Supplier performance measurement systems: communication and reaction modes

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ABSTRACT

The paper examines the dynamics arising from the adoption of supplier performance measurement systems along the supply chain, specifically considering: (1) the way the buyer company communicates the performance information to the supplier and (2) the way the supplier reacts to the performance reported. The empirical investigation consists of multiple case studies, including nine big multinational companies within three tiers of the automotive supply chain: Elaborating on the theoretical nuance of Signalling Theory, four different communication modes from the buyer side (measuring actor – the Signaller) and three different reactions from the supplier side (measured actor – the Receiver) have been identified, each emerging under different circumstances. The relationship among the communication and reaction modes along the supply chain is critically discussed.

Keywords: supplier performance measurement system; buyer-supplier relationship; supply chain; case studies

Full reference

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1. Introduction

Over the years, due to the growing trends towards outsourcing, offshoring, and the generalized focus on core competences, companies have been increasingly dependent upon external supply chain (SC) partners (e.g., Choi and Hartley, 1996; Kannan and Tan, 2002; Ploetner and Ehret, 2006; Wynstra et al., 2003). Consequently, the more firms entrust suppliers with a greater share of activities, the more an extended control beyond the company boundaries becomes necessary (Kannan and Tan, 2002). To this aim, supplier performance measurement systems (SPMSs), defined as a as a set of metrics used to quantify the efficiency and effectiveness of suppliers' actions (Hald and Ellegaard, 2011; Neely et al., 1995) have become critical. There is a large body of literature on the topic, mostly addressing the SPMS design phase, thus studying which performance dimensions to tackle and how to define the set of metrics (Luzzini et al., 2014; Maestrini et al., 2017).

This focus on the SPMS design features has prevented thoroughly addressing the other phases of the SPMS lifecycle (i.e., implementation, use, and review), which, instead, play a fundamental role in determining the overall effectiveness of the system itself (Bourne et al., 2000). Furthermore, in most cases, the SPMS investigation focuses on the buyer's perspective, while it seems relevant to analyse also how suppliers perceive and react to the SPMS, especially when it comes to the use of the system. Indeed, factors like misinterpretations, insufficient communication and lack of trust might greatly affect suppliers (and buyer's) performances, (Jain et al., 2014), if not the quality of the relationship (Hald and Ellegaard, 2011; Purdy et al., 1994).

Finally, extant literature looks just at first-tier suppliers (Franco-Santos et al., 2012; Melnyk et al., 2014).

On the base of these premises, this research focuses in particular on the use of SPMS, analysing the flow of information between buyer and supplier dyads along the SC. This

dynamic process is read through the theoretical lens of the Signalling Theory, which seems to be very suitable for interpreting contexts in which managerial tools are used to communicate information and drive behaviours. Indeed Signalling Theory (Spence, 1973) analyses the behaviour of two parties, with information asymmetry, and one (the Signaller) needs to decide if and how communicating the information to the other (the Receiver), who in turns needs to decide how to interpret the communication (Connelly et al., 2011).

The SPMS is essential to facilitate and direct the performance communication between the buyer and the supplier company. In a signal sent-received scenario, the SPMS is a way to condense and formalize the buyer company feedback on supplier performance. While the information flow (i.e. the signals in terms of signalling theory) is frequent and includes information other than performance (i.e. orders), the SPMS reporting is surely a powerful attention catalyst for both parties: the buyer company acting as the Signaller and the supplier company acting as the Receiver.

The present paper applies Signalling Theory to analyse the dynamics arising from the use of a SPMS between the buyer and the supplier company. More precisely, the investigation addresses how the information is conveyed through the SPMS, and the corresponding reaction generated along the supply chain (SC). On this behalf, an empirical case study is conducted across three tiers of the automotive SC (the vehicle maker, the first-tier supplier and the second-tier supplier), studying the following: (1) how the vehicle maker's purchasing (or SC) managers communicate the performance information embedded in their SPMSs to the first-tier suppliers and their related reactions; (2) how the first-tier suppliers purchasing (or SC) managers communicate the performance data to second-tier suppliers and their related reactions; (3) the relationship existing between the communication and reaction modes identified along the SC.

This investigation allowed to gain deeper insights into how the performance information affects the buyer-supplier relationship management process, a central issue within the Industrial

Marketing domain. In particular, intended contributions are: (1) The identification of the different buyer communication and supplier reaction modes, shedding lights on how the information exchange is shaped between the two parties, thus going beyond the SPMS design stage. (2) Collect empirical evidence on how the communication-reaction interaction affects the relationship. (3) Analyse multiple tiers in the supply chain, thus providing insights on the way in which the features of the SPMS used by the focal company impact on the SPMSs used by the suppliers. (4) The adoption of Signalling theory in the context of supplier performance measurement to investigate the interaction between the parties.

The remainder of the paper is organized as follows: in the next section, we review relevant scientific literature addressing SPMSs. In the third section, we formulate the research questions driving the empirical investigation. The fourth section describes the methodology adopted in conducting multi-level case studies. In the fifth section, main findings for each research question are reported, critically analysed, and condensed into four propositions. Conclusions end the paper.

2. Literature review

Three converging literature streams deal with supplier performance measurement, varying according to the scope of the measurement process: (1) literature on supplier/vendor evaluation systems focuses on the performance measures and metrics adopted to assess suppliers' capabilities (e.g., quality, delivery, innovation, sustainability) (Bourlakis et al., 2014; Cousins et al., 2008; Kannan and Tan, 2002; Simpson et al., 2002;); (2) literature on supply chain (SC) PMS, where SPMSs are considered a component of wider models for supply chain performance management (Maestrini et al., 2017); (3) the literature on buyer-supplier relationship management, suggests soft metrics to adopt when assessing the quality of the relationship (e.g.,

trust, commitment, integration) (Giannakis, 2007; Paparoidamis et al., 2017; Ramanathan et al., 2011).

A few empirical studies partially focus on the SPMS adoption outcomes, tackling the link between SPMS adoption and performance improvement. For example, Cousins et al. (2008) find that socialization mechanisms fully mediate the relationship between the SPMS adoption and buyer's performance. Similarly, Mahama (2006) recognizes SPMSs to have a positive impact on buyer-supplier relationship performance by enhancing cooperation. Finally, Luzzini et al. (2014) highlight some key elements related to the SPMS design and implementation (such as the presence of a cross-functional team, the alignment with the corporate strategy, and the system reliability) that positively affect the buyer's satisfaction with the system. Other studies tackle the supplier's perspective. For example, through a supplier-side survey, Prahinski and Benton (2004) highlight that the SPMS-related communication does not improve supplier performance unless the supplier is committed to the buying firms. Later, Prahinski and Fan (2007) show that two main elements need to be considered when assessing the quality of the buyer's communication to the supplier: the SPMS content and the frequency of communication. Purdy et al. (1994) and Purdy and Safayeni (2000) explore suppliers' perceptions of the SPMS reliability, leading to three important conclusions: most suppliers felt that their effectiveness was not accurately reflected in the evaluation; data collected were not properly utilized in the measurement process; the rating achieved was more a question of bargaining power rather than the result of an objective evaluation.

Previous evidence suggests quite a tortuous path between SPMS and supplier (and eventually relationship) performance improvement. Internal PMS literature, historically focused on these issues, unravels some interpretation: poor performance reported may discouraged the measured party, while positive performance may lead to over-relaxing (Henri, 2006). However, in addition to the final performance result per se, the approaches of both

parties in sharing and discussing performance metrics play a critical role in determining the system effectiveness and its impact on the relationship (Koufteros et al., 2014).

Given this preliminary evidence, it seems worth looking closer at the information flow related to the SPMS between the buyer and supplier dyads along the SC, thus gaining insights on the arising behavioural dynamics and the related outcomes. A more granular view on the information flow in terms of content, frequency, disclosure, approach may lead to a deeper understanding on the SPMS sharing phenomenon.

3. Signalling Theory and SPMS

Grounding on the theoretical nuance of Signalling Theory (see Spence, 1973 as a seminal work), the present study considers the SPMS as a condensed and powerful synthesis of the signals the buyer company can send to the supplier company. Signalling Theory is thought to be useful for describing behaviours when two parties (individuals or organizations) have access to different information. Typically, one party as the Signaller must choose whether and how to communicate (or signal) that information; the other party as the Receiver, must choose how to interpret the signal (Connelly et al., 2011; Spence, 2002). The theory has been widely used in a variety of management literature, including strategic management (Zhang and Wiersema, 2009), entrepreneurship (Certo, 2003; Lester et al., 2006), and human resource management (Suazo et al., 2009).

Its application in buyer supplier relationship management literature is surprisingly limited. In particular when dealing with performance measurement and management practices, well established theoretical grounds are Resource Based View (RBV) and derivatives such as Resource Orchestration Theory (ROT), Agency Theory (AT), Goal Setting Theory (GST). (see Franco-Santos et al., 2012 for a thorough discussion on the topic). These kinds of theoretical lenses tend to focus on the PMS (and the SPMS) per se, as a set of performance measures and

targets. In light of previous theories, the SPMS becomes a critical tool to coordinate suppliers (ROT), reduce information asymmetry and foster goal alignment (AT), focus attention and motivate towards increasing performance standards (GST).

Previous theories however fail in addressing the important role of SPMS-related information exchange among the two parties, which overcome the way the system is designed to address disclosure, frequency, attitude etc. Willing to go in depth on this specific issue, the present research benefits from the application of Signalling Theory, which is suitable to address the issue under scrutiny. The SPMS is an important synthesis of the signals sent by the buyer company to the supplier company, resuming the assessed performance. In light of Signalling Theory, the supplier company may eventually undergo diverse reactions, depending upon the way the signals are constituted.

This study focuses on the SPMS being communicated and reacted, aiming at portraying different modes arising within these dynamics. Focusing on the first stage of the process, the first research question addresses the Signaller (i.e. the buyer company), investigating how the SPMS can be communicated (which kind of SPMS related information to be shared and how):

RQ1: What are the possible ways for the buyer company to communicate the SPMS to the supplier?

Shifting to the other side, the second research question addresses the Receiver, focusing on the supplier reaction towards the SPMS reported.

RQ2: What are the possible ways for the supplier to react to the buyer's SPMS reporting?

Following Signalling Theory, it is expected that the reaction of the Receiver depends upon the signal communication strategy chosen by the Signaller. Since the SPMS effectiveness is strictly dependent upon the impact on the supplier, it is interesting to take a closer look at the interdependency among the SPMS communication and reaction modes. Consistently, we can formulate the following:

RQ3: How is the supplier reaction affected by the way the SPMS is communicated?

The dyadic buyer-supplier interaction takes place at all levels of the supply chain. The signal (i.e., the SPMS 1, referring to Figure 1) sent by the focal company to the first-tier supplier may also affect the signal that the first-tier supplier itself sends to the second-tier supplier (SPMS 2, referring to Figure 1). Therefore, extending the focus to multiple tiers in the supply chain helps understanding the possible "cascade" (or "domino") effects generated by the SPMS along the SC. The following research question aims to explore this issue:

RQ4: How does the SPMS adopted by the focal company influence the SPMSs adopted by the 1st tier supplier (and similarly along the upstream SC)?

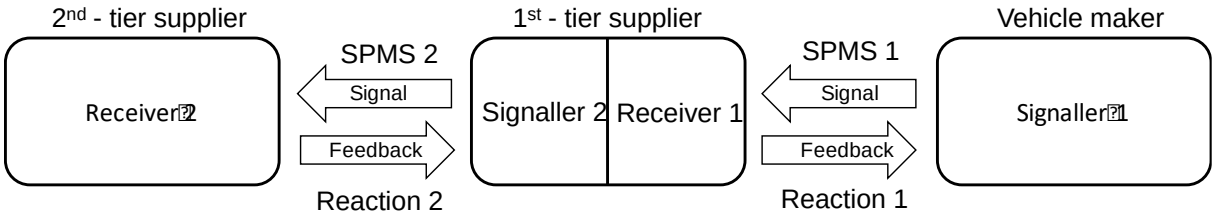

Figure 1. The Signalling effect of SPMS along the SC

4. Methodology

4.1 Rationale

This study has a theory building nature; therefore, we opted for an abductive case study approach (Eisenhardt and Graebner, 2007), grounding on a multiple case studies procedure. Indeed, the research draws on Signalling Theory to shape the research questions and provide the skeleton of the coding. Besides, the methodology proves to be particularly suitable to collect opinions from different actors in the chain. Finally, the "how" research questions implicitly qualify the case study methodology as the ideal instrument for the investigation (Voss et al., 2002; Yin, 1994).

4.2 Sampling

Starting from a list of ten vehicle makers in the industry, which were contacted and asked to participate in the research, three companies have finally been selected, as they showed interest in the research project and were available to share the needed information. Each of them was asked to provide a list of first-tier suppliers in the industry to be contacted. Strategic suppliers with on-going commercial relationships with all the three vehicle makers were contacted and invited to join the research. This resulted in a final list of eleven companies, out of which four agreed to participate. The same procedure was then replicated between first-tier and second-tier suppliers, achieving a short list of five companies, out of which two joined the project.

Companies in the sample have been selected for theoretical reasons (Eisenhardt, 1989) and share the following features:

- They are manufacturing companies operating in the automotive SC (vehicle makers, first-tier suppliers, second-tier suppliers). The automotive industry is generally acknowledged to implement mature operations and SC management (Choi and Hong, 2002; Wu and Choi, 2005), and many studies dealing with strategic SCM address this sector (e.g.,

Baglieri et al., 2007; Lockström and Lei, 2013; Paulraj et al., 2008; Wong et al., 2011). In addition, the SC structure is rather clear, along with the role of the companies at each tier: vehicle makers selling final products through different channels and acting as focal companies within the automotive SC; first-tier suppliers producing parts for the final assembly of the vehicle; second-tier (and eventually other tiers) suppliers manufacturing components for the first-tier suppliers.

- They are all large companies (more than 500 million Euro in revenues). Large companies generally display a thorough approach towards SPMSs, as they are more likely to implement mature systems. Second, dealing with large companies, we avoid the case of "captive" suppliers (i.e., suppliers with just one very large customer, usually characterized by a very low bargaining power).
- They are either Italian companies or Italian subsidiaries of a multinational company, and the regional management has been addressed. Indeed, National regulation and different country culture may affect the design of the SPMS (set of metrics included) as well as the way the measurement system is used. The theoretical sampling applied, with the selection of companies from the same geographical area, should have prevented related inconsistencies.

In the end, we obtained a final sample of nine companies (two second-tier suppliers, four first-tier suppliers, and three vehicle makers) characterized by mutual relationships along three tiers of the automotive SC (see Figure 2). Companies were asked information about their own SPMSs and/or the SPMSs reported by their customers. In particular, the vehicle makers were asked about the SPMSs they adopt in respect to their first-tier suppliers. In turn, first-tier suppliers were asked about the SPMSs reported from the vehicle makers but also about their own SPMSs addressing second-tier suppliers. Finally, second-tier suppliers were asked about the SPMSs reported by first-tier suppliers. Both SPMS design features and behavioural

dynamics occurred when communicating the SPMS, and the reaction of suppliers have been investigated.

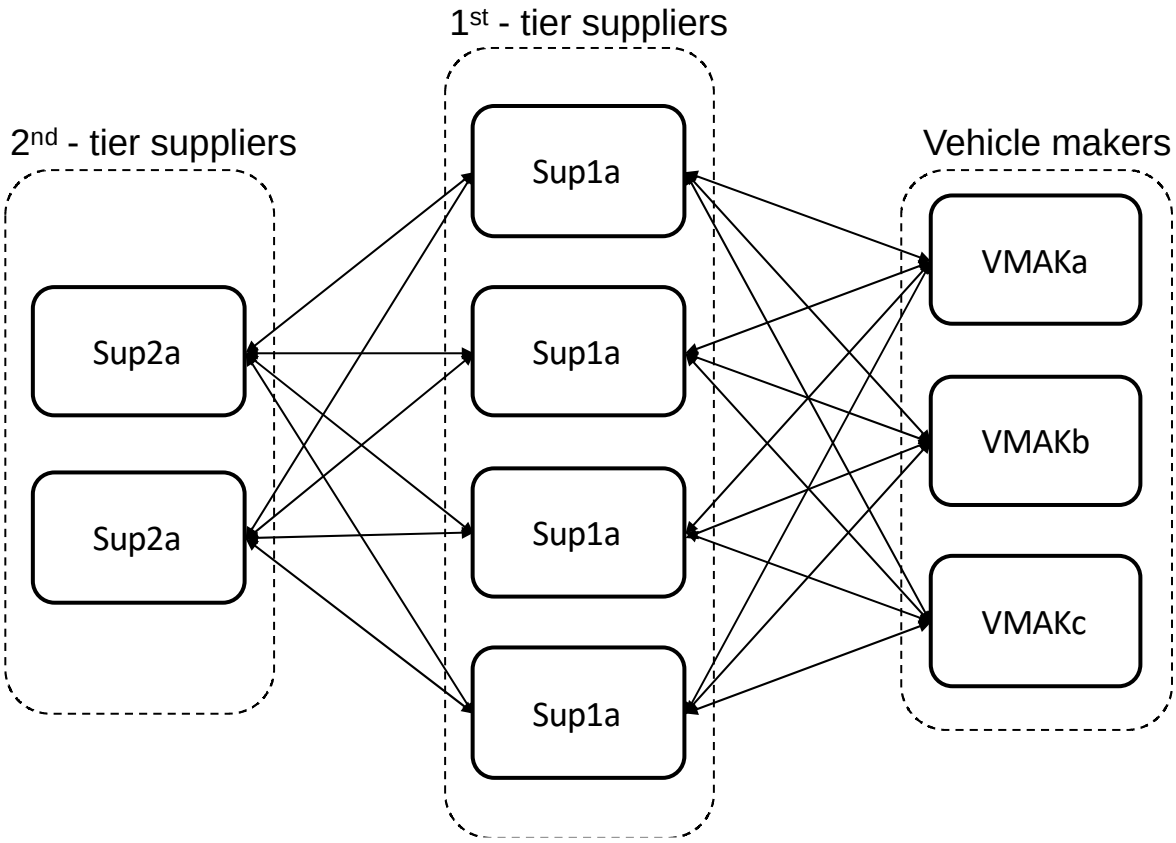

Figure 2. The SC under scrutiny

4.3 Data collection

Nineteen informants within the nine companies agreed to be interviewed for the study. Table 1 reports basic sample information. Anonymity has been guaranteed for confidentiality reasons. To easily witness the role of each company in the SC, the following acronyms have been introduced: VMAK to identify the vehicle maker, SUP1 to identify the first-tier supplier, and SUP2 to identify the second-tier supplier.

The informants hold managerial positions, either in purchasing functions (or in SCM units dealing with suppliers) or in the customer management/service units (or in SCM units dealing with customers). The former were asked about the SPMSs adopted and the way they manage

communication and supplier involvement. The latter were asked about their opinions and reactions towards the SPMSs reported by their customers. All the first-tier suppliers interviewed have commercial relationships in place with all the vehicle makers of the sample as well as with the two second-tier suppliers.

Table 1. Sample overview

Fictitious Company Name	SC tier	Industry	Revenues [€]	Employees	No. of interviews	Interviewees' role
SUP2a	2nd - tier supplier	Electronics (automotive division)	Over 6 billion	About 45.000	2	Planning Deputy Director of Automotive Product Group SC; Senior Manager Programme Management and Customer Service
SUP2b	2st - tier supplier	Energy and Telecom (automotive division)	Over 7 billion	About 20.000	2	Global Commodity Leader and Senior Buyer; Supply Chain Manager (distribution)
SUP1a	1st - tier supplier	Automotive (breaks)	Over 1,5 billion	Over 7.000	2	Global Commodity Buyer; Supply Chain Manager
SUP1b	1st - tier supplier	Automotive (tyres)	Over 6 billion	Over 37.000	2	Head of distribution SC in the Motorcycle business unit; Purchasing Manager
SUP1c	1st - tier supplier	Automotive (high technology systems, modules, components)	Over 4 billion	Over 35.000	2	SC Manager; Customer service manager
SUP1d	1st - tier supplier	Automotive (batteries)	Over 0,5 billion	About 3.000	2	SC and Purchasing Manager of the Industrial Batteries division; After Sales Responsible
VMAKa	Vehicle maker	Automotive (cars)	Over 80 billion	Over 200.000	3	Head of Manufacturing and Supply Chain and Product Configuration; Project Manager for Supply Quality Information Systems; Manager and ICT Supervisor of Supplier Quality Business Process
VMAKb	Vehicle maker	Automotive (motor vehicles)	Over 1 billion	Over 7.500	2	Vendor Assessment Responsible; Global Commodity Buyer
VMAKc	Vehicle maker	Automotive (motorcycles)	600 mln	1250	2	Head of SC operations; Logistics planner

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

Semi-structured interviews have been conducted following a list of questions sent in advance from a maximum of two weeks to a minimum of five days depending upon the timing of the interview arrangements (see Appendix A, which reports the interview questionnaire). We did so in order to give enough time to the interviewees to gather all the information, also involving other colleagues, if necessary. The interview protocol was adapted coherently with the function representative engaged and the company position in the supply chain. Each interview lasted between 120 and 180 minutes: 15 interviews were conducted on site and the other four via telephone. In addition, they were taped upon permission so that, after each site visit, it was possible to produce transcripts and check field notes for accuracy. In case of critical information missing, companies were contacted again through e-mails or phone calls.

Several additional documentations were used to triangulate the information: internal documents from the companies regarding the SPMSs put in place, external accounting documents (e.g., balance sheets, shareholder reports), and publicly available data from the Internet.

Finally, on-site observations during company visits resulted in great value: observations address the SPMS in place as it appeared on the companies' ICT systems as well as the operators' (employees directly in touch with the systems) opinions and activities. When possible, pictures on metrics dashboards and performance charts have been taken.

4.4 Data analysis

Three researchers coded the interview data, grounding on the literature for the most known constructs. Table 2 reports the thematic constructs addressed in the research, along with the main corresponding references.

Table 2. Constructs investigated in the research

Constructs	References
Signal – *SPMS design feature* • Performance dimensions tackled • Metrics adopted: type (quantitative vs. qualitative and financial vs. not financial) • Involvement of other internal functions • Involvement of other external SC partners • Management information system underneath	Neely et al. (1995); Kannan and Tan (2002); Hald and Ellegaard (2011); Beamon (1999); Gunasekaran et al. (2004); Bhagwat and Sharma (2007); Bullinger et al. (2010); Bourne et al. (2003); Bourne et al. (2000); Sharif et al. (2007)
Signaller – *buyer company SPMS communication modes* • Reporting of measures: communication management • Consequences on performance reported and on the relationship • Benefits and criticalities of your own SPMS • Opinions and general satisfaction degree within your SPMS	Henri (2006); Luzzini et al. (2014); Cousins et al. (2008); Mahama (2006); Carr and Pearson (1999); Hald and Ellegaard (2011)
Receiver – *supplier company reaction to the SPMS reported* • Reaction to the SPMS • Consequences on performance reported and on the relationship • Benefits and criticalities of your buyers' SPMSs • Opinions and general satisfaction degree within your buyers' SPMS	• Prahinski and Benton (2004); Prahinski and Fan (2007); Hald and Ellegaard (2011); Prahinski and Benton (2004)

As stated before, the SPMS is the formal synthesis of the performance signals reported by the buyer. The set of signals may include the metrics, the stakeholders involved in the SPMS development and supporting management information systems. Both sides of the relationship (the buyer company – the signaller, and the supplier company – the receiver) are described in terms of activities, consequences and perceptions related to the signal under scrutiny (Connelly et al., 2011).

The within-case analysis was used to enhance the knowledge of each single case independently, thus allowing specific patterns and relationships to emerge. The results were then compared to those of the other cases through a double-level cross-case analysis (Eisenhardt, 1989): a "horizontal" cross-case analysis, tackling companies within the same tier of the SC (vehicle makers with vehicle makers, first-tier suppliers with first-tier suppliers, second-tier suppliers with second-tier suppliers); a "vertical" cross-case analysis entailing a

comparison among different tiers. This twofold analysis allowed finding similarities and recurrent patterns, both along a specific tier in the industry and along the SC.

5. Results and discussion

In this section, we present the results derived from the within- and cross-case analysis, and we synthetize the relevant elements in a limited set of propositions. The structure of the section follows the previously reported research questions: the first paragraph is devoted to the first research question, thus analysing the buyer company communication modes of its own SPMS towards suppliers. The second paragraph deals with the supplier's reaction towards the SPMS reported by the buyer companies, thus answering the second research question. The third paragraph addresses the third research question, focusing on the relationship between the suppliers' reaction towards the SPMS and the buyers' communication modes. Finally, the fourth paragraph analyses the design features of SPMSs along the SC, thus looking at the extended signal generated by focal company SPMS along the upstream SC.

5.1 SPMS communication modes

Four distinctive modes of performance communication emerged from the cases:

- *No sharing*: companies do not share any performance information with SC partners. This may happen, either because they do not measure anything (SUP1d and SUP1a for non-strategic suppliers), or because they prefer to keep the information internal: once a performance pitfall is recognized, the buyer company may simply switch to another supplier. Under a Signalling Theory perspective, no signal is sent to the supplier. This attitude often entails relationships with non-strategic suppliers (SUP1c, VMAKa), in which buyer companies are not willing to invest time and money in performance

improvement plans or supplier development programmes. Reporting the words of the supplier quality manager of SUP1a:

> *Non-critical suppliers represent commodity relationships for us…it is pure price negotiation. As far as supplier performance measurement is concerned, we just track their performance and when not satisfying values are recorded, we just switch to other suppliers*.

In other cases, metrics are not shared, because service level agreements have been set to regulate the relationships, and both parties are expected to monitor the performance under scrutiny (VMAKb, SUP1a). The VMAKb vendor assessment responsible reports the following:

> *As for delivery performance, we have contractually defined performance targets for the punctuality index. Of course, we measure suppliers' performance and most suppliers do the same. Only when performance decreases under the target defined, we start an informal or formal litigation*.

- *Synthetic sharing*: a set of suppliers' performance is measured and ultimately synthetized into a score through weighting algorithms. The final score can be a number or a letter in a categorical scale, and this is the only information reported to suppliers, configuring itself as a synthetic signal. In some cases, buyer companies adopt supplier management tools that automatically produce a rating at the end of the performance measurement process; the information systems in place implicitly drive the SPMS towards a synthetic rating communication (VMAKb, SUP1d). In other cases, the synthetic sharing is motivated by conscious managerial choices: both VMAKc and SUP1b highlighted that a synthetic sharing enables a practical comparison of different actors' performances. The synthetic sharing could also be adopted as a strategic choice for disclosure reasons: according to SUP1a, complete and disaggregated performance information may lead the supplier to gain bargaining power and to build new relationships with other customers.

Furthermore, VMAKa observed that – in case of satisfactory performance – the full transparency of metrics objectively showing the supplier's positive performance might lead the supplier to "relax" and decrease performance in the longer term. Instead, synthetic ratings are more anonymous and leave more negotiating space to the buyer in the relationship with the supplier. This statement seems to suggest that preventing the visibility of elementary data to suppliers can result in a source of power for buyers (even allowing, in some cases, for opportunistic behaviours).

- *Performance sharing with explanation*: in this case the buyer reports the complete list of metrics measured. In addition, the buyer provides qualitative feedbacks on specific aspects and suggests possible improvement programmes. Usually, this reporting solution is adopted when dealing with strategic suppliers. One of the most critical issues is the explanation of metrics' formulas: when the metric has not been previously explained, evaluated suppliers hardly understand the actual meaning of performance measures reported. The SUP1c customer service manager observes:

  > […] *our analysts receive reports every day and some of them are really hard even to understand, since the metrics' formulas are not explained. As supplier, I think we deserve a clear explanation of the performance measures reported…it is both ours and customers' interest.*

  By reporting a clear and explanatory view of the suppliers' performance (i.e., a complete signal), the buyer company shows a favourable and transparent attitude, hopefully stimulating the suppliers' effort in performance improvement (VMAKa, VMAKb, SUP1d).

- *Joint design*: there is an early involvement of the suppliers, aimed at setting together the goals of the relationships and agreeing on key metrics design. The buyer company anticipates the communication towards the suppliers: the supplier is involved from the early stage of SPMS design and not just in the reporting phase. Applying Signalling

Theory, we can refer to a co-created Signal. The overall objective is the collaboration on mutual SC performance, which is frequently discussed but rarely implemented. Each company interviewed (from the perspective of both the evaluating and the evaluated part) displays an explicit interest in increasing the collaboration on mutual performance with SC partners, expected benefits being: (1) frequent problems connected to perceived inappropriateness and unfairness of the measurement system could be anticipated and avoided; (2) the specific responsibilities of each part in respect to the performance monitored could be clearly identified at the beginning; (3) mutual trust and commitment increase (SUP1a, VMAKb). Despite the emphasis on expected benefits, actual attempts of SPMS joint design are very limited. From our investigation, it is worth mentioning the VMAKc case as a "best practice" example. The company has set two task forces with two of its major suppliers in order to jointly define some performance metrics and make a first attempt for a collaborative management of SC performance. The metrics are connected to both parties' performances and are measured according to contractual agreements. In addition to the three benefits highlighted above, consistent operational improvements have been remarked: order cycle optimization (order lead time reduction, documentation accuracy, cost reduction); planning optimization with a reduction of the total inventories; reduction of the total cost of ownership and the total costs of selling. Nevertheless, VMAKc also reported that projects of this kind are highly demanding in terms of resources, time, and cost. Moreover, benefits are quantifiable only in the long term. A strong commitment of both parties is eventually a fundamental antecedent of success. Reporting the words of the Head of SC operations:

> *At the beginning it was not easy…though we were already partners, when you deal with performance measurement systems everybody tries to pull to his side. Days and days of meetings and actual costs resulted almost twice the budget… but eventually when the system was in place, soon everybody*

recognized the benefits. I mean tangible benefits in terms of operational performance improvement (our delivery punctuality; the customer's orders homogeneity) but also intangible ones like increasing integration and mutual trust.

Building on the evidence discussed so far, we can elaborate the following proposition, providing an answer to the first research question:

Proposition 1. *When implementing a SPMS, the buyer can opt for four communication modes (configuring as diverse signals) to the supplier:*

(1) No sharing: performance measures are not systematically shared with suppliers but could be shared in particular situations (e.g., critical/unexpected performance falls); this generally happens with non-strategic suppliers and/or when contractual agreements are put in place to regulate the relationship.

(2) Synthetic sharing: communication of a synthetic rating summarizing the supplier's overall performance in a Likert-like scale (e.g., A-E, 1-5, etc.); this communication mode could be chosen intentionally by the buyer in order to limit the information disclosure for bargaining reasons.

(3) Complete signal: communication of all the metrics adopted with relevant elements explained (formulas, targets, initiatives); this is generally applied with strategic suppliers whose development in critical performance is of primary importance for the buyer company.

(4) Joint design: the buyer and the supplier jointly define the metrics (performance measures, targets, and improvement initiatives); this could be the result of a highly strategic and integrated buyer-supplier relationship, where both parties can take advantage of a mutually coordinated system.

5.2 SPMS reaction modes

In order to provide an exhaustive view of the dynamics characterizing the performance information flow along the SC, we also addressed the supplier's reactions to the performance reported. Grounding on Signalling Theory, a feedback should be expected by the Receiver once the signal has arrived. On this behalf, three main reaction modes have been observed and codified:

- *Indifference*: the supplier does not consider the performance information reported by the customer. This may happen for several reasons. Some companies simply show no interest in SPMSs reported. In the cases of SUP1a and SUP2a, this happens because they have a high bargaining power and act as lock-in suppliers for their customers. In other cases, the indifference directly derives from the way performances are communicated. Reporting the words of SUP1c customer service manager: "*Often I just receive a C or a B or a "3 out of 5" grade from customers…what does it mean? How can I reply to such an evaluation?*"
- *Passive interest*: the supplier passively accepts the evaluation made by the buyer but no interaction (either formal or informal) occurs afterwards. The supplier takes note of the performance reported, but no specific performance improvement action plans are activated. Consequently, the buyer's effort in the SPMS development is not re-paid by a real commitment of the counterpart. This is mainly due to the high number of heterogeneous customers. Quoting SUP2b distribution SC managers:

> *We interact with a lot of customers in different channels, spread all over the world…this leads to a huge number of performance measurement systems with different metrics adopted. It is simply impossible to follow them all. In the end what we do is keeping the information tracked, making some internal analysis and take into account only the reports of the most critical customers,*

let's say a 10%-20% of them, or the ones reporting a falling performance from us.

- *Active interest*: the supplier not only records the performance reported, but also actively responds, recognizing the contingent impact on the relationship. The SUP1d after sales manager observes that:

  Satisfying the customers, and in particular, keeping a close engagement with them…no matter if we are a multinational company… is of primary importance for us, the real key element of our strategy. That's why we have such a large customer service group with planners and analysts spending their work routine in engaging customers and analysing their feedbacks. On this behalf, SPMSs represent the kind of information we absolutely can't neglect. It is of great interest for us and we do provide feedbacks to almost any reports we receive.

  Responding to SPMSs generally activates a dialogue with the customer that eventually can end in two situations: (1) the supplier accepts the results of the customer's evaluation and coherently undertakes corrective actions, often jointly planned with the customer; (2) the supplier rejects the customer's evaluation and argues against it. This second case arises when the metric calculation is considered unreliable, as it does not ground on a rigorous data collection process or does not properly reflect the intended performance dimensions. Such a dialogue is almost a routine in buyer-supplier relationships. The two parties' attitudes may have a negative impact on the relationship (stiffening the contrasting positions) or a positive impact in terms of mutual trust and commitment improvement. Still, in the words of SUP1d "[…] *the fact that we care about our customers does not mean that we always agree on their evaluations. Sometimes we receive data that are unexpectedly far from our own performance measures; so we start arguing…*"

Previous arguments can be resumed in the following proposition, answering the second research question:

Proposition 2. *The supplier can react to the buyer's adoption of a SPMS in three ways:*

(1) Indifference: suppliers do not take into account the customers' performance communication or give any feedback to their customers. This generally happens in regards to customers of secondary importance or with a relatively low bargaining power.

