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Supply chain roles and performance measurement procedures: evidence from Brazilian agribusiness companies

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ABSTRACT

The purpose of this paper is to analyse the extent to which companies' roles in supply chain coordination mechanisms affect supply chain (S.C.) performance measurement processes. It addresses the gap in the S.C. performance measurement literature for empirical studies of participant roles across whole supply chains.

A survey of 114 individual agribusiness companies was undertaken in Brazil, and it was found that both performance measurement process and performance indicators selection were statistically related to the role played by companies in supply chain coordination mechanisms. Usage of performance indicators regarding new customers and quality was also statistically related to the role played by companies in supply chain mechanisms, as was the overall usage of internal processes performance indicators. The findings also suggest that the specificities of an S.C. coordination mechanism could be related to the design and implementation of S. C. management control practices, rather than being based only on contracts and formal long term agreements.

KEYWORDS

Performance measurement;
supply chain performance;
supply chain management

Introduction

Supply chains (S.C.s) are formed by several individual interrelated companies with the objective of delivering products to end customers. Ideally, all members should be functionally coordinated as an extended enterprise (Simatupang and Sridharan 2002; Chan and Qi 2003). S. C. coordination mechanisms are based on hierarchy (integrated) or market (non-integrated) business relations along the S.C. structure (Williamson 1975; Grandori 1997; de, Groot et al. 2003).

Integration between S.C. business partners is expected to improve customer satisfaction, firm performance and firm competitiveness (Ou et al., 2010), and S. C. integration and performance (Lee, Kwon, and Severance 2007; Cai et al. 2009; Ganga and Carpinetti 2011). Integrated S.C.s are typically coordinated by one leading company that makes all relevant decisions about the management processes of the chain, and other participating companies, even though they are legally independent entities (Kulmala, Paranko, and Uuzi-Rauva 2002). Thus, the upstream companies become only a small part of a more complex network of interactions within the S.C. structure, no longer in control of all aspects of their businesses (McAdam and McCormack 2001). However, little appears to be known about the specific role played by individual companies in such S.C. coordination mechanisms in relation to the performance measurement managerial procedures of

which they become a part. This is consistent with Maestroni et al. (2017) comprehensive literature review of S.C. performance measurement systems, which demonstrates that there is insufficient research carried out to date on multi-tier or many-to-many S.C. and the roles that participants play in those systems. Also, they observe that less than half of the papers are empirical studies and that survey based research tends to be exploratory. This study is also exploratory but addresses the gap in the literature highlighted by Maestroni et al. (2017) by addressing S.C. performance measurement processes along the whole agri-food supply chain and the roles played by multiple actors.

Agri-food S.C.s are perceived as networks of companies that work together to deliver agricultural products to final consumers (Christopher 2005). Agri-food individual companies are more likely to keep their own identity or autonomy than in other types of S.C.s (Van der Vorst 2006). The structure of an agri-food S.C. can be complex, with many entities being included and with numerous interactions (Matopoulos et al. 2007), and their operational aspects are distinct from other kinds of S.C.s (Yu and Nagurney 2013), making them a useful site of investigation into S.C. roles and performance measurement.

A good context in which to examine the interactions within complex S.C. is the agribusiness industry in Brazil. This has been recognised as a crucial vector for economic growth with the sum of goods and services

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generated in agribusiness reaching the equivalent of UK £20 billion, 21.4% of Brazilian GDP (CNA 2020). Brazilian agri-food S.C.s are formed of companies occupying discrete functional roles, such as input suppliers, producers, processors, distributors, and retailers, who work together through dynamic flexible interactions (Araújo 2010; Mendes and Padilha Junior 2007). These agri-food S.C.s behave as single entities in search of achieving business goals (Neves, Zylbersztajn, and Neves 2006), and all of them have a leading company (Callado and Callado 2014), which coordinates the S. C. activities through either formal (hierarchy) or relational (market) approach (Cabral 2014).

The identification of desirable characteristics of an S. C. measurement system has become a goal for academics and practitioners (Ganga and Carpinetti 2011; Najmi, Rigas, and Fan 2005). According to Elrod, Murray, and Bande (2013), S.C. performance should encompass various aspects of the operations carried out, and the set of performance indicators used should assess organisational performance based on the nature of the organisation. However, Fawcett and Magnan (2002) point out that extensive integration might not be easy to accomplish, and identifying such characteristics for supply chains rather than individual companies is problematic.

In particular, there is little previous evidence concerning S.C. performance measurement and specific roles played in S.C. structure (Sarode and Khodke 2008; Chia et al. 2009; Callado and Jack 2015, 2017; Susanty et al. 2018). Further discussion is needed to understand the implications for the role of companies within S. C. coordination mechanisms in which they agree to trade. The research question underlying the investigation is 'to what extent does the role played by companies in S.C. coordination mechanisms affect the implementation of performance management procedures in the S. C.?' This paper contributes towards our understanding of the forms of S.C. performance measurement chosen and used in complex S.C. environments, such as food.

Performance measurement in the supply chain environment

Maestroni et al. (2017) identify that there are few empirical studies that address the roles of multiple participants within a S.C. and their relationship with performance measurement systems. Although S.C. coordination mechanisms have been examined, the specific accounting mechanisms associated with performance measurement have received less attention.

For Liu, Wang, and Xu (2020), S.C. coordination mechanisms should be related to information sharing, profit distribution and profit sharing. Furthermore, market coordination is characterised by open market transactions with price-based discussions and adversarial relationships (Spekman, Kamauff, and Myhr

1998), while hierarchical coordination has been considered as a valid mechanism only when market is not an efficient protection against opportunism (de Groot et al. 2003). The concept of S.C. relies on the notion that there is some sort of interdependence among activities performed by individual companies regardless the presence of market or hierarchical coordinating process among them (Dubois, Hulthén, and Pedersen 2004).

It has long been recognised that managerial accountants face challenges relating to inter-organisational relations and control when considering both contexts and boundaries of individual companies (Mouritsen and Thrane 2006). Managerial actions that attempt to improve individual performance without considering the interdependence among S. C. participants may generate undesirable effects (Simatupang and Sridharan 2002), as many such participants may act as autonomous units instead of components of a larger system and thus neglect actions arising from their interdependencies (Holberg 2000). It is still the case that supply chain management involves cooperation in order to vertically integrate the various different levels of the structure of the chain through information sharing, technology, infrastructure and skills, in search of quality standards considering specifications required by end consumers (Cooper and Ellram 1993).

The management of S.C. can be carried out by either a single entity through the presence of a dominant (controlling) member or through a system of partnerships that requires cooperation and coordination (Kuo and Smits 2003). Controlling companies that makes all relevant decisions are often seen within integrated S.C.s, while non-integrated S.C.s are formed by individual companies that act through a process of coordination.

In integrated S.C., controlling companies are responsible for the decisions addressed to key aspects relating to the S.C., although the effects of these decisions may generate some conflicts between other S. C. participants because of their impact on current activities (Kaplan and Norton 1997). Controlling companies may consider behavioural preference and coordination strategy as key factors in S.C. decision-making (Loch and Wu 2008). Managerial issues, such as tasks and activities performed by S.C. members, goods flow structure (supply, production and distribution along the chain) and planning and controlling of operations are important for the integration process within a S.C. (Pires 2004).

Senior managers dictate practices and influence the development of organisational culture (Teller, Kotzab & Grant, 2012; Kurien & Qureshi, 2011). Furthermore, the personal characteristics of senior managers, who are in charge of the performance measurement process, may also impact the degree of performance measurement integration (Forslund & Jonsson, 2009). This leads to an

hypothesis based on the assumption that demographics of senior managers may be related to the role played by companies in S.C. coordination mechanism:

H1. Senior managers' characteristics are related to the role played by their organisation in S.C. coordination.

Hill & Scudder, however, identify that the sales volume, number of employees, and market range require more sophisticated procedures when analysing the role of the organisation in a S.C. (Hill & Scudder, 2002). Different operational roles within the S. C. structure may require specific management controls (Prieto et al. 2006; Callado and Jack 2015) to be in place in different companies within the S.C. Kim (2007) also finds that organisational structures might be related to performance of S.C. Hence, a second hypothesis is required, based on the assumption that characteristics of individual companies may be related to the role played by companies in S.C. coordination mechanism.

H2. Individual company's characteristics are related to the role played in S.C. coordination.

It follows then that the role played by individual companies within the integration process of a S. C. might influence their decisions relating to S. C. performance measurement (Folan and Browne 2005), and each member may possess different levels of power over control decision variables for other members along the S.C. structure (Shi, Zhang, and Ru 2013). Decisions regarding S.C. performance measurement design are expected to have senior managers' support (Folan and Browne 2005). The third hypothesis is based on the assumption that the role played by companies in S.C. coordination mechanism may be related to performance measurement process and the decisions made by management of individual companies within that process.

H3. The role played in S.C. coordination is related to the performance measurement process in place.

The design of an S.C. performance system should consider key objectives from each participant (Lohman, Fortuin, and Woulters 2004). The S.C.C.P. carried out by a coordinating company is a key aspect for the development of the decision domain (Simatupang and Sridharan 2002). The definition of an ideal set of performance indicators that should be used by individual companies may depend on the upstream/mid-stream/downstream position of the company in the S. C. (Kleijnen and Smits 2003), as well as its decision-making capability (Coyle, Edward, and Langley 2003).

When considering the relevance of the specific roles of individual S.C. participants to overall S. C. performance, deciding what metrics to select for

performance measurement is an important issue, as different companies may use different sets of relevant performance indicators according to their respective characteristics and managerial needs (Callado and Jack 2017). If relevant issues relating to S. C. management are made *only* by the integrating companies, other S.C. participants may not accept the sacrifice of some of their respective internal efficiencies in search of overall chain-optimisation, as their position in the S.C. structure may affect the relevance of specific performance metrics (Van Hoek 1998). Hence, the fourth hypothesis is based on the assumption that performance indicators selection may be related to the role played by companies in S.C. coordination mechanism.

H4. The role played in S.C. coordination is related to performance indicators' selection criteria.

Another relevant factor for the design of an S. C. performance system is the differences in levels of use, as well as the integrating process between performance indicators (Melnyk, Stewart, and Swink 2004). Differences in interest can be seen as a threat to S. C. performance if individual participants seek their own profit instead of overall S.C. profit (Simatupang and Sridharan 2002).

Hence, performance systems designed for an S. C. should consider both performance measurement indicators prescribed by integrating controlling companies *and* specific performance indicators that are important to other S.C. participants, through the establishment of a hierarchy of measures drawing on both (Pohlen 2003; Callado and Jack 2015). The multi-dimensional and inter-organisational characteristics of S.C. performance measurement systems should include the definition of weights for all individual performance indicators to reflect the hierarchy of relationships existing among them (Cai et al. 2009; Ganga and Carpinetti 2011) and how each individual company affects the overall S.C. (Lambert and Pohlen 2001). The final hypothesis is based on the assumption that the usage of performance indicators may be related to the role played by companies in S.C. coordination mechanism.

H5. The role played in S.C. coordination is related to performance indicators usage.

Figure 1 shows the linkage between hypotheses:

Hypotheses H1 and H2 are based on the assumption that the managerial challenges related to the role played by companies in S.C. coordination mechanisms may require specific characteristics amongst senior managers and individual companies. Hypotheses H3, H4, and H5 are based on the assumption that the role played by companies in S.C. coordination mechanisms

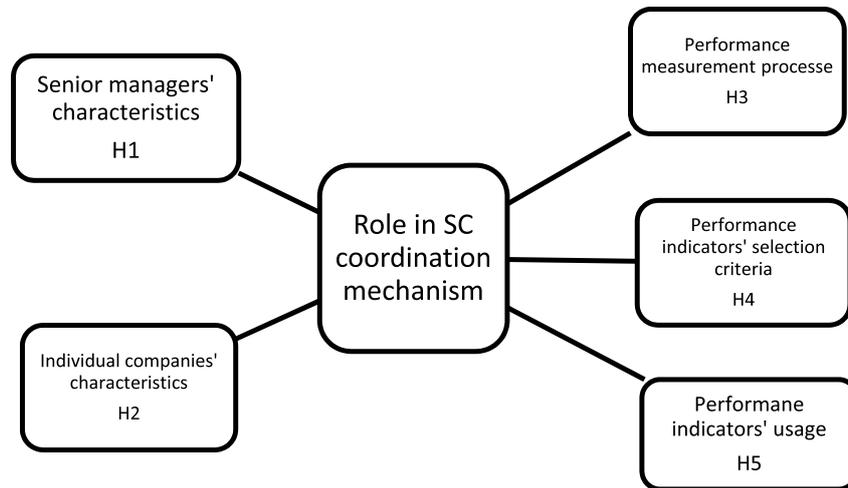


Figure 1. Linkage between hypotheses.

may have a specific relative influence on performance measurement process, as well as on performance indicators' selection and usage.

Methodology

A survey of Brazilian agribusiness companies was conducted to investigate the extent to which the role played by companies in S.C. coordination mechanisms is related to S.C. performance measurement managerial procedures. Three groups of variables, represented as Likert scales, were created:

- **Senior managers:** age (Teeratansirikool et al. 2013), gender (Teeratansirikool et al. 2013), level of education (Papadakis, Lioukas, and Chambers 1998), and experience (Quinones, Ford, and Teachout 1995);
- **Individual companies:** time doing business (Teeratansirikool et al. 2013), market range (Lever and Turok 1999), size (Hall 1984), and role in the S.C. structure (Kleijnen and Smits 2003);
- **Performance measurement managerial procedures:** performance measurement process (SEI 2004), performance indicators selection (Lohman, Fortuin, and Woulters 2004), and performance indicators usage (Callado and Jack 2015).

A representative sample (95% confidence level) of 114 agribusiness companies was gathered from a finite population of about 34,000 individual agribusiness companies located in Pernambuco State.

Data collection procedures were similar to those applied by Chia et al. (2009): structured interviews with senior managers using pre-elaborated and sequentially placed questions regarding the variables considered in this research. This approach was pre-tested in a pilot study. (Chizzotti 1991; Gil 2002).

Senior managers were asked which of the following 34 performance indicators (Beamon 1999; Brewer and Speh 2000; Gunasekaran, Patel, and McGaughey 2004; Beamon 1998; Chia et al. 2009; Callado, Mendes, and Callado 2013; Rafele 2004; Bhagwat and Sharma 2007) should be classified into which of the four perspectives of the Balanced Scorecard Card (B.S.C.). These were represented as binary variables.

- **Financial perspective:** profitability, return over investment, increase in sales, total costs, unit costs, delivery costs, cash flow, order costs, inventory;
- **Customer perspective:** number of clients, new customers, quality, price, devolutions, delivery time, delay in delivery, responsiveness;
- **Internal processes perspective:** operations time, flexibility, time in stock, suppliers, scale flexibility, use of structure, after sales, on time delivery, wastes;
- **Learning and growth perspective:** employee productivity, employee satisfaction, employee flexibility, turnover, product innovation, investment in training, risk management.

Senior managers were also asked to state the role played by their respective companies in S. C. coordination mechanism, and two independent groups were formed accordingly. The first group was composed of individual companies that play the role of S.C. participant (72 companies). The second group was composed of individual companies that play the role of S.C. coordinator (42 companies).

Mann-Whitney U tests were carried out to analyse age of senior managers, characteristics of agribusiness companies, and performance measurement managerial procedures considering the role played by companies in S.C. coordination mechanisms as the grouping variable. The null hypothesis of this test states that

there is no difference between the groups (Bisquerra, Sarriera, and Martín 2004), and they should be considered as part of the same population (Levin 1987; Silver 2000).

Fisher's Exact test was carried out to analyse the statistical significance of the relations between the role played by companies in S.C. coordination mechanisms with gender and level of education of senior managers and also with usage of performance indicators. This test should be used when characteristics of variables are not suitable for more sophisticated tests (Levin 1987). The null hypothesis of this test states that is no difference between the groups and their behaviour should be considered similar to each other regardless of the groups to which they belong (Martins and de 2006).

For both tests, the significance level considered was 95%, and p-values < 0.05 would mean null-hypothesis rejection, pointing out evidence of statistically significant relations between the considered variables and the role played by individual companies in S. C. coordination mechanism.

Results

Statistical tests were carried out to analyse the significance of the relations between the role played by companies in an S.C. coordination mechanism and the characteristics of senior managers and individual companies. Table 1 presents the results concerning the characteristics of senior managers (H1).

The results show that the null hypothesis cannot be rejected, and so the characteristics of senior managers are not statistically related to the companies in a S. C. coordination mechanism.

The same procedures were performed to analyse the statistical significance of the relations between the role played by companies in an S. C. coordination mechanism and the characteristics of agribusiness companies (H2). The results are presented in Table 2.

Table 1. Characteristics of senior managers and role in S. C. coordination mechanism (%).

Information	S.C. participant	S.C. coordinator	p value
Age			0.49
40 years old or less	41.67	31.10	
41–50 years old	30.55	26.19	
More than 50 years old	27.78	35.71	
Gender			0.76
Male	26.39	23.81	
Female	73.61	76.19	
Level of education			0.17
Undergraduate	38.89	26.19	
Postgraduate	61.11	73.81	
Professional experience			0.29
10 years or less	62.50	52.38	
More than 10 years	37.50	47.62	

Table 2. Characteristics of agribusiness companies and role in an S.C. coordination mechanism (%).

Information	S.C. participant	S.C. coordinator	p value
Time doing business			0.84
10 years or less	19.44	26.19	
11–20 years	37.50	28.57	
More than 20 years	43.06	45.24	
Market range			0.06
Local	55.55	33.33	
Regional	29.17	50.00	
National	11.11	11.90	
International	4.17	4.77	
Revenues (UK £)			0.29
Up to 60,000	52.78	35.71	
From 60,000 to 600,000	26.39	45.24	
From 600,000 to 2,666,667	9.72	16.67	
More than 2,666,667	11.11	2.38	
Number of employees			0.00
20 employees or less	83.33	52.38	
From 20 to 99	5.56	30.95	
From 100 to 499	4.17	14.29	
More than 499	6.94	2.38	
Role in S.C. structure			0.12
Upstream	34.72	19.05	
Midstream	36.11	50.00	
Downstream	29.17	30.95	

The results indicate the presence of one statistically significant relation. The role played companies in an S. C. coordinating mechanism was statistically related to the companies' number of employees, rejecting the null hypothesis. S.C. coordinating companies have a larger number of employees in comparison to S. C. participating companies. This finding suggests that the size of organisation's workforce matters, with larger companies more likely to play coordinating roles in an S.C.

The same procedures were carried out to analyse the statistical significance of the relations between the role played by companies in an S.C. coordination mechanism and the performance measurement process and performance indicators selection (H3, H4). The results are presented in Table 3.

There is a statistically significant relationship between the roles played by companies in S. C. coordinating mechanism. The null hypothesis was rejected for both performance measurement process and performance indicators selection. These results

Table 3. Performance measurement procedures and role in an S.C. coordination mechanism (%).

Information	S. C. participant	S. C. coordinator	p value
Performance measurement process			0.00
Neither defined nor standardised	48.61	9.52	
Planned and controlled	30.56	35.71	
Standardised and improved	9.72	14.29	
Specific performance objectives	6.94	14.29	
Continuously improved	4.17	26.19	
Performance indicators selection			0.00
No expert support	86.11	61.90	
Some expert support	11.11	23.81	
Full expert support	2.78	14.29	

indicate that agribusinesses that coordinate S.C.s tend to adopt more sophisticated procedures (for example, standardised processes, specific objectives, and continuous improvement) designed to measure performance. They are more likely to seek expert support with the selection of performance indicators. This finding suggests that the wider range of managerial attention that comes from an S.C. coordination role affects how companies deal with performance measurement.

Statistical tests were carried out in a two-step approach to analyse the significance of the relations between the role played by companies in an S.C. coordination mechanism and the usage of performance indicators (H5). The first step considered performance indicator's individual usage, and the second step considered their overall usage. The results regarding performance indicators from the financial perspective are shown in Table 4.

The results of the first step show that no financial performance indicator individually obtained results that could reject the null hypothesis. No statistically significant difference regarding overall usage of financial performance indicators between S.C. participants and S.C. coordinating companies. This finding suggests that the overall usage pattern of financial indicators is not related to the role played by an S.C. coordination mechanism at all, and the null hypothesis could not be rejected.

The same procedures were followed with responses obtained from senior managers of individual companies investigated to analyse the statistical significance of the relations between the use of performance indicators and the role played in S.C.CP. The results relating to the use of performance indicators from the customer perspective of the B.S.C. are presented in Table 5.

It can be observed that two of the performance indicators from the customer perspective produced significant results that reject the null hypothesis, indicating that both new customers and quality have been receiving more managerial attention among individual companies that play a coordinating role in the S.C. The result regarding overall usage of *customer* performance indicators was similar to the result concerning

Table 4. Usage of performance indicators (from the financial perspective) and role in an S.C. coordination mechanism (%).

Performance indicators	S.C. participant	S.C. coordinator	p value
Profitability	93.06	97.62	0.27
Return over investment	87.50	97.62	0.06
Increase in sales	95.83	97.62	0.52
Total costs	87.50	92.86	0.28
Unit costs	87.50	88.10	0.58
Delivery costs	54.17	69.05	0.08
Cash flow	83.33	83.33	0.60
Order costs	70.83	71.43	0.46
Inventory	59.72	52.38	0.28
Overall usage	79.93	83.33	0.45

Table 5. Usage of performance indicators (from the customer perspective) and role in an S.C. coordination mechanism (%).

Performance indicators	S.C. participant	S.C. coordinator	p value
Number of clients	69.44	80.95	0.18
New customers	65.28	85.71	0.02
Quality	87.50	100.00	0.03
Price	93.06	100.00	0.24
Devolutions	45.83	57.14	0.20
Delivery time	69.44	66.67	0.37
Delay in delivery	72.22	69.05	0.34
Responsiveness	70.83	76.19	0.43
Overall usage	71.70	79.46	0.49

financial performance indicators: no statistically significant difference in overall usage between S.C. participant companies and S.C. coordinating companies. This finding indicates that the overall usage levels of customer indicators are not related to the role played by an S.C. coordination mechanism at all, and therefore, the null hypothesis could not be rejected.

The data collected from senior managers of the individual companies was also used to analyse the statistical significance of the relations between the role played in S.C.C.P. and the use of performance indicators from the internal processes perspective of the B.S.C. The results are presented in Table 6.

The results of the first step show that no internal processes performance indicator individually obtained results that could reject the null hypothesis. There was a statistically significant difference between S.C. participants and S.C. coordinating companies regarding overall usage of internal processes performance indicators ($p = 0.02$). This finding indicates that the overall usage levels of internal processes indicators are not related to the role played by an S.C. coordination mechanism, so the null hypothesis could be rejected.

Finally, the same statistical procedures were used to analyse the responses obtained from the senior managers of the individual companies investigated to ascertain the statistical significance of the relations between the role played in S.C.CP and the use of performance indicators from the learning and growth perspective of the B.S.C. The results are presented in Table 7.

Table 6. Usage of performance indicators (from the internal processes perspective) and role in an S.C. coordination mechanism (%).

Performance indicators	S.C. participant	S.C. coordinator	p value
Operations time	56.94	69.05	0.13
Flexibility	58.33	76.19	0.06
Time in stock	69.44	73.81	0.39
Suppliers	83.33	90.48	0.22
Scale flexibility	50.00	61.90	0.15
Use of structure	56.94	71.43	0.08
After sales	59.72	66.67	0.29
On time delivery	59.72	66.67	0.29
Wastes	63.89	69.05	0.36
Overall usage	62.03	71.69	0.02

Table 7. Usage of performance indicators (from the learning and growth perspective) and role in an S.C. coordination mechanism (%).

Performance indicators	S.C. participant	S.C. coordinator	p value
Employee productivity	81.94	92.86	0.08
Employee satisfaction	73.61	73.81	0.58
Employee flexibility	54.17	42.86	0.16
Turnover	61.11	73.81	0.11
Product innovation	76.39	73.81	0.46
Investment in training	65.28	61.90	0.43
Risk management	47.22	50.00	0.46
Overall usage	65.67	67.01	0.89

Once again, no performance indicator individually obtained results that could reject the null hypothesis. The result regarding overall usage of customer performance indicators was similar to the result for financial and customer performance indicators: no statistically significant difference between overall usage by S.C. participants and S.C. coordinators. This finding indicates that the overall usage levels of learning and growth indicators is not related to the role played by an S.C. coordination mechanism at all and that therefore the null hypothesis could not be rejected.

Discussion

The evidence indicates that the role played by companies in supply chain coordination mechanisms affects *some* procedures regarding performance measurement. The literature points out that performance measurement of operational processes related to activities that are *not* executed by S.C. coordinating companies must be carried out by one or more of the other, non-coordinating S.C. participants (Van Hoek 1998), and that each operational activity should have a specific performance target (Morgan 2004). Furthermore, measurement activities should not be managed as one system, but several, independent, fragmented systems that are managed by the S.C. level (Folan and Browne 2005).

The literature also indicates that the performance measurement process should take into account a wider range of controlling targets (Bhagwat and Sharma 2007) and that the selected set of performance indicators should be both adequate and suitable for accounting procedures designed for capturing inter-organisational data (Ballou, Gilbert, and Mukherjee 2000). From the findings in this investigation, it was found that *individual* performance indicators, 'new customers' and 'quality' were used more by coordinating companies than by non-integrated companies. The *overall* usage level of internal processes performance indicators was also statistically related to the role played by companies in supply chain coordination mechanisms.

Considering the challenges of the S.C. coordinating process, metrics regarding customers are crucial, particularly if these customers may also be another company's supplier (Kleijnen and Smits 2003). This fits with other research linking management control and customer needs. Management control concerns regarding new customers are shared by companies that play different roles in S.C. (Callado and Jack 2015). Quality is a key factor for S.C. performance (Elrod, Murray, and Bande 2013), and product conformity to customers' requirements is a managerial concern for that matter (Bigliardi, Bottani, and Amaratunga 2010).

Furthermore, the results here show significant structural differences in the intensity of the usage patterns for internal processes performance indicators, depending on the role played by companies' S.C. coordinating process. Inter-organisational processes carried out in S.C. consider all participants (Park, Lee, and Yoo 2005) as a single entity (Bigliardi, Bottani, and Amaratunga 2010). Optimisation of production is a key source of value (Lazzarini, Chaddad, and Cook 2001), as is the identification of best practices for improvement of S.C. performance (Barros, Barbosa-Póvoa, and Blanco 2013). However, we find that the S.C. coordinating role may require different levels of managerial attention relating to operational aspects, not just related to its own organisational boundaries, but considering the entire structure of the S.C.

The evidence also shows that companies' size is related to the role played in the S.C. coordination mechanism. Brazilian agri-food S.C. are more likely to be led by large companies (Callado and Callado 2014). The number of individual companies, the frequency of transactions, the specificities of products, and the level of uncertainty are the key aspects considered to identify the most appropriate type of coordination to Brazilian agri-food S.C.s (Callado and Jack 2015). Coordinating companies may also influence the behaviour of companies regarding their relations towards other S.C. participants (Callado and Jack 2015). The formalisation degree of performance measurement procedures carried out by individual companies may change according to S.C. roles (Callado and Jack 2017).

Extending these findings, here the role played by companies in the S.C. coordination mechanism is significantly related to the overall usage of performance indicators in operational processes. This suggests that managers should consider operational performance indicators as a group rather than individually to monitor the efficiency of the entire agri-food S.C. (Araújo 2010). Furthermore, operational performance should also be linked to market competitiveness, not just because of efficiency, but also because of the search for potential new customers (Batalha and Silva 2007).

These findings indicate that managers in S. C. coordinating companies should be concerned primarily in prospecting for new customers.

Conclusions

To identify the extent to which the role played by agribusiness companies in S.C. coordination mechanisms affects performance measurement procedures, 114 individual Brazilian agribusiness companies grouped accordingly to their respective roles in S. C. coordination mechanisms were analysed. The results give statistically significant evidence that performance measurement operational processes and selection of performance indicators made by S.C. coordinating and S.C. participating companies are different, with the former tending to apply more complex procedures in both cases. The empirical data presented here provides some insights that address the gap in the literature identified by Maestroni et al. (2017), concerning the lack of empirical studies addressing the roles of partners in longer and more complex supply chains.

Although supply chains are expected to function as a single entity and all participants should cooperate with each other, the implication from our findings is that the role of supply chain coordination on performance measurement procedures, regardless of information sharing, complementary activities and strategy, differs depending on whether the S.C. participant is the controlling company or a another company within the supply chain. The results in this paper offer a new perspective, that managers and researchers need to consider the inter organisational relationships between the supply chain controlling company and the other supply chain participants when designing performance measurement systems.

Brazilian agribusiness companies were used, as they represent a complex context of supply chain management. The findings suggest that in contrast to a traditional balanced approach, more attention needs to be paid by researchers to the complexity of performance measurement procedures put in place by coordinating companies. In addition, the internal processes of S.C. partners needs to be considered as a factor in how effective performance measurement processes are for the S.C. as a whole.

Overall, the results add to our understanding about S.C. performance measurement and the specific roles played in S.C. structure, and add substantially to previous studies (Sarode and Khodke 2008; Chia et al. 2009; Callado and Jack 2015, 2017; Susanty et al. 2018). The findings also suggest that the specificities of an S.C. coordination mechanism could be related to the design and implementation of S.C. management

control practices, rather than being based only on contracts and formal long term agreements.

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