International Food and Agribusiness Management Review
Volume 20 Issue 4, 2017; DOI: 10.22434/IFAMR2016.0152

Received: 15 September 2016 / Accepted: 1 March 2017

Management support for agricultural enterprises: a case study for a fruit-producing company

CASE STUDY

Leonardo Ensslin[a], Vinícius Dezem[b], Ademar Dutra[a], Sandra R. Ensslin[c], and Karine Somensi[d]

[a]Professor and [b]Researcher, University of South Santa Catarina (Unisul), Av. José Acácio Moreira, 787-Dehon, Tubarão, SC 88704-900, Brazil

[c]Researcher and [d]Student, Federal University of Santa Catarina (UFSC), Campus Reitor João David Ferreira Lima, Trindade, Florianópolis, SC 88040-900, Brazil

Abstract

Over the last few decades, agricultural production has improved its productivity significantly. This improvement has notably focused on the genetic development of plants and on equipment technology. Nevertheless, its managers have not monitored this growth in the competitiveness of the sector. Based on this context, this study has a central question: how can performance evaluation, from its decision-making support perspective, improve the management process of an agricultural company? In order to answer this, the purpose of creating a decision-making model to support the management decisions of an agricultural company is taken into consideration. Seven strategic objectives were identified, operationalized by 57 performance indicators, for the levels of reference set by the decision maker; fourteen performance indicators are at a compromising level, showing the need for intervention. With the model created, it was possible to have a picture of this situation and provide a process to propose improvement actions.

Keywords: performance evaluation, fruit production, MCDA-C, multi-criteria
JEL code: M11

Corresponding author: vinidezem@yahoo.com.br

1. Introduction

Agricultural productive systems use sophisticated techniques to correlate human, natural, industrial and economic resources. This is undertaken to meet the demand for food in today's highly competitive and exacting market in terms of environmental and social sustainability (Bronnmann and Asche, 2016; Figueiredo Junior *et al.*, 2016; López *et al.*, 2008; Neves and Chaddad, 2012).

In these contexts, performance evaluation systems must be used to generate useful information for managers. Such systems enable managers to foresee the consequences of potential decisions on the aspects they regard as critical to the success of the enterprise (De Barros *et al.*, 2009; Neves *et al.*, 2015).

A great deal of scientific effort has been dedicated over the years to ensuring the well-balanced and sustainable development of the agricultural sector. Such efforts have given rise to the genetic engineering of species and the development of cost-effective equipment that is better adapted to its purpose. In the area of management, science has offered performance evaluation systems, which, though greatly based on mathematical calculations, have not met the needs of managers in this area in practical terms. Recent studies have shown that general management models do not provide the enterprise-specific detail required in such cases. Despite their success in other academic fields, such as physics and mathematics, these models ultimately frustrate managers and confuse researchers (Roy, 1993). Researchers such as Roy (1993), Landry (1995), Dantsis *et al.* (2010), Scott *et al.* (2015) and Keeney (1992) found that decision-making environments in areas with rapid development, such as the agricultural sector in recent years, have found a competitive edge in the singularities of their physical context and managers' values and preferences. Therefore, attempts to use systems to support the management of agricultural enterprises that have been developed using information gathered from outside the specific decision-making context of this sector have often not been satisfactory.

Over the last few years, the mid-western region of the Brazilian State of Santa Catarina has shown conditions suitable for growing fruit in terms of its climatic characteristics, the suitability of its soils, the state's favourable logistics system and, mainly, the profiles of its entrepreneurs. One such fruit producer, located in the western region of the state, is Sitio do Vale. It is a young company, characterised by the technology used in its fruit production; these are determining factors in how it grows distinctive products of a higher standard than its competitors. The company's productive potential is currently low regarding market demands. This necessitates the use of a management tool to help improve the company's production performance without negatively impacting product quality.

As this is an agricultural context undergoing rapid technological development, and highly influenced by its managers' choices and involving many actors, with multiple conflicting and poorly defined objectives with unique characteristics, the use of general models is not advisable. The Multi-Criteria Decision Aiding-Constructivist methodology (MCDA-C) is therefore used as an instrument of intervention as it can deal with complex and conflicting contexts (Ensslin *et al.*, 2012, 2015; Lacerda *et al.*, 2011; Tasca *et al.*, 2012; Zamcopé *et al.*, 2010).

By understanding the aforementioned context, this study addresses the following research question: how can a constructivist model improve an agricultural company's management process in terms of its decision-making? This study aims to answer this question by creating a model that can support the decision-making processes of the management of an agricultural company, using its managers' perceptions to:

1. identify those aspects (performance indicators, criteria) regarded as critical for the company's performance and the creation of scales used to measure performance and show levels of reference;
2. show the profile of the current performance level (*status quo*), taking into account the criteria (indicators) set for the decision-making context;
3. suggest actions to improve indicators at a compromising performance level.

This study is justified by its uniqueness, importance and viability (Castro, 1977). It is unique because no other articles were found in the literature searched that address management in agricultural companies or take into account performance evaluation as a system to support decision-making and the specifics of the context and authors involved in the management process.

By the end of this study, a model will have been created, which allows managers to be familiar with: the critical factors for the success of the company; the current performance level in each of these factors, including which factors present compromising characteristics and which provide a competitive edge; the current goal of each indicator; and how to use the process available to improve strategic actions. All of this information helps managers broaden their understanding of financial and non-financial consequences for their organisation in decision-making processes.

In addition to this introductory section, this study has four more sections: theoretical framework, methodology of the research, case study, and final considerations.

2. Theoretical framework

In this section, the research axes are presented: (1) constructivist performance evaluation and (2) management in agricultural production, taking its development and recently published articles into consideration.

2.1 Constructivist performance evaluation

Performance evaluation and its indicators have gone hand in hand with humankind since the very first signs of life in groups of human beings. Its documented beginnings are found in the *Tratactus de Computis et Scripturis do Summa de arithmetica, geometrica, proportioni et proportionalita* by Frei Luca Bartolomeo de Paccioli (1494), containing descriptions of Venetian merchants' accounting methods (Ensslin *et al.*, 2015).

Over the course of the eighteenth-century Industrial Revolution, Francis Bacon (1620) added an experimental scientific characteristic to performance evaluation, initially to operations and quality control purposes. This suggested that processes could improve competitive conditions based on reducing production costs. Performance evaluation was further consolidated in the twentieth century with mass production in the industrial segment and scientific administration taking shape within academia. In this context, realistic models gained importance and were successful in such areas as physics, mathematics and business administration.

Constructivist approaches began to be used in recent decades, as proposed by Landry (1995), Roy (1993), and Keeney (1992), helping researchers and managers in their professional and personal capacities. Such studies have made use of scientific knowledge to perfect and innovate commercial methods and courses of action.

The multiplicity of definitions of performance evaluation and the existing knowledge gaps regarding the decision-making support perspective prompted Ensslin *et al.* (2010: 130) to propose the following conceptualization for performance evaluation as an instrument to support decision making:

> Performance evaluation is characterized as the process which aims to build knowledge in the decision maker regarding a specific context which he/she intends to evaluate, by means of activities that from the perception of the decision maker him/herself identify, organize and measure, both ordinally and cardinally, integrate and allow to see the impact of actins and their management
> (Ensslin *et al.*, 2010: 130).

According to this perception, performance evaluation is defined as a management tool conceived to build, establish and disseminate knowledge so that it is possible to monitor and improve the context in which a decision maker performs their managerial function (Ensslin *et al.*, 2014). This is the perception proposed for the type of management described in this study, as presented in Figure 1.

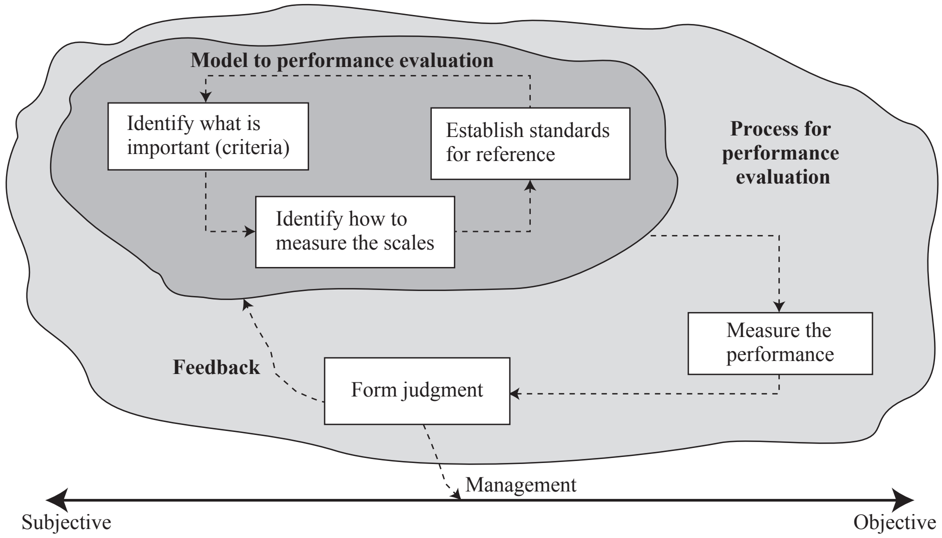

Figure 1. Process of performance evaluation (adapted from Ensslin *et al.,* 2007).

By creating a performance evaluation model with a focus on decision-making support, a process is used that consists of phases that integrate the subjectivity and objectivity of the decision-making context by structuring the addressed problem by in turn identifying the main goals and concerns of the decision makers. Performance scales and levels are then defined to measure such concerns, which are based on the following statement by Lord Kelvin:

> When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind: it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science (Thomson, 1968: 53).

This is the main responsibility of performance development systems; this study will develop its model based on this perspective using the MCDA-C.

2.2 Management in agricultural production

Over the last years, fruit production has been centralized in family-based farming – small productive units with low technical development (Bronnmann and Asche, 2016). As large urban centers started to form, demand for high quantities of food emerged, providing favorable conditions for investment in management in the agricultural sector.

A variety of management tools are used in food production, among which performance evaluation stands out (De Barros *et al.*, 2009; Dantsis *et al.*, 2010; López *et al.*, 2008). In a recent bibliometric analysis, a significant fraction of the literature on this topic was found to include prominent use of the multi-criteria methodology. Table 1 shows a summary of these works, highlighting: (1) objectives; (2) methodology used; and (3) results achieved.

Table 1 shows a tendency towards multi-criteria research in agricultural management, as the present authors regard the analysis of subjective and objective aspects as necessary elements in managers' decision-making contexts. In line with the information in Table 1, the present authors used realistic models (normativist, descriptivist) to aid agricultural managers. According to Roy (1993), the use of the normativist/descriptivist path describes realities independently of decision makers and other human actors. This approach tends to impoverish the managerial reality and decision-making process. The formulation of a problem cannot be

Table 1. Summary of the multi-criteria studies (adapted from Bibliographic analysis, 2016).

Article	**Objective**	**Model used**	**Results**
Multi-metric evaluation of leaf wetness models for large-area application of plant disease models (Bregaglio *et al.*, 2011).	Evaluate irrigation models and their impact on large farming areas, based on the comparison of six models.	The models evaluated had their application in the US and Italy, and their results were compared with a multi-criteria model, which evaluated irrigation capacity and simulated the results of pathogen infection in plants.	The classification model and classification and regression tree achieved the best performance in most of the conditions; the authors suggest the adoption of decision-making support in future research.
A methodological approach to assess and compare the sustainability level of agricultural plant production systems. (Dantsis *et al.*, 2010).	Evaluate and compare the level of sustainability of certain Greek productive systems, taking into account three sustainability pillars: Environmental, Economic and Social.	21 individual indicators were generated with integration in a single score system by means of Multi-attribute Value Theory.	The results show the particularities of the regions studied regarding sustainability. The continuity of the research is suggested, with the same indicators in other regions.
A systemic comparative assessment of the multifunctional performance of alternative olive systems in Spain within an Analytic Hierarchy Process (AHP)-extended framework (López *et al.*, 2008).	Test the hypothesis of superiority of the production of organic olive trees with conventional systems in the south of Spain.	A systemic analysis was performed, using multiple criteria, examining such questions as economy, technique, culture and environment. To this end, the AHP technique was adopted.	Despite the existence of ideological tendencies, the results show that organic systems achieve better performance. According to the authors, there are still conflicting issues between environment and production.
Using multiple indices to evaluate scenarios for the remediation of contaminated land: the Porto Marghera (Venice, Italy) contaminated site (Critto and Agostini, 2009).	This work suggests a set of indicators used to evaluate contaminated sites.	The DESYRE system was used *(DEcision Support sYstem for REhabilitation),* which is software composed of 6 different modules that are integrated into the final decision-making support module where scenarios and possible solutions are presented.	3 different scenarios were presented to the management board of Porto Marghera, which considered using technologies to treat the soil, identifying the best use of the land.
Conventional versus alternative pig production assessed by multi-criteria decision analysis (Degré *et al.*, 2007).	The work classifies and compares conventional and organic pig production, evaluating parameters such as nitrogen, ammonia, greenhouse gases and radius of odour discomfort.	The multi-criteria model used compared the performance of the processes, which were evaluated by a jury composed of 16 experts.	The organic production achieved the best evaluated performance; however, the variability of performance was a highlight.
Energy evaluation and economic performance of banana cropping systems in Guadeloupe (De Barros *et al.*, 2009).	Improve management capacity and decision making in investments regarding banana cropping in Guadeloupe.	The six main production systems were compared by means of a multi-criteria model which considered factors such as use of the soil, disease control, and healthy environmental practices.	The results indicate that banana cropping in Guadeloupe presents low environmental performance and improving performance would cause costs to be higher; therefore, subsidies from the government should be granted.

treated independently of the relationship between an individual and reality. These findings led Roy (1993) to recommend the use of the constructivist path for such scientific contexts.

3. Research methodology

For this study, the applied research methodology will be presented in two stages. The first stage refers to the methodological framework of the research; the second shows the instrument of intervention, the MCDA-C, using the Brazilian fruit producer Sitio do Vale to create a performance evaluation model.

3.1 Methodological framework

According to Richardson (2008), the methodological framework comprises the following factors:

- Nature of the research: this study is characterized by its applied nature, as a case study, aiming to understand and address a real phenomenon by creating a performance evaluation model for the decision-making process of a certain company in the agricultural sector.
- Nature of the objective: it is characterized by being exploratory, as it expands knowledge in the decision maker involved in the process, aiming to develop the knowledge of a certain field of expertise and, from it, obtain a set of criteria which may be transformed into management performance indicators of Sitio do Vale, taking into account the personal perception and values of the decision maker himself.
- Problem approach: a qualitative-quantitative approach is considered, so that the qualitative aspects that occurred when the decision maker's concerns were identified, during the stage of structuring the model, especially in the development of Primary Elements of Evaluation (PEEs) and Cognitive Maps, can be evaluated. Next, the quantitative stage takes place by developing ordinal scales of performance indicators.
- Data collection: data collection comprised primary and secondary data (Richardson, 2008). The primary data comes from the observations made when the *status quo* profile of the performance indicators took place. The secondary data is obtained from the analyses of documents and financial statements.

3.2 MCDA-C as an instrument of intervention

The instrument of intervention chosen for the creation of the model was the MCDA-C, (Ensslin *et al.*, 2010). This methodology was chosen because it meets the requirements for the creation of the model. The requirements taken into consideration were that: (1) decision makers wish to improve their understanding of a problem; (2) decision makers wish to present critical factors for the success of business management; and (3) decision makers want specific details of their environment taken into account.

One of the principles of the MCDA-C consists of incorporating objective and subjective elements that are present in the decision-making process (Ensslin *et al.*, 2001). In management contexts, objectivity and subjectivity are inherent in the decision-making process, therefore situations that involve decision making need to be analyzed based on both of those elements (Bana e Costa, 1993; Micheli and Mari, 2014). Thus, the MCDA-C shifts the focus of the analysis from being ontological (knowing how reality is) to epistemological (expressing how reality is understood or perceived) (Micheli and Mari, 2014).

Drawing on the concept of constructivism, as proposed by Roy (1993), this study is based on the recognition that a decision maker must expand his or her understanding of the consequences of their decisions regarding the aspects that they deem to be important and, through constructed knowledge, evaluate these aspects and recommend improvements without imposing on the rationalism of objectivity (De Moraes *et al.*, 2010; Ensslin *et al.*, 2010; Lacerda *et al.*, 2011; Roy, 1994; Skinner, 1986).

The MCDA-C process of intervention operates in a systemic and systematic way through three sequential and interactive stages: structuring, evaluation and recommendation (Bana e Costa, 1993; Ensslin *et al.*, 2017; Lacerda *et al.*, 2014; Longaray and Ensslin, 2015).

The method proposes to build knowledge in those involved in the process that will be reflected in a performance evaluation model. The decisions made from this model are based on what are believed to be the decisions most suitable for the given situation (Roy, 1993). By considering this information, the methodology is composed of three stages: (1) structuring; (2) evaluation; and (3) recommendation, as shown in Figure 2.

The first stage (structuring) focuses on understanding the problem in accordance with the decision maker's perceptions. The main objective at this stage is to help actors to identify, characterize and organize the relevant factors in the decision-making process. Soft approaches to operational research structuring, such as Cognitive Mapping (Ackermann and Eden, 1998) or the Soft Systems Methodology (Checkland and Scholes, 1999) can be used at this stage to elicit knowledge and engage decision makers. This procedure is followed by an elaboration of a hierarchical structure that represents the decision maker's judgments (Bana e Costa, 1993; Lacerda *et al.,* 2014; Longaray and Ensslin, 2015). Finally, the process involves the construction of ordinal scales to measure each criteria and sub-criteria of the model (Ensslin *et al.*, 2013).

The evaluation stage, as Bana e Costa (1999) explains, involves clarifying potential choices through the application of mathematical methods. These methods assist in modelling and aggregating decision makers' preferences. The development of the evaluation model should provide decision makers with a tool to understand the different consequences of the alternative decisions for each criterion (Ensslin *et al.*, 2001; Lacerda *et al.*, 2014; Longaray and Ensslin, 2015).

The Macbeth method – Measuring Attractiveness by a Categorical Based Evaluation Technique (Bana e Costa *et al.*, 2012a,b) is used at this stage to transform the ordinal scales into cardinal scales and to help the decision maker to establish the taxes between criterions.

The last stage of the MCDA elaborates on the recommendations. This stage involves a discussion of the possible actions that could help the decision maker improve the performance of the assessed object. These actions are specific for each case and are established following the analysis of the performance profiles. This analysis identifies the criteria that the decision maker is expected to meet to improve performance. The sensitivity analysis can be performed whenever the effects of any variation in the model parameters are to be tested (Bana e Costa *et al.*, 1999). As observed in the two previous stages, the recommendations stage does

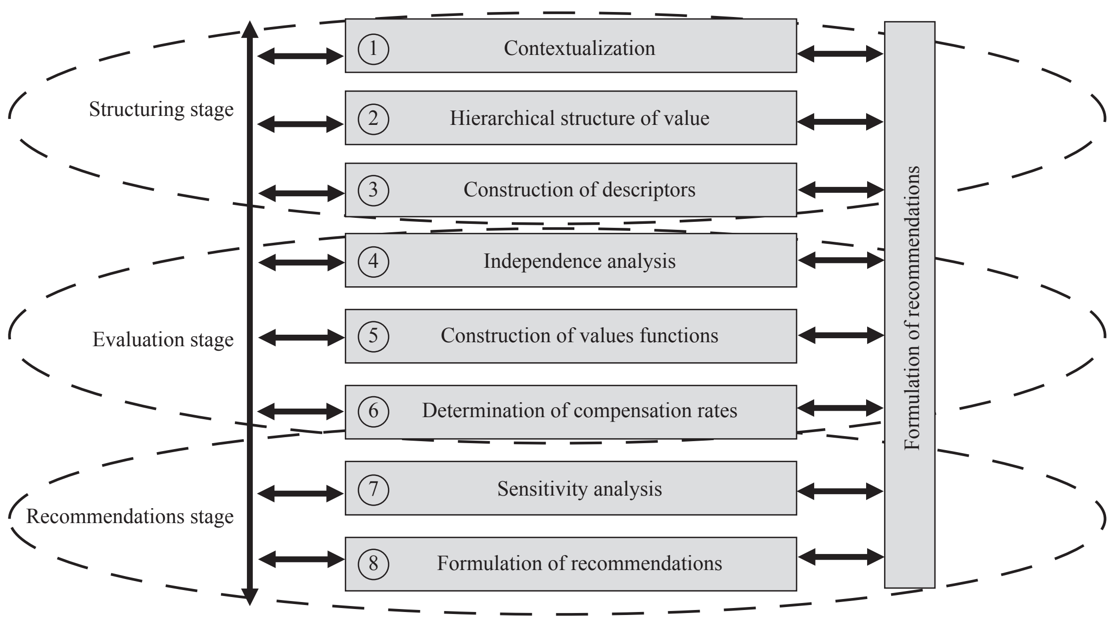

Figure 2. Stages of performance evaluation (adapted from Ensslin *et al.,* 2001).

not have a prescriptive character either (Roy, 1993; Roy and Vanderpooten, 1996). The recommendations derived during the final stage as well as those that originate during the process are a result of the learning generated due to participation in the construction of the model (Roy, 1993).

The implementation of the phases of the MCDA-C will be detailed in the description of the case study. The structuring and recommendation stages were addressed together.

4. Case study

This section shows how a performance evaluation model is structured for the management process of a certain company in the agricultural sector, supported by the value systems, interests and preferences of the decision makers. This takes into account stakeholders' requirements in accordance with decision makers' perceptions.

4.1 Identification of the decision-making context

The western region of the Brazilian State of Santa Catarina is characterized by the strength of its family farming enterprises. Several varieties of food are produced in small agricultural units. Infrastructure and production volumes are limited as products are essentially handmade but control over the environmental impacts and the quality of the products is extensive, thus generating a great competitive differential.

In this context, we address the agricultural company Sitio do Vale. It faces several challenges, the greatest of which is establishing a competitive position based on management tools that enable it to improve its performance according to the particularities of its operating context.

Actors are the people involved in the decision-making process; they are classified as decision makers, stakeholders and facilitators (Ensslin *et al.*, 2001) The models developed, as influenced by the MCDA-C, are structured based on the values and preferences of decision makers; therefore, it is important to highlight the importance of the appreciation of the actors' subjectivity by valuing the internal and external particularities of the context, and the motivation and preferences of the decision makers (Roy, 1993).

- the actors involved in the question of improving the management process, to be presented, are as follows: decision makers – manager and business partner at Sitio do Vale;
- stakeholders: company employees;
- the ones influenced: clients;
- facilitator: Vinicius Dezem.

The title established was 'Model to the Management Support of Sitio do Vale'.

■ *Primary elements of evaluation*

By contextualizing the question of improving the management process, the MCDA-C, in its structuring stage, continues to identify the PEEs. They represent the concerns, wishes and motivations associated with the values and objectives of the decision maker in a particular decision-making context. In the present case, the PEEs were identified by means of open interviews with the decision maker, where he was encouraged to detail the problem he faced (Ensslin *et al.*, 2001; Lacerda *et al.*, 2014; Longaray and Ensslin, 2015).

Each PEE can generate more than one concept as sometimes more than one objective can be related to the element of concern; for example, 'Plant diseases' represented three preoccupations: (1) to control diseases; (2) to prevent diseases; and (3) to have processes in place to do so. After interactions with decision makers, 98 PEEs were identified. Table 2 shows the PEEs obtained.

The PEEs allow subjective and context-dependent concerns or objectives to be identified in such a way that makes the values of interest explicit.

Table 2. Primary elements of evaluation.

1	Knowledge	33	Delivery	66	Monitoring of results
2	Weather conditions	34	Incentives	67	Risk
3	Market	35	Develop	68	Security
4	Work force	36	Debts	69	Access
5	Input	37	Guarantees	70	Market trends
6	Distance	38	Payroll	71	Visits
7	Investment	39	Shipping	72	Appearance
8	Brand	40	Payment Default	73	Side activities
9	Products	41	Surpluses	74	Bills
10	Cost accounting	42	Sustainable	75	Expenses
11	Society	43	Understanding	76	Communication
12	Partnerships	44	Leadership	77	Environmental
13	Maintenance	45	Disagreements	78	strategies
14	Use	46	Liquidity	79	Investors
15	Weather/time	47	Plant diseases (to control them)	80	Employees
16	Insecurity	48	Plant diseases (to prevent them)	81	Challenges
17	Cash flow	49	Plant diseases (to have processes to deal with them)	82	Update
18	Long term relationship	50	Human diseases	83	Superiority
19	Legalization	51	Goals	84	Crop growing techniques
20	Control	52	Motivation	85	Point of sale
21	Costs	53	Commitment	86	Industrialization
22	Production	54	Sustainable business	87	New cultures
23	Product mix	55	Soils	88	Focus
24	Productivity	56	Suppliers	89	Plagues
25	Rent	57	Purchasers	90	Weekend
26	Innovate	58	Marketing	91	Opportunities
27	Performance	59	Advertising	92	Performance
28	Motivation	60	Focus	93	Research
29	Planning	61	Brand	94	Extension
30	Package	62	Diversification	95	Recession
31	Election	63	Balance Points	96	External environment
32	Competition	64	Cost-effectiveness	97	Internal environment
		65	Profitability	98	Decision making

The MCDA-C methodology recommends expanding understanding by identifying the direction of preference represented by each PEE as well as its psychological opposite to understand the minimum degree of acceptability of the underlying goal. This evolutionary form of presenting the PEE is called a concept or action-oriented concept (Ensslin *et al.*, 2010; De Moraes *et al.*, 2010).

It is important to highlight that each PEE can develop more than one concept; this occurs when more than one objective is related to the concern element. Table 3 shows the first five concepts associated with the first five PEEs mentioned above. In each concept where an ellipsis (...) is used, this should be interpreted as 'it is preferable to' or 'instead of' (De Moraes *et al.*, 2010; Lacerda *et al.*, 2011)

Based on the initial understanding of the decision maker in addition to the knowledge built, with the identification of the PEEs and development of the concepts, the facilitator prompts the decision maker to define the major areas of concern indicated by candidates for Fundamental Points of View (FPVs). These are perceived by the decision maker as necessary and sufficient for the management of the context of the study.

Table 3. Concept of the five first primary elements of evaluation.

N°	Primary elements of evaluation	Concept (implied objective)[1]
1	Knowledge	Build knowledge in those involved in productive processes...run tests and experiments, wasting time and money.
2	Storms	Improve prevention systems and create stocks in order to have supplies in case of incidents ... to be completely unprepared with unreliable systems.
3	Market	Expand in and keep secure market ... having products and not knowing where to sell them.
4	Workforce	Have qualified workforce, capable of developing related activities with fair pay ... work overload and unfinished work.
5	Inputs	Quality and availability of necessary inputs for the activities developed, at right prices ... to obtain products found in distant areas.

[1] An ellipsis (...) should be interpreted as 'is preferable to' or 'instead of'.

To progress with the sequence of this process, the facilitator exhaustively tests the FPVs, arranging concepts into their respective areas of concern. If some concepts cannot be grouped accordingly, a suitable FPV is analyzed together with the decision maker; any areas of concern without corresponding concepts should be excluded.

The resulting structure is called a Hierarchical Structure of Values and the areas that describe them are composed of the family of FPVs of the context, as shown in Figure 3.

The next stage of structuring consists of arranging these concepts into a hierarchy and organizing them in terms of their influence relations. In order to achieve this, cognitive maps are used, as proposed by Montibeller *et al.* (2008).

■ *Maps of mean-end relationships, hierarchical structure of values and descriptors*

At the very beginning, the analyst must try to understand 'what the problem is' from the perspective of the actors involved in a given situation. To aid in this understanding, many tools have been developed by researchers in the field to schematically represent the construction of the problematic situation. In this study,

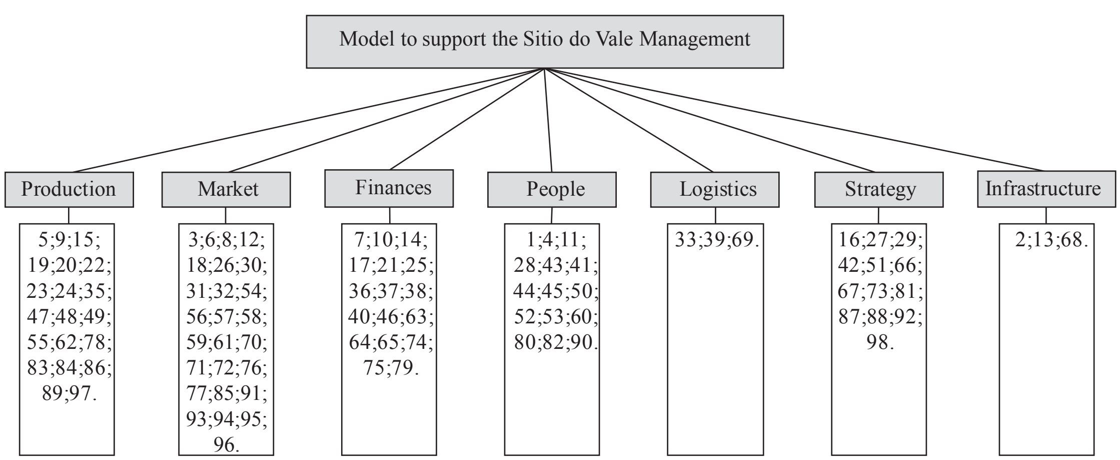

Figure 3. Areas of concern for the evaluation of the Management Process of Sitio do Vale. The numbers in the figure correspond to the primary elements of evaluation numbers of Table 2.

the technique identified as being the most appropriate was the Cognitive Maps proposed by Eden (1988, 1983) for its adequacy in the structuring of multicriteria models. These maps depict causal and influential relationships.

According to the decision maker's perspective, the concepts grouped into areas of concern, called FPVs, are used to start the process of creating maps of mean and end relationships. The purpose of these maps is to have a better understanding of each FPV so that they can be operationalized and measured (Montibeller *et al.*, 2008).

This step consists of constructing a hierarchy of concepts and establishing influence links. Mean and end relationships are created by requesting that the decision maker talks about each concept and explains why it is important and can be resolved (Eden, 1988, 1983). Thus, when mapping focuses on the ends, the decision maker explains his system of values through the higher-level hierarchical concepts. The mapping of the means also provides a set of potential actions through subordinate hierarchical concepts. Following the establishment of concept hierarchy, the connections between concepts are made using influence relationships.

This procedure facilitates the creation of chains of concepts and, within them, the creation of new concepts to justify lines of argument, from strategic concepts to the most operational ones. Figure 4 shows one of the cognitive maps for FPV1: 'Production – Product Area'.

Once all maps have been constructed, the MCDA-C methodology proposes, in order to continue its process of constructing the understanding, that the structure of influence relations be converted into a hierarchical structure of value. This incorporates the understanding of the preferred judgments of the decision maker in the model under construction (Keeney, 1992).

One concern to be considered is that initial maps should be tested to represent aspects of the context in order to be: essential, controllable, complete, measurable, operational, isolable, non-redundant, concise and understandable (Keeney, 1992).

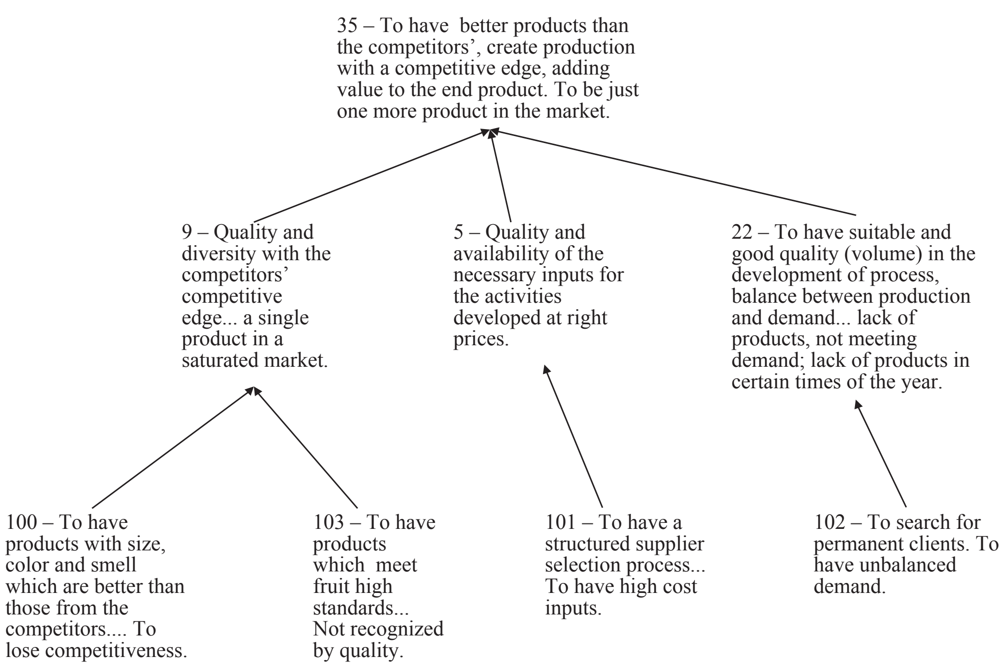

Figure 4. Map of the mean and end relationships for the strategic objective: 'Production – Product Area'. An ellipsis (...) should be interpreted as 'is preferable to' or 'instead of'.

Maps of mean and end relationships were created for all of the strategic objectives of the top-down hierarchical structure. The MCDA-C, in its process of expanding knowledge about the evaluated context, suggests that the structures of a causal relationship be transformed and transferred to the Hierarchical Structure of Values, as created and shown in Figure 4. For such, each of the cognitive maps, associated with each of the FPVs, has its concepts grouped into clusters representing subareas of concern to be addressed. These clusters are transferred to the Hierarchical Structure of Values, where they are called Elementary Points of View (EPVs).

After the transition stage was developed, it was possible to create the Hierarchical Structure of Values, where the EPVs are decomposed into EPVs and SubEPVs to enable them to be measured, resulting in:

- 53 EPV of the 3rd level;
- 11 EPVs of the 2nd level;
- 20 EPVs of the 1st level;
- 7 FPVs.

The hierarchical structure of values, also called the tree structure, contains all of the points of view, which are branched until the moment it is possible to measure them; from this level on, the EPVs are operationalized by ordinal measurement scales called descriptors.

The next stage to be developed for each aspect identified in the hierarchical structure is the creation of descriptors. These are ordinal scales that indicate the direction in which the decision maker's preference goes in relation to each item (Bortoluzzi *et al.*, 2014; Dezem, 2015). According to Bortoluzzi *et al.* (2010: 12), 'The measurement scale of each descriptor associates the decision maker's abstract values with one or more physical properties of the objectives in the context'. Once each descriptor's scales are created, the level of reference for the scales are set; such levels are called 'Compromising' (representing the performance evaluated by the decision maker as insufficient to keep competitive), 'Market' (representing acceptable performance corresponding to market standards) and 'Excellence' (representing a competitive edge in the market). At the end of this stage, the following quantities of descriptors in each FPV were identified:

- production: 12 criteria;
- market: 15 criteria;
- finances: 8 criteria;
- people: 7 criteria;
- logistics: 3 criteria;
- strategy: 7 criteria;
- infrastructure: 5 criteria.

With a total of 57 indicators in the Hierarchical Structure of Values, aiming at a better understanding of the descriptors and their measurement levels, Figure 5 represents the FPV Production and the descriptors of the EPV Product, with their levels of reference.

4.2 Performance profile

To create the current performance profile of Sitio do Vale, in order to meet the second specific objective of this study, the performance in each of the 57 criteria was identified by means of primary data collection, during day-to-day activities, by means of management reports made available by the company and interviews with the decision maker. Figure 6 shows the same EPV, with a dotted line, which represents the profile of the descriptor evaluated.

After identifying the performance of the criteria, it is possible to determine which points of the process in question exceed the market performance level (good level), are at the market level (between good and neutral) or are below the market level (below and neutral). In the criteria where the performance level is below neutral, improvement actions must be promoted with efforts geared towards performance improvement (Ensslin *et al.*, 2001).

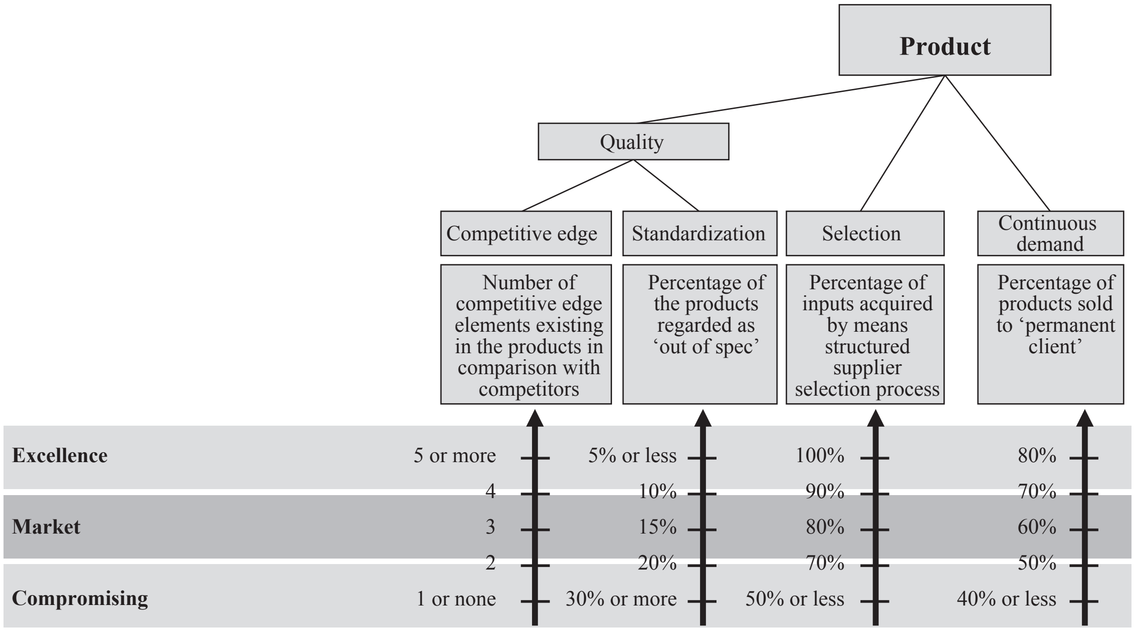

Figure 5. Descriptors and levels of reference for the EPV Product – FPV Production. EPV = elementary point of view; FPV = fundamental point of view.

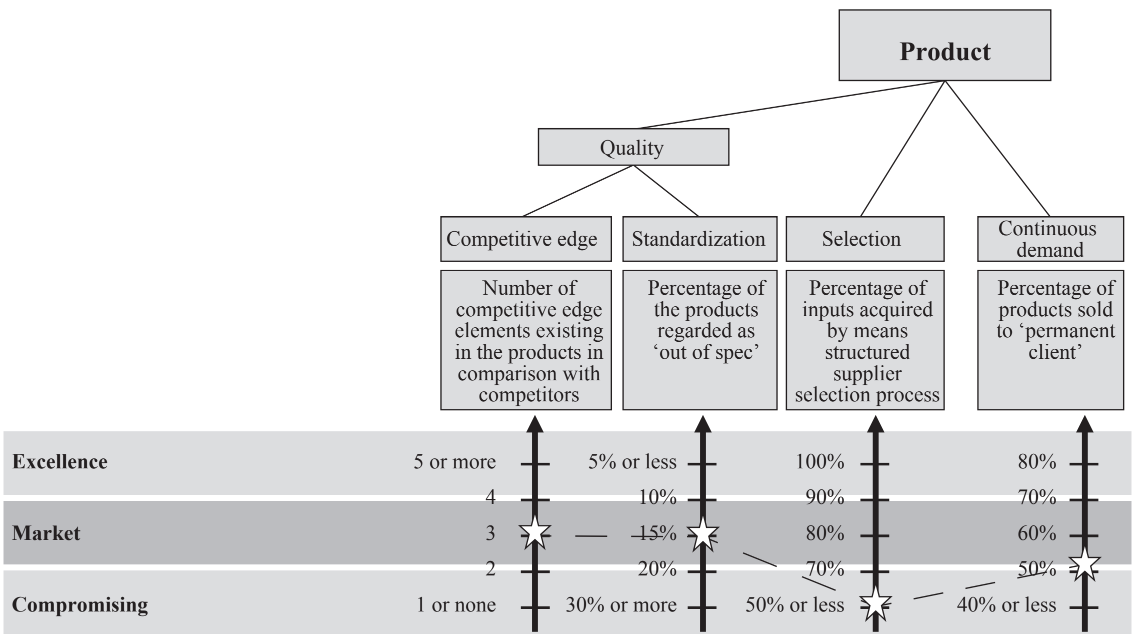

Figure 6. Performance profile EPV1 Product – FPV Production. EPV = elementary point of view; FPV = fundamental point of view.

In Figure 6, the results achieved are presented, taking an Elementary Point of View into account. This aims to measure the performance level of the product; it is possible to see that one out of the four factors analyzed is at a compromising level, and the other three factors are at a market level.

With the second specific objective of this study at hand, which aims to show the performance profile of the management process of Sitio do Vale, the following was identified:

- In 3 aspects, the performance level exceeds the level of excellence.
- In 40 aspects, the performance level is at a market level.
- In 14 aspects, the performance level is at a compromising level.
  For these 14 aspects at a compromising level, improvement actions were developed, as seen in Table 4.

5. Final considerations

In recent decades, productivity in agricultural production has improved significantly. This improvement has notably focused on the genetic engineering of plants and advancements in equipment technology. Nevertheless, managers have not monitored growth in the competitivity of the sector.

By analysing the existing literature on this topic, an opportunity to perform a study was identified, using performance evaluation from the decision-making support perspective as a management tool for a particular company in the agricultural sector. In Bregaglio *et al.* (2011), the authors present a multi-criteria model and suggest new studies, taking into account a constructivist approach (López *et al.*, 2008). They also present the multi-criteria approach in their work, highlighting the importance of taking into account the complexity of the given context when validating the models proposed.

Drawing on this theoretical foundation, the purpose of this study was to create a model that supports the decision-making process of the management of an agricultural company. This aim was met by achieving the following specific objectives:

1. identifying the aspects that show the performance of the process, regarding evaluation criteria (indicators), and creating scales to measure performance and show its levels of reference;
2. showing the profile of the current performance level (*status quo*), taking into account the criteria (indicators) set for the management process of Sitio do Vale; and
3. suggesting a course of action, structured for the improvement of indicators at a compromising performance level.

By facing the first specific objective, after interviewing the decision maker and contextualizing the problem, 57 PEEs were identified, which were expanded by means of action-oriented concepts, grouped into areas of concern, better understood by means of concepts, and then arranged into maps of mean and end relationships to clarify their strategic, tactical and operational contribution.

Table 4. Performance profile EPV1 Product – FPV Production.[1]

Descriptor	Action
Selection percentage of the inputs acquired by means of a supplier selection structured process	Create a supplier database, taking into account cost-effectiveness of each input
Expected result	Have reliable suppliers, who offer a fair price for the inputs
Necessary resources	Time the manager takes to perform searches and create a database
Person in charge	Manager
Commencement date	February
End date	February
Follow-up process frequency	Every week
How to follow up	Number of registered suppliers
Person in charge of follow-up process	Manager and business partner

[1] EPV = elementary point of view; FPV = fundamental point of view.

These maps were grouped into clusters and subclusters, which were named according to what the decision maker associated with the set of concepts therein. They were then transferred to the Hierarchical Structure of Values to respectively compose the FPVs and the EPVs. The subclusters that compose the most extreme EPVs were used to support the process that identified the most suitable descriptor. The performance levels of these ordinal scales were classified as Excellence, Market and Compromising by the identification of reference levels classified as Good and Neutral.

Next, performance was presented, from global, strategic, tactical and operational levels, in each scale where the current situation was and presented by means of a graph and numbers. All of this information enabled the decision maker to be familiar with the aspects presenting weak and/or strong performance levels and their corresponding consequences at strategic and global levels, meeting the second specific objective of this study.

The decision maker's participation in the whole process ensured that, on one hand, everything being developed corresponded with his perceptions and represented his values and preferences; on the other hand, his confidence in the created model helped him to use it in order to make his management stronger and more transparent. He thereby felt more comfortable justifying his choices and showing how his process was developed.

The final specific objective was achieved when improvement actions were proposed for the fourteen identified descriptors at a compromising level; essentially, such actions rely on a performance process, which develops in a pragmatic manner.

Therefore, the general purpose of this study was met, with the creation of a performance evaluation model for the management process of Brazilian fruit producer Sitio do Vale, developed from the values and preferences of the company's team manager.

Thus, the use of the MCDA-C methodology as the research instrument is justified for confusing environments involving multiple actors, with conflicting and partially set objectives. This study was based on representative studies such as Dantsis *et al.* (2010), López *et al.* (2008) and De Barros *et al.* (2009), and supported such studies by using performance evaluation in a manner which had not been used previously, taking into account decision-making process support.

Taking into account the assumptions of performance evaluation, as a tool to support decisions, there were scientific contributions for the management of the Sitio Vale agricultural enterprise. These highlighted the incorporation of the constructivist approach and establishing a structured management process capable of measuring the objective and subjective elements present in decision making. It is important to highlight the knowledge built in the decision maker, which fostered an appropriate positioning in the decision-making context, putting into practice strategies and actions consistent with the needs of the company.

By being graphically and ordinally aware of the situation analyzed, the decision-maker was provided with information with which they could improve their company. This gave them confidence regarding which factors to target for improvement actions, and to what extent they should be addressed in order to develop the business.

As number of research limitations must be acknowledged. The model herein presented is specific to a company in the agricultural sector; therefore, its direct application, without being adapted to a new context (other companies) is not recommended. The MCDA-C process used is, however, general and can be used in different contexts. Also, the model created takes the decision maker's perceptions into account when dealing with his work team and managed context, which makes the model legitimate for this decision maker in this context.

In this sense, the following areas are suggested for future research: (1) adapting and applying the model created herein to other companies of the addressed sector, with other decision makers; (2) continuity in the creation process of the model, regarding evaluation, which corresponds with the methodology used

(MCDA-C); and (3) monitoring the management of the performance of the process when faced with the improvement suggestions proposed in this study.

The model developed to aid decision makers is specific to Sitio Do Vale, but the constructivist process used is general and can be used to develop models to help other companies to monitor and improve their performance.

References

Ackermann, F. and C. Eden. 2011. *Making strategy: mapping out strategic success*. Sage, Thousand Oaks, CA, USA.

Bacon, F. 1620. *Novum organum*. PF Collier and Son, New York, NY, USA.

Bana e Costa, C.A. 1993. Três convicções fundamentais na prática do apoio à decisão. *Pesquisa Operacional* 13: 9-20.

Bana e Costa, C.A., J.M. De Corte and J.C. Vansnick. 2012b. MACBETH. *Journal of Information Technology and Decision Making* 11: 359-387.

Bana e Costa, C.A., L. Ensslin, E.C. Corrêa and J.C. Vansnick. 1999. Decision support systems in action: integrated application in multicriteria decision aid process. *European Journal of Operational Research* 113: 315-335.

Bana e Costa, C.A., R. Lopez and B. Baets. 2012a. The MACBETH approach for multi-criteria evaluation of development projects on cross-cutting issues. *Annals of Operations Research* 199: 393-408.

Bortoluzzi, S.C., S.R. Ensslin, L. Ensslin and L.C. Chaves. 2014. Indicadores de desempenho propostos em pesquisas nacionais e internacionais para avaliar redes de pequenas e médias empresas (PMEs). *Espacios* 35: 18.

Bortoluzzi, S.C., S.R. Ensslin, M.V.L. Lyrio and L. Ensslin. 2010. Proposta de um modelo multicritério de avaliação de desempenho econômico-financeiro para apoiar decisões de investimentos em empresas de capital aberto. *Accounting and Management* 3: 92-100.

Bregaglio, S., M. Donatelli, R. Confalonieri, M. Acutis and S. Orlandini. 2011. Multi metric evaluation of leaf wetness models for large-area application of plant disease models. *Agricultural and Forest Meteorology* 151: 1163-1172.

Bronnmann, J. and F. Asche. 2016. The value of product attributes, brands and private labels: an analysis of frozen seafood in Germany. *Journal of Agricultural Economics* 67: 231-244.

Castro, C.M. 1977. A prática da pesquisa. McGraw-Hill, São Paulo, Brazil.

Checkland, P. and J. Scholes. 1999. Soft systems methodology in action: include a 30 years retrospective. Wiley, New York, NY, USA.

Critto, A. and P. Agostini. 2009. Using multiple indices to evaluate scenarios for the remediation of contaminated land: the Porto Marghera (Venice, Italy) contaminated site. *Environmental Science and Pollution Research* 16: 649-662.

Dantsis, T., C. Douma, C. Giourga, A. Loumou and E. Polychronaki. 2010. A methodological approach to assess and compare the sustainability level of agricultural plant production systems. *Ecological Indicators* 10: 256-263.

De Barros, I., J.M. Blazy, G.S. Rodrigues, R. Tournebize and J.P. Cinna. 2009. Emergy evaluation and economic performance of banana cropping systems in Guadeloupe (French West Indies). *Agriculture, ecosystems and environment* 129: 437-449.

De Moraes, L., R. Garcia, L. Ensslin, M.J. da Conceição and S.M. de Carvalho. 2010. The multicriteria analysis for construction of benchmarkers to support the clinical engineering in the healthcare technology management. *European Journal of Operational Research* 200: 607-615.

Degré, A., C. Debouche and D. Verheve. 2007. Conventional versus alternative pig production assessed by multicriteria decision analysis. *Agronomy for sustainable development* 27: 185-195.

Dezem, V. 2015. *Modelo Construtivista para apoiar a gestão: o caso do processo de atendimento e negócios de uma agência bancária*. Administration Master's Dissertation. University of South Santa Catarina, Tubarão, Brazil.

Eden, C. 1988. Cognitive mapping. *European Journal of Operational Research* n. 36: 1-13.

Eden, C., S. Jones and D. Sims. 1983. *Messing about in problems*. Pergamon, Oxford, UK.

Ensslin, L., A. Dutra, S.R. Ensslin, L.C. Chaves and V. Dezem. 2015. Research process for selecting a theoretical framework and bibliometric analysis of a theme: illustration for the management of customer service in a bank. *Modern Economy* 6: 782-796.

Ensslin, S.R., L. Ensslin, F. Back and R. Tadeu de Oliveira Lacerda. 2013. Improved decision aiding in human resource management: a case using constructivist multi-criteria decision aiding. *International Journal of Productivity and Performance Management* 62: 735-757.

Ensslin, S.R., L. Ensslin, L.C. Chaves, M.G. Gabriel and C.C. Oliveira. 2014. Seleção e análise de conteúdo de um portfólio de artigos sobre a avaliação do desempenho logístico. *Espacios* 35: 21.

Ensslin, L., S.R. Ensslin and A. Dutra. 2007. *Avaliação de desempenho: objetivos e dimensões*. Avaliação de Políticas Públicas. Governo do Estado de Santa Catarina, Florianópolis, Brazil.

Ensslin, L., S.R. Ensslin, A. Dutra, N.A. Nunes, and C. Reis. 2017. BPM governance: a literature analysis of performance evaluation. *Business Process Management Journal* 23: 71-86.

Ensslin, L., S.R. Ensslin and G.C. Pacheco. 2012. Um estudo sobre segurança em estádios de futebol baseado na análise bibliométrica da literatura internacional. *Perspectivas em Ciência da Informação* 17: 71-91.

Ensslin, L., E. Giffhorn, S.R. Ensslin, S.M. Petri and W.B. Vianna. 2010. Avaliação do desempenho de empresas terceirizadas com o uso da metodologia multicritério de apoio à decisão-construtivista. *Pesquisa Operacional* 30: 125-152.

Ensslin, L., N.G. Montibeller and S.M. Noronha. 2001. *Apoio à decisão: metodologias para estruturação de problemas e avaliação multicritério de alternativas*. Insular, São Paulo, Brazil.

Figueiredo Junior, H.S., M.P.M. Meuwissen, J. Amaral Filho and A.G.J.M. O Lansink. 2016. Evaluating strategies for honey value chains in brazil using a value chain structure – conduct – performance (SCP) framework. *International Food and Agribusiness Management Review.* 19 (3): 225-250.

Keeney, R.L. 1992. Value-focused thinking: a path to creative decision making. Harvard University Press, Cambridge, UK.

Lacerda, R.T.O., L. Ensslin and S.R. Ensslin. 2011. A performance measurement framework in portfolio management: a constructivist case. *Management Decision* 49: 1-15.

Lacerda, R.T.D.O., L. Ensslin and S.R. Ensslin. 2014. Research opportunities in strategic management field: a performance measurement approach*.* *International Journal of Business Performance Management* 15: 158-174.

Landry, M. 1995. A note on the concept of problem. *Organization Studies* 16: 315-343.

Longaray, A.A. and L. Ensslin. 2015. Use of multi-criteria decision aid to evaluate the performance of trade marketing activities of a Brazilian industry. *Management and Organizational Studies* 2: 15-31.

López, P.C., J. Calatrava-Requena and T. De-Haro-Giménez. 2008. A systemic comparative assessment of the multifunctional performance of alternative olive systems in Spain within an AHP-extended framework. *Ecological Economics* 64: 820-834.

Micheli, P. and L. Mari. 2014. The theory and practice of performance measurement. *Management Accounting Research* 25: 147-156.

Montibeller, G., V. Belton, F. Ackermann and L. Ensslin. 2008. Reasoning maps for decision aid: an integrated approach for problem-structuring and multi-criteria evaluation. *Journal of the Operational Research Society* 59: 575-589.

Neves, M.F. and F.R. Chaddad. 2012. The benefits of sugarcane chain development in Africa. *International Food and Agribusiness Management Review* 15(1): 159-165.

Neves, M.F., E.S. Simprini and F.R. Valerio. 2015. Management level evaluation in distribution channels of agricultural inputs. Available at: http://tinyurl.com/khopyrt.

Richardson, R.J. 2008. *Pesquisa social: métodos e técnicas*. Atlas, São Paulo, Brazil.

Roy, B. 1993. Decision science or decision-aid science? *European Journal of Operational Research* 66: 184-203.

Roy, B. 1994. On operational research and decision aid. *European Journal of Operational Research* 73: 23-26.

Roy, B. and D. Vanderpooten. 1996. The European school of MCDA: emergence, basic features and current works. *Journal of Multi-Criteria Decision Analysis* 5: 22-38.

Scott, J., W. Ho, P.K. Dey, S. Talluri. 2015. A decision support system for supplier selection and order allocation in stochastic, multi-stakeholder and multi-criteria environments. *International Journal of Production Economics* 166: 226-237.

Skinner, W. 1986. The productivity paradox. *Harvard Business Review* 75: 41-45.

Tasca, J.E., L. Ensslin and S.R. Ensslin. 2012. A avaliação de programas de capacitação: um estudo de caso na administração pública. *Revista de Administração Pública* 46: 647-675.

Thomson, W. and L.J. Kelvin. 1968. Popular lectures and addresses in Bartlett Bartlett's Familiar Quotations. Little Brown, Boston, MA, USA.

Zamcopé, F.C., L. Ensslin, S.R. Ensslin and A. Dutra. 2010. Modelo para avaliar o desempenho de operadores logísticos: um estudo de caso na indústria têxtil. *Gestão y Produção* 17: 693-705.