(2) Passive interest: suppliers may show interest towards the customers' performance communication but do not activate any coherent action plan for improvement. Companies with a very large customer base tend to react this way towards most of the SPMSs reported.

(3) Active interest: suppliers are interested in the customers' performance communication and react in two main ways: either they accept and agree to the customers' evaluation (interest with acceptance), or they do not accept the customers' evaluation, complaining about metrics definition or reported results (interest with objection). This behaviour is stimulated when dealing with strategic customers, characterized by a high commitment of the supplier, and generally grounds on a structured approach towards customer relationship management.

5.3 The relationship between communication and reaction modes

Previous evidence rationalizes the signal-feedback dynamics arising around the supplier performance information flow, which can be represented as in the following Figure:

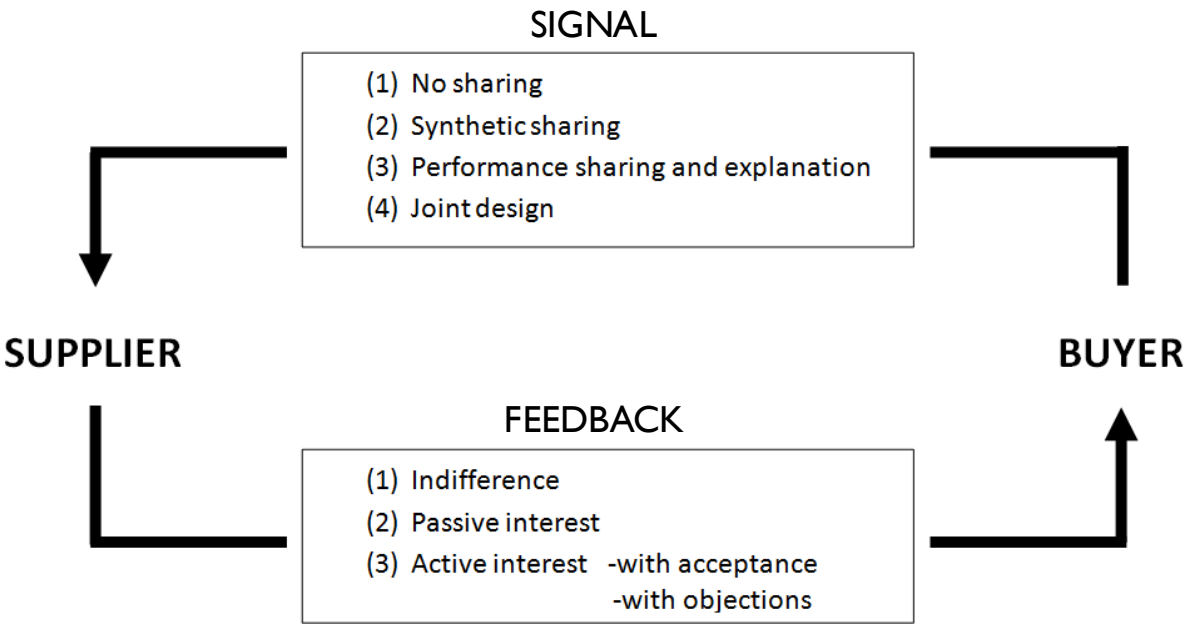

Figure 3. SPMS communication and reaction modes

The empirical investigation shows that the buyer's communication modes regarding the SPMS do influence the supplier's reaction. This is in line with the literature on communication quality: as a general rule, the Receiver's perception of the communication quality has an influence on the Receiver's response to the information (Maltz, 2000; Mohr et al., 1996; O'Reilly, 1982). The empirical evidence suggests the existence of a relationship between the evaluation content and suppliers' commitment: the clearer the information, the higher the suppliers' interest. A synthetic sharing (typically a score expressed through a single letter or number) tends to annoy the supplier and may produce unintended consequences. In particular, when the supplier receives a good score, he thinks he is over-performing and tends to maintain the status quo, forgetting about continuous improvement and risking decreasing performance in the long run (VMAKa, VMAKb). Instead, when the supplier gets a bad score, he starts raising many objections to challenge the buyer's evaluation, since it is not entirely clear how the rating has been calculated (SUP1c, SUP2b). Reporting the words of the VMAKc head of SC operations: "*Some suppliers really do not stand a C or a D… they start complaining and ask*

for further information, even if we confirm orders for future supplies […] I guess this is positive, but honestly we seldom answer them". This seems to suggest that the lack of trust in the SPMS is amplified when everything is reduced to a one-number/letter rating (SUP1c). The performance sharing with explanation allows overcoming such pitfalls (Trent, 2010). In this case, the metrics are reported with related formulas, explicit targets, and required improvement initiatives, thus resulting in more customized and specific assets for the relationship. Consequently, the supplier perceives the SPMS as more useful. Yet, the buyer might risk overloading the supplier with unnecessary information, whereas he should only focus on the few metrics that matter, making sure that the supplier has understood them and acts accordingly. As the supply quality manager of VMAKa claims:

> *Our golden rule with supplier performance measurement is to report them all and only the key metrics, which are critical to assess their performance: moreover, we invest time to educate them about the SPMS, so that everything is transparent and efficient*.

A comprehensive and easy-to-read evaluation report is a fundamental step, even though other factors contribute to achieve the buyer-supplier alignment (e.g., relative bargaining power, previous relationship history, contractual agreements) (Cousins et al., 2008; Corsaro and Snehota, 2011; Mahama, 2006; van der Walk and van Iwaarden, 2011; Wuytz and Geysken, 2005).

We can therefore summarize the signal-feedback dynamics, i.e., the link between the buyer's communication modes and the supplier's reaction, through the following proposition.

Proposition 3. *There is a correspondence between specific buyer's communication modes regarding the SPMS and the supplier's reaction. In particular:*

- *If the buyer does not share any information regarding the SPMS, the supplier remains indifferent;*

- *The buyer's synthetic sharing communication mode does not stimulate the supplier's active interest and might result in indifference;*
- *The buyer's performance sharing with explanation communication mode stimulates the supplier's interest, which can be passive or active, depending upon the supplier perception about the importance of the relationship with the specific buyer.*
- *The buyer's joint design mode stimulates the supplier's active interest.*

This result is coherent with Signalling Theory, which conceptualizes the existence of a relationship between the signal sent by the Signaller and the feedback from the Receiver. The SPMS is a critical Signal the buyer company can exploit when managing the relationship with active suppliers. In particular, leveraging on different communication modes, the buyer company (the Signaller) can coordinate the performance information sharing with its suppliers, eventually leading to diverse reactions by the suppliers (the Receiver). In this sense, it is not the evaluation content (the set of metrics within the SPMS), but the way the performance information is reported that displays the major impact on the supplier's behaviour. This evidence is coherent with previous studies on internal PMS use (Henri, 2006; Koufteros et al., 2014) and consistently extends knowledge on SPMS, where empirical studies (Mahama 2006; Cousins et al., 2008; Heide et al., 2007) are still largely focused on the design features of the system (i.e. which metrics to include).

5.4 The extended signalling process

The scope of the empirical investigation, which is extended across three tiers of the automotive SC, allowed for comparing the design features of SPMS put in place at different SC tiers. In other words, the consistency of the signals at different SC tiers can be tested. Table 3 describes the main characteristics of the vehicle makers' and first-tier suppliers' SPMSs, according to the coding (cf. Table 2).

Table 3: suppliers PMSs design and implementation

	Vehicle makers			First tier suppliers			
	VMAKa	**VMAKb**	**VMAKc**	**SUP1a**	**SUP1b**	**SUP1c**	**SUP1d**
Performance dimensions tackled	Quality; delivery; quality of the relationship; financial stability; innovation capabilities	Quality; Delivery (delivery); quality of the relationship; financial stability; sustainability effort	Quality; delivery; quality of the relationship; financial stability; innovation capabilities; sustainability effort	Quality; delivery	Quality; delivery; quality of the relationship; financial stability	Quality; delivery: innovation capabilities; sustainability effort	Quality; delivery; innovation capabilities financial stability
Metrics typology	Quantitative and qualitative; financial and not financial	Quantitative and qualitative; financial and not financial	Quantitative and qualitative; financial and not financial	Quantitative; not financial	Quantitative and qualitative; financial and not financial	Quantitative and qualitative, not financial	Quantitative; financial and not financial
Internal functions involved	SC, production, logistics, finance	Purchasing, logistics, R&D, marketing	Purchasing, production	SC	SC, production, accounting and finance	Purchasing, logistics, R&D	Purchasing, logistics
Criteria for involving suppliers	Quality of the relationship, financial stability and innovation capabilities for strategic suppliers; whole supply base for the rest	Quality of the relationship, financial stability and sustainability measures for strategic suppliers; whole supply base for the rest	Quality of the relationship only for strategic suppliers; whole supply base for the rest	Strategic suppliers	Quality of the relationship for strategic suppliers; whole supply base	Innovation capabilities for strategic suppliers; whole supply base for the rest	Strategic suppliers
Information system adopted	Tracking and tracing tools for data collection; emails for reporting	Tracking and tracing tools; electronic data interchange for reporting	Tracking and tracing tools for data collection; supply base web portal for reporting	Tracking and tracing tools; Excel and emails	Tracking and tracing tools; supply base platform for reporting	Manual data collection; Supply base web platforms for reporting	Tracking and tracing tools for data collection; supplier relationships management (SAP) to report

Grounding on both within- and cross-case analysis, we can cluster metrics within the SPMSs in four main performance dimensions: product quality performance (e.g., quality rate, number of defects), delivery process performance (e.g., lead time, punctuality, flexibility), supplier's capabilities (e.g., financial stability, innovation effort, sustainability), and buyer-supplier relationship (e.g., mutual trust, commitment, integration, etc.). This result is aligned with previous studies about SPMSs design, focusing on metrics and performance framework development (De Boer et al., 2001; DeBoer and Van der Wegen, 2003; Kannan and Tan, 2002; Luzzini et al., 2014; Narasimhan and Talluri, 2006; Prahinsky and Fan, 2007; Sarkis and Talluri, 2002). While the four clusters give a rather complete representation of the performance dimensions tackled when measuring supplier performance, the specific metrics applied naturally vary, according to each company strategy and the ICT structure supporting the SPMS implementation. Specific metrics could also vary, considering different functions within the same company. This often results (e.g., VMAKa, SUP1b) in a large number of metrics disseminated across different functions and not always under the scope of the purchasing/SC function.

From the multi-level investigation emerges certain homogeneity of the SPMSs adopted by the vehicle makers and the first-tier suppliers with respect to their suppliers. Compared to previous studies that considered the buyer-supplier dyad (Hald and Ellegaard, 2011; Purdy and Safayeni, 2002), we broaden the analysis to a three-tier SC and find that performance metrics propagate along the SC. Under a Signalling Theory perspective, the signal sent by the focal firm manages to arrive upstream in the SC. In the case of VMAKa, this has happened because of a direct exposure of the focal firm. The company has recently launched a project of multi-level SPMS for a specific electronics component, thus involving second-tier suppliers within the performance measurement process. In this case, a direct signal is sent not only to first-tier suppliers but also to second-tier suppliers. This decision was motivated by an unexpected

supply disruption from the first-tier suppliers, depending on problems with far-east second-tier suppliers. Setting multi-level SPMSs eventually ensures extended SC visibility and the upstream communication of strategic objectives. The multi-level SPMS should be considered as an empowered signal that is sent not only to first-tier suppliers but also to the second-tier suppliers as well. Reporting the words of the VMAKa head of Manufacturing and SC:

> *With the multi-level SPMS we really wanted to push to the extreme our business intelligence capabilities. The project was launched to extend the visibility and manage risk from second tier supplier disruption. This was the occasion to redesign our SC strategy towards an extended visibility and an empowered SC planning by proactively influencing the relationship between our first tier and the second tier suppliers. The multi-level SCPMS was the mean to achieve our goals. Certainly, it is a complex tool to manage routinely, that's why we have started with a pilot supplier. So far we are satisfied and we are planning to extend the system to other suppliers, till it would be manageable*.

The key message emerging is that along with benefits in terms of higher control and planning capabilities, the multi-level SPMSs appear as a complex tool to manage, grounding on higher organizational and technological capabilities. Only large and highly structured companies display the financial and managerial strengths to afford and properly exploit such systems. When asked about the possibilities of adopting multi-level SPMSs, the VMAKb vendor assessment responsible reports: "*We do not have enough resources to manage a systematic performance measurement beyond the first tier. It rarely happens that we interface with second tier suppliers and when it happens it is because our first tiers suppliers ask to do so*". The VMAKc head of SC operations is even more explicit:

> *We can't and do not want to measure performance of second tier suppliers, it is too much entropy for us and we honestly do not see the point. Managing the relationship with the upstream SC is part of our first tier suppliers' duties. A good supplier is a*

supplier who can properly deal with its own supply base without causing any problems to our operations.

In both cases, the focal companies do not want to manage a multi-level SPMS. Interestingly, the performance dimensions monitored along the SC are still homogeneous across tiers. What emerges addressing first-tier suppliers is that their own SPMS is naturally affected by the SPMS received from their customer (the vehicle makers). On this behalf, the SUP1b purchasing manager states:

Success in this business is mainly related to fulfil vehicle makers needs, no matter what they ask. Our suppliers are vital to achieve this goal. If customers are asking for flexibility, we must rely on flexible suppliers; if they ask for super quality, our suppliers should respect the highest quality standard […].

