

Balanced scorecard metrics and specific supply chain roles

1. Introduction

An Agri-food supply chain (ASC) is a network of individual companies that delivers agricultural products to end consumers (Christopher, 2005). However, within an ASC there is a greater tendency for companies to keep their own identity or autonomy than in other supply chain (SC) configurations (van der Vorst, 2006). The structure of an ASC can be complex and include many entities performing numerous interactions (Matopoulos *et al.*, 2004). For example, intermediary companies have one-to-many relationships with retailers downstream and separate one-to-many relationships upstream. The relationships can dissolve and re-form frequently because, although they typically want the quality and delivery that comes from long-term relationships, retailers and processors also want the prices that come from trading (Jack *et al.*, 2012). Therefore, ASCs provide an interesting environment in which to explore the use of performance metrics to manage relationships between SC partners. It is argued that the balanced scorecard (BSC) approach can provide a suitable basis for performance measurement in the supply chain context (Brewer and Speh, 2000).

There is little survey evidence regarding key practical aspects of BSCs, such as the characteristics of the models tested, the information generated or the combinations of metrics that should be used (Chenhall, 2005). Limitations of BSC frameworks designed for SC performance measurement include their top-down approach, lack of formal implementation methodology and subjectivity of metrics selection (Abu-Suleiman *et al.*, 2003). The identification of the appropriate set of metrics to be applied by multiple individual companies across a SC structure is not an easy task and there is insufficient

literature about the selection of suitable metrics (Chan *et al.*, 2003). The design of specific approaches addressing this issue could provide a significant contribution to this field of study (Lambert and Pohlen, 2001).

The objective of this research note is to identify whether particular metrics used in BSCs relate to specific supply chain roles in ASCs. The overarching question to this investigation is whether common BSCs are possible between partners in supply networks. From data gathered in Brazil, customer satisfaction was the single common metric used by all roles (input suppliers, producers, distributors and retailers). In addition, the set of metrics and their distribution across the four perspectives of a BSC are different for each SC role. These findings suggest that it may be very difficult to achieve, in practice, a common BSC framework for all supply chain participants and that other alternatives should be investigated.

2. Literature review

The BSC was designed as a managerial tool to help individual companies that have overemphasised short-term financial performance (Brewer *et al.*, 2000). This managerial tool enables the companies to develop a more comprehensive view of their operations and provides a clear prescription of that which companies should measure to evaluate the implications arising out of the strategic intent (Chavan, 2009).

One view is that a BSC should have 20–25 balanced metrics allocated across the financial, customer, internal processes, and learning and growth perspectives (Punniyamoorthy and Murali, 2008). The balance between the perspectives is a central issue with respect to the BSC, however, it has become evident that balance does not mean that the four perspectives are equally important (Johanson *et al.*, 2006).

The alignment between the developments in BSC principles and the theoretical aspects of control and management processes indicates that there is potential for modern BSC designs when measuring complex organisations (Lawrie and Cobbold, 2004). As the BSC was developed for large and medium-sized corporations, the challenge is to develop a BSC suitable for a SC context (Kleijnen and Smits, 2003).

The BSC has been used as a suitable basis for the measurement of SC performance (Brewer and Speh, 2000) and there are several case studies that address the challenge, such as Lohman *et al.* (2004), Park *et al.*, (2005), Bhagwat and Sharma (2007), Varma *et al.* (2008), Zago *et al.* (2008), Thakkar *et al.* (2009), Bigliardi and Bottani. (2010) and Rajesh *et al.* (2012).

The literature also presents BSC frameworks structured by non-traditional perspectives. Brewer and Speh (2000) examine how the traditional perspectives of the BSC can be used to develop a framework for assessing SCs by providing an adaptable metric-selection process. Kleijnen and Smits (2003) consider three of the traditional perspectives (financial, customer and internal processes) but choose innovation as the fourth perspective, using this formulation to run forecast simulations for bullwhip effects and values of fill rates. Furthermore, Savaris and Voltolini (2004) propose a methodology for the design of a SC scorecard structured by non-traditional perspectives.

The identification of a BSC framework for SC performance measurement would become simpler if all participants shared the same metrics. However, individual companies tend to choose different sets of metrics and define their own specific BSC (Kleijnen *et al.*, 2003).

Metrics selection criteria become ever more important when considering how the specific roles of individual participants relate to the overall performance of the SC (Harland, 1997). The perspectives of the BSC of different companies should present sets of

relevant metrics according to the respective characteristics and managerial needs of the companies (Prieto *et al.*, 2006). Furthermore, the position of individual companies in the SC structure as well as their level of integration and strategic approach may affect the relevance of metrics (van Hoek, 1998).

Even without a BSC approach, complex framework models for performance measurement have been developed in many fields since the late eighties (Folan and Browne, 2005). The literature about SC performance measurement has increased dramatically for the last two decades and efforts have been addressed to improve performance measurement methods; the selection process of relevant metrics (Melnyk *et al.*, 2004) and the search for whether suitable performance indicators exist are the main focus of managerial concern (Beamon, 1998).

It should be noted that there are still several theoretical questions unanswered about the appropriate use of BSCs to measure SC performance. This is because of the considerable range of performance metrics among SC participants and the balance between the BSC perspectives.

3. Methodology

A survey was undertaken to identify whether particular metrics used in BSCs can be related to specific supply chain roles. To develop a sufficient database, individual companies were asked to participate in this survey and 121 Brazilian agribusiness companies accepted. According to Gil (1996), to obtain significant and relevant data the sample must be composed by an adequate amount of elements. Silver (2000) goes even

further stating that samples with at least 30 elements should be used to assure proper statistical testing that is designed to investigate any given characteristic.

Two groups of variables were used. The first group considered four supply chain roles: input suppliers, producers, distributors and retailers. The second group of variables was composed of 49 performance indicators presented in Beamon (1998), Rafele (2004), Gunasekaran *et al.* (2004) and Callado *et al.* (2013). These were classified against the four perspectives of the BSC, as shown below.

- Financial perspective: profitability, liquidity, revenues by product, revenue per employee, contribution margin, level of indebtedness, return on investment, unit cost, minimising costs, maximising profits, inventory, overall earnings and operation costs;
- Customer perspective: customer satisfaction, customer loyalty, new customers, market share, brand value, profitability per customer, revenue per customer, satisfaction of business partners, delivery time, responsiveness to clients, growth in market share, maximising sales;
- Internal processes perspective: new products, new processes, productivity per business unit, product turnover, after sales, operational cycle, suppliers, waste, flexibility, response time to customers, delay in delivery, responsiveness of suppliers, storage time, information/integration of materials;
- Learning and growth perspective: investment in training, technology investment, investment in information systems, employee motivation, employee capability, managerial efficiency, employee satisfaction, innovative management, number of complaints, risk management.

Each company was asked to declare its SC role and to identify which of the 49 performance indicators it used.

Data collection was carried out by structured interviews with the use of a questionnaire in which all 49 variables were shown. This approach is characterised by Chizzotti (1991) and Gil (1996) as a tool composed by pre-elaborated and sequentially placed questions, which is used to obtain answers relating to a specific subject. Marconi and Lakatos (1996) add that this approach generates quick and precise answers as well as providing uniformity of data collected.

Data analysis was performed through descriptive statistics. According to Levin (1987), descriptive statistics aim to gather data into groups in a way that allows easy identification of the data's characteristics. Frequency distributions were applied to identify sample distribution among SC roles. The extent to which performance indicators are used was calculated through the percentages of responses of usage. A two-reference criterion was applied to identify eligible performance metrics for the BSC frameworks for input suppliers, producers, distributors and retailers:

- Metrics that present usage percentages within the upper quartile
- Metrics that present usage percentages higher than the estimated percentage reference.

These procedures were applied to generate specific BSC frameworks for the SC roles considered, as well as to identify similarities and differences among them.

4. Results

Initially, descriptive statistics were used to identify the frequency distribution of individual companies from the sample among the four SC roles considered. The results are presented in table 1.

Table 1: Frequency distribution of individual companies among SC roles

Specific roles	Frequency
Input suppliers	31
Producers	13
Distributors	47
Retailers	30

These results confirm that the 121 participating companies were spread unevenly across the four SC roles. The second step consisted in identifying the extent to which performance indicators are used from the BSC perspectives. The results relating to performance indicators from the financial perspective of the BSC are presented in table 2.

Table 2: The extent of performance indicator use from the financial perspective according to supply chain roles (%)

Performance indicators	Input suppliers	Producers	Distributors	Retailers
Profitability	90.32	84.62	65.96	100.00
Liquidity	6.45	53.85	51.06	13.33
Revenues from products	32.26	61.54	48.94	20.00
Revenue per employee	3.23	23.08	17.02	0.00
Contribution margin	3.23	30.77	25.53	0.00
Level of indebtedness	3.23	23.08	36.17	40.00
Return on investment	16.13	15.38	19.15	20.00

Unit cost	67.74	61.54	38.30	3.33
Minimising costs	70.97	84.62	59.57	100.00
Maximising profits	38.71	61.54	36.17	23.33
Inventory	3.23	61.54	12.77	3.33
Overall earnings	12.90	38.46	23.40	3.33
Operation costs	45.16	76.92	25.53	0.00
Upper quartile reference value	56.45	69.23	50.00	31.66
Estimated reference value	68.00	70.00	71.00	66.00

The results show similarities and singularities in the choice of specific performance indicators among the roles. Financial performance indicators for profitability and minimising costs are present in the upper quartile for all four SC roles considered, which suggests that these metrics have been used by individual agribusiness companies regardless of the company's position in the SC structure; the usage percentages, however, indicate that the SC roles do not accord the same level of managerial concerns to these indicators. Each role also indicated significant use of specific performance indicators relating to its respective characteristics (unit costs among input suppliers, operational costs among producers, liquidity among distributors and level of indebtedness among retailers); the results also indicate that the related roles do not share similar levels of managerial concern for these performance indicators either.

Use of the reference percentages reveals that the number of suitable performance indicators is smaller in comparison with the number of performance indicators placed within the upper quartiles. Profitability and minimising costs are suitable for input

suppliers, producers and retailers. No individual performance indicator presents a usage pattern higher than the reference percentage among distributors. These results suggest that the amount of the eligible group of performance indicators changes significantly when different reference values are applied.

The same procedure was used to assess the extent to which performance indicators from the customer perspective of the BSC are used. The results are presented in table 3.

Table 3: The extent of performance indicator use from the customer perspective according to supply chain role (%)

Performance indicators	Input suppliers	Producers	Distributors	Retailers
Customer satisfaction	87.10	84.65	72.34	76.27
New customers	80.65	61.54	34.04	43.33
Customer loyalty	51.61	61.54	63.83	46.67
Market share	32.26	61.54	42.55	0.00
Brand value	19.35	53.85	14.89	0.00
Profitability per customer	6.45	46.15	25.53	10.00
Revenue per customer	3.23	53.85	38.30	10.00
Satisfaction of business partners	35.48	61.54	19.15	26.67
Delivery time	90.32	0.00	21.28	23.33
Responsiveness to clients	3.23	23.08	12.77	3.33
Growth in market share	3.23	38.46	12.77	0.00
Maximising sales	35.48	76.92	42.55	63.33

Upper quartile reference value	35.48	61.53	38.29	26.66
Estimated reference value	67.00	67.00	72.00	67.00

The results found are similar to the results of the financial performance indicators for the upper quartile reference. Customer performance indicators relating to customer satisfaction, customer loyalty and satisfaction of business partners are present in all four SC roles considered. These findings corroborate that different SC roles use some similar performance indicators. However, instances of no usage were also found, such as for delivery time and market share.

Only the performance indicator relating to customer satisfaction was eligible for all SC roles when the estimated percentage reference was used. New customers and delivery time is suitable for input suppliers and maximising sales is suitable for producers. These results for customer performance indicators are similar to those for the financial performance indicators, in that they present significant changes to the group when different reference values are applied.

The extent to which internal processes performance indicators are used was also calculated. The results are shown in table 4.

Table 4: The extent of performance indicator use from the internal processes perspective according to supply chain roles (%)

Performance indicators	Input suppliers	Producers	Distributors	Retailers
New products	87.10	53.85	40.43	86.67
New processes	35.48	76.92	29.79	33.33
Productivity per business unit	6.45	53.85	14.89	0.00

Products turnover	3.23	46.15	36.17	3.33
After sales	12.90	53.85	25.53	30.00
Operational cycle	51.61	53.85	14.89	0.00
Suppliers	54.84	46.15	46.81	26.67
Waste	3.23	61.54	42.55	13.33
Flexibility	12.90	69.23	34.04	3.33
Responsiveness to customers	3.23	0.00	8.51	10.00
Delay in delivery	0.00	0.00	8.51	16.67
Responsiveness of suppliers	35.48	61.54	19.15	26.67
Storage time	6.45	53.85	34.04	3.33
Information and integration of materials	0.00	38.46	8.51	0.00
Upper quartile reference value	35.48	61.53	36.17	26.66
Estimated reference value	68.00	71.00	72.00	68.00

The results from the upper quartile reference show that the indicator for operational cycle is found in the upper quartile for input suppliers, while flexibility, product turnover and after sales are found, respectively, in producers, distributors and retailers. None of the internal processes performance indicators tested was found in the upper quartile for all SC roles. These findings indicate that this perspective is particularly sensitive to specific aspects of SC roles.

None of the internal processes performance indicator tested was considered suitable when the estimated percentage reference was considered. The new products performance indicator is eligible for both input suppliers and retailers, and the performance indicator for

new processes is eligible for producers. These findings corroborate the assumption that different reference values affect the composition of the group of performance indicators for specific SC roles.

Finally, the same procedure was carried out to assess the extent to which performance indicators from the learning and growth perspective of the BSC are used. The results are presented in table 5.

Table 5: The extent of performance indicator use from the learning and growth perspective according to supply chain roles (%)

Performance indicators	Input suppliers	Producers	Distributors	Retailers
Investment in training	9.68	69.23	40.43	40.00
Investment in technology	6.45	69.23	55.32	13.33
Investment in information systems	12.90	69.23	40.43	16.67
Employee motivation	51.61	38.46	48.94	13.33
Employee capability	67.74	46.15	36.17	23.33
Managerial efficiency	6.45	53.85	27.66	6.67
Employee satisfaction	38.71	53.85	51.06	6.67
Innovative management	3.23	53.85	17.02	3.33
Number of complaints	22.58	0.00	12.77	0.00
Risk management	0.00	38.46	14.89	0.00
Upper quartile reference value	38.70	69.23	48.93	16.66
Estimated reference value	68.00	68.00	70.00	72.00

Considering the upper quartile reference values, none of the learning and growth performance indicators tested was found in the four SC roles. These findings further

suggest that specific aspects of SC roles relate to the use of specific performance indicators.

Only producers presented performance indicators that could match the estimated percentage reference (investment in training, investment in technology and investment in information systems). Once more, the results corroborate the notion that different reference values affect the composition of the group of performance indicators for specific SC roles.

After identifying the eligible performance indicators, the specific BSC frameworks relating to supply chain roles were formed. The BSC framework structures considering the references values for the upper quartiles are presented in table 6.

Table 6: Balanced scorecard framework structures according to upper quartile references from supply chain role

Perspectives	Input suppliers	Producers	Distributers	Retailers
Financial	<ul style="list-style-type: none"> • Profitability • Unit costs • Minimising costs 	<ul style="list-style-type: none"> • Profitability • Minimising costs • Operational costs 	<ul style="list-style-type: none"> • Profitability • Liquidity • Minimising costs 	<ul style="list-style-type: none"> • Profitability • Level of indebtedness • Minimising costs
Customer	<ul style="list-style-type: none"> • Customer satisfaction • New customers • Customer loyalty • Satisfaction of business partners • Delivery time • Maximizing sales 	<ul style="list-style-type: none"> • Customer satisfaction • New customers • Customer loyalty • Market share • Satisfaction of business partners • Maximizing sales 	<ul style="list-style-type: none"> • Customer satisfaction • Customer loyalty • Market share • Revenue per customer • Satisfaction of business partners 	<ul style="list-style-type: none"> • Customer satisfaction • New customers • Customer loyalty • Satisfaction of business partners • Maximising sales
Internal processes	<ul style="list-style-type: none"> • New products • New processes 	<ul style="list-style-type: none"> • New processes • Waste 	<ul style="list-style-type: none"> • New products 	<ul style="list-style-type: none"> • New products • New processes

	<ul style="list-style-type: none"> • Operational cycle • Suppliers • Responsiveness of suppliers 	<ul style="list-style-type: none"> • Flexibility • Responsiveness of suppliers 	<ul style="list-style-type: none"> • Products turnover • Suppliers • Waste 	<ul style="list-style-type: none"> • After sales • Suppliers • Responsiveness of suppliers
Learning and growth	<ul style="list-style-type: none"> • Employee motivation • Employee capability • Employee satisfaction 	<ul style="list-style-type: none"> • Investment in training • Investment in technology • Investment in information systems 	<ul style="list-style-type: none"> • Investment in technology • Employee motivation • Employee satisfaction 	<ul style="list-style-type: none"> • Investment in training • Investment in information systems • Employee capability

The BSC configurations for each SC role show that they share some similarities relating to management control concerns, as well as the number of performance indicators included. However, areas of specific attention can be identified according to the type of SC role. Specific performance indicators for each SC role considered can be found in three perspectives of the BSC presented. Only the learning and growth perspective did not present any specificity.

After identifying the BSC frameworks relating to SC roles by considering the metrics that present usage percentages within the upper quartile, the estimated percentage reference was applied to identify the eligible metrics for the BSC framework structures by considering the higher usage percentages. The results are presented in table 7.

Table 7: Balanced scorecard framework structures according to the estimated percentage references of the supply chain role

Perspectives	Input suppliers	Producers	Distributers	Retailers
Financial	<ul style="list-style-type: none"> • Profitability • Minimising 	<ul style="list-style-type: none"> • Profitability • Minimising 		<ul style="list-style-type: none"> • Profitability • Minimising

	costs	costs • Operational costs		costs
Customer	<ul style="list-style-type: none"> • Customer satisfaction • New customers • Delivery time 	<ul style="list-style-type: none"> • Customer satisfaction • Maximising sales 	<ul style="list-style-type: none"> • Customer satisfaction 	<ul style="list-style-type: none"> • Customer satisfaction
Internal processes	<ul style="list-style-type: none"> • New products 	<ul style="list-style-type: none"> • New processes 		<ul style="list-style-type: none"> • New products
Learning and growth		<ul style="list-style-type: none"> • Investment in training • Investment in technology • Investment in information systems 		

The configuration of the specific BSCs relating to each SC role show that the shared concern among the roles is limited to the management of customer satisfaction. Furthermore, the roles reveal significant differences in the number of performance indicators and the distribution of metrics among the four perspectives of the BSC according to their type of role. Only producers presented specific performance indicators in all four perspectives for each SC role considered and only the customer perspective presented performance indicators in all SC roles.

The results demonstrate that selection criteria for performance indicators among different SC roles may affect directly the set of eligible performance indicators for a BSC designed for SCs. Furthermore, the identification of common and specific performance indicators should be taken into consideration.

5. Discussion

It is accepted in the literature (van Veen-Dirks and Wyn, 2002; Angerhofer and Angelides, 2006 Chavan, 2009) that SCs are increasingly customer driven, that is managers pay most attention to their immediate customers and the performance measures demanded by their customers. The results presented conform to this expectation. Customer satisfaction is the only indicator that presents a high percentage of usage in all SC roles. This result is particularly relevant because non-integrated SC participants do not address attention to the end customers of the SC (Fawcett and Magnan, 2002).

The results also indicate significant structural differences relating to the set of performance indicators within the BSC structure among SC roles. From the usage percentages relating to the performance indicators tested, it can be seen that input suppliers, farmers, distributors and retailers present different configurations of the BSC composition. Bearing in mind the overall number of performance indicators and their distribution among the four perspectives, this difference indicates a lack of balance. (Punniyamoorthy and Murali, 2008). These findings indicate that the four perspectives of the BSC may not command equal importance among the SC roles (Johanson *et al.*, 2006). Indeed, individual companies with specific roles in a SC may place greater or lesser importance on specific metrics according to the operational contribution of the metrics and the distinct requirements of each company (Holmberg, 2000; Park *et al.*, 2005; Prieto *et al.*, 2006).

The BSC structures for input suppliers and producers presents a few common performance indicators. However, customer satisfaction is the only commonly used performance indicator among the distributors. The results also suggest that individual companies performing multiple roles in ASCs might place greater or lesser importance on

specific metrics. This is due to their own strategies (van Hoek, 1998; Kleijnen and Smits, 2003) as the performance indicators are meant to link the strategic objectives adopted by individual companies (Chenhall, 2005).

For ASCs the results reflect the scenario given in the introduction. Where long-term relationships are less usual, and networks of relationships exist, then to retain business the key concern is with meeting the needs of the immediate customer. For most agri-food businesses this means on-time, in-full, to-specification delivery (Jack *et al.*, 2012). There are low levels of trust in the industry, meaning that information is rarely shared and, unlike other more aligned supply networks, there is less sharing of infrastructure between partners. Therefore, it is unsurprising that the only common measure is customer satisfaction. The main question, however, is whether this is desirable and whether the common use of other indicators in the SC between partners would generate beneficial discussions about topics such as costing and returns, waste management, agronomy, etcetera.

It is unlikely that one single set of performance indicators would fit all SC participants. Implementation of effective performance measurement systems in the SC context lacks cohesion between SC metrics and the strategies of individual companies (Gunasekaran *et al.*, 2001). Evaluating SC performance is a complex task due to the need for a transversal approach involving several actors (Estampe *et al.*, 2013), and the fact that a market orientation appears to be the driving force connecting these individual companies with networks rather than a drive for collaboration (Hsieh *et al.*, 2008; Trainor *et al.*, 2011).

6. Conclusions

The objective of this research note is to identify whether particular metrics used in BSCs are related to specific SC roles. A sample composed by 121 individual Brazilian agribusiness companies was analysed through the use of descriptive statistics.

The results presented statistically significant evidence that the BSC profiles are not the same for all SC roles, although several common performance indicators have been identified that apply to most of the SC. The presence of particular performance indicators relating to specific SC roles suggests that future investigation in other supply networks is warranted.

These findings show that specific SC roles use sets of performance indicators for specific purposes. Any implementation of a SC performance measurement system should consider the use of performance indicators that are common to the role-type and specific to the constituent companies. In addition, the set of metrics and their distribution across the four perspectives of a BSC are different for each supply chain role. These findings suggest that it may be very difficult to achieve a balanced scorecard framework that is common and practical for all SC participants and that other alternatives should be investigated.

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