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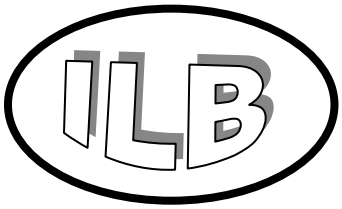

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Assessing the Supply Chain Governance Scenario in the Agri-food Sector: Development of a Measurement Tool[1].

Cosimo Rota , *Cesare Zanasi , and**Nikolai Reynolds
cosimo.rota@unibo.it, cesare.zanasi@unibo.it, nikolai.reynolds@ipsos.com
** DISTAL – Department of Agri-Food Science and Technology, University of Bologna, Italy*
*** IPSOS InnoQuest, Ipsos Germany, Frankfurt, Germany*

Abstract
Defining a supply chain governance structure able to adapt to the supply chain technical and organizational characteristics positively influences the relationships between the agents and its overall competitiveness. The present study proposes a tool for the evaluation of the impact on the supply chain governance structure resulting from the adoption of sustainability improvement options in the area of organization and management in the agri-food sector. Two different approaches, proposed by (Gereffi et al., 2005) and (Hobbs and Young, 2000) are merged to provide a theoretical framework supporting the tool implementation. Gereffi *et al*., suggest that supply chains fall into one of five different governance structures, depending on the relative levels of three dimension: *complexity of transaction*, *ability to codify* and *capabilities in the supply-base*. Hobbs and Young link the *product characteristics*, *regulatory* and *technology* aspects to a change in supply chain vertical coordination. The parameters linking the sustainability improvement options to the change in the supply chain governance structure should result by interviewing a panel of experts, considering the difficulty to generalize the influence of the improvement options in different food chains contexts. This difficulty seems to be, to date, the main methodological limitation to the tool application. However, its represent a first step towards the assessment of the existing governance structure and its management.

Keywords: *supply chain governance, agri-food, assessment tool, TCE.*

1 Introduction

The present paper derives from the research project SALSA which aims at tackling the environmental challenges in Latin America by supporting the implementation of sustainable beef and soy chains. In order to allow farmers to assess and benchmark their sustainability performances, as well as the involved stakeholders to obtain a deeper understanding of what sustainability is, SALSA project provides analytical tools for defining and monitoring the different sustainability dimensions of these food chains.
A quantitative and qualitative analysis on core indicators of *environmental* (global warming, land use change, energy use, water consumption, biodiversity) *economic* (operating profit, volatility) *social* (employability, working conditions animal welfare, food safety and food quality) and *institutional* dimensions (degree oh chain coordination) was performed.
When considering the monitoring of the soy and beef chains sustainability, several improvement needs emerged; consequently, different sustainability improvement options were defined in relation to four focus areas: i) technological, ii) logistics, iii) food quality/safety, iv) institutional/supply chain governance.
The present paper focuses on the institutional area, proposing a tool for the evaluation of the changes in the supply chain governance structure resulting from the adoption of sustainability improvement options. Two different approaches, proposed by (Gereffi et al., 2005) and (Hobbs and Young, 2000) are merged to provide a theoretical framework supporting the tool implementation; detailed methodological steps are proposed in order to assess and validate the related measurement instrument.

[1] This article derives from the research project on "Knowledge-based Sustainable vAlue-added food chains: innovative tooLs for monitoring ethical, environmental and Socio-economical impActs and implementing Eu-Latin America shared strategies" (SALSA, KBBE.2010.2.5-02) which is funded by the European Commission as part of the Seventh Framework Programme.

2 Theoretical Background

2.1 Supply chain governance

According to the Transaction Cost economics (TCE) approach, a governance structure refers to the manner in which transactions are organized within the chain. Supply chain governance attempts to mitigate conflict and promote cooperation between trading partners (Williamson, 1999; Lumineau and Henderson, 2012). TCE provides an important analytical framework explaining the firms' organization and their relationships along the supply chains (Barringer and Harrison, 2000). This approach considers a firm as a governance body whose goal is to grant reliable and efficient contractual relationships. According to Williamson (Williamson, 1975) the necessity to compensate the costs that arise from bounded rationality and from uncertainties due to partners' opportunism, leads to a firm orientation towards either vertical integration or less coordinated market relations (e.g. spot markets). One of the determinants of the governance structure is the nature and level of transaction costs that is the degree of uncertainty, asset specificity and frequency of the transaction. Several studies have confirmed the hypothesis that transaction costs were a primary motivation for vertical coordination (Hobbs, 1996; Frank and Henderson, 1992). TCE has been widely applied in industrial marketing and management, such as buyer-seller relationships (Jap and Ganesan, 2000), the choice of organizational structure (Houston and Johnson, 2000), as well as marketing channel integrations (Klein et al., 1990). Recently TCE has been applied to agri-food markets, particularly in the context of supply chain management (Wever et al., 2010).
Gereffi et al. (Gereffi et al., 2005) utilize TCE, global supply chain and firm-level learning literature to conceptualize three dimension useful in assessing a given supply chain governance structure; Hobbs and Young (Hobbs and Young, 2000), also referring to TCE approach, link drivers for change to product characteristics, regulatory and technology aspects to a change in supply chain governance structure.
These two conceptual frameworks will be adopted within this paper as the main theoretical basis for the development of the supply chain governance scenario measurement tool.

2.2 Supply chain governance scenario

According to some authors (Vlajic et al., 2012; Vorst and Beulens, 2002) a supply chain scenario can be described by four elements:

- *Chain configuration*, which refers to the structure, facilities and means, the parties involved and the roles to be performed in the supply chain;
- *Chain control structure*, the set of decision functions (located at multiple decision layers with different decision horizons) that govern the execution of operational activities aimed at realizing objectives within the constraints set by the chain configuration and strategic objectives;
- *Chain information systems*, the systems (with their characteristics) that support decision-making (by enabling data exchange and information availability) and/or are required to perform business operations (e.g. EDI, ERP, QMS, Tracking and Tracing, etc.);
- *Chain organization and governance structures*, which assign roles, functions and tasks (along with the corresponding responsibilities and authorities) to organizations and persons in the supply chain.

A change in a specific element describing the supply chain scenario that results in an (potential) improvement of performance is defined as *improvement options*.
An *improvement scenario* is a combination of multiple improvement options, resulting in specific defined settings of all the elements of the SC scenario.
The present study only investigates the impact of the improvement options on the *governance structure*. The anticipatory scenarios typology, policy-responsive and based on different and subjective visions of the future collecting judgments from experts and stakeholders (McCarthy, 2001), is proposed as a method for the assessment of the supply chain scenario.

2.3 Goal and research question

The goal of the paper is to create a tool for assessing the impact of sustainability improvement options on the food supply chain governance structures. To this end, the following research question needs to be answered: *"What is the influence of the supply chain improvement options on the supply chain governance structure?"*

3 Materials and Method

In order to answer this research question three methodological steps are needed:

- A theoretical framework to define and assess the existing governance structure;
- Identify the key drivers influencing the supply chain vertical coordination, thereby affecting its governance structure;
- Assess the impact of the improvement options on the governance structure through the selected key drivers.

3.1 Defining and assessing the existing governance structures

The theoretical framework supporting the defining of the governance structures was proposed by Gereffi et al. (Gereffi et al., 2005), which suggests that supply chains fall into one of five different governance structures, depending on the relative levels of three dimension:

a) *Transaction complexity* captures the extent of "non-price information flowing across the inter-firm boundary" and refers to information like detailed product specifications, special requirements, etc.;
b) *The ability to codify* identifies how efficient is the information and knowledge transfer between supply chain agents without transaction-specific investments. A broadly adopted technology standards for communication provides a codified language for use in knowledge transfer activities;
c) *Supply base capabilities* indicate the competence of suppliers in assessing the extent to which suppliers are able to meet buyer requirements with little interference or direction from the focal firm.

The authors suggest that these three dimensions result in a typology that consists of 5 supply chains governance structure: *market*, *modular*, *relational*, *captive*, *hierarchy*. The three remaining high/low combinations are discarded as unlikely structures (figure 1).

Governance type	Complexity of transactions	Ability to codify transactions	Capabilities in the supply-base	Degree of coordination
Market	Low	High	High	Low
Modular	High	High	High	↕
Relational	High	Low	High	
Captive	High	High	Low	
Hierarchy	High	Low	Low	High

Figure 1. Governance types proposed by Gereffi et al., 2005

The measurement instrument to assess the different governance structures is proposed by Ashenbaum et al. (Ashenbaum et al., 2009), which suggest 6 items (two items of each dimension) based on a 5-point Likert scales (table 1).

Table 1.
Supply Chain Governance Structures measurement scale

To what extent do you agree with the following statements? (1 = disagree, 5 = agree)
Transaction complexity
We exchange considerable information with our key suppliers (e.g. product design info or inventory and item movement info)
We require more than a simple "price quote" to award business to a supplier
Ability to codify
Technology is by and large the same across potential suppliers
Our industry is characterized by well-known and accepted technical standards
Supply base capabilities
Our key suppliers are "full service" outfits who can deliver a complete design with little input from us
We do not have to spend a lot of time monitoring our suppliers for quality or to make sure they are fulfilling their commitments

The authors consider these 6 items (indicators) as measures of a "formative" model; we suggest considering them as "reflective" model. According to Jarvis et al. (Jarvis et al., 2004) no comprehensive list of criteria exists for determining whether a construct is formative or reflective. However, if the following conditions prevail, a construct should be modelled as formative; otherwise, the construct will be reflective:

a) The indicators are viewed as defining characteristics of the construct;
b) Indicators need not be interchangeable;
c) Changes in the indicators are expected to cause change in the construct;
d) The indicators do not share a common theme;
e) Eliminating an indicator may alter the conceptual domain of the construct;
f) Not necessary for indicators to covary with each other

Considering the theoretical foundation behind the proposed instrument (Ashenbaum et al., 2009) to measure the supply chain governance structure we expect to increase the number of the items, as well as a set of interchangeable indicators with similar content and high covariance among them; therefore, we expected a reflective construct.
Consequently, the following methodological steps are needed to develop, validate and assess the proposed measurement instrument.

- ***Conceptualization***

According to (Nunnally and Bernstein, 1994) "*to the extent that a variable is abstract and latent rather than concrete and observable (such as the rating itself), it is called a construct. Such a variable is literally something that scientists construct (put together from their own imaginations) and which does not exist as an observable dimension of behavior".*
As above indicated, according to the theoretical framework proposed by Gereffi et al., the measurement instrument to assess the governance structures is proposed by Ashenbaum et al. (Ashenbaum et al., 2009), which conceptualized a set of items grouped into 3 constructs: transaction complexity, ability to codify and supply base capabilities.

- ***Scale development***

The scale development phase consists of two main steps: items generation and the content (or face) validity assessment.

Items generation

The purpose of item generation is to ensure that questionnaire items *"capture the specific domain of interest yet contains no extraneous content"* (Hinkin, 1995).

The main questionnaire has to be adapted in order to capture, with the same measurement instrument, the farmers and processors' point of view for both chains. Therefore, four questionnaires will be obtained; the beef and soy farmers/processors will answer on a 5-point Likert scale.

Content validity

Content validity refers to the extent to which the items fit into different aspects/dimensions of a construct (Vaus, 2002).

In order to provide clear linkages between the items with the theoretical literature and to assure the consistency of the responses, the finalized version of the questionnaire will be pre-tested with some farmers and processors organizations representatives to exclude problems regarding the clarity of the questions and to ensure that each question is relevant (Bagozzi and Yi, 1988). Based on the feedback received, some redundant and ambiguous items will be modified or eliminated.

- ***Data collection***

A convenience sample has to be adopted. Farmers/processors association have to be contacted to invite the associate members to answer the questionnaire. Given the relatively large amount of interviews needed (> 50) and likely geographical distance among the respondents, an on-line questionnaire is suggested.

- ***Scale evaluation***

After the data gathering, the refinement and the validation of the measurement scales have to be performed. Factor analysis and reliability measures are recommended as part of these processes (Hinkin, 1995).

Factor analysis

First an exploratory factor analysis has to be performed to assess the construct validity and (if any) to reduce the amount of items. Construct validity is *"a measure of the degree to which the scale measures the abstract or theoretical construct it is intended to measure"* (Hensley, 1999). Exploratory factor analysis is the most often used method to assess whether a set of questions forms a single scale.

In a second step a confirmatory factor analysis has to be performed to assess convergent and discriminant validity. Convergent validity exists when the items of a measure are high correlated; discriminant validity addresses the question of whether two different constructs in the model are really distinct from one another (Vaus, 2002).

Reliability

Reliability is used to describe the overall consistency of a measure. A measure is said to have a high reliability if it produces similar results under different conditions.

Inter-correlations among test items are maximized when all items measure the same construct; to this end Cronbach's alpha is widely adopted to indirectly indicate the degree to which a set of items measures a single one-dimensional latent construct.

- ***Assessment of the governance structure***

The supply chain governance structure will be assessed by comparing the values of the three following indicators: *complexity of transaction*, *ability to codify* and *capabilities in the supply chains*; each indicator is calculated as the average of its defining items' score. The different scores will be grouped into a two-category variable defined by *high* and *low* levels.

The authors proposing the governance structure measurement instrument do not provide any indication on the threshold variable. In the present paper we adopt a threshold level of 3; consequently indicators ranging from 0 to 3 will be considered "low" while values from 4 to 5 will be considered "high". The underlying assumption is that the respondents tend to consider as "high" a value which is greater than 3.

3.2 Key drivers influencing the supply chain governance structure

The conceptual model related to the drivers behind vertical co-ordination in agri-food supply chains refers to the Hobbs and Young's work (Hobbs and Young, 2000). The authors, according to Williamson (Williamson, 1975), recognise that certain transaction characteristics affect the choice of the governance structure through their influence on transaction costs. In addition to the widely discussed *frequency*, *uncertainty* and *asset specificity* (Williamson, 1975), Hobbs and Young argue that these specific transactions characteristics are influenced by the following drivers: *product characteristics*, *regulatory, technological an socio economic drivers* (Figure 2)

	Transaction characteristics						
	Uncertainty for buyer: quality	Uncertainty for buyer: reliable supply (timeliness and quantity)	Uncertainty for buyer and seller: price	Uncertainty for seller: finding a buyer	Frequency of transaction	Relationship-specific investment	Complexity of transaction (variety of outcomes)
Product characteristics							
Perishability	✓	✓		✓	✓		✓
Product differentiation	✓	✓	✓	✓		✓	✓
Quality variable and visible		✓	✓	✓			✓
Quality variable and invisible	✓	✓	✓				✓
New characteristics of importance to consumers	✓	sometimes	✓	✓		✓	✓
Regulatory drivers							
Liability	✓			✓		sometimes	✓
Traceability				✓		✓	✓
Technology drivers							
Company-specific technology						✓	sometimes

Figure 2. Generic model proposed by Hobbs and Young, 2000**.**

For the purpose of the present study, we selected these key drivers as theoretical reference to guide the expert judgment through the governance structure definition process.

4 Results: The Improvement Options' Impact Assessment Tool

4.1 Assessing the impact of the improvement options on the governance structure through the selected key drivers

Gereffi et al. (Gereffi et al., 2005), in order to develop a theory of global value chain governance, consider "cumulatively" different theories of industrial organization (TCE, Network theories and Resource Based View of the firm) to include the transactions characteristic reported by Hobbs and Young (Hobbs and Young, 2000) (uncertainty, frequency, asset specificity, complexity) under the proposed dimensions of *complexity of information*, *ability to codify*, *capabilities in the supply base* (figure 3).

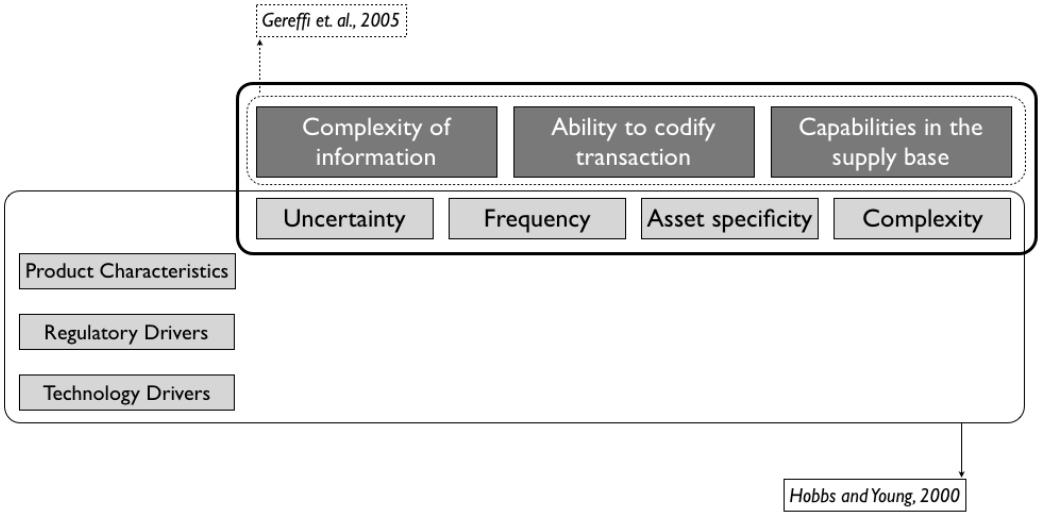

Figure 3. Merging the theoretical frameworks proposed by Gereffi et al. (2005), Hobbs and Young (2000)

The merging of the theoretical framework proposed by Gereffi et al. with the framework proposed by Hobbs and Young can be adopted to assess the impact of the improvement options on the supply chain governance structure.
To this end, the Hobbs and Young key drivers have been included as they provide a classification scheme for the improvement options; this because the product characteristics, the regulatory and technology drivers influence the scores of the dimensions defining the governance structure (figure 4).

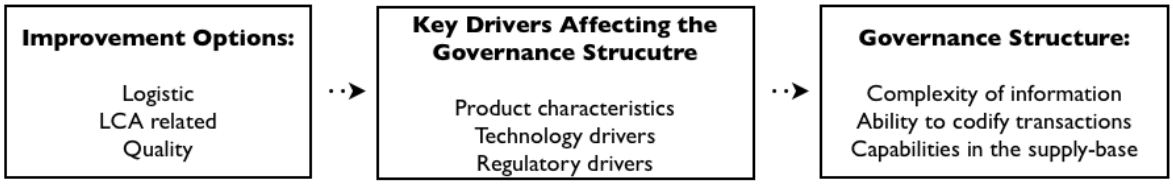

Figure 4. Conceptual scheme

Following this conceptual scheme the assessment of the impact of improvement options on the governance structure is calculated as follow.

Considering the highly complex topic and the specific knowledge required to assess the impact of the improvement options, a panel of expert of different disciplines is required. In particular, for each *improvement option* proposed within the logistic, technical and food quality/safety improvement area, the panel of experts will indicate (using a 5-point Likert scale) how much the related changes in the supply chain drivers proposed by Hobbs and Young (*product characteristics*, *regulatory* and *technology* drivers) will affect the dimensions defining the governance structures according to Gereffi et al. (*complexity of transaction*, *ability to codify, capabilities in the supply-base*) (figure 5).

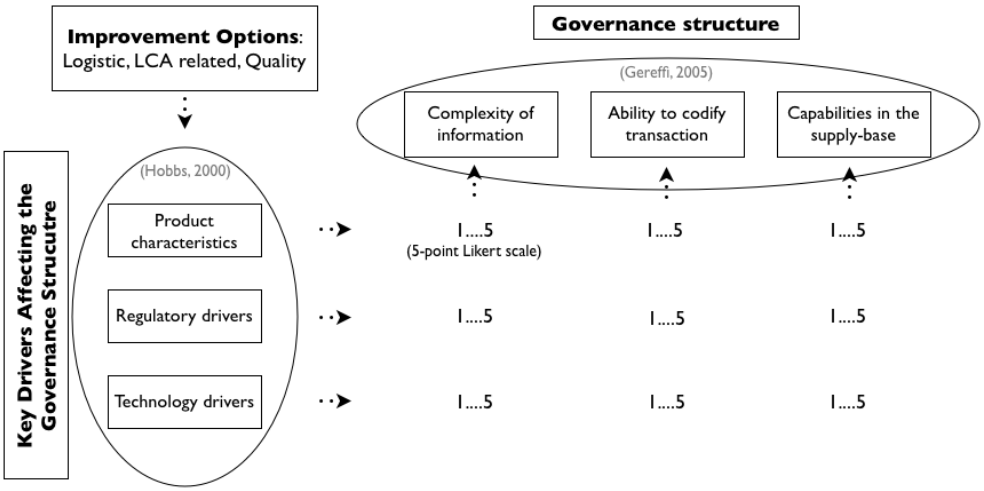

Figure 5. Conceptual model to assess the impact of the improvement options on the governance structure

4.2 Defining the impact assessment tool

The tool obtained is mostly oriented at showing the different stakeholders and experts how to use the methodology and allow for the possibility to adapt to their specific context.

The resulting conceptual scheme of this merge is reported in figure 6a, 6b, 6c, which propose (as example) the adoption of the *organic standard* in the beef sector as improvement option.

Considering the "*adoption of the organic standard in the BEEF sector*" and the related changes (if any) in the following product characteristics, regulatory and technology drivers, to which extent the information will be **codified** and transmitted without transaction-specific investment between farmer-processors?

	CODIFICATION of Information				
	1. Not a codification	2	3	4	5. High codification
PRODUCT CHARACTERISTICS					
Perishability					
Product differentiation					
Quality variable and visible					
Quality variable and invisible					
New characterisitcs of importance to consumer					
REGULATORY DRIVERS					
Liability					
Tracebility					
TECHNOLOGY DRIVERS					
Company-specific technology					

Figure 6a.

Considering the "*adoption of the organic standard in the BEEF sector*", how much the related changes (if any) in the following product characteristics, regulatory and technology drivers will influence the **complexity of information exchange** between farmers and processors?

	COMPLEXITY of Information				
	1. No influence	2	3	4	5. Major influence
PRODUCT CHARACTERISTICS					
Perishability					
Product differentiation					
Quality variable and visible					
Quality variable and invisible					
New characterisitcs of importance to consumer					
REGULATORY DRIVERS					
Liability					
Tracebility					
TECHNOLOGY DRIVERS					
Company-specific technology					

Figure 6b.

Considering the "adoption of the organic standard in the BEEF sector" and the related changes (if any) in the following product characteristics, regulatory and technology drivers, to which extent the **capabilities** of the actual suppliers are appropriate in relation to the requirements needed?

	CAPABILITIES of suppliers				
	1. Inappropriate	2	3	4	5. Appropriate
PRODUCT CHARACTERISTICS					
Perishability					
Product differentiation					
Quality variable and visible					
Quality variable and invisible					
New characterisitcs of importance to consumer					
REGULATORY DRIVERS					
Liability					
Tracebility					
TECHNOLOGY DRIVERS					
Company-specific technology					

Figure 6c.

Also in this case, the different scores collected from the questionnaires will be translated into *high* and *low* levels using a threshold level as indicated in paragraph 3.1

The results obtained from both assessment perspectives are compared in order to identify a set of improvements opportunities (figure 7).

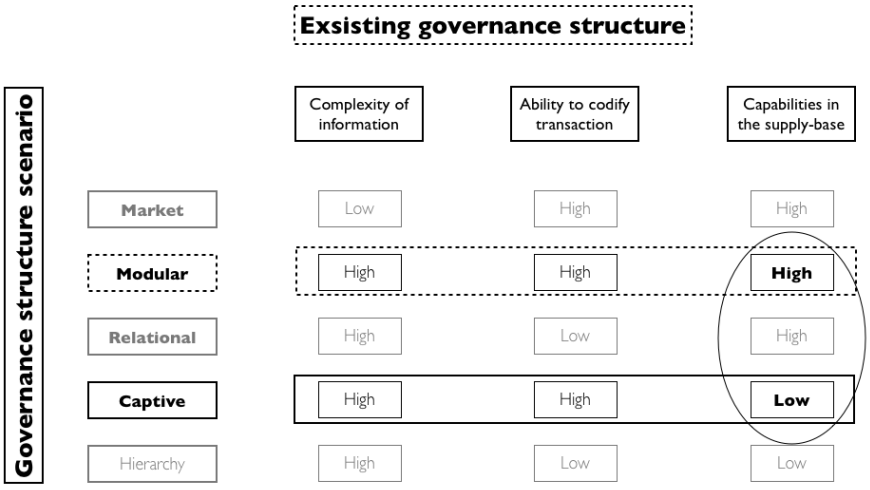

Figure 7.

5 Discussion and Conclusions

The present contribution proposes a theoretical and methodological framework for the definition of a tool for assessing the impact of sustainability improvement options on the agri-food supply chain governance structures

By linking the chain governance to the logistics, technical and food quality/safety related improvements it increases the SALSA project decision support system's capacity to guide the different food chain stakeholders' sustainability strategies definition. E.g. if the food chain becomes more hierarchical as a result of introducing complex technical innovations or certification schemes to reduce the greenhouse gas emission, the different stakeholders can decide if alternative sustainability strategies can be considered or changes in the certification schemes can be asked for. This can be particularly relevant when a desired outcome of a sustainability strategy is to enhance the small farmers or SMEs role in sustainable global food supply chains.

Being at a first development stage this study shows different limitations related to the following aspects:

- the relative complexity of the concepts involved in the key drivers and chain governance structure definition makes it difficult to interpret the results for an average user form SMEs or farmers organizations;
- involving expert panels can result in a demanding task considering the level of expertise required and the context dependent answers, difficult to generalize for the different improvement option categories and/or supply chains involved;
- expand the supply chain governance structure related items to better define the meaning of the different governance structure dimensions.

Further research efforts should then be oriented towards the improvement of the theoretical and methodological approach and the tool definition in order to make it more users friendly and useful.

The pre-test on the usability and usefulness of the tool will provide a relevant contribution to its adjustment to the users' needs.

Last but not least the theoretical approach of the TCE should consider the contribution of recent studies on the supply chain collaboration. They integrate the collaboration dimension with the TCE and the Resource Based View approaches. A set of supply chain agents' relational norms, including intangible factors like trust commitment and satisfaction, is defined.

References

Ashenbaum, B., Maltz, A., Ellram, L. and Barratt, M. A. (2009) "Organizational Alignment and Supply Chain Governance Structure: Introduction and Construct Validation," *The International Journal of Logistics Management*, **20**, 169–186.

Bagozzi, R. P. and Yi, Y. (1988) "On the Evaluation of Structural Equation Models," *Journal of the Academy of Marketing Science*, **16**, 74–94.

Barringer, B. R. and Harrison, J. S. (2000) "Walking a Tightrope: Creating Value Through Interorganizational Relationships," *Journal of Management*, **26**, 367–403.

Bates, B., Kundzewicz, Z., Wu, S. and Palutikof, J. (2008) *Climate Change and Water.*

Frank, S. D. and Henderson, D. R. (1992) "Transaction Costs as Determinants of Vertical Coordination in the U.S. Food Industries," *American Journal of Agricultural Economics*, **74**, 941–950.

Gereffi, G., Humphrey, J. and Sturgeon, T. (2005) "The Governance of Global Value Chains," *Review of International Political Economy*, **12**, 78–104.

Hensley, R. L. (1999) "A Review of Operations Management Studies Using Scale Development Techniques," *Journal of Operations Management*, **17**, 343–358.

Hinkin, T. R. (1995) "A Review of Scale Development Practices in the Study of Organizations," *Journal of Management*, **21**, 967–988.

Hobbs, J. E. (1996) "A Transaction Cost Approach to Supply Chain Management," *Supply Chain Management: An International Journal*, **1**, 15–27.

Hobbs, J. E. and Young, L. M. (2000) "Closer Vertical Co-Ordination in Agri-Food Supply Chains: A Conceptual Framework and Some Preliminary Evidence," *Supply Chain Management: An International Journal*, **5**, 131–143.

Houston, M. B. and Johnson, S. A. (2000) "Buyer-Supplier Contracts Versus Joint Ventures: Determinants and Consequences of Transaction Structure," *Journal of Marketing Research*, **37**, 1–15.

Jap, S. D. and Ganesan, S. (2000) "Control Mechanisms and the Relationship Life Cycle: Implications for Safeguarding Specific Investments and Developing Commitment," *Journal of Marketing Research*, **37**, 227–245.

Jarvis, C. B., Mackenzie, S. B. and Podsakoff, P. M. (2004) "A Critical Review of Construct Indicators and Measurement Model Misspecification in Marketing and Consumer Research," , **30**.

Klein, S., Frazier, G. L. and Roth, V. J. (1990) "A Transaction Cost Analysis Model of Channel Integration in International Markets," *Journal of Marketing Research*, **27**, 196–208.

Lumineau, F. and Henderson, J. E. (2012) "The Influence of Relational Experience and Contractual Governance on the Negotiation Strategy in Buyer–supplier Disputes," *Journal of Operations Management*, **30**, 382–395.

Mahmoud, M., Liu, Y., Hartmann, H., Stewart, S., Wagener, T., Semmens, D., Stewart, R., Gupta, H., Dominguez, D., Dominguez, F., Hulse, D., Letcher, R., Rashleigh, B., Smith, C., Street, R., Ticehurst, J., Twery, M., van Delden, H., Waldick, R., White, D. and Winter, L. (2009) "A Formal Framework for Scenario Development in Support of Environmental Decision-Making," *Environmental Modelling & Software*, **24**, 798–808.

McCarthy, J. J. (2001) *Climate Change 2001: Impacts, Adaptation, and Vulnerability: Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*.

Nunnally, J. C. and Bernstein, I. H. (1994) *Psychometric Theory, Edizione 972*.

Vaus, D. de (2002) *Surveys in Social Research*.

Vlajic, J. V., van der Vorst, J. G. A. J. and Haijema, R. (2012) "A Framework for Designing Robust Food Supply Chains," *International Journal of Production Economics*, **137**, 176–189.

Vorst, J. G. A. J. van der and Beulens, A. J. M. (2002) "Identifying Sources of Uncertainty to Generate Supply Chain Redesign Strategies," *International Journal of Physical Distribution & Logistics Management*, **32**, 409–430.

Wever, M., Wognum, N., Trienekens, J. and Omta, O. (2010) "Alignment between Chain Quality Management and Chain Governance in EU Pork Supply Chains: A Transaction-Cost-Economics Perspective.," *Meat science*, **84**, 228–37.

Williamson, O. E. (1975) *Markets and Hierarchies*, Free Press.

Williamson, O. E. (1999) *The Mechanisms of Governance*, Oxford University Press, USA.