Asked about the starting point to design their SPMS, the SUP1c SC managers reply:

The SPMS is designed to operationalize our goals towards the supply base, which are synthetized from our company business strategy. When taking decision about our supply base we must consider what our customers ask to our company. Therefore, we have several meetings with our customer service functions.

These findings suggest an explanation of the homogeneous SPMSs across various SC tiers: what seems to happen is that the vehicle maker sets the direction with its first-tier suppliers by identifying the performance dimensions that matter within its SPMS, which then eventually propagates to other tiers in the SC. While the multi-level SPMS is a proactive attempt of the focal company to inform the extended SC with a direct signal, similar SPMSs replicating tier after tier can be explained by a propagation of the signals from the focal companies to the upstream SC levels to drive the behaviours of the upstream SC actors. This evidence can be synthetized with the following proposition, answering the fourth research question:

Proposition 4. *The focal company SPMS can influence the SPMSs adopted upstream along the SC in two main ways:*

- *Direct signal: the focal company sends signals to the extended supply chain by setting a multi-level SPMS;*
- *Indirect signal: the focal company sends signals to first-tier suppliers (by means of the SPMS), which influence the signals they send to second-tier suppliers (by means of their SPMSs).*

This element uncovers an important by-product of the research, further exploiting Signalling Theory applied to information (and more specifically performance information) sharing along the SC. The signal sent from the focal company to the first-tier suppliers affects not only their feedback but also the signals they do send to their own suppliers. In the broad context of upstream SC management, this element proves to be critical, in the sense that it may partially mitigate the need of an extended visibility. Indeed, while extended information sharing is often claimed as a major challenge for a focal company today, just a few put in place managerial practices aimed at doing so (like multi-level SCPMS). This is mainly due to the fact that such systems are expensive. In the realm of Signalling Theory (Bird and Smith, 2005), the direct signal embedded in a multi-level SCPMS could be extremely precious; however, implementation costs may discourage the buyer company to send it.

These findings, though preliminary in nature, represent an interesting contribution to buyer-supplier relationship management literature, which is still stuck to a buyer side or dyadic analysis (Spina et al., 2013). This is an attempt to match buyer supplier relationship management (and performance measurement in particular) within the wider concept of (extended) supply chain management.

6. Conclusions

In this paper we adopted Signalling Theory as the theoretical underpinning to elaborate on the SPMS-related information flows within the buyer-supplier dyad and along the SC. Evidence from multiple case studies involving companies at three SC tiers led to the formulation of four propositions addressing the signal-feedback between the buyer and the supplier upon the SPMS. Propositions 1 and 2 (answering the first and second research questions) aim at codifying the recurrent behavioural patterns, respectively, on how performance is communicated by buyer companies and the possible corresponding reactions by suppliers. Proposition 3 highlights the relationship existing between the two previous elements. The fourth proposition finally reports how the focal company SPMS influences the SPMSs adopted by the first tier suppliers, recognizing the emergence of two signalling processes: a direct signal when multi-level SPMSs are put in place to actively inform the extended SC and an indirect signal with homogenous SPMSs along the upstream SC, enabling the propagation of the focal company signal.

This study provides several contributions to the Industrial Marketing literature stream dealing with buyer-supplier relationship management and, more specifically, SPMS. In particular: (1) we overcame the current limitation of the literature, still generally focused on the SPMS design stage, by identifying the existing SPMS communication and reaction patterns, (2) we demonstrated the fundamental role of the buyer-supplier dialectic regarding the SPMS within the relationship management; (3) we extended the empirical analysis by considering three SC tiers, thus providing insights about the performance information propagation along the chain; (4) we applied Signalling Theory as an innovative yet effective theoretical lens to frame the research, given its focus on information flow framed as a Signaller – Signal – Receiver context. The present study provides some preliminary evidence, supporting its effectiveness in explaining the SPMS-related information flow as a signal-feedback interaction

between the buyer company acting as the Signaller and the supplier company acting as the Receiver.

We deem our results relevant for managers too, since SPMSs are a major priority for purchasing and SC managers of buyer companies and a useful source of information for sales and customer service managers of supplier companies. Practitioners could get insights on the benefits and criticalities associated with different communication and reaction modes upon supplier performance information sharing. Some important insights are provided: (1) do not focus on the SPMS design only – picking the right metrics is important, but also, the way performance is communicated proves to be critical; (2) diverse signals lead to diverse feedbacks, shaping the buyer-supplier relationship management process; (3) a multi-level SPMS could be a viable means to send direct signals to the extended SC; otherwise, the signals sent to first-tier suppliers will likely affect the signals they sent to their own suppliers.

The main limitation of the study is that findings derive from the investigation of a single SC, the automotive one. This inevitably affects the cross-industry generalizability of the research outcomes, since there could be some contextual variables affecting the findings. Further studies could replicate this research in other industries. A second important limitation consists of the relatively limited empirical evidence deriving from the multiple case study approach; while preliminary evidence suggests a good fit between Signalling Theory and buyer-supplier performance information sharing, further data should be collected to test the validity of this study's main insights and speculations; in particular the relationship between the buyer company communication modes (i.e. the characteristics of the signal sent) and the supplier company reaction modes unravel a promising avenue for future research. Finally, multi-level SPMSs represent an interesting research area in the next future, for both purchasing/SCM scholars and performance measurement and management scholars. Technological innovations in management information systems (such as big data and cloud solutions) could open viable

implementation scenarios for these systems, which are critical to achieve extended visibility over the SC (Barratt and Barratt, 2011).

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Appendix A – Interview questionnaire

PURCHASING/SC FUNCTION REPRESENTATIVE (vehicle makers and 1st-tier suppliers)

- What is your role in the company, and what are your responsibilities within the purchasing/SC function?
- Which performance dimensions of your suppliers do you measure?
- Which kind of suppliers are involved in the measurement process? How many tiers?
- Which other internal functions are involved in the measurement process?
- What is the degree of adoption of management information systems in managing the supply base?
- Is the supplier actively involved in the measurement process?
- What kind of information do you communicate to your suppliers? How frequently?
- Do you use the suppliers' PMS mainly to evaluate your suppliers or to collaborate with them?
- What are the benefits of the suppliers' PMSs adopted?
- What are the criticalities of the suppliers' PMSs adopted?
- Do you receive feedback from the suppliers about the SPMSs you report to them?
- How do they react normally?
- Do they take in serious consideration the measurement process?
- Do you often engage with them in discussion about performance reported?

CUSTOMER SERVICE/DISTRIBUTION REPRESENTATIVE (1st-tier suppliers and 2nd-tier suppliers)

- What is your role in the company, and what are your responsibilities within the customer service/distribution function?
- Do you receive suppliers' PMSs reported from your customers?
- What do they evaluate?
- How do your customers communicate the performance information to you? Frequency, completeness, way of communication?
- Do you take into consideration the suppliers' PMSs reported?
- How do you feel being evaluated by your customers?
- How do you react to the SPMSs reported?
- What is your opinion about the supplier PMS of your customer? List benefits and criticalities related to different cases.
- Do you often engage with customers on discussion of mutual performance?