23rd Cambridge International Manufacturing Symposium
University of Cambridge, 26 – 27 September 2019

Soft Systems as a Helping Tool in the Assessment of Sustainable Business Practices and Risks in a Socio-Economic-Environmental Context

Isabel Duarte de Almeida[a,b,*], J. M. Vilas-Boas da Silva [b]

[a] Universidade Lusíada, (CLISSIS-UL), Lisboa, Portugal

[b] Instituto Universitário de Lisboa (ISCTE-IUL), Business Research Unit (BRU-IUL)

[*]isabel.dalmeida@edu.ulusiada.pt

Abstract

Sustainability indicators (SI) are fundamental instruments in business practices towards evaluation of general sustainability, its inherent risks, or the interaction of socioeconomic perspectives in an environmental sustainability context. The complex nature of the models applied call for a revision of the scientific methodologies used in the production of indicators addressing measurability, fitting them to a different nature of the problem characterised by: (i) multiple, circular, conflictual relations in a web of heterarchical relations; (ii) the social component relevance; (iii) the existence of an observer bias and interest, stakeholders pressure, interaction with the phenomenon and interpretation, establishing unrepeatable situations that can only be analytically discussed in different contexts. Multicriterion alternatives are advocated and one is briefly characterised: the Soft Systems Methodology (SSM). Its advantages are summarised. The logic and impact of SSM in a classical evaluation process based on the need for feedback are also discussed. The conclusion argues in favour of SSM contribution for scientific knowledge, focusing on validity, in comparison with other methodologies utilised in the Economic, Social, and Environmental Impact Assessment of business practices.

Keywords: Business Responsibility; Sustainability Indicators (SI); Soft Systems Methodology (SSM)

1. Introduction

Sustainable Development (SD) is associated to the maintenance of the properties and capabilities that enable ecosystems to sustain life. SD is associated with the use of nature in productive systems, insofar as those capabilities are kept safe from risk and individuals are provided with adequate quality of life standards. In assigning value to the different dimensions of Sustainability, it is a common notion that long-term preservation of natural resources cannot be reached without simultaneous economic, social and political-institutional development that benefits all individuals, mainly those in greater need (Almeida and Delgado, 2019). One key condition for measurable progress in sustainability is to provide the people in charge of decision-making, be they rulers or entrepreneurs, with better access to relevant data. And that is, in a current perspective, what indicators are for: instruments for simplifying, quantifying and analysing technical information, and conveying it to the various interest groups. However, sustainability indicators (SI) cannot be the traditional indicators of economic, social and environmental progress – such as shareholders' profits, unemployment rates or the quality of air – that only assess changes in one part of the community, as though it were independent of all others. SI are fundamental instruments of social responsibility, enabling the evaluation of social development objectives, their risks, potential and tendencies, and their incorporation into policy formulation (Almeida and Craveiro, 2011). These indicators should reflect reality in the Environment, Economy and Social dimensions, interlinked in their multiple components.
Companies have been pressed not only to change the way they do business but also to monitor and report on more than just their economic performance. Therefore, an agreement has emerged about the need to develop assessment methods based on SI as a prerequisite to implementation of this concept. This need has entailed a growing number of indicators and assessment methods. Antanasijević, Pocajt, Ristić and Perić-Grujić, (2017), compared an ample set of SI, concluding that although concision and transparency were attributed to sustainability indexes, they are not able to satisfy fundamental scientific demands concerning the three main steps of index construction: normalisation, pondering and aggregation. Indicator normalisation and pondering – usually associated with subjective judgement – reveal a degree of arbitrariness, without mentioning or systemically evaluating critical assumptions. In regard to aggregation, there are scientific rules that can guarantee the consistency and significance of composite indexes. However, these rules are often not taken into account. Consequentially, the sustainability indexes currently being used in the political praxis are doomed to be useless, if not even deceiving, when it comes to choosing a concrete and correct modus operandi in a given situation. Thus, the impossibility of convergence of the existing indicators makes way for the compilation of indexes that are adequate to specific situations, resulting from the development of theories that explain the respective phenomena. In accordance with the above considerations and brief analysis of the object of interest, the following research questions emerged and are now summarised:

RQ1: How to approach the choice/construction of SI that are positioned in a holistic and systemic context that integrates the social, economic and environmental dimensions?
RQ2: How to ensure the choice/construction of SI that measure what we intend to, while sometimes incorporating the uncertainty inherent to the nature of the problem?
RQ3: What should be sought when choice SI: simple causality, multiple causality or circularity?
RQ4: How viable can we expect generalisation to be?
RQ5: How to guarantee the existence of a transparent and participatory research process for open discussion and decision-making, in order to attain sustainability?

With these questions in mind, the main objective of this research is to find and apply a model business processes suitable for general problem solving and managing changes in the organisation, under a TBL approach. In short, to find and apply a helping multicriterion tool to assess long-term sustainable business strategies towards Economic, Social, and Environmental Impacts. The primary use of Soft Systems Methodology (SSM) targets the analysis of complex situations, such those related to sustainability, with differing views on the problem definition. SSM can intervene in such situations by making discussion between all parties involved possible. This makes it possible to reach a consensus, in which can please all parties involved.

2. Outcomes of the Literature review

A. Sustainability as a product of systemic relations

SD depends upon social responsibility, individual conduct (singular and collectively), social processes and the time needed by the environment in order to recover. Usually, reaching sustainability demands long-term vision, proactivity and methodical monitoring of the results of decisions made and actions undertaken. It is in this stage that indicators are instrumental, because: (i) they allow the difference between the current situation of a society and the initially proposed development objectives to be measured, (ii) they are able to clarify the existence of risks, potential and tendencies in the development of a given territory, and (iii) they allow for modelling the incorporation of sustainability into the formulation and application of public policies. Thus, it is made evident that the absence of clear and well-defined goals can pose, due to the nature of the problem, a threat to the classic evaluation of social change and intervention processes, which is developed within the feedback paradigm (Ashby, Rakow and Yechiam, 2017). So, it is not possible to establish comparisons to a pattern or feeding back corrective actions.
Thus, generating indicators immediately questions the model about the validity of its construction, i.e. 'are we measuring what we want?' (Antanasijević et al, 2017). The existence of a rigorous connection to the definitions of sustainability is important. On the other hand, a keen observer would be even more concerned if one were to pay attention to the previously provided definition of the phenomenon, which argues in favour of the vagueness of its content and, consequently, of its objectives and their respective evaluation indicators. As if that were not enough, the complexity of the phenomenon and the resulting need to consider multiple variables with numerous occurrences spawns a web of multiple circular relations, instead of the linear and mechanistic relations of causality. As such, another question arises, regarding the establishment of causal relations, in what concerns the definition of their respective correlations and explanations, thus constituting an indelible threat to the internal validity of the model (Almeida, 2015). In fact, everything seems to point to the need for selection of meaningful indicators that represent holistic areas of knowledge. The external validity (generalisation) faces specific difficulties in what concerns statistical application, given the complex nature of the phenomenon at hand (Almeida, 2015).
Sustainability, in its multidimensional concept that entails economic, environmental, and social aspects, is nowadays generally accepted as one of the key success factors in the long term business strategy of the firm. Numerous forces in the global environment have pushed managers to re-conceptualize their companies and how they think about business performance. These forces that include ethical scandals, shortages of natural resources brought on by economic growth in China and India, cries for fair as opposed to free trade, and significantly more stringent environmental regulations in many parts of the world, especially the European Union. The end result is that top managers are starting to think, not necessarily by choice, about how their responses to social and environmental issues are related to profits. In modern businesses, Sustainability and its assessment demands an integrated vision – requiring multidimensional indicators that can not only show the connections between the economy of a community, the environment and society, but also guarantee that such sustainability can be properly measured and monitored. In fact, the grand purpose is the conjugation of environmental, social and economic parameters, in order to know the current situation from a sustainability standpoint and warn the community about the risks and possible tendencies of development, which would make it easier to look for political solutions for its possible achievement (Tayra and Ribeiro, 2006). Thus, besides indicators, SD must have specific strategies for assessing growth and therefore guarantee the existence of a transparent and participatory process for open discussion and decision-making, in order to attain sustainability.

B. Indicators and Sustainability

In parallel with the discussion about the concept of sustainability, there has been a search for methodologies (and, inherently, SI and SD indexes) that can evaluate the development of a country or region, the sustainability of its

respective socioeconomic and ecologic systems, and the levels of social responsibility that aim to reach such sustainability. An indicator is no more than a variable that can have multiple (quantitative) values or (qualitative) states; these values or states can be measured directly but, in most cases, result from analysing and processing basic information. At times, such processing can achieve greater complexity, through aggregations and combinations, giving rise to indexes. Therefore, SI and indexes are of the same nature, being distinguishable only by their degree of complexity (Bericat, Camarero and Jiménez-Rodrigo, 2019). On the other hand, an indicator does not constitute basic and absolute information, since its meaning may not correspond to its value. Usually, each of the many lines of thinking about human development or SD is linked to an indicator. Ever since the first efforts towards finding a single macro-indicator that could replace conventional macro-indicators (such as GDP per capita) until now, many tools were developed in an attempt to reconcile the many dimensions of sustainability. And, although they vary in terms of their sub-components and the way they are combined or aggregated, in general, they have all been referred to as the most promising. However, no methodological guidance that is compatible with the nature of the phenomenon has been evoked for the operationalization of a process for the following aspects: (i) evaluation of general sustainability, (ii) inherent risks, and (iii) level of integration of results and socioeconomic perspectives, in a context of environmental sustainability.

Can economic indicators, calculated in monetary values, outperform natural ones that are evaluated in physical units, when it comes to measuring sustainability? And should the methodology be founded in the concept of weak or strong sustainability?

The importance of both indicators and indexes results from their interpretation and utilisation as an analytical and diagnostics tool. According to the literature, the most cited and used are: the EF Ecological Footprint, the ESI Environmental Sustainability Index, and the ISEW/GPI Index of Sustainable Economic Welfare/Genuine Progress Index, the HDI Human Development Index, the DS Dashboard of Sustainability, and the Barometer of Sustainability. Nowadays some well-known guidelines and measurement systems on sustainability in the business world are often pointed: Global Reporting Initiative GRI, the DJSI Dow Jones Sustainability Index, the Triple Bottom Line Index TBL, and the OECD guidelines for multinational enterprises. Each of these approaches falls short when attempting an absolute evaluation of sustainability, since all these indicators refer to a variation – usually a decrease – of the multidimensional effects in a single unit, be it currency, energy, biomass or area of land, and this has been somewhat criticised in regards to the consistency of assigned values and to valuing one theory to the detriment of others (Ashby et al, 2017). Consequently, no questions about sustainability can be conclusively answered with any of the referred indexes or indicators. They all reflect issues with methodology and with the quantification of problems, so using one of them to classify regional or national sustainability, or to negatively or positively emphasize consumption in society (or societies) can lead to false results (Kuo and Smith, 2018). Assessment of sustainability is by nature a multi-criteria problem that addresses several criteria belonging to various themes generally structured in sustainability dimensions, i.e., the economic, environmental and social tripod (de Olde et al., 2016). This rapid development of a multi-criteria assessment method of sustainability over the last 30 years was supported by different approaches that draw on diverse fields of research (Popovic, Barbosa-Póvoa, Kraslawski, Carvalho, 2018).

C. Soft Systems Methodology (SSM)

Checkland (1981) Soft Systems Methodology (SSM) is a method that has been used by many and applied in different aspects of business and beyond. It is often not referred to as a methodology but a problem solving tool, which makes it suitable for a variety of situations. SSM is a systemic approach to real-world contextual problems that exhibit a characteristic complexity and ‘confusion’, while having different meanings. This methodology provides structured guidance towards examining the social context of any scientific intervention in real-world matters. SSM is an action-oriented methodology that means to facilitate the application of change and intervention programmes in real problems. Some of the strengths of SSM reside in its detailed and holistic analysis, and in how it clarifies the different — and sometimes conflicting — perspectives of the various interest groups that may be involved. These kinds of methodologies are interpretative, seeking to show the way in which the many actors perceive the real world in day-to-day life. According to Checkland (1994), whenever an algorithm is utilised, the analyst should also explore the activity systems from various standpoints. Thus there exists, in SSM, a learning dimension that promotes discussion and opinion-making among the stakeholders in order to consider different interests and objectives (Wang, Liu and Mingers, 2016).

As such, SSM generates a conceptual framework that emerges in a negotiable and adaptable manner, taking into consideration multiple perspectives of reality, and promoting an inquiry method that adapts to changes in the contextual problem. This is true of SSM, despite its focus on the definition of its relevant dimensions through a negotiated agreement of different perceptions of the real world, which in turn originate from debating and learning about the situation in a way that is duly positioned in its respective and relevant social and political contexts (Vilas-Boas, 2009). The main traits of the soft systems inquiry typology are closely related to a learning process, as specified by Jackson (1982) in the following manner: (i) the analyst should accept different assessments of the social reality; (ii) the perspective, subjectivist and non-functionalist approach; (iii) social problems are not suited

to technical solutions; (iv) space for argumentation and debate; (v) social systems should serve their stakeholders; (vi) technical assumptions should be confronted with plausible counter-assumptions; (vii) clients and decision-makers may reach an objective agreement on the system's purposes, through consensus; (viii) the purpose should developed within the framework of human society; and (ix) the development of the social world is not wholly knowledgeable by a creator.

3. Results and discussion of SSM application as a helping tool in assessment of sustainable business practices and inherent risks in a socio-economic-environmental context

Checkland's (1988) SSM focuses on organisational problems by considering the organisation as a whole, not just looking at one particular problem and not attempting to make an early decision on a solution to a problem. SSM is composed of seven stages (Figure 1).

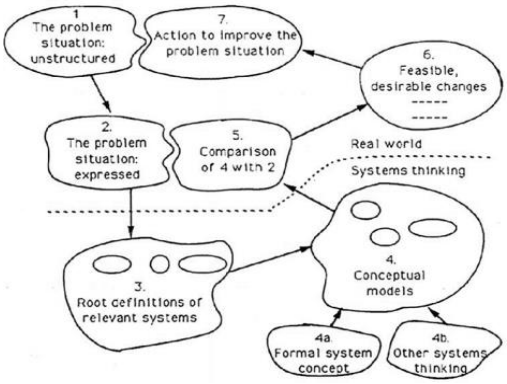

Figure 1. Stages of Soft Systems Methodology (from the original figure created by Checkland, 1981)

Stages 1 and 2 are about **perceiving and structuring the situation**. The nature of the contextual problem in relation to the *sustainability indicators* reveals a complex and dynamic situation. Such situations are placed by Checkland in the fourth quadrant of the Malouin and Landry matrix (1983), requiring and advising a heuristic problem-solving typology. This approach opposes that of a predominantly algorithmic-natured causal relation. The nature of the situation and the solution would therefore be mismatched, generating a serious lack of efficiency, should we seek to apply algorithmic solutions to the indicators.

- *As such, we have an initial and conclusive approach to the subject matter expressed in the **RQ3.***

On the other hand, structuring a contextual problem (stage 2) implies converting initial perceptions and requests into a set of matters fitting the research practice, before initiating the data collection further on. Therefore, the process of structuring the real world into the intended contextual problem should take the perspectives of different stakeholders into consideration, that is, the different *Weltanschauung*[1] (Checkland and Poulter, 2006), duly positioned in the situational environment.

- *This approach fits the needs expressed in the **RQ1** quite well, as it allows for the integration of the social, economic and environmental dimensions of specific sustainability indicators for a given situation.*

SSM stage 3 is about the **concise expression of human activity systems** that are seen as relevant for the contextual situation. In stage 4, models of these systems are to be developed, which will, in turn, constitute relevant systems for explaining the phenomenon, instead of being exact representations of real systems.

This is how the main guidelines for sustainability indicators that are adequate to the social, economic and environmental dimensions should be *a priori* defined, through previous literature review. It is quite likely that such indicators would have to be adjusted for other contextual problems and/or contexts, and/or objectives, and/or stakeholders. In what concerns the **RQ4**, this means that statistical generalisation is pointless. If anything, Yin's (1994) analytical generalisation can be applied, in order to analyse what kind of generalisation is logical according to the differing demands of different contexts. In this stage and the next, the relation between reality and theory is of a somewhat iterative nature, from a perspective that can be seen as abductive (Dubois and Gadde, 2002), but never of abusive convenience of some less restrained interest.

- *Here there is also a contribution for **RQ1** aside from an explicit integration of what is to be measured according to the contextual situation, thus addressing **RQ2**.*

Finally, it should be borne in mind that the systems bearing relevance towards modelling the phenomenon — often providing conflicting perspectives of the contextual problem — are deliberately chosen by the researcher. These systems determine the point of view through which the situation is examined and prevent the researcher from only incorporating a single perspective.

[1] It is a comprehensive conception or apprehension of the world especially from a specific standpoint

SSM stage 4 is about **developing and testing the conceptual model**. In fact, the previously established root definitions should support the development of a conceptual model through literature review — now in-depth and, always in synch with learning about the contextual problem, in an abductive perspective. The four ways in which to use the conceptual model will be addressed in stage 5.

- *Propositions corresponding the development of the subjects of research and in need of theoretical validation will be defined during the construction of the conceptual model. It is in this phase that sustainability indicators are developed, defined and refined according to **RQ1**.*

Validating the conceptual model does not imply an absolute decision of affirm/infirm type but should, instead, identify models that are more defendable than others (Checkland, 1994). SSM recommends that the theoretical validation take place in two phases, 4a and 4b (Vilas-Boas, 2009). In SSM stage 4a, a 'main theory' must be identified, in order to verify that the developed conceptual model is free from any fundamental flaws in regards to inconsistencies, inadequateness, absence of critical components, completeness and usefulness. In SSM stage 4b, the validity of the conceptual model is examined through comparison with other, rival models from authors seen as authorities on the Sustainability subject of research, such as EF, ESI, HDI, GRI, GRI, DJSI, TBL, among others the researcher decides choose. He or she will need to explain and defend such options, if requested to do so.

- *This theoretical validation (stages 4a and 4b) means the response of SSM to the concern voiced by **RQ2**.*

In SSM (Checkland, 1988), the system is not part of the real world, rather representing an organised inquiry process developed under a deductive approach (Malouin and Landry, 1983). Thus, stage 5 of SSM guarantees a transparent and participatory process for open discussion and decision-making, in order to attain sustainability.

- *The concern enunciated by **RQ5** is therefore satisfied through defining a credible inquiry process.*

In the fifth stage, Checkland (1994) identified **four major possibilities** for the operationalization of this inquiry process, presenting **four ways of comparing the contextual problem to the conceptual model**, as follows:

i. Use of relevant system models to stem the debate about change; as such, these conceptual models would be seen as a source of queries to question the existing situation in a systematic and ordered fashion, in order to clarify the stakeholders. This research typology adopts an increasingly operational character and seems to be well-positioned once possibilities (iii) and (iv) have taken place.
ii. Reconstruction of a string of past events and comparing that mapping with what would have happened had the relevant conceptual models been duly implemented. This possibility is particularly useful for studying the reliability and availability of data about the indicators, for long timespans.
iii. Mapping of strategic questions about activities, instead of detailed questions about procedures; with the purpose of identifying what traits of conceptual models differ from the present reality and pointing towards explanations for that fact. This research possibility is particularly attractive for developing objectives that orderly and systematically contribute to certain policies, under a cycle of continued learning that additionally allows indicators to be related to processes.
iv. Construction of a second conceptual model of "what exists"; the differences between both models will substantiate the debate about change. This operationalization allows guidance of the study towards the normalisation of certain sets of variables and their respective scales, which is a relevant thematic concern.

On the matter of the contextual problem in relation to sustainability indicators, any of the four possibilities are highly applicable, with the choice hinging solely on research interest. While the **first possibility (i)** is a better fit to cross-sectional-type programmes for intervention and change, **the second one (ii)** takes on situations of typically longitudinal essence. On the other hand, while the first possibility (i) might be a better fit for operational situations requiring immediate action**, the third one (iii) addresses more strategic matters**. Lastly, **the fourth and final possibility (iv)** firstly places the discussion in a conceptual foreground, building a second model of what already exists, according to the same rules and format that apply to the general conceptual model, for which it may precede possibility (i), in case a previous, broader discussion is justified on a dialectical plane.

SSM stage 6 addresses the feasibility of change, along with how desirable it is. As such, from the changes that are identified as systemically desirable, some are culturally viable, while others are not (Checkland, 1988), for the debate caused by human involvement and by social and political aspects may constrain potential change, possibly giving rise to the need for another methodological iteration (Checkland, 1994). Despite that, the final decision belongs to the organisation and not to the analyst, and this apparent conflict of competencies (Jenkins, 1983) may well take place in the case of sustainability indicators.

Lastly, SSM stage 7 refers to action aimed at improving the contextual problem, which is often left out of research projects ending with a list of recommendations.

4. Conclusions

The present work argued in favour of choosing SSM as the methodological option that is best adjusted to a model of a contextual problem that exhibits the traits of Sustainable Development, in which preserving natural resources cannot be achieved without simultaneous economic, social and political-institutional development. This introduces a high degree of complexity & conflict in the nature of the research matter, which is magnified by the involvement of social actors with significantly different interests, therefore requiring delicate and cooperative integration.

It was therefore argued that the approach provided by SSM — while interpretative, hermeneutic and promoting learning about problems that are complex, confusing, and often insufficiently defined — had the necessary conditions for favouring the comprehension and knowledge of the studied phenomenon. Indeed, it is not possible to deal with problems of a nature involving ambiguity, change, doubt and disorder in a functional and mechanistically regulated way, nor can that nature be distorted, ignored, covered up or disguised. According to Patton (1987:158), "solutions that are efficient and ineffective at the same time are in fact useless or even deceiving". The vagueness of one-way causal relations is therefore justifiable in favour of circularity, in specific contexts of the contextual problem, which may seem unusual in research environments that follow traditional, hard science-type methodologies. On the other hand, the feedback paradigm can also be confronted with the difficulties inherent to the prior definition of objectives, in a contextual problem characterised by learning and in which, therefore, both the problem and its objectives are progressively defined, in lieu of being definitively introduced a priori. It should suffice to remember how hard it is to guarantee equality between future and present consumptive practices, in order to grasp the lack of definition of structural objectives for satisfying the needs of generations to come. Once more, "there is a clash of principle with the positivist paradigm in the sense that unpredictability should be eliminated at all cost", as Winfield (1991:100) mentioned. We believe that the choice of the soft systems thought paradigm, as well as of SSM, constitute relevant, up-to-date and unusual contributions towards the conception of inquiries regarding contextual problems with significant social and political dimensions in which neither statistical generalisation from sample to population, nor nomological theoretical laws have to forcibly make sense. As such, we also believe that these aspects represent a relevant and credible challenge to the research methodologies applied to knowledge development and to the operationalization of common practices, in relation to Sustainability Indicators. In fact, SSM operationalizes the approach to change through four typological inquiry possibilities, sustained by the development and validation of a conceptual model of human activity systems that have been identified as relevant for the contextual problem. In addition, it offers a transparent and participatory process for operationalizing an organised, systematic, complete and useful debate on the feasibility of desirable change programmes, within a given framework of societal values and in order to reach sustainability. This research process is well-established in and recognised by the scientific community, which is an important condition in order to accredit the proposals for change.

In summary, while directly addressing the subjects of research, it is argued that SSM provides a holistic and systemic context that integrates the social, economic and environmental dimensions towards developing sustainability indicators, while ensuring the construction of indexes that allow for purposeful evaluation, incorporating the uncertainty that is inherent to the problem's nature and being able to alternate between cause and effect, in a circular perspective. Adding to that, the research process provided by the seven stages of SSM accommodates the various actors' perspectives, during the learning experience generated through the specific debate of change in the contextual problem of sustainable development that is being researched in a particular sector of economy. As such, any results that may be reached can only be transposed into other scenarios through a process of analytical generalisation that is able to personalise potential extrapolations according to a discursive, subjective and interpretative perspective, after its due contextualisation.

Selected References[2]

Almeida I.D. and Delgado M.J., 2019. The Challenge of Designing New Work Systems towards Effective e-Health Interventions, in: Lightner, N.J. and Kalra, J. (eds) *Advances in Human Factors and Ergonomics in Healthcare and Medical Devices*. Proceedings of the AHFE 2019 International Conference on Human Factors and Ergonomics in Healthcare and Medical Devices, July 24–28, 2019, Washington D.C., USA, pp. 107-119.

Antanasijević, D., Pocajt, V, Ristić, M. and Perić-Grujić, A., 2017. A differential multi-criteria analysis for the assessment of sustainability performance of European countries: Beyond country ranking, *Journal of Cleaner Production*, Vol.165, No. 1, pp. 213-220.

Bericat E., Camarero M., and Jiménez-Rodrigo M.L., 2019. Towards a System of Indices on the Quality of European Societies (SIQES). In: Bericat E., Jiménez-Rodrigo M. (eds) *The Quality of European Societies. Social Indicators Research Series*, Vol. 75, pp. 1-26.

Checkland, P., 1981, 1994. *Systems thinking, systems practice*. John Wiley & Sons Ltd. England.

Kuo, T.-C. and Smith, S., 2018. A systematic review of technologies involving eco-innovation for enterprises moving towards sustainability. *Journal of Cleaner Production*, Vol. 192, pp. 207-220.

Popovic, T., Barbosa-Povoa, A., Kraslawski, A. and Carvalho, A., 2018. Quantitative indicators for social sustainability assessment of supply chains. *Journal of Cleaner Production*, Vol. 180, pp. 748-768.

Vilas-Boas da Silva, J.M., 2009. Restating a research definition in conformance to soft systems semantics. In: Johansson, M. and Jonsson, P. (eds.), *Implementation – realizing operations management knowledge*, XVI international annual conference of the EurOMA, Department of Technology Management and Economics, Chalmers University of Technology, Göteborg, Sweden, 14th-17th June 2009.

[2] Due to the limit of pages, all the other references supporting the text can be asked to the author.