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## Organizational Maturity Assessment Model for Collaborative Networks

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This paper aims to propose an organizational maturity assessment model for taking part in collaborative networks, aiming to contribute to the theory on this topic. It uses the mixed research method, with a qualitative approach, using systematic research and focus group techniques, to highlight the theoretical gaps and the establishment of evaluation criteria, and a quantitative approach with the use of the multicriteria decision-making method, to assign the importance of each criterion and establish the level of maturity of an organization. The result was an assessment instrument composed of eight dimensions and fifty-five categories, with the organization's positioning in indicators according to the four possible levels for each category.

**Keywords:** Preparedness, Readiness, Multicriteria decision-making method, Capability, Ability.

### 1 Introduction

The ecosystems evaluate ideas, projects, and business plans of established or emerging companies, to make the activities feasible. Once inserted in these environments, organizations are encouraged to develop with the formation of collaborative networks, establishing a process of preparation to integrate networks among organizations for sharing resources and competencies.

There is a perception that networks are fragile, and participants need to be mobilized and involved to maintain collaborative networks, whose organizational maturity facilitates this participation [1]. For example, the development of vaccines against covid-19 by organizations: Pfizer and Biotech; Oxford and AstraZeneca; Modern and NIAID. This shows the importance of networks to counter the disease very quickly with the maturity to share skills and resources.

The higher the organization's maturity, the lower the need for preparation, to maintain or enter into networks. A conscious assessment of maturity conditions provides clarity for understanding the organization's conditions. Thus, the organization will be able to self-evaluate to know how to improve, to become a member of collaborative networks.

The challenges for this study include, among others, integration and interconnection of formal knowledge, development of rules of cooperation, the establishment of trust and recognition among members [2], training, preparation, awareness, commitment, and resilience [3].

Therefore, it is a process that involves many dimensions and decision-making, after all, a network can fail in its objectives, if all aspects are not considered already in the selection stage [4]. Thus, we have the research question: What is the maturity assessment model applicable to organizations for taking part in collaborative networks?

This paper aims to propose a model for assessing organizational maturity for taking part in collaborative networks, providing elements that enable a conscious business analysis.

## **2 Literature Review**

The organizational maturity assessment to take part in collaborative networks considers the type of network being composed, permanent networks such as Virtual Breeding Environment (VBE) and temporary networks such as Virtual Enterprise (VE).

These networks are discussed together because of dependence between them, thus, the study refers to different analyzes for each type of network, although it considers this interdependence.

VBE is an association of organizations with a long-term cooperation agreement, supported by common infrastructure and operating principles, to increase their readiness to collaborate in potential goal-oriented temporary alliances [5], such as VE.

### **2.1 Organizational Readiness for Collaborative Networks**

The relationship between organizations is one of the factors considered to identify the ability of organizations to compose collaborative networks, such as technological compatibility (structural element) and relationships of affection and empathy (relational element) [6]. Partner characteristics, market knowledge, intangible assets, capabilities, complementary and aptitude [4]. These are principles for identifying the characteristics of organizations and aligning them to the suitable level.

The working principles in the VBE can be described from five perspectives [7]: the organizational perspective, VBE structure, governance rules and statutes; the business process perspective; the resource perspective; the value system and business model perspective; and interaction perspective.

Many of the concepts discussed diverge among the authors, some alignments are presented and analyzed, this divergence of concepts contributed to the heterogