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Does relationship control hinder relationship commitment? The role of supplier performance measurement systems in construction infrastructure projects

Andrea S. Patrucco [a,*], Antonella Moretto [b], Louise Knight [c]

[a] College of Business – Department of Marketing and Logistics, Florida International University, 11200 S.W. 8th St., Miami, FL, 33199, USA
[b] School of Management Politecnico di Milano Piazza Leonardo da Vinci, 32 20133, Milan, Italy
[c] Faculty of Behavioural, Management and Social Sciences Universiteit Twente Drienerlolaan 5, 7522 NB, Enschede, the Netherlands

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ABSTRACT

Though supplier performance measurement systems (SPMS) provide a key tool for buyers to govern supplier relationships and performance, they can have a detrimental impact on trust and commitment, when perceived as just a means of control. SPMS are particularly valuable in sectors characterized by high complexity and variability of supplier performance, such construction. In projects with public sector buyers, regulations can constrain the development of comprehensive SPMS and the establishment of long-term perspectives on buyer-supplier relationships, and the impact of performance measurement practices are less well understood. To explore whether and how control and commitment can be achieved through structured use of SPMS in the public sector, this paper investigates the impact of a systematic approach to supplier performance measurement on project performance (i.e. cost, time, and quality), and how these effects are mediated by commitment. These relationships are tested using structural equation modeling on dyadic survey data collected from both suppliers and public buyers in 206 construction infrastructure projects in Italy. Results show that more rigorous qualification and performance evaluation processes have a positive impact on project performance, whereas this is not the case for supplier selection processes. Supplier commitment has a positive mediating role on the relationship between performance evaluation and project performance, while buyer commitment negatively mediates the impact of a more rigorous qualification process. These findings inform our understanding of the trade-off between control and commitment, focusing on public buyer-supplier relationships in construction projects. They demonstrate the differential relevance of SPMS to final performance across phases of the contracting cycle, and the contrasting impact of buyer and supplier commitment.

1. Introduction

Effective management of supplier relationships and orchestration of the supply base are key to achieving and maintaining sustainable competitive advantage (Gong et al., 2018; Verghese et al., 2019). Buyers need to *control* supplier relationships, to direct their partner towards required performance (Kim and Choi, 2015). One widely debated approach is supplier performance measurement systems (SPMS) – which include all the tools and actions used to evaluate suppliers (Hald and Ellegaard, 2011). While the academic literature on SPMS has gained momentum in recent years (e.g., Dey et al., 2015; Maestrini et al., 2018a; 2018b; 2018c; Paparoidamis et al., 2019), most of this research focuses on the question "*what to include?*", dealing with the components of the SPMS and the indicators to be measured (e.g., Caniato et al., 2014; Kataike et al., 2019). Few studies have addressed "*what is the impact?*" and considered the implications of SPMS design choices for buyer-supplier relationship outcomes (e.g., Maestrini et al., 2018a).

Research on intra-company performance measurement systems (PMS) show that the more detailed the structure of these systems, the better their ability to contribute to orchestrating the focal resources (e.g., Henri, 2006; Sakka et al., 2016; Koufteros et al., 2014; Bedford et al., 2019). Similarly, other research demonstrates how SPMS and activities can extend management's control of the upstream supply chain, increasing suppliers' coordination and alignment (e.g., Maestrini et al., 2018c; Romule et al., 2019). This higher control enables the identification of potential areas for improvement (Bourne et al., 2018) which, in

* Corresponding author.
E-mail addresses: apatrucc@fiu.edu (A.S. Patrucco), antonella.moretto@polimi.it (A. Moretto), l.a.knight@utwente.nl (L. Knight).

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turn, can secure higher performance (Autry and Golicic, 2010; Nair et al., 2015), and improve overall business results (Hsu et al., 2009).

This evidence of the positive value of SPMS has however been contested, and may not be uniform across sectors. Investing in the design and implementation of comprehensive SPMS can have drawbacks, as SPMS can be perceived by suppliers as a tool for buyers to gain more power in the relationship (Chae et al., 2017), leading to less motivation and relationship commitment and, eventually, worse performance (e.g., Schmitz and Platts, 2004; Cousins et al., 2008; Gundlach and Cannon, 2010).

The public sector is of particular interest. Compared to the private sector, the value of SPMS to achieve greater control over public buyer-supplier relationship is still unclear (Greiling, 2006). Public buyers need to demonstrate transparency in decision-making and equal treatment of potential suppliers (Graells, 2015). This constrains performance management activities and the establishment of formalized systems as a means of control. While in private buyer-supplier relationships there is evidence of the conditions under which SPMS can increase the level of commitment (e.g., Giannakis, 2007; Krause et al., 2007; Prahinski and Fan, 2007), these effects are not so clear in the public sector, where regulations encourage supplier turnover to provide more opportunities to bidders (Harland et al., 2019), and the duration of buyer-supplier relationships is often limited to a single contract. This short-term view can generate a highly variable and unpredictable level of commitment from both parties (Schiele, 2020). Investing in the design of an SPMS might be seen by the supplier as an attempt to control, or alternatively as a motivating effort to improve mutual value from the relationship (Ruuska et al., 2013; Yuan et al., 2009).

The aim of this study is to broaden the understanding of the value of SPMS across sectors, in particular exploring the impact of SPMS on this control vs commitment trade-off, with a particular focus on the public sector. To address these gaps, two questions frame this research:

RQ1. What is the impact of SPMS on the performance of buyer-supplier relationships in the public sector?

RQ2. What is the impact of SPMS on the level of commitment in buyer-supplier relationships in the public sector?

With this focus, construction infrastructure projects provide an interesting context for this research, as a sector with a long history of adversarial relationships with, more recently, efforts to work more collaboratively (Bemelmans et al., 2012). These projects are characterized by high complexity and high variability of supplier performance (Kamann et al., 2006; Noorizadeh et al., 2019), and literature has recognized supplier performance measurement activities and the level of relationship commitment as prerequisites to achieve desired project outcomes (e.g., Kagioglou et al., 2001; Bemelmans et al., 2011). However, an integrated view of the impact that these aspects have on supplier relationship management and project performance is still missing.

The magnitude of government spending on these projects represents a significant part of the overall spending in many countries, making this an interesting unit of analysis for studying what levers can be implemented within the buyer-supplier dyad to achieve the best value for money (Yuan et al., 2009). Focusing on projects with public authorities as the buyer, where regulations constrain the simple adoption of 'best practices' from the private sector, and yet buyers are economically important in the market, enables the exploration of commitment and control.

Unlike most SPMS research, this study includes the supplier perspective, which is essential in evaluating control and commitment. We designed a dyadic survey and collected data from a sample of 206 construction suppliers and their public buyers, and then tested the impact of SPMS on project performance and the mediating role of buyer and supplier commitment using structural equation modeling. In this context, results show how the implementation of SPMS can increase control over relationship outcomes, and also generate higher commitment. Buyer and supplier commitment, however, are able to provide a different impact on overall performance.

2. Theoretical background

2.1. The role of SPMS in buyer-supplier relationships

From a supply chain perspective, suppliers directly impact internal company activities such as stock, cash and quality management, and production planning with important consequences for overall business performance (e.g., Ross and Buffa, 2009; Chatain, 2011; Prajogo et al., 2016). Companies implement SPMS to monitor and control these inter-organizational relationships, and to improve supplier (and thus company) performance (Modi and Mabert, 2007; Maestrini et al., 2018a). Past research has framed SPMS in various ways. Hald and Ellegaard (2011) and Maestrini et al. (2018a) propose a three-phase model representing SPMS-in-use, including 1) *design* – i.e., where key areas to be measured are selected, and specific indicators defined; 2) *implementation* – i.e., where systems and procedures are put in place, and decision makers identified; 3) *use* – i.e., where performance data are collected, reviewed and acted upon. Luzzini et al. (2014) propose a complementary model, grouping SPMS choices at three levels – *strategic alignment* between the SPMS and firm strategy (through the definition of objectives, commitment and units involved); *process configuration* (through the definition of the moments to evaluate suppliers' performance); *execution* (through the definition of evaluation methods and tools). Focusing on process configuration, SPMS measures and activities can be distinguished in three steps: 1) the *qualification* phase – i.e., where buyers assess the suitability of potential suppliers (e.g., Wan and Beil, 2009; Ojadi et al., 2017); 2) the *selection* phase – i.e., where buyers evaluate bids and contract supplier(s) offering the highest value to supply a given good/service (e.g., Wetzstein et al., 2016; Badorf et al., 2019; Kurpjuweit et al., 2020); and the 3) *performance evaluation* phase – i.e., where buyers measures and control the suppliers' performance *during* contract execution (e.g., Prahinski and Benton, 2004; Prahinski and Fan, 2007; Ruuska et al., 2013).

A structured approach to SPMS strengthens relationship governance and control between buyer and supplier (Maestrini et al., 2018c), by establishing key performance metrics and goals for operational performance improvement, such as for cost, quality and service levels (e.g., Sharland et al., 2003; Sharma, 2013; Su et al., 2018; Maestrini et al., 2018a). Beyond this, several authors also discuss the role that SPMS plays in improving relationship quality. SPMS can provide incentives (Xie et al., 2016; Maestrini et al., 2018d), promote better integration (Um and Kim, 2019), improve communication quality (Maestrini et al., 2018b) and, ultimately, increase the buyer and supplier's commitment to the relationship (Krause et al., 2007; Caniëls et al., 2012; Huang and Chiu, 2018). Closer governance and control through SPMS can however also generate drawbacks. Excessive emphasis on performance measurement can be perceived by suppliers as a way to gain and exercise power in the relationship, thus decreasing motivation and relationship commitment and, ultimately, negatively impacting relationship outcomes (Schmitz and Platts., 2004; Hald and Ellegaard, 2011; Jack et al., 2018).

2.2. Buyer-supplier relationships and SPMS in the public sector

Relationship dynamics and the use of SPMS between public buyers and suppliers differ significantly from those between two firms, mainly because of the constraints imposed by public procurement regulations which can limit the degree of freedom in the design of SPMS. According to the EU Directives (2014/24/EU: http://data.europa.eu/eli/dir/2014/24/oj), the qualification and selection of suppliers based on reputational issues and company characteristics are only exceptionally allowed (Baltrunaite et al., 2018). In the selection phase, public buyers must avoid the use of discriminatory criteria in their tendering

procedures, to assure fairness and equal treatment of bidders (Bergman et al., 2013; De Carolis, 2014). Whereas procurement activities are highly regulated, contract management is a matter for best practice, as included e.g., in the Good Practice Contract Management Framework (National Audit Office, 2008). In this context, post-award management has been relatively neglected. In several countries, public procurement legislation forbids consideration of past contract performance in future tender procedures (Mamavi et al., 2015). Elsewhere, the use of past performance data is required and present (Goodrich, 1997), although mostly used as a qualifying criterion rather than to compare bids, as this could generate potential risks of debarment of contractors, undermining open competition and unjust treatment for those suppliers requesting equitable claims. These complexities further discourage investments in performance evaluation during the contract, since the potential to make use of this data is limited.

Regulations also limit the degree of freedom in managing supplier relationships. In the private sector, buyers tend to keep a core supply base, relying on trusted suppliers to minimize operating risks and assure performance continuity (e.g., Nam et al., 2011). By contrast, in the public sector, buyers are expected to include many bidders to ensure, for each tender, the highest level of competition (Spagnolo, 2012), often resulting in a relationship lifecycle limited to a single contract. Parties' willingness to invest in the relationship cannot be assumed; the dynamics of public buyer-supplier relationships are complex and highly dependent on specific circumstances (Smyth and Edkins, 2007). Taken together, these characteristics can explain why a systematic approach to supplier performance measurement is frequently missing in public contracting settings (e.g., Spekle and Verbeeten, 2014). This different context also raises the question whether the benefits and impact of SPMS on supplier performance and the relational aspects are the same to those highlighted for the private sector (e.g., Maestrini et al., 2018c).

2.3. The case of construction infrastructure projects

Construction infrastructure projects – defined as the physical structures and facilities developed or acquired by public agencies to house governmental functions and provide water, waste disposal, power, transportation, and similar services to facilitate the achievement of common social and economic objectives (e.g., Guccio et al., 2014) – represent an important field for improvement and interesting unit of analysis for three reasons: 1) their economic impact, especially in the public domain; 2) the variety of approaches to procurement and contract management; 3) the relevance of the supply chain and the consequent strategic role of performance measurement to control project outcomes.

The construction industry plays an important role in every national economy (e.g., Deloitte, 2018), and there seems to be consensus that a link exists between economic growth and construction investments (Fay et al., 2019). Between 2010 and 2015, China's annual average infrastructure spending was one of the highest in the world at 8.3%; in comparison, India spent 5.6%, Russia 4%, Canada 3.4%, the United States and Italy 2.3%, and the United Kingdom and Germany 2.1%.

Public procurement strategies available to governments for managing infrastructure project contracts are extremely varied (Lenferink et al., 2013b; Brunet, 2019). Governments may choose to take responsibility for financing, designing, building and/or operating directly infrastructure projects, or choose to pursue public-private partnerships, where private actors take responsibility for all aspects from financing to operation (Osey-Kyei et al., 2017). The last two decades have seen a marked increase in public-private partnerships across countries for infrastructure projects (Lenferink et al., 2013a; Wang et al., 2018), generating the need to manage and control the public buyer-supplier relationship using more structured approaches.

Construction infrastructure projects are characterized by high complexity, long duration and high capital investment, with a higher risk of incurring cost and time overruns and quality deterioration due to several supply chain actors involved (e.g., Dikmen et al., 2007; Cheng, 2014). Of the factors affecting delays, cost increases and poor quality in public construction projects, supply network characteristics and the nature of the buyer-supplier relationships are the biggest determinants of ultimate project performance (e.g., Chan et al., 2004; Larsen et al. (2016). So, designing a structured process to qualify and select suppliers, and evaluate performance during the execution of the contract is a prerequisite to control, reduce variability and improve overall project performance (e.g., Huang and Keskar, 2007; Gori et al., 2017).

In conclusion, although regulations limit the development of a systematic approach to SPMS and supplier relationship in the public context, the economic impact, relationship strategies, and project risks of infrastructure projects make this a unit of analysis worthy of further investigation.

3. Research model and hypotheses development

Using construction infrastructure projects as the context for our analysis, the goal of this paper is to explore the research model presented in Fig. 1, to understand better how public buyers can benefit from a systematic approach to managing supplier relationships.

On the left, we have elements of SPMS, as a tool to govern the relationship (Maestrini et al., 2018c), grouped into the three stages of the contracting process: 1) supplier qualification, 2) supplier selection, and 3) supplier performance evaluation (Luzzini et al., 2014). Procurement regulations force public buyers to communicate in advance to suppliers their evaluation criteria, as well as what information will be gathered during contract execution in order to evaluate final performance (and its use in future decision making). We assume however that buyers nevertheless have some degrees of freedom in designing and implementing SPMS, with different effects on project performance (e.g., Berssaneti and Carvalho, 2015; Gori et al., 2017). In this study, we also introduce a broader view of performance of the project and, to potentially address existing endogenous conflicts among different variables, we do not just consider cost performance – as often happens in the public sector – but we include also time and quality (Larsen et al., 2016). So, our model relies on the idea that investing in a detailed design and systematic implementation of supplier qualification, selection, and performance evaluation can help the buyer to obtain the desired level of performance from suppliers (Hald and Ellegaard, 2011). The academic debate about the role of SPMS as a tool to control the relationship and its consequence on the level of buyer and supplier commitment is ongoing, with conflicting evidence of the impact of greater control on commitment (particularly from suppliers). Therefore, commitment is included in the framework, distinguishing between buyers' and suppliers'. The emphasis on performance measurement for better governance and control of the buyer-supplier relationships influences the relationship perception of buyer and supplier and, consequently, their level of commitment (Chae et al., 2017). This, in turn, can also impact final performance. The model relies on five hypotheses, detailed below.

3.1. The relationship between SPMS structure and project performance

In line with Hald and Ellegaard (2011), Bourne et al. (2018) and Maestrini et al. (2018c), this study considers the SPMS as a tool that the buying organization designs and implements to better control and govern supplier relationships. In the case of infrastructure projects, for appropriate control of the relationship with the supplier, public buyers should define structured approaches to qualify, select and evaluate contract performance of suppliers, to obtain desired project outcomes (Sharland et al., 2003; Sarkar and Mohapatra, 2006).

Consistently with this, it is reasonable to assume that a well-structured qualification process will lead to the inclusion of the 'best suppliers' in the supply base. Some studies show how rigorous qualification requirements allow the contracting authority to reliably anticipate whether a supplier will be able to meet the specifications (e.g., Ojadi et al., 2017). Ineffective qualification may lead to a poor supplier

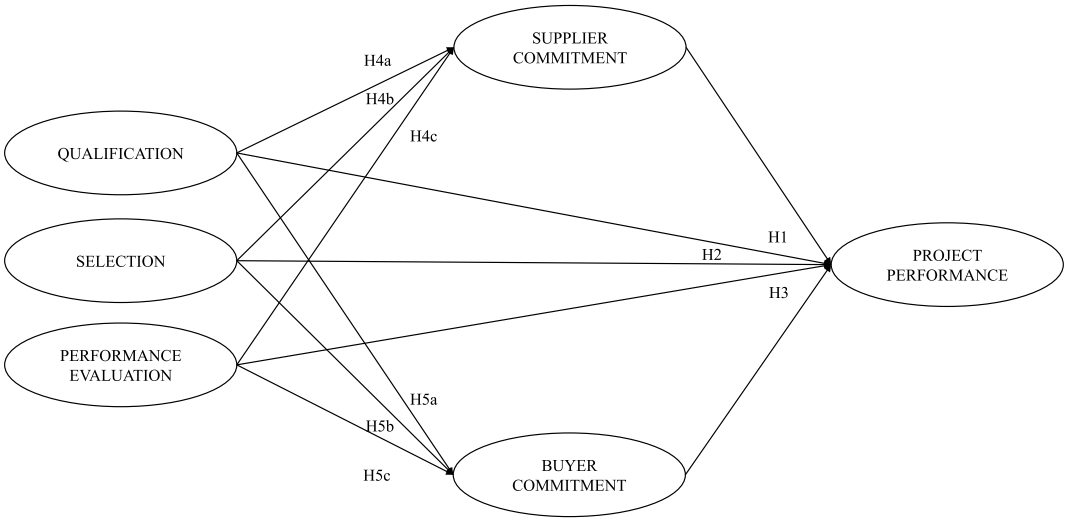

Fig. 1. Research model.

selection, thus affecting the overall success of the work (Banaitiene and Banaitis, 2006; Mamavi et al., 2015). Thus:

H1. More comprehensive evaluation during the qualification stage has a positive impact on infrastructure project performance.

In supplier selection, multi-criteria approaches are always used to identify the most suitable supplier (Kannan and Tan, 2002; Kannan and Tan, 2006; Hosseini and Barker, 2016). The relationship between appropriate supplier selection and better performance has been convincingly demonstrated in the supply chain management literature (e.g., Liu et al., 2000; Kannan and Tan, 2002; Roeheric et al., 2017). It can be related to infrastructure projects, where the economic evaluation of the project must be integrated with the technical proposal, and each dimension needs to be assigned a specific weight (Kotula et al., 2015). On the one hand, from an economic point of view, it is crucial to select a supplier offering a reasonable bid when dealing with expensive purchases such as public works (Huang and Keskar, 2007). On the other hand, identifying the best economic offer is not enough, given the multi-dimensional complexity of infrastructure projects (Lenferink et al., 2013a; Kivilä et al., 2017) that makes non-price attributes similarly important during bid evaluation, to assure better project performance. Public buyers need to pay attention to the design of appropriate selection systems, able to integrate and weight all the relevant dimensions, in order to choose the supplier with the highest potential and capability to realize the project in line with expectations. Thus:

H2. More comprehensive evaluation during the selection stage has a positive impact on infrastructure project performance.

A comprehensive approach to supplier performance management during contract execution represents one of the driving factors for obtaining better performance (e.g., Dey et al., 2015; Nair et al., 2015). Infrastructure projects are different from most of the traditional goods and services purchased, as they are characterized by long contract durations and complex execution (Ahadzi and Bowles, 2004; Lenferink et al., 2013b); this generates the need to measure supplier performance over an extended period (Chan et al., 2004), making this phase even more important. Although measuring project execution performance is complicated and time-consuming, it represents the starting point for the identification of operational improvements, as well as for reducing project costs and duration, and be sure the right level of quality is obtained (Ruuska et al., 2013; Wegelius –Lethonen, 2001; Larsen et al., 2016). For these reasons, public buyers need to develop a structured approach for contract performance evaluation, as this allows higher control over the execution of activities, and alignment toward desired performance targets. Thus:

H3. More comprehensive evaluation during the performance evaluation stage has a positive impact on infrastructure project performance.

3.2. The mediating role of buyer andsupplier relationship commitment

Much of the recent literature on buyer-supplier relationships focuses either on the attributes of relationships, or on how relationships contribute to performance. Among the different traits that characterize buyer-supplier relationships, the level of commitment has attracted attention in several studies in the industrial marketing and supply chain management fields (e.g., Chae et al., 2017; Shahzad et al., 2018; Patrucco et al., 2020). Commitment shows engagement in the relationship and demonstrates a willingness to work together to increase the value arising from this relationship, with motivation that goes beyond each party's own interests. Studies in the private sector have demonstrated that commitment from both sides of the relationship provides higher returns for both the buyer and the supplier (e.g., Nyaga et al., 2010).

In the private sector, an intensive use of SPMS for controlling the relationship seem to have a mixed impact on the level of supplier commitment. On the one hand, more comprehensive SPMS can be seen as a buyer initiative to stimulate the supplier to provide the best possible outcome (Giannakis, 2007) which, in turn, positively affects commitment on the supplier side (Prahinski and Benton, 2004; Prahinski and Fan, 2007; Huang and Chiu, 2018). On the other hand, an excessive emphasis on control can also be seen negatively by the supplier, who might perceive this as the buyer's intention to collect data and information that can be used to 'punish' the supplier (Cousins et al., 2008), thus negatively affecting relational commitment (Sheng et al., 2018).

Similarly, a buyer who invests in more structured SPMS can be more motivated and committed in the relationship, because of the specific investment made (Patrucco et al., 2020). But, at the same time, the SPMS are tools that (if well designed) can guarantee a degree of automatic monitoring and control of the relationship, thus lowering the level of attention (and commitment) from the buyer (Kannan and Tan, 2006).

Despite the particular characteristics of the public sector, we assume that, for buyer-supplier relationships in infrastructure projects, SPMS and buyer and supplier commitment are related, with these possible mixed effects. As regulation limits the attention paid by public buyers to design and implementat SPMS, a structured performance measurement approach can be perceived either positively as a relational investment on the buyer's side to develop the relationship, or as a lack of confidence in the supplier that requires an additional effort. In either case, we

assume that perceiving the SPMS as a means of control has an impact on both the level of buyer and supplier commitment, and this might affect the direct impact of SPMS on final performance. Thus:

H5. Supplier commitment mediates the relationship between a more comprehensive evaluation during a) qualification, b) selection and c) performance evaluation stages and infrastructure project performance.

H6. Buyer commitment mediates the relationship between a more comprehensive evaluation during a) qualification, b) selection and c) performance evaluation stages and infrastructure project performance.

4. Research methodology: data collection and sample characteristics

4.1. Questionnaire design and scale development: the dyadic perspective

Given the main purpose of the research is theory testing (Malhotra and Grover, 1998), data was collected via a survey designed specifically for this study, and administered online in 2016. As the constructs in our model deal with relationship-specific issues and are potentially subject to single-respondent bias, dyadic data (e.g., Carter, 2000) was collected for buyer-supplier pairs via the survey and public records.

A pair of matching questionnaires was developed, one for the buyer and the other for the supplier. Both included questions about the structure of the SPMS, the level of the commitment in the relationship and project performance. Multiple-item, 5-point Likert scales measures were used for the primary constructs in the research model (Klassen and Jacobs, 2001). To measure these constructs, we relied on existing literature about SPSM in the private and public sectors; existing scales were found to be not fully suited to the features of the infrastructure projects, so requiring adaptation to this particular context (see also the table in *Appendix* for details on constructs and scales).

Supplier qualification was measured by asking respondents to rate the thoroughness of this phase, considering both the number and type of aspects evaluated. This included dimensions to assess supplier's suitability to execute the project, such as supplier reputation, financial position and technical capabilities (e.g., Wan et al., 2012). Similarly, *supplier selection* was measured by asking the respondents to rate the thorougness of this phase, considering the criteria used to choose the suppliers and the approach adopted to assess their relative strengths and weaknesses (Kannan and Tan, 2006). This included the typical dimensions considered when evaluating project proposals, such as price/cost, time, and quality (e.g., Chester and Hendrickson, 2005; Larsen et al., 2016). To measure *supplier performance evaluation*, respondents were asked to rate the throughness of this phase, considering both the number and type of aspects evaluated during contract execution. This included an assessment of quality, time and cost aspects (considered during selection), together with the economic/financial stability and the organizational capabilities of the suppliers – essential aspects to be monitored during contract execution for projects that can extend over a long period of time (e.g., Prahinski and Fan, 2007; Noorizadeh et al., 2019).

Given the infrastructure context and the endogenous short-term perspective of relationship promoted by public sector regulation, for *buyer and supplier commitment*, we followed the stream of scholars who conceptualize commitment through the level of engagement, trust in, and loyalty to the relationship (e.g., Gao et al., 2005; Ferro et al., 2016), rather than through the type of operational investments made by the parties (i.e., asset specificity; Patrucco et al., 2020). Respondents were asked to rate to what extent they themselves: were committed to assuring a successful relationship outcome; considered the needs of the counterpart when taking decisions; and anticipated further engagement in future relationships.

Finally, the dependent construct *project performance* was assessed according to the traditional performance indicators associated to construction project evaluation. In particular, in line with the project management literature (e.g., Kaliba et al., 2009; Guccio et al., 2014a; 2014b; Larsen et al., 2016; Gori et al., 2017), project performance was evaluated in terms of variance from the targets established in the contract for total cost (i.e., cost overruns), time (i.e., schedule delays), and quality (i.e., adherence to initial design).

In addition to the main variables in the model, a number of dummy variables were used as controls over project performance, such as the project value (using four dummy variables if the project value was below 100,000€, between 100,000 and 500,000€, between 500,000€ and 1,000,000€, or higher than 1,000,000€) and duration (using three dummy variables if the project duration was below 6 months, between 6 and 12 months, or more than 1 year).

4.2. Sample characteristics and data collection

To increase internal validity and the comparability of results with other dyadic studies on SPMS (e.g., Maestrini et al., 2018a), and to assure a homogeneous regulatory and economic context, our data collection was limited to a single country. The survey was conducted in Italy, for convenience but also considering the magnitude of government spending for infrastructure projects. (Italy ranks 14th worldwide for national infrastructure spending compared to GDP, according to Deloitte, 2018). To build our sample, we started from the publicly available list of suppliers to the Italian public sector during the preceding two years. From the original 83,000 companies named, 6,013 were recognized as construction companies with a contract awarded and concluded in the last three years.

Before administering the survey, the questionnaire was pre-tested with 15 of these companies (where contacts were already in place), to check the clarity and validity of questions (Groves et al., 2011). Data was collected between January 2016 and June 2016. Due to public buyers' possible reluctance to disclose the name of a contractor, the questionnaire was sent first to the suppliers – using their institutional mail – asking the recipient to identify the most suitable person in the company to answer the questions. All the respondents were people involved directly in the project, and were mostly senior and highly qualified project managers (Table 1). We collected questionnaires from 258 suppliers (4.3% response rate). In the questionnaire, supplier respondents were asked to provide the name of the public buyer, along with contact details of a suitable respondent (if available), who had to be aware of the characteristics of the project executed.

Once the suppliers returned the questionnaires, the buyers were contacted, briefed on this research, and then asked to complete the questionnaire. Respondents for the buying organizations were equally distributed between technical departments and procurement offices

Table 1
Sample descriptive – supplier companies.

	Frequency	%
Employees		
1–9	25	12%
10–49	78	38%
50–250	96	47%
>249	7	3%
Revenues (million €)		
1–9	92	45%
10–49	73	35%
50–250	37	18%
>250	4	2%
Industry (top 3)		
Construction of buildings	86	42%
Installation of electrical and electronic plants and systems	22	10.5%
Construction of highways and runaways	20	10%
Respondent position		
Senior project manager (>5 years of experience)	167	81%
Junior project manager (1–5 years of experience)	29	14%
Other project role	10	5%

Table 2
Sample descriptive – buyer institutions.

	Frequency	%
Type of public organization		
Municipalities and local governments	153	74%
State-owned companies	22	11%
Health institutions	13	6%
Regional governments	12	6%
Universities	6	3%
Respondent position		
Technical office - Manager	42	20.5%
Technical office - Administrative	63	30.5%
Procurement office - Manager	66	32%
Procurement office - Administrative	35	17%

(Table 2). Both parties were assured that their responses would not be disclosed to their counterpart. We were able to collect data from public buyers only for 206 of the 258 projects. This became our final sample. Tables 1 and 2 summarize characteristics of the respondents, while Table 3 presents characteristics of the projects.

The sample is composed mainly of small-medium enterprises (SMEs), which reflects the distribution of companies in Italy, where SMEs represents the majority of the companies(European Commission, 2019). The majority of the suppliers operate in the construction business (for buildings, roads and production sites), and have realized projects mostly for local governments and municipalities. Most of the projects included in our sample relate to building construction (for maintenance, renewal and/or refurbishment).

Non-response bias was checked through independent sample *t*-test on questionnaire variables (Dalecki et al., 1993), e.g., employees, revenues, project value, which indicated no statistically significant differences between early and late respondents. Furthermore, social desirability bias in the entire survey was reduced through the assurance of confidentiality and through questions clearly focused on the institution and its members in general rather than about personal behaviors or individual performance.

The survey procedure was designed to minimize common method bias (Podsakoff, 2003). First, though the research project was labelled as a study to understand how public buyers manage supplier performance measurement and management for infrastructure projects, no reference was made to the model in Fig. 1, so that respondents' attention was not drawn to the relationships being targeted in this study. Moreover, questions were organized in order to separate the different sections, to prevent respondents from developing their theories about possible cause-effect relationships. Finally, the dyadic buyer-supplier approach used avoided the risk of subjective responses to self-executed activities. The common latent factor technique was also applied on the measurement model (see Section 5.1) to statistically test common method bias (Podsakoff, 2003). Through this analysis, we found that the common latent variable has a linear estimate of 0.572 This value, when squared, indicates a variance of 0.327, which is below the threshold of 0.500.

Table 3
Sample descriptive - projects.

	Frequency	%
Type of project (top 4)		
Building maintenance	30	15%
Building renewal	29	14%
Highway maintenance	28	14%
Refurbishment of buildings, monuments or public plazas	21	10%
Type of contract		
Execution of infrastructure project	174	84.5%
Design and execution of infrastructure project	23	11.2%
Acquisition, design and execution of infrastructure project	9	4.3%
Project value (,000 €)		
< 100	8	4%
100–250	47	23%
251–500	44	21.5%
501–1,000	54	26%
> 1,000	53	25.5%
Project duration		
Short (1–6 months)	33	16%
Medium (6–12 months)	131	63.6%
Long (>12 months)	42	20.4%

4.3. Data analysis approach

Dyadic data leads to several choices in data analysis. For this paper, the decision was taken to measure the mean between the buyer and the supplier for the constructs supplier qualification, selection, and evaluation. This was done in order to increase the robustness of measures, by triangulating buyer and supplier perceptions on the SPMS structure. Measuring the mean, in fact, allows for data triangulation on items which are experienced, at the same level, by both buyer and supplier, leading to a more robust measure (e.g., Aminoff and Tanskanen, 2013). For project performance, by contrast, we used data received from the buyer, since this was more likely to be stated more accurately given the availability of public documents on the buyer side (where time, quality, and cost variations are officially tracked in public records).[1] Finally, for supplier and buyer commitment, each construct was measured using items taken from the supplier and buyer questionnaires, respectively.

Since the objective of our research is theory-testing and confirmation, the presented hypotheses were tested using covariance-based structural equation modeling (CB-SEM; Anderson and Gerbing, 1988). The maximum likelihood (ML) estimation method was used, as ML is able to provide more robust parameters estimation and goodness of fit indicators compared to other estimators (White, 1982). 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 and Henze-Zirkler tests (both with $p > 0.1$).

5. Results

5.1. Measurement model

The final measurement model (Fig. 1) consists of 6 multi-item constructs with a total of 21 indicators, with no relevant cross-loading among different constructs. Table 4 reports the results of the Confirmatory Factor Analysis (CFA), and the information for each construct. All of the measurement model fit indicators show a sufficient fit (χ^2/d.f. = 1.78; CFI = 0.938; TLI = 0.925; RMSEA = 0.061). According to Nunnally and Bernstein (1994), for each construct, convergent validity was assessed looking at significant values of item loadings, and looking at both composite reliability (CR) and average variance extracted (AVE). AVE ranges between 51% and 67% (above the 50% recommended threshold), while CR between 0.71 and 0.88 (above the 0.7 recommended threshold).

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. This condition is valid for all constructs (see Table 5).

5.2. Structural model

In order to test our hypotheses, we separately tested three path models through SEM. Table 6 shows the structural model results, including standardised path coefficients, with the significance based on two-tailed t-tests for our hypotheses. The first model tests the direct effect of SPMS phases on project performance. In line with H1 and H3, more comprehensive supplier qualification ($\beta = 0.204$, $p < 0.05$), and

[1] A check on suppliers' responses on project performance was made, and no significant variations on performance measures were found.

Table 4
Confirmatory Factor Analysis (CFA) of the reflective constructs.

Construct	Mean	S.D.	Factor Loadings	AVE[a]	CR[b]
Qualification				50.8%	0.756
QUAL1	2.72	1.78	0.724		
QUAL2	2.28	1.59	0.656		
QUAL3	2.52	1.66	0.756		
Selection				54.7%	0.739
SEL1	4	1.08	0.757		
SEL2	3.75	0.99	0.793		
SEL3	4.03	1.44	0.711		
SEL4	3.47	1.15	0.693		
Performance evaluation				60.3%	0.883
EV1	2.55	1.24	0.804		
EV2	2.66	1.29	0.870		
EV3	2.61	1.24	0.804		
EV4	2.65	1.28	0.677		
EV5	2.75	1.35	0.711		
Buyer commitment				67.4%	0.861
BC1	3.81	1.04	0.751		
BC2	3.52	0.83	0.844		
BC3	2.8	1.12	0.863		
Supplier commitment				59.8%	0.816
SC1	3.89	0.75	0.694		
SC2	3.91	0.71	0.779		
SC3	3.52	0.83	0.841		
Project performance				50.9%	0.713
PERF1	3.36	1.32	0.707		
PERF2	3.29	1.25	0.724		
PERF3	3.37	1.47	0.710		

[a] Average Variance Explained.
[b] Composite Reliability.

performance evaluation ($\beta = 0.425$, $p < 0.001$), lead to higher project performance. By contrast, no statistical evidence is found regarding supplier selection ($p > 0.05$) and project performance.

The second model includes all the latent variables, and tests the mediation effect of buyer commitment and its impact on project performance (H4). Among the SPMS phases, only supplier qualification ($\beta = 0.325$, $p < 0.001$) has a positive impact on buyer commitment, while no relationship can be established for selection and performance evaluation. Still, qualification ($\beta = 0.211$, $p < 0.05$) and performance evaluation ($\beta = 0.409$, $p < 0.001$) maintain a direct positive effect on project performance, whereas the direct effect of selection is not significant. Surprisingly, higher buyer commitment leads to lower project performance ($\beta = -0.317$, $p < 0.001$).

Similarly, the third model includes all the latent variables, and tests the mediation effect of supplier commitment and its impact on project performance (H5). In this case, only supplier performance evaluation ($\beta = 0.342$, $p < 0.001$) has a positive impact on supplier commitment. Qualification ($\beta = 0.233$, $p < 0.01$) and performance evaluation ($\beta = 0.312$, $p < 0.001$) maintain a direct positive effect on project performance, whereas the direct effect of selection is still not significant. Finally, higher supplier commitment leads to higher project performance ($\beta = 0.453$, $p < 0.001$).

As shown in Table 6, none of the dummy control variables are significant, which means that project duration and value do not significantly affect project performance.

The results show that H1 and H3 should be accepted, while H2 should be rejected. H4 and H5 are partially rejected, as 1) no mediation effect is observed for buyer commitment on the relationship between selection and project performance (H4b), or between performance evaluation and project performance (H4c); 2) no mediation effect is observed for supplier commitment on the relationship between qualification and project performance (H5a) and between qualification and project performance (H5b).

To verify if H4 and H5 can partially be accepted (through H4a and H5c), we followed some of the most recent recommendations about mediation analysis (e.g., Rungtusanatham et al., 2014), and we assessed the reliability of our results through multiple criteria (see Table 7). First, we applied the classical Baron and Kenny method (Baron and Kenny, 1986), that compares 1) the direct effect of our independent variables on project performance without mediators and with mediators; 2) the direct effect of our independent variables on the mediators; 3) the effect of the mediators on project performance; and 4) finally, it computes the total effect of our independent variables. Second, we tested the

Table 5
Correlation matrix (The square root of the average variance extracted (AVE) is shown in italics on the diagonal. Correlations are in the lower triangle of the matrix).

	1	2	3	4	5	6
1. Qualification	71%					
2. Selection	0.015	74%				
3. Performance evaluation	0.034	0.022	78%			
4. Buyer commitment	0.217**	0.208*	0.143	82%		
5. Supplier commitment	−0.075	0.181	0.273**	0.546***	77%	
6. Project performance	0.198*	0.084	0.251**	−0.378***	0.402***	78%

Table 6
Parameter estimates (***p-value<0.001; **p-value<0.01; *p-value<0.05; [ns]p-value≥0.05. The values of t statistics are shown in brackets.).

	Model 1	Model 2		Model 3	
	Project performance	Buyer commitment	Project performance	Supplier commitment	Project performance
Independent variables					
Qualification	0.204* (2.17)	0.325*** (3.68)	0.211* (2.12)	0.015[NS]	0.233** (2.19)
Selection	0.037[NS]	0.1378[NS]	−0.012[NS]	0.091[NS]	−0.013[NS]
Performance evaluation	0.425*** (4.45)	0.044[NS]	0.409*** (4.34)	0.342*** (3.71)	0.312*** (3.36)
Buyer commitment	–	–	−0.317*** (3.66)	–	–
Supplier commitment	–	–	–	–	0.453*** (5.23)
Control variables					
Project length - Medium	0.074[NS]	–	0.108[NS]	–	0.94[NS]
Project length - Long	0.042[NS]	–	0.056[NS]	–	0.041[NS]
Project value - Medium (100–500.000 €)	0.082[NS]	–	0.075[NS]	–	0.098[NS]
Project value - Big (>500.000 €)	−0.102[NS]	–	−0.087[NS]	–	−0.107[NS]
Chi/df	1.832	1.718		1.827	
CFI	0.921	0.925		0.919	
TLI	0.905	0.910		0.903	
RMSEA	0.064	0.059		0.060	

Table 7
Mediation tests.

		Direct effect on project performance with the mediator	Direct effect on the mediator	Effect of the mediator on the project performance	Indirect effect on project performance	Bootstrapping	Total effect on project performance
Buyer commitment	H4a: Qualification–> Buyer commitment–>Project performance	0.211* (2.01)	0.325*** (3.23)	−0.317*** (3.13)	−0.103** (-2.23)	[-0-124; −0.023]	0.108^{NS}
	H4b: Selection–>Buyer commitment–>Project performance	−0.011^{NS}	0.138^{NS}		−0.044^{NS}	–	−0.055^{NS}
	H4c: Performance evaluation–>Buyer commitment–>Project performance	0.409*** (3.63)	0.044^{NS}		−0.014^{NS}	–	0.395*** (3.83)
Supplier commitment	H5a: Qualification–>Supplier commitment–>Project performance	0.233** (2.04)	0.015^{NS}	0.453*** (3.68)	0.006^{NS}	–	0.241** (2.01)
	H5b: Selection–>Supplier commitment–>Project performance	−0.013^{NS}	0.091^{NS}		0.041^{NS}	–	0.028^{NS}
	H5c: Performance evaluation–>Supplier commitment–>Project performance	0.312*** (3.13)	0.342*** (2.98)		0.155** (2.57)	[0.103; 0.177]	0.467*** (4.40)

significance of the indirect effects through bootstrapping analyses by considering bias corrected and accelerated confidence intervals (97.5%), where mediation is said to occur if the derived confidence interval does not contain zero.

The indirect effects are significant for both H4a and H5c, which means that the mediation effects are significant. We can conclude that supplier commitment partially mediates the relationship between SPMS phases and project performance, as a positive mediation is found for the performance evaluation phase. Buyer commitment, as well, partially mediates the relationship between SPMS phases and project performance, but this mediation effect is negative for the qualification phase.

6. Discussion of results

6.1. SPMS impact on performance

Our analysis shows that infrastructure project performance benefits from a sound evaluation at the qualification stage, and detailed measures for assessing supplier performance during the execution of the contract. Although neither of them are extensively adopted by public buyers, when implemented in a comprehensive way, these stages reveal a positive and significant impact on project performance. By contrast, more efforts and thoroughness in the selection stage do not relate to better performance.

The positive relationship between a sound qualification stage and subsequent supplier performance (H1) is recognized in private sector studies as one of the most important factors to ensure higher supply network performance (e.g., Sarkar and Mohapatra, 2006; Wan et al., 2012). Our results support this evidence also for the public sector (in line with some pioneering studies e.g., Mamavi et al., 2015). Supplier qualification enables public buyers to gather information about supplier capabilities; to assess suppliers' ability to meet an immediate product or service need; to qualify candidates in anticipation of future competitions, independently from the procedure used (open or restricted; Fernandez, 2007). EU Directives themselves encourage a preliminary supplier assessment in the areas of professional competences, financial capabilities and technical capabilities. This becomes even more critical for infrastructure projects, where public organizations invest a significant portion of their budget with little scope for remedy or re-sourcing if a supplier fails to perform adequately, when compared to a failing supplier of a product or ongoing service. A poorly structured (or absent) qualification process may lead to a poor supplier selection, which might result in poor project performance (e.g., Gori et al., 2017).

The positive relationship between the evaluation of suppliers' performance during contract execution and project performance (H3) drives attention toward another long-standing public sector problem: the approach to contract performance measurement. While, in the private sector, buyers have developed a culture of measuring supplier performance (Maestrini et al., 2018c), public buyers tend conversely to implement very simple performance evaluation systems, usually limited to what was agreed at contract level (Noorizadeh et al., 2019). In the case of complex purchases– such as infrastructure projects – this is not sufficient to understand how suppliers are actually performing (Lenferink et al., 2013a). This lack of focus is partially due by the fact that a formal use of past supplier performance is not allowed in public procedures by EU public institutions (Graells, 2015), and this often discourages the investment in performance monitoring activities. Supplier performance evaluation should not be limited to verifying that the supplier simply accomplishes what has been established at contract level (i.e., normative approach). It should be the starting point for collecting information and identifying improvements for future projects. Nevertheless, when information is gathered during the project execution, and results are communicated to suppliers (while contracts are still ongoing), suppliers can be pushed to improve (or sustain) their performance, thus positively affecting the value of the final project output (Lenferink et al., 2013b; Berssaneti and Carvalho, 2015). This result is

also supported by positive evidence found in private sector studies and, for example, the U.S. public sector (e.g., Mamavi et al., 2015).

By contrast, our data does not show a positive relationship between a comprehensive supplier selection process and overall project performance (H2). In most public organizations, this is the phase where buyers focus their attention the most, being the one most influenced by regulation. Because of this, further investment in this stage (e.g., by elaborating more detailed and complex selection criteria) might be redundant, and unlikely to yield further benefits for project performance. Although authors have emphasized the need to design appropriate selection approaches (e.g., Luzon and El-Sayegh, 2016), the combination of technical and commercial aspects for selecting suppliers represents a mature practice in infrastructure projects (Taherdoost and Brard, 2019) even in the public sector (Waara and Bröchner, 2006). For this reason, though supplier selection is relevant, further investments to develop more detailed and complex proposal evaluation systems do not lead to supplier performance improvement and better project outcomes.

In conclusion, in the context of public buyer-supplier relationships, investing in SPMS as tools to better control the relationship does pay back in terms of performance obtained from suppliers, but not for all the phases. Public buyers should develop their capabilities to qualify and evaluate supplier performance during contract execution, as this is where a more in-depth assessment yields higher benefits. These conclusions, valid in the case of construction infrastructure projects, may be more widely relevant for the cases of complex purchases made by public organizations (e.g., social services, technologies, research and development, military acquisitions), characterized by higher contract and relationship risks, high impact on public service delivery, and multiple aspects to be assessed and controlled (Caldwell and Howard, 2014).

6.2. SPMS impact on buyer and supplier commitment

Unexpected results are found for the impact of SPMS on the level of buyer (H4) and supplier (H5) commitment, and the mediating effect that this commitment has on the relationship with performance. For buyer commitment, our findings first show that higher commitment from the public buyer is present when more effort is put on the design and implementation of a more comprehensive qualification system, but not for selection and performance evaluation. This result can be explained in two ways. The qualification stage, being (chronologically) the first in the SPMS process, is usually the most neglected, especially in the public sector, where this preliminary assessment can result in an exclusion of suppliers only under very specific circumstances (Baltrunaite et al., 2018). When done in a comprehensive way, this can be perceived as the buyer's decision to invest a significant amount of time (and resources e.g., information systems) to arrive to a more structured pre-evaluation of suppliers; this increases the asset specificity in buyer-supplier relationships, a variable recognized as one of the antecedents of commitment (Patrucco et al., 2020). Furthermore, in the specific case of infrastructure projects (and, more generally, complex acquisitions), a more comprehensive qualification provides to the public buyer better knowledge about the potential suppliers. Being aware of their strengths and weaknesses, public buyers cane be more capable of supporting suppliers' needs, and so to cooperate toward successful relationship outcomes (Chen et al., 2018a; b). The fact that the same effect is not present for the selection and the performance evaluation phases can be explained by noting that structured assessments in these areas are already part of the public buyer routine (especially in the case of infrastructure projects), and thus would not be a significant driver of higher commitment.

The surprising finding is the negative mediating effect that buyer commitment has on the relationship between supplier qualification and performance (H4a). A possible explanation is that high buyer commitment (signaled by a higher investment in the SPMS) - unusual in public organizations - might be perceived by the supplier as a sign of weakness, dependence and/or inexperience (Poppo et al., 2016). This, in turn, can generate opportunism from the supplier side, thus leading to worse performance. High commitment from the buyer could also raise suppliers' confidence about winning contracts in future projects, and so encourage them to devote less attention to performance within existing contracts, as suppliers feel less pressure to improve.

For supplier commitment, results show that, among the different phases of SPMS, ongoing performance evaluation is the only one to have an impact on commitment. The attention provided by the buyer to measure performance during the execution of the contract can be in fact perceived by the supplier as a sign of buyer's focus on the activities executed by the supplier (and, so, on the relationship). By investing in a more comprehensive performance dashboard while the contract is in place, the buyer is able to strictly control supplier's progress, but also to potentially provide timely feedbacks, that might lead to implementation of corrective actions when at risk of missing performance targets (Henri, 2006). In either case, these aspects push suppliers to assure a successful project outcome, be open to buyer requests and, overall, stimulate the willingness to continue the relationship in the future. The fact that this effect is not present for more comprehensive qualification and selection stages can be explained by considering that these activities take place before an actual contract is in place; suppliers can be appreciative of a structured and in-depth qualification and selection approach from the buyer, but without this resulting in an ex-ante commitment to contract delivery. Finally, results show that more committed suppliers are actually able to deliver higher performance, and supplier commitment positively mediates the relationship between performance evaluation and project performance (H5c). While this result is in line with private sector studies (e.g., Shahzad et al., 2018), this relationship is less straightforward in the public context (and in the case of infrastructure projects), where the need to deal with public buyers, and the uncertainty about the future of the relationship, might push the supplier toward a lower level of interest and commitment – without this resulting in worse performance (Gori et al., 2017). Our study is able to demonstrate the relevance of having committed suppliers, as higher supplier commitment is able to increase the benefits resulting from the buyer investments in more comprehensive SPMS.

6.3. Relationship control and commitment: is there a trade-off?

In light of these results, we can conclude that the answer to the question "*does higher control hinder relationship commitment?*" is negative in the context of public buyer-supplier relationships, although understanding the role of commitment on project performance needs to differentiate between the buyer and the supplier perspectives. In contrast with existing arguments that theorize the effects for buyer and supplier commitment on supplier performance as being mutual and reciprocated (e.g., Nyaga et al., 2010; Bemelmans et al., 2011), our study shows that, in the case of a dyad composed of a public buyer and a private supplier, for infrastructure projects, commitment has a positive role as driver of better performance only when it comes from the supplier. Apparently, contrary to the evidence from previous research in the private domain, mutual high levels of commitment are not the key to improving the overall performance. The implication of this is that public buyers seeking to improve the performance of their projects need to

invest more in increasing the commitment of their suppliers rather than in showing their own strong level of commitment. For example, contract incentives in combination with highly formalized evaluation of performance might yield better performance than a partnership approach with mutual learning.

7. Conclusions and future developments

The analysis of the effect of the SPMS as tools to control contract performance, and its impact on relationship commitment in the context of infrastructure project, provides interesting developments to the literature on buyer-supplier relationship management in the public sector and in the construction industry. This study, unique in its nature, open avenues for future research in the context of buyer-supplier relationships in the public sector, and provides several theoretical and managerial contributions.

7.1. Limitations and further developments

The findings of the paper indicate some limitations and suggest avenues for further research. First, though we have a large dataset, we describe the phenomenon of SPMS only in one national setting. Although Italian procurement regulation is aligned with the European Directives, it would be interesting to compare these results with other EU countries; this would provide an overview of cross-country public buyer's behaviours and approaches to performance measurement. Second, this paper presents a framework for supplier evaluation adopting infrastructure projects as the unit of analysis; it would be interesting to analyze if similar results are obtained by changing the nature of the purchase, such as e.g., information systems projects , where different performance needs to be measured. Finally, some of the limitations described here are a consequence of the survey methodology. Indeed, although results are relevant to other contexts, it is not possible to deeply understand some factors usually connected to SPMS implementation, such as the internal organizational dynamics of public buyers and suppliers, or the level of expertise of public buyers and project managers. This limitation could be solved by designing (for example) an exploratory case study research, including additional factors currently excluded from our research framework.

Future research should also go into more detail on the results found in this paper, especially focusing on the dichotomy between control and commitment. While our findings support the idea that control does not compromise commitment, they also show that buyer and supplier commitment have different impacts on performance; a better understanding of these dynamics – possibly through a more detailed comparison with the private context – is necessary. Understanding the reasons behind these relationships (e.g., through interviews) could lead to interesting insights particularly from a managerial perspective, where an effective management of this trade-off represent an important lever that public buyers could use to obtain better performance from suppliers.

7.2. Theoretical contribution

This work analyses the effects of the use of structured SPMS in a supplier-buyer dyad composed of a private company and a public organization , a unit of analysis not considered in the supply chain management literature, and it focuses on the infrastructure project domain, an area under-investigated in literature on buyer-supplier relationships. This study supports previous arguments that SPMS have a positive role to control and regulate buyer – supplier relationships (e.g., Koufteros et al., 2014; Maestrini et al., 2018c), specifically when investing in designing and implementing structured approaches for supplier qualification and performance evaluation. This expands the validity of previous theoretical findings, limited to private buyer-supplier dyads (e.g., Kannan and Tan, 2002; Ross and Buffa, 2009; Wan et al., 2012; Maestrini et al., 2018a).

Results also contribute to the discussion about the role that commitment has in driving performance improvements (e.g., Bemelmans et al., 2011; Shahzad et al., 2018). In particular, by concluding that performance measurement (at least in some phases) is able to determine higher commitment in the context of a public buyer-supplier relationship, we enrich the discussion about the impact of control tools on the level of commitment, limited to industrial relationships (e.g., Cousins et al., 2008; Gundlach and Cannon, 2010; Chae et al., 2017), and still unexplored in both construction and public sector. Finally, by demonstrating that a higher level of commitment from both parties does not always lead to performance improvement (as, for our unit of analysis, a performance boost is provided only by a high level of supplier commitment in the relationship), we challenge existingfindings and suggest that further research is needed using dyadic data to avoid assuming levels of commitment are mutual.

7.3. Managerial contribution

From a practical perspective, our results can be considered useful for two reasons. From the public buyer perspective, we demonstrate that sound supplier qualification and performance evaluation systems are useful for relationship control and obtaining better project performance. This means that public organizations are now aware of where to focus their attention when designing SPMS. Independently from award and selection procedures, they should rely on a proper qualification stage – that will increase information collected on potential suppliers and their knowledge on the supply network. Independently of what specified at contract level, they should establish a comprehensive set of metrics for project oversight and management, this being the main lever for obtaining superior performance. These results also have potential benefits for policy makers, as they indicate where to focus attention when designing an SPMS for complex acquisitions, to optimize suppliers' performance and, consequently, the success of the project. Further, public buyers should be aware that demonstration of higher commitment might be perceived as sign of weakness signal by the supplier; so, they should pay attention to how they signal their commitment in the relationship to avoid prompting opportunistic behavior.

From the suppliers' perspective, results show that it is beneficial for them to collaborate in the design and implementation of structured SPMS for infrastructure projects. Based on our evidence, suppliers working with public authorities which are keen to improve performance might expect a more formalized evaluation process especially at prequalification and contract performance stages, rather than partnership-type initiatives. Whilst suppliers' commitment may not be reciprocated by buyers, it is a significant factor in performance, and is therefore important if suppliers want to perform well to enhance their prospects for winning future contracts.

Credit author statement

Andrea S. Patrucco: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration. Antonella Moretto: Conceptualization, Methodology, Validation, Investigation, Writing – original draft, Writing – review & editing, Visualization. Louise Knight: Conceptualization, Methodology, Validation, Investigation, Writing – original draft, Writing – review & editing, Visualization.

APPENDIX. Survey items

	Constructs	Description	Code	Scale
Supplier Performance Measurement System	**Qualification**	Rate to what extent you (the buyer) evaluated the supplier (your) **formal suitability** to execute the work (e.g., registration in public registers)	QUAL1	1 = Not at all (e.g., not measured)
		Rate […] **economic and financial capabilities** (e.g., balance sheet and income statement data)	QUAL2	5 = To a large extent (e.g., measured with more than 3 indicators)
		Rate […] **technical capabilities** (e.g., number and type of plants, level of education)	QUAL3	
	Selection	Rate how much importance you (the buyer) gave to the **price** in the supplier (your) proposal/quotation	SEL1	1 = Very low (with weight between 0 and 10%)
		Rate […] **other types of cost** included in the supplier (your) proposal/quotation (e.g., additional services, resources, services …)	SEL2	5 = Very high (with weight > 60%)
		Rate […] the **quality of work** described in the supplier (your) proposal/ quotation (e.g., initial design, labor competences employed, environmental impact, innovation)	SEL3	
		Rate […] to the **time of work** described in the supplier (your) proposal/ quotation	SEL4	
	Performance evaluation	Rate to what extent you (the buyer) evaluated the supplier (your) **economic and financial capabilities** (e.g., balance sheet and income statement data) during the execution of the project	EV1	1 = Not at all (e.g., not measured)
		Rate […] **organizational capabilities** (e.g., ability to manage the project team)	EV2	5 = To a large extent (e.g., measured with more than 3 indicators)
		Rate […] **overall time** […]	EV3	
		Rate […] **total cost** of the project	EV4	
		Rate […] **final quality** of the project	EV5	
Commitment	**Supplier commitment**	Please rate how much your company was committed to assure a **successful outcome**	SC1	1 = Not at all (committed)
		Please […] accommodate **customer request**	SC2	5 = To a large extent (committed)
		Please […] try and **win other future projects** with this customer	SC3	
	Buyer commitment	Please rate how much your institution was committed to assure a **successful outcome**	BC1	
		Please […] support **supplier needs**	BC2	
		Please […] **engage this supplier** in some future projects	BC3	
Relationship outcomes	**Project performance**	Please rate to what extent the project met the performance expectations regarding **cost**	PERF1	1 = Strongly below (positive variation higher than 50%)
		Please […] regarding **time**	PERF 2	5 = Strongly above (negative variation higher than 50%)
		Please rate to what extent the **quality** of the project was in line with the initial design	PERF3	1 = Not at all (0–10% adherence to the initial design)
				5 = To a large extent (100% adherence to the initial design)

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