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Sustainable Criteria to the self-decision making of the partners regarding its integration in collaborative networks

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Abstract

There are several works and research related to the formation of Collaborative Networks (CN). The participation of an Organization in a Collaborative Network is a theme of broad spectrum and of great interest in research, although it appears that it continues to be far from being fully explored. The objective of this work is centred on the identification of the critical success factors (CSF) that can serve as a basis for reaching a suitable model that assesses whether the participation of an Organization in a CN brings sustainability gains. This work analyses some models or studies available in the literature and identifies important CSF. The Triple Bottom Line (TBL), related to environmental, social, and economic effects is considered to guide the selection and categorization of these CSF. Regarding the results obtained, it appears that there is still large room for improving the research in this field, for instance, regarding further development of a robust and flexible evaluation model based on the identified CSF taking into account the TBL of the sustainability concept for each Organization considering its participation in a CN.

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1. Introduction

Nowadays, companies face major challenges resultant by increasing globalization. Thus, it appears that companies need to invest constantly, through innovation and competitiveness. In addition, one of the important critical success factors (CSF) associated with the challenges that companies live at the moment, is their degree of sustainability.

Companies are approached with many forms of collaborative network associations, such as collaborative or productive networks. Deciding which network should participate can be difficult. Due to this issue, the theme that we present becomes important to investigate [1, 2].

The term collaboration is mentioned between companies, and its objective is to gain benefits for all associated participants [3]. In addition, this term, collaboration, does also refer to companies and / or individuals working together and with an objective common [4], even though according to other sources, there is no need for having a "common goal" [5]. Moreover, this concept is also frequently mismatched with the term "concurrent engineering" and does, in fact, imply the existence of a 'common goal' or objective, and is in fact different from the term "collaboration" or "collaborative engineering" [5, 6]. Collaborative networks have great skills, allowing for new knowledge, sharing of risks and resources and knowledge interconnection, able to focus on their goals [7].

It appears that collaborative projects have increased the challenges of companies, due to changes in market conditions, through new developments in information technologies. [8]. In recent years, various types of Collaborative Networks (CN) have emerged as a result of these changes in companies [7]. The dynamics of the network began to gain great importance among researchers, thus leading to the need for an assessment of the dynamic processes that start in networks [9, 10]. CN's main issues are related to its structure, behaviour, and dynamic evolution of networks of its autonomous entities that collaborate to achieve common goals [11]. Additionally, they do further refer to the existence of several other types of CN [11]. However, it turns out that the Virtual Company or Enterprise (VO/VE) is also a type of collaborative network. To better frame the concept of VE, it appears that there is no universally accepted definition of the concept of VE, [12, 13, 14, 15] a *VE consists on the creation of a temporary network of several physical organizations in order to develop and produce one or more products/ services in the desired quantities, responding promptly to a market request or opportunity*.

The importance of social issues and the natural environment for societies and companies has evolved dramatically in the past 50 years. Corporate managers are becoming aware of the need to expand their goals, in addition to traditional financial expectations. It can be seen that, since the term sustainability in business emerged, more and more companies have emerged that address the importance of sustainability for their business, thus improving their economic, environmental and social goals [16].

Given this definition and the focus of the work, we can assume that sustainability is linked to economic, environmental and social pillars, which favours the present and future of all [17].

In this way, it is perceived that organizations that seek to be sustainable must pay attention to their performance in three dimensions: economic performance, social equity and ecological preservation [18]. The production and consumption processes are necessary for the development of human society, but it is a fact that all of them will generate economic, environmental and social impacts, therefore these impacts must be carefully evaluated and integrated into the planning to achieve the global objectives of sustainable development [19]. Natural resources must be preserved and respect for cultural issues and social development must be guaranteed [20].

The concept of sustainability has received increasing global attention from the public, academic and business sectors. The World Commission on Environment Development (WCED) defined sustainable development as the *development that meets the needs of the present without compromising the ability of future generations to meet their own needs* [21]. In their special issue of governance and sustainability [22] reinforce the importance of the theme and even reinforce the character of ubiquity in the word 'sustainability'. Explain why sustainability is now the key driver of innovation, according to their study of sustainability initiatives, including a set of 30 large corporations [23]. In

spite of everyone's knowledge about the three pillars of sustainability (economic, environmental, and social), it is quite difficult to choose the criteria or CSF to enable to reach a certain degree of sustainability on each organization [24].

Based on the above considerations, collaboration between companies can be a valid model for improving the performance of the entire CN and also for each partner individually. There are some frameworks and models to perform the design of a CN, but not so many related with each partner decision model to support its entry or not in a specific CN [45]. The contribution of this article concerns the analysis and investigation of works / models in order to enable a partner to decide to participate in a CN. The main motivation of this article is to present guidelines, in the scope of sustainable CN, in order to further provide useful information to enterprises or potential business partners to decide whether to participate in a given CN or not, and, in addition, to show the importance of this subject and how recent works have been contributing to it, thus leaving the doors, and incentivising future works in this regard.

Next, according the main aspect presented, the central research question underlying this work is formulated.

- **From a partner's point of view, how will it be possible to assess its participation in a collaborative network?**

There are several models that assess the entry of new partners in the collaborative network, but what is at stake in this work is the analysis from the point of view of the new potential partner choosing in which collaborative network it will participate.

In this work, the main concern is centred on the identification of the CSF underlying the creation of a model for assessing whether the participation of an Organization in a CN brings some gains in terms of sustainability issues for that Organization.

To achieve this goal underlying this work, the remaining of this paper is organized as follow. In section 2 is presented and explained the research methodology used in this work. Section 3 presents the articles synthesis and analysis, summarizing the main information about the models and works found, along with the CSF that were identified, based on the analysis of the works found related to the focused scientific domain. To finalize, some conclusion is made in Section 4, along with future some planned future work.

2. Research Methodology

The research methodology underlying this work was based on the analysis of a set of considered relevant data sources. Throughout this work, relevant information for the topic under study will be put forward, based on the set of contributions analysed, from leading authors who addressed this theme or some part of it. The collection of articles found and analysed was obtained by using the database of the online "B-on" library. This platform was selected as it does enable to reach the full content of a wide range of scientific publications in relevant and indexed journals, along with publications in international scientific conferences, also indexed in ISI WOS and/ or Scopus systems. "B-on" is one of the most extensive databases, which includes thousands of peer-reviewed journals in a widened range of fields of different scientific areas. Through the online scientific library "B-on", from the Portuguese Foundation for the Science and Technologies, researchers can access to most well-known international scientific databases, thus this library was used to carried out the search process underlying this work, based on the following three groups (**Group** 1, **Group** 2, and **Group** 3) of shown in the Table 1.

Table 1. Groups of searched through "B-on"

Group 1	Group 2	Group 3
'Collaborative network' or 'Virtual Enterprise' or 'Agile Enterprise' or 'Distributed Enterprise' or 'Virtual Organization' or 'Cloud Manufacturing' or 'Collaborative Organization' or 'Collaborative Enterprise'	'Integrate' or 'Participate' or 'Associate' or 'Join' or 'Connect'	'Sustainability' or 'Sustainable' or 'Social Sustainability' or 'Environment' or 'Environmental Sustainability' or 'Economic Sustainability' or 'Sustainable development'

Four research tests were carried out through the "B-on" by using the three groups and the **OR** operator as a connector between the *Title* or the K*ey words (KW)* of the intended sets. In Table 2 are expressed the number of articles found in each research test.

Table 2. Research tests performed through the "B-on"

	Title	**OR**	*Key words (KW)*	
Set 1	(Group 1 AND Group 2 AND Group 3)	**OR**	(Group 1 AND Group 2 AND Group 3)	n = 0
Set 2	(Group 1 AND Group 2)	**OR**	(Group 1 AND Group 2)	n = 110
Set 3	(Group 1 AND Group 3)	**OR**	(Group 1 AND Group 3)	n = 785
	Total number articles:			**n = 895**

Next, throughout the research process, a set of filters were applied, based on the sets of publications obtained, and the results obtained, in terms of number of publications, are summarized in Table 3.

Table 3. Publications obtained through the B-on, after the application of some filters.

	Set 1	**Set 2**	**Set 3**
Initial result:	0	110	785
1 - Restrict to: Peer Reviewed	0	39	587
2 -Type of fonts: Academic Journals; Conference Materials; Books	0	39	580
3 - From: 2001 to 2021	0	34	576
4 - Language: English	0	32	569
5 - Restrict to: Full Text	0	27	513
Final result:	**0**	**27**	**513**

After the applied filters, a reading of the title, the key terms and the resume of each of the articles was carried out to verify which articles were directly related to the research. From the carried-out research, 895 papers were obtained, applied the filters we verified a total of 540 articles and of which only 19 were framed with the theme. One of the reasons for the small number of framed papers is related with the fact that most of them were related with evaluation of the formation of a collaborative network that is not the scope of this work. So, evaluating the formation of a network is not the same as evaluating the participation or integration of an organization in a network. Figure 1 represents a flow diagram of the literature search carried out, and respective screening of the methodology used in this research work.

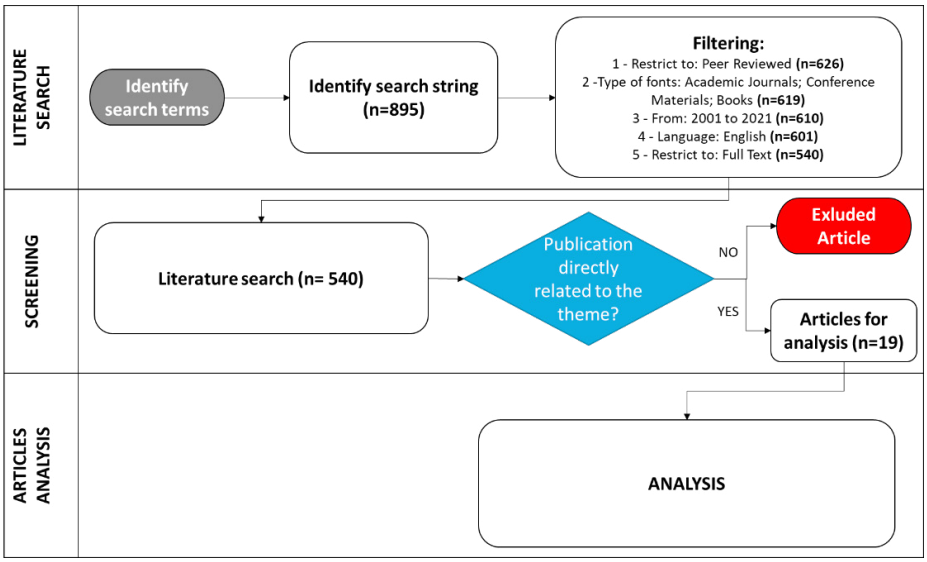

Fig. 1. Flow diagram of literature search and respective screening, adapted of [25]

3. Articles Synthesis and Analysis

In this section are presented of the articles synthesis and analysis. Data will be presented regarding the articles found, and which were considered the most relevant ones on the subject focused in this work. At first, an analysis was made on the selected articles, verifying which sustainability pillars (Environmental, Social and/ or Economic) were addressed on each article. The Table 4 presents, for each of the sustainability pillars, the articles that address the corresponding pillar and identify the type of contribution of each of the articles.

Table 4. Analysis before the pillars of sustainability of the articles selected in the research

Pillars of Sustainability / **Research papers**	Environmental	Social	Economic	**Type of contributions**
Huang, C. and Wu, Y. (2003)	x		x	Model
Danilovica, M. and Winroth, M. (2005)		x	x	Framework
Sari, B. et al. (2007)	x		x	Framework
Chituc, C. and Nof, S. (2007)			x	Model
Störmer, E. (2008)	x			Model
Cardoni, A. et al. (2010)	x		x	Framework
Verdecho, M. et al. (2010)	x	x	x	Framework
Won Yoon , S. and Nof, S. (2011)			x	Model
Manning, M. et al. (2012)	x			Model
Poler, R and Andrés, B. (2012)	x		x	Framework
Romero, D. and Molina, A. (2012)	x	x	x	Model
Renna, P. (2013)	x		x	Model

Osório, A. et al. (2014)	x	x	x	Framework
Polyantchikov, I. et al. (2016)	x		x	Model
Saether, E. and Sætre, A. (2017)		x		Framework
Giermindl, L. et al. (2017)		x		Framework
Shirazi, B. (2018)			x	Model
Wang, H. and Shu, C. (2020)	x	x		Model
Almeida, J. et al. (2020)	x	x	x	Framework
% Articles p/ pillar	68	42	**74**	

Analysing the previous tables, it is possible verify the following remarks:

- The Sustainability pillars most addressed is the economic, covered by 74% of the papers;
- The "environmental" sustainability pillar has a percentage value very close to the "economic" sustainability pillar.
- Verified that the works analyzed here present a kind of balanced contribution between models and framework.

In order to present the results of this work, next, we detail the selection of the important CSF to be taken into account when evaluating the participation of an organization in a CN. For or each of the sustainability pillars the most relevant CSF are presented in the Table 5, 6 and 7. This selection results from the deep analysis carried out in the articles investigated.

3.1. Environmental sustainability

In the Table 5 can be seen the CSF identified after analysing the articles mentioned above for the 'Environmental sustainability' pillar [26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 42, 43, 45].

Table 5. Main CSF about the environmental sustainability pillar.

Environmental sustainability	**% Articles p/ CSF**
Investment in environmental responsibility actions.	**62**
Respect for environmental legislation in the implementation and management of projects involving natural resources.	**62**
Manufacture of more durable products.	**62**
Adoption of cleaner production processes.	46
Creation of educational projects to raise awareness among employees and surrounding residents about the importance of preserving the environment.	46
Conscious energy consumption.	31
Elimination of the use of disposable cups and other types of disposable materials.	31
Solid waste management.	15
Recycling.	15
Water reuse.	15

3.2. Social sustainability

In the table 6, the CSF identified after analysing the articles about the social sustainability pillar are shown [26, 31, 32, 34, 35, 36, 37, 38].

Table 6. Main CSF about the social sustainability pillar.

Social sustainability	% Articles p/ CSF
Design of the analytical structure of the work and work packages, allowing a high level and a high scope of integration within and between systems integrator, supplier and customer.	**63**
Attracting and retaining customers, partners, suppliers and investors who want to collaborate with the social cause.	50
That demonstrates consideration of the expectations of different stakeholders and partners.	50
Integration of partners with cultural differences that can positively influence collaboration between new partners.	50
Creation of organizational procedures and routines that enable a high degree and high intensity of integration.	50
Reduction of possible scenarios of scarcity of natural resources, with positive impacts both in the supply chain and in the organization itself.	38
Contribute to sustainable development, including the health and well-being of society.	38
Duration of tasks or definition of projects that influence the integration time horizon.	38
Promotion of positive impacts on society and creation of opportunities for people impacted by the organization's actions.	25
Resilience for risk management and crisis scenarios.	25
Attracting and maintaining qualified human capital in the organization, while promoting their motivation and increasing their productivity.	25
Compliance with applicable legislation and consistent with international standards of behaviour.	25

3.3. Economic sustainability

In the table 7, we can see the CSF identified after analysing the articles related to this sustainability pillar. [27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 39, 40, 41, 43].

Table 7. Main CSF about the economic sustainability pillar.

Economic sustainability	% Articles p/ CSF
Competitive advantage in the market.	**57**
Quality and cost of products and / or services developed and provided.	**57**
Market focus and analysis.	**57**
Business strategy.	43
Increased profit.	43
Increased competitiveness.	43
Satisfactory results in the network.	29
Good corporate image on the network.	29
Active operating profitability.	29
Net profitability and operational sales.	29
Financial tranquillity in the network.	14
Turnover / liabilities.	14
General and reduced liquidity.	14
Return on equity.	14
Gross value added.	14

3.4. Synthesis of the results

Analysing the previous results, it is possible to verify that there are CSF with a greater number of times identified in the analysed works.

For the pillar of environmental sustainability, an analysis was carried out with a total of 13 articles. In this set, it was found that the highest percentage of articles that address the CSF is 62%. The CSF most often identified were:

- Investment in environmental responsibility actions.
- Respect for environmental legislation in the implementation and management of projects involving natural resources.
- Manufacture of more durable products.

For the pillar of social sustainability, an analysis was carried out with a total of 8 articles. In this set, it was found that the highest percentage of articles that address the CSF is 63%. The CSF most often identified were:

- Design of the analytical structure of the work and work packages, allowing a high level and a high scope of integration within and between systems integrator, supplier and customer.

For the pillar of economic sustainability, an analysis was carried out with a total of 14 articles. In this set, it was found that the highest percentage of articles that address the CSF is 57%. The CSF most often identified were:

- Competitive advantage in the market.
- Quality and cost of products and / or services developed and provided.
- Market focus and analysis.

For each of the pillars, other CSF were identified, but with a smaller number of times identified. However, these CSF may be important to integrate in a future model.

4. Conclusion

The participation of an Organization in a CN is a topic of broad spectrum and of great interest in research worldwide, since the magnitude of the value resulting from the evaluation of the integration in a CN can compromise the sustainability of an Organization and/ or Partner.

This work analysed the models and works available in the literature and identified important CSF for the pre-evaluation of future integrations of Organizations and Partners in a CN. The identified CSF are divided into the three pillars of sustainability: environmental, social and economic. A given organization and / or partner may carry out the

pre-assessment thinking about the pillar or the pillars of sustainability that will make the most sense for their integration in a CN.

Considering the results of the work, the authors are convinced that there is room to improve research in this area and that a more robust and flexible evaluation model should be developed. It appears that there are not many works on this theme, making a connection between sustainability pillars and CN, and this work aimed at this integration, by further considering the three pillars of sustainability. These pillars are of upmost importance for companies and individuals, e.g. business partners, while evaluating its potential inclusion in some CN, to increase its collaboration levels, and properly acknowledge the relevance of sustainability concerns.

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