships emphasize the positive role of relational strength and trust (e.g., Zhang *et al.*, 2011; Fawcett *et al.*, 2017). However, the effect of SPMSs in that regard remains largely unexplored. Leveraging on the arguments mentioned above in relation to internal PMSs and the extant literature on buyer-supplier relationships, we aim to explore trust's intervening role as a central construct to explain the SPMS use-supplier performance relation.

Buyer-supplier trust has been identified as an indicator of the goodness of the relationship itself, in terms of benevolence, a constant effort towards counterpart satisfaction, and absence of opportunistic behavior (Nyaga *et al.*, 2010; Tsanos *et al.*, 2014; Van der Valk *et al.*, 2016; Glas, 2017; Yang *et al.*, 2017). The concept of "trust" often embeds several relationship capabilities, such as collaboration, integration, socialization mechanism, absence of opportunism (Poppo *et al.*, 2016; Liu *et al.*, 2017), and previous contributions highlight how higher trust can be obtained through cooperative relationship behaviors (e.g., Johnston *et al.*, 2004), integration and information sharing (Wang *et al.*, 2014), and relational commitment (Patrucco *et al.*, 2020a, b). Previous studies have addressed the relationship between system adoption and specific relational constructs, such as socialization mechanisms (e.g., Cousins *et al.*, 2008), cooperation (e.g., Mahama, 2006), opportunism (e.g., Heide *et al.*, 2007), and

collaboration (e.g., Narayanan *et al.*, 2015). Still, no one explicitly refers to the effect of relationship trust.

According to the discussion so far, a diagnostic SPMS use should be an important deterrent for opportunistic behaviors, keeping tight attention on the relationship goals and increasing the relational trust; similarly, the interactive SPMS use is designed to align the two parts on how to improve the relationship – thus positively influencing relational trust. Building on these arguments, we expect that the combined use of the diagnostic and the interactive SPMS use should positively affect trust and ultimately drive better supplier performance (Ebrahim-Khanjari *et al.*, 2012; Brinkhoff *et al.*, 2015). Thus, relationship trust is identified as a key mediator within the SPMS use–supplier performance relation, leading to introduce the second set of hypotheses:

H2. Buyer-supplier relationship trust mediates the relationship between SPMS use and supplier performance improvement.

H2a. Buyer-supplier relationship trust mediates the relationship between SPMS diagnostic use and supplier performance improvement.

H2b. Buyer-supplier relationship trust mediates the relationship between SPMS interactive use and supplier performance improvement.

The theoretical model resulting from the hypotheses introduced above is shown in Figure 1.

4. Research methodology

A dyadic survey has been conducted to test previous hypotheses, since the constructs of the model are potentially subject to single-respondent bias. Despite valuable exceptions (e.g., Rossiter Hofer *et al.*, 2014), buyer-supplier surveys are still limited in academic literature. Still, they represent a powerful tool to obtain more robust results in studies that deal with relationship-specific issues. Previous studies in the field of internal PMSs literature (e.g., Micheli and Manzoni, 2010; Franco-Santos *et al.*, 2012) and external SPMSs (Hald and Ellegaard, 2011; Maestrini *et al.*, 2018a) highlight, in fact, that a dichotomy perception may arise between the measuring part and the measured part about the PMS in place, thus making a dyadic approach particularly reliable.

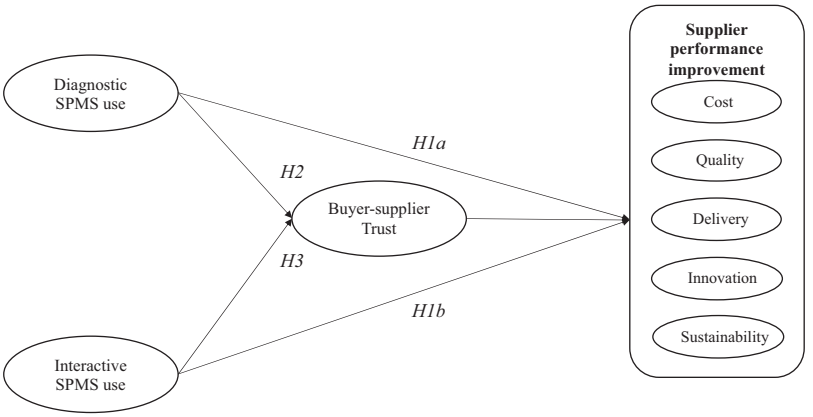

Figure 1.
Research framework

4.1 Sampling and data collection

An initial database of buyer companies was built by putting together several contacts from different sources available to the research team. On the buyer side, we decided to focus the attention on manufacturing companies (ISIC codes from 10 to 33), with more than 100 employees, for two reasons: (1) manufacturing companies purchase a large variety of goods, thus relying on a broader supply base and a structured purchasing department; (2) big companies tend to have comprehensive and well-designed SPMSs, being able to contribute to the study significantly. Smaller companies were instead excluded since they rarely have a structured supply chain and purchasing department, and they generally do not have mature SPMSs in place.

Data were collected from July 2015 to December 2015 in Italy. Buyer companies were first contacted. Respondents were reached over the phone to explain the project, the survey's dyadic nature, and determine their availability to participate. After a respondent agreed to participate, they received a customized email including the survey link. Reminder emails and telephone calls were made to those who delayed answering. As in similar key-informant-based research studies (e.g. Cini *et al.*, 1993), a critical element was to find the right respondent within the buyer company. The respondent had to be knowledgeable about the SPMS in place and be directly involved in supplier relationship management activities.

For this reason, most respondents consisted of purchasing or supply chain professionals, holding managerial positions in their companies (Table 1). Respondents of buyer companies were asked to identify a relevant supplier for their company (where "relevant" referred to both the amount of dollar spent with the supplier and the type of goods purchased from the supplier), for which a structured SPMS was in place, and answer the survey questions considering the relationship in place with this partner. At the end of the questionnaire, the buyer company respondent was asked to provide the name of the supplier company, along with contact details of an adequate respondent, who had to be aware of the relationship with the specific buyer company and the SPMS in place. Once the buyers returned the questionnaires, filled with related information about suppliers selected, the supplier company representatives were contacted and made aware of the project and of the buyer company who had selected them. Most respondents belonged to sales and customer service departments (Table 2), and they were asked to fill the questionnaire considering the relationship with the specific counterpart and

Table 1. Buyer companies sample descriptive

Descriptive	Freq	%	Descriptive	Freq	%
Revenues (million€)			*Employees*		
0–5	0	0	Small (1–49)	0	0
5–50	43	29.2	Small-Medium (50–99)	0	0
50–100	30	20.4	Medium (100–249)	62	42.2
100–1000	67	45.6	Medium large (250–499)	32	21.8
>=1000	7	4.8	Large (500–999)	31	21
			Very large (>=1000)	22	15
Industry sector			*Respondent department*		
Machinery and equipment	62	42.2	Purchasing	114	77.5
Metallurgy and steel goods	17	11.6	Supply chain and logistics	20	13.6
Chemical and pharmaceutical	15	10.2	Operations	9	6.1
Textile	11	7.5	Other	4	2.8
Vehicles	10	6.8			
Food and beverages	8	5.4			
Other manufacturing	24	16.3			
Total	147	100		147	100

Descriptive	Freq	%	Descriptive	Freq	%
Revenues (million€)			*Employees*		
0–5	28	19	Small (1–49)	65	44.2
5–50	67	45.6	Small-Medium (50–99)	22	15
50–100	19	12.9	Medium (100–249)	27	18.4
100–1000	25	17	Medium large (250–499)	15	10.2
>1000	8	5.5	Large (500–999)	5	3.4
			Very large (>1,000)	13	8.8
Industry sector			*Respondent department*		
Metallurgy and steel goods	40	27.2	Sales & Marketing	87	59
Machinery and equipment	27	18.4	Operations	18	12
Retail	19	12.9	Customer Service	7	5
Chemical and pharmaceutical	14	9.5	Quality	7	5
Wood and paper	12	8.2	Accounting	5	3
Other services	18	12.2	Other	23	16
Other manufacturing	17	11.6			
Total	147	100		147	100

Table 2. Supplier companies sample descriptive

its SPMS. Both parties were reassured about the non-disclosure of their answers with the relative counterpart, which also reduced the risk for social desirability bias.

458 buyer companies agreed to join the research, and 238 of them started to fill the questionnaire. 75% of the questions had to be answered in order to consider the questionnaire useable. According to this criterion, 204 useable buyer questionnaires were received, achieving a response rate equal to 44.5%. On the supplier side, 156 useable questionnaires were obtained, with a response rate of 65.6% with respect to all the contacts provided by the buyers. As a final result, 147 dyads turned out to be acceptable (i.e. both buyer and supplier filled the questionnaire with a completion rate at least equal to 75%). Overall descriptive information of the final empirical sample is reported in Table 1 (buyer companies) and Table 2 (supplier companies).

After the data collection process, data were cleaned and checked for response bias (Armstrong and Overton, 1977). Non-respondent bias was tested by ruling out the differences in terms of size and industry distributions between respondents and non-respondents. Similarly, early responses bias was tested too. Both tests show no significant differences between groups.

4.2 Questionnaire design

Two specular questionnaires were developed – one for the buyer and the other for the supplier.

The questionnaires were developed in English, since the original scales were in English. The English version of the questionnaire was pre-tested by submitting it to four international academic scholars, experts in the field of supply chain and performance measurement. The wording was modified coherently with their advice. The questionnaires were then translated into Italian using the TRAPD (Translation, Review, Pre-testing, and Documentation) procedure (Harkness *et al.*, 2004). The Italian versions were first sent to three Italian academic experts to further check for clarity. Secondly, they were pre-tested with two dyads that agreed to participate at this stage (two purchasing managers for the buyer-side and two sales managers for the supplier-side). Before and during the pre-testing phase, special emphasis was placed on the quality of the question formulation, in order to reduce potential bias resulting from respondents' misleading cognition (Poggie, 1972; Schwarz and Oyserman, 2001). The wording was modified based on suggestions received at each iteration. The final

versions were uploaded onto the project website and made visible only to respondents selected in the sampling procedure. We opted for an Internet survey, as it offers higher levels of accuracy and reduces missing values due to either the respondent or some data entry mistakes (Boyer *et al.*, 2002).

4.3 Constructs measurement

The items included in the questionnaire to measure the constructs included in the research framework were re-adapted from existing literature (see also details about items used in the Table A1).

To measure the SPMS types of use, we transposed what was used by Henri (2006) from internal PMS use to the context of buyer-supplier relationships. In detail, the *diagnostic SPMS use* was measured by asking the respondents how much the SPMS was used to monitor results, check the progress toward established goals, and compare actual results with expected results; the *interactive SPMS use* was instead measured by asking how much the SPMS was used to encourage open discussion between buyer and supplier, focus the attention on common relational issues, define continuous improvement plans, and agree to a joint relationship strategy.

The *buyer-supplier trust* construct was adapted from Nyaga *et al.* (2010) and Cheung *et al.* (2010), and it includes items that asked the respondents to rate the concern for mutual success, interest and welfare of the counterpart in the relationship.

Finally, *supplier performance improvement* follows suggestions from Gonzalez-Benito (2007) and Luzzini *et al.* (2014), and it includes items that asked the respondents to rate the improvements reached by the supplier in the cost, quality, delivery, innovation and sustainability areas.

All the items used to measure the latent variables are shown in Table 3. 1–5 Likert-like scale was adopted for each item of previous constructs, with 1 being "Completely disagree" and 5 "Completely agree."

4.4 Approach for data analysis

Dyadic data can be analyzed in different ways (e.g., Peugh *et al.*, 2013). For both diagnostic and interactive SPMS uses, we opted to use the responses collected from suppliers, since they are likely more accurate key informants as representing the perspective of the measured part (they are subject to the SPMS). For the same reason, we used the buyer's perception to

Table 3. Confirmatory factor analysis

	Items (corresponding to the survey questions)	Loading	Item-item correlation	CR	CA	AVE
SPMS diagnostic use (supplier's perspective)	DIAGN1	0.911	0.941-0.863	0.930	0.914	81.6%
	DIAGN2	0.931	0.947-0.879			
	DIAGN3	0.867	0.918-0.818			
SPMS interactive use (supplier's perspective)	INT1	0.859	0.895-0.811	0.926	0.924	75.6%
	INT2	0.893	0.919-0.856			
	INT3	0.895	0.917-0.849			
	INT4	0.831	0.881-0.784			
Buyer-supplier trust (supplier and buyer's perspective)	TRUST1	0.793	0.873-0.729	0.856	0.877	70.5%
	TRUST2	0.904	0.917-0.806			
	TRUST3	0.819	0.896-0.749			
Performance improvement (buyer's perspective)	PERF1	0.741	0.766-0.621	0.851	0.806	53.3%
	PERF2	0.729	0.770-0.623			
	PERF3	0.727	0.793-0.634			
	PERF4	0.799	0.822-0.689			
	PERF5	0.646	0.704-0.596			

measure supplier performance improvement, as in this case we consider the perspective of the measuring part (the buyer) more accurate. As for trust, we believe it is relevant to consider the perspective of both parties, who can provide their perception about intangible relationship-specific issues. Therefore, we measured trust as the mean between buyer's and supplier's responses for each specific dyad, thus triangulating their perceptions and increasing the measure robustness.

The presented hypotheses were tested using covariance-based structural equation modeling (CB-SEM); since our research objective is theory-testing and confirmation, we decided to adopt CB-SEM as it is more suitable when the research objective is prediction and theory development (McCullaugh and Nelder, 1989). The model was tested using the maximum likelihood (ML) estimation method (White, 1982), as ML is able to provide more realistic indexes of overall fit and less biased parameter values for paths that overlap with the true model, as compared to other methods such as partial least square (Nunally and Bernstein, 1994). The ML estimation assumes that the variables in the model are (conditionally) multivariate normal, which is true for our dataset according to the Doornik–Hansen test. Model fit was evaluated through chi-square goodness-of-fit statistic and the use of other absolute or relative fit indices, such as RMSEA and CFI (Hu and Bentler, 1999). Stata 16.0 was used for all the analyses.

5. Results

5.1 Measurement model

The final measurement model consists of 4 multi-item constructs, with a total of 15 indicators (Table 3). We run multiple tests to determine the convergent and discriminant validity of the constructs. First, we controlled through exploratory factor analysis (EFA) that all item loadings were greater than 0.6 – with no relevant cross-loadings. This condition is true for all the constructs, and also all Cronbach's alphas are higher than the suggested 0.7 thresholds. Next, the measurement scales have been tested through confirmatory factor analysis (CFA), which verifies the measures by assessing each of the four constructs' reliability and unidimensionality. According to Fornell and Larcker (1981) and Nunnally and Berstein (1994), for each construct, both composite reliability (CR) and average variance extracted (AVE) were above the recommended threshold of 0.7 and 0.5, respectively. As an additional test for discriminant validity, the squared correlation between two latent constructs and their AVE estimates were compared (Fornell and Larcker, 1981), assuring that the latter exceeds the former (see Table 4). This condition is valid for all the constructs. Finally, we evaluated the overall model fit, and the CFA reveals a good model fit attested through such fit indices for the measurement model ($\chi^2 = 119.4$; χ^2/d.f. = 1.42; RMSEA = 0.054; CFI = 0.975).

5.2 Structural model

Two path models have been tested before the final theoretical research framework.

Variables	1	2	3	4
1. SPMS diagnostic use	*0.903*			
2. SPMS interactive use	0.368	*0.870*		
3. Buyer-supplier trust	−0.276	0.358	*0.840*	
4. Supplier performance improvement	0.397	0.402	0.384	*0.730*

Note(s): The square root of the average variance extracted (AVE) is shown in italic on the diagonal. Correlations are in the lower triangle of the matrix

Table 4. Correlation matrix

The first model tests the direct relationship between the diagnostic and the interactive SPMS uses and supplier performance improvement (H1a and H1b). In contrast, the second model includes the latent variables altogether and tests the mediation effect of relationship trust through direct and indirect effects (H2a and H2b).

Table 5 reports the results of the two models.

Model 1 has a good fit (χ^2/d.f. = 1.53; RMSEA = 0.059; CFI = 0.967) and confirms our hypothesis H1, as both *diagnostic SPMS use* and *interactive SPMS use* display a positive significant effect on *supplier performance improvement* (respectively, with $\beta = 0.197$, $p < 0.01$; and $\beta = 0.361$, $p < 0.001$).

Model 2 has a sufficient fit (χ^2/d.f. = 1.62; RMSEA = 0.064; CFI = 0.943), and it shows interesting results. First of all, with the inclusion of *buyer-supplier trust*, there is no more a significant direct relationship between the *diagnostic SPMS use* and performance improvement, while the *interactive SPMS use* still maintains a significant direct relationship with *performance improvement*. The uses of SPMS have a mixed effect on *buyer-supplier trust*: while the *interactive SPMS use* positively impacts trust ($\beta = 0.485$, $p < 0.001$), the *diagnostic SPMS use* contributes to decrease trust ($\beta = -0.194$, $p < 0.05$). In turn, higher *buyer-supplier trust* is positively associated with higher *supplier performance improvement* ($\beta = 0.242$, $p < 0.01$).

As a last note to Table 5, we also introduce the difference in size between buyer and supplier (in terms of employees) in the dyad to control for performance improvement, but no statistical evidence is found.

To test the mediation effect of *buyer-supplier trust* for the *diagnostic SPMS use* (H2a) and *interactive SPMS use* (H2b), we apply the Baron and Kenny (1986) method, together with the bootstrapping analysis of confidence intervals (Table 6).

For *SPMS diagnostic use*, we can see that the total effect ($\beta^{tot} = 0.019$) is not significant. This is determined by an indirect effect – in the presence of the mediator – that is, as well, not statistically significant ($\beta^{ind} = -0.047$).

For *SPMS interactive* use, instead, we have a significant total effect ($\beta^{tot} = 0.342$, $p < 0.01$), and an indirect effect that passes through *buyer-supplier trust* statistically significant as well

	Model 1 Supplier performance improvement	Model 2 Buyer-supplier trust	Model 2 Supplier performance improvement
Independent variables			
SPMS diagnostic use	0.197^{*} (2.03)	-0.194^{*} (–2.08)	0.066^{ns} (0.61)
SPMS interactive use	0.361^{***} (3.54)	0.485^{***} (5.51)	0.225^{*} (2.21)
Buyer-Supplier trust	–	–	0.242^{**} (2.64)
Control variables			
Buyer-Supplier size difference (buyer larger)	0.072^{ns} (0.59)	–	0.082^{ns} (0.86)
Buyer-Supplier size difference (supplier larger)	0.094^{ns} (0.93)	–	0.101^{ns} (0.82)
Fit indices			
Chi-Square	79.75		137.73
Chi-Square/d.f.	1.53		1.62
RMSEA	0.054		0.064
CFI	0.967		0.943
TLI	0.958		0.929

Table 5.
Model results

Note(s): $^{ns}p > 0.05$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

	Direct effects (β^{dir})	Indirect effects (β^{ind})	Total effects (β^{tot})	Bootstrapping confidence intervals for indirect effects (200 replications, 97.5%)	
Buyer-supplier trust					
SPMS diagnostic use	-0.194^{*}	–	-0.194^{*}		
SPMS interactive use	0.485^{***}	–	0.485^{***}		
Supplier performance improvement					
Buyer-supplier trust	0.242^{**}	–	0.242^{**}		
SPMS diagnostic use	0.066^{ns}	-0.047^{ns}	0.019^{ns}	−0.114	0.052
SPMS interactive use	0.225^{*}	0.117^{*}	0.342^{**}	0.101	0.397

Note(s): $^{ns}p > 0.05$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

Table 6.
Mediation tests

($\beta^{ind} = 0.117, p < 0.01$). The robustness of this result is confirmed by testing the indirect effect through bootstrapping, which suggests that mediation occurs if the derived confidence interval does not contain zero – a condition which is valid for *SPMS interactive use* (but not for diagnostic, as reported in the last columns of Table 6).

This makes us conclude that our hypothesis H2 is only partially confirmed, as *buyer-supplier trust* positively mediates the relationship between *SPMS use* and *supplier performance improvement* only in the case of an interactive use (thus accepting H2b), but not for the diagnostic case (thus rejecting H2a).

6. Discussion

Our statistical tests partially confirm the hypothesized theoretical framework. Model 1 in Table 5 shows that the first hypothesis (H1) is strongly supported, given that both the interactive (H1a) and diagnostic (H1b) use of the SPMS have a significant positive impact on supplier performance improvement. Overall, this result is coherent with past studies on internal PMS use (e.g., Widener, 2007; Mundy, 2010) and shows that, when both the diagnostic and interactive approaches are present, these components contribute together to the SPMS effectiveness in improving performance (Koufteros *et al.*, 2014). The mechanistic type of control provided by the diagnostic SPMS use, in fact, is usually considered to be useful to monitor and improve operational performance dimensions, such as cost, quality, and service level (Prajogo *et al.*, 2012), that are objective measures in nature, and mostly under the supplier's responsibility. For these aspects, a top-down control benefits of a diagnostic SPMS, as frequent and objective monitoring of target achievement (in line with established service level agreements) could lead to the identification of the best opportunities for performance improvements (Prahinski and Fan, 2007; Cousins *et al.*, 2008; Porteous *et al.*, 2015). On the other hand, the interactive SPMS use is able to initiate an active engagement between the buyer and the supplier. This represents the starting point for improving long-term oriented performance, such as innovation and sustainability, which is more difficult to be objectively quantified and measured through a top-down diagnostic SPMS use (Prahinski and Benton, 2004). In line with previous studies (e.g., Henri, 2006), our results support the idea that the interactive SPMS use enables an increased interaction and collaboration between the measuring and the measured parts that, in turn, enables the development of strategic capabilities on the supplier side (e.g., market orientation capabilities, entrepreneurship,

innovativeness and organizational learning). These are key prerequisites for improving and developing long-term supplier performance.

Overall, these results confirm that the simultaneous presence of a diagnostic and interactive use is able to increase the benefits of an appropriate SPMS adoption in buyer-supplier relationships. These two approaches complement each other, and this demonstrates the value, from the buyer perspective, of using the SPMS to both regulate (through the diagnostic use) and stimulate (through the interactive use) the relationship with the suppliers (Maestrini *et al.*, 2018b). This evidence also support our objective to extend the applicability of the ROT to external PMSs. Similarly to internal PMSs, the different SPMS uses help synchronizing the external resources orchestration process, which positively affects the improvement of supplier performance.

Moving to the mediating role of trust, our hypothesis (H2) is only partially supported. First of all, our results show that the different components of the SPMS have a different impact on the level of buyer-supplier trust. In line with previous studies (e.g., Mahama, 2006; Narayanan *et al.*, 2015), the "relationship stimulator" component (i.e., the interactive use) contributes to increasing the level of relationship trust, as it discusses performance improvements by setting a collaborative environment between the buyer and the supplier. On the other hand, the "relationship regulator" (i.e., the diagnostic use) negatively impacts the level of trust. The introduction of top-down control mechanisms by the buyer frequently happens in presence of uncertainty about the relationship outcomes. In a way, the supplier can perceive the SPMS diagnostic use in isolation as an implicit lack of trust in its willingness to operate in the buying company's best interest, which increases the buyer's need to monitor the supplier (Yang *et al.*, 2017). As a consequence, the emphasis on control and the perception of buyer's reduced trust can generate, on the supplier side, mutual mistrust and opportunistic behavior (Heide *et al.*, 2007; Poppo *et al.*, 2016). For these reasons, trust ultimately does not represent a significant mediator between SPMS diagnostic use and performance improvement (thus rejecting H2a).

Instead, trust positively mediates the relationship between SPMS interactive uses and relationship performance (thus accepting H2b). This is in line with previous evidence on internal PMS studies (e.g. Henri, 2006; Koufteros *et al.*, 2014), stating that the interactive component of a PMS is able to affect performance through the development of organizational capabilities. In the buyer-supplier scenario, trust is a relationship characteristic that can be developed through collaboration and cooperation (which are the essence of the interactive use), eventually leading to improved performance. The interactive component enables the establishment of a positive climate within the relationship, stimulating benevolence and mutual reliability, blocking opportunistic behaviors, and enhancing relationship trust which, in turn, sets the basis for developing long-term performance improvement plans (Liu *et al.*, 2017).

These considerations are supported by the fact that, according to our findings, an increase of buyer-supplier trust always leads to a performance improvement, in line with several studies in the SCM field (e.g., Ebrahim-Khanjari *et al.*, 2012; Brinkhoff *et al.*, 2015; Glas, 2017). This also enriches the ROT application to external PMSs, as it introduces a key relational factor – trust – that is usually not considered when adopting an internal perspective. This factor seems to have an important role when implementing SPMSs as tools to support the resource orchestration process.

7. Contributions and future developments

With this paper, we define different ways of SPMS use, grounding on Henri's (2006) diagnostic vs. interactive framework. The outcomes of SPMS use are analyzed in terms of impact on relationship trust and supplier performance improvement. Empirical evidence

from a sample of 147 buyer-supplier dyads highlights the positive relationship between an SPMS diagnostic-interactive use and performance improvement, with buyer-supplier trust being a mediator of this relationship only for the interactive component. These findings provide theoretical and managerial contributions in several ways.

7.1 Theoretical contributions

This paper represents an attempt to apply the ROT perspective in the context of supplier performance measurement and management. It provides a reliable theoretical foundation to unravel mechanisms stimulated by SPMS use and allows to report significant advancements to the emergent literature stream on the link between SPMS adoption and performance.

First, while previous studies are mostly grounded on SPMS design (e.g., Mahama, 2006; Cousins *et al.*, 2008; Patrucco *et al.*, 2020b) and implementation (e.g., Prahinski and Benton, 2004; Prahinski and Fan, 2007), to the best of our knowledge, this is one of the few theory testing papers focusing on the SPMS use and proposing measures for the related constructs. These measures have been refined and tested using explorative and confirmative factor analysis. As a result, diagnostic and interactive constructs have been introduced, and could hopefully be replicated in future studies.

Second, the application of ROT is extended to SPMS in the context of buyer-supplier relationships, as the research model is grounded in the idea that SPMS is a tool that the buyer needs to use in order to shape the supplier orchestration process. This extends previous performance measurement research, which mainly applied ROT to internal PMSs (e.g., Koufteros *et al.*, 2014).

Third, interesting insights are derived from the research model. Testing the relationships between SPMS use, trust and performance represents a new perspective, only partially considered by SCM scholars (e.g., Cousins *et al.*, 2008; Prahinski and Fan, 2007; Fawcett *et al.*, 2017; Glas, 2017; Patrucco *et al.*, 2020b). Accordingly, we were able to highlight the positive mediation of trust in the relation between interactive SPMS use and supplier performance, while the SPSM diagnostic use might be counterproductive.

Fourth, the dyadic data collection leads to more robust results and represents an important methodological advancement in an area that is mostly dominated by qualitative theory-building research (e.g., Hald and Ellegaard, 2011; Luzzini *et al.*, 2014; Maestrini *et al.*, 2018b), and where survey-based research usually takes into consideration only one perspective, either the buyer (e.g., Carr and Pearson, 1999; Mahama, 2006; Heide *et al.*, 2007; Cousins *et al.*, 2008) or the supplier side (e.g., Prahinski and Benton, 2004; Prahinski and Fan, 2007).

7.2 Managerial contributions

Findings uncover important practical implications. Supply chain managers in charge of supplier performance measurement and management are advised on the importance of including and balancing both the diagnostic and the interactive approach when using the SPMS, given their complementary roles and effect on performance improvement. Further, results provide interesting suggestions for managers interested in developing collaborative and trust-based relationships with their suppliers. While an interactive SPMS use can result in an increased relationship trust (and higher performance improvement), the same benefits are not obtained when using the SPMS for the sole purpose of monitoring and controlling. In this regard, to smooth the negative effect of diagnostic SPMS on trust, managers should rely on a fair and transparent communication with the suppliers (who must be aware that the diagnostic approach is of mutual benefits), but also with internal supply chain employees (who must be aware that diagnostic tools should not represent a mean to exercise power and

control over suppliers, but rather a way to collect objective and clear information about supplier performance, to drive future improvements).

7.3 Limitations and future developments

Limitations of this study open venues for further research. First, this study uses a cross-sectional design. Because both the SPMS use can vary over time and relationship trust is developed over time, future studies could examine the relationship between SPMS use and trust using a longitudinal approach. Second, because data was only collected from Italian manufacturing companies, future studies could broaden the scope by addressing other industries and other countries, as cross-cultural and cross-industry differences might arise. Finally, our model is currently focused on the independent variables (SPMS use and trust), and their impact on operational performance improvement. A further step towards understanding the impact of SPMS might involve testing the relationship on a subset of performance dimensions, thus contributing to specific supply chain literature (e.g. innovation and/or sustainability).

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Appendix

Constructs	Items (corresponding to the survey questions)	Label	Buyer Mean	Buyer Std dev	Supplier Mean	Supplier Std dev
SPMS diagnostic use (supplier's perspective)	We (the buyer) use the SPMS to monitor results	DIAGN1	4.14	0.99	3.93	0.91
	We (the buyer) use the SPMS to track progress towards goals	DIAGN2	3.96	1.05	3.90	0.87
	We (the buyer) use the SPMS to compare outcomes to expectations	DIAGN3	3.98	1.00	3.90	0.88
SPMS interactive use (supplier's perspective)	The buyer uses the SPMS to encourage discussion in meetings with us (the supplier)	INT1	4.12	0.91	3.78	1.01
	The buyer uses the SPMS to enable their organization and us (the supplier) to focus on common issues	INT2	4.16	0.91	3.82	0.97
	The buyer uses the SPMS to launch continuous improvement plans with us (the supplier)	INT3	3.97	0.96	3.83	1.00
	The buyer uses the SPMS to develop a share strategy with us (the supplier)	INT4	3.87	1.02	3.76	1.03
Buyer-supplier trust (supplier and buyer's perspective)	This supplier (buyer) is genuinely concerned that we succeed	TRUST1	4.05	0.70	4.07	0.86
	We trust this supplier (buyer) keeps our best interest in mind	TRUST2	4.29	0.75	4.08	0.91
	This supplier (buyer) considers our welfare as well as its own	TRUST3	4.25	0.85	3.97	0.96
Performance improvement (buyer's perspective)	Our relationship with this supplier has improved their product quality	PERF1	3.08	1.06	2.78	1.09
	Our relationship with this supplier has improved on-time delivery of the orders we place with them	PERF2	3.50	1.05	4.08	0.89
	Our relationship with this supplier had a positive effect on their ability to develop successful new products	PERF3	3.84	0.95	3.98	0.96
	Our relationship with this supplier has improved their environmental sustainability performance	PERF4	3.12	1.12	3.75	1.01
	Our relationship with this supplier has provided us with competitive prices	PERF5	2.52	1.18	3.07	1.12

Table A1. Constructs measurement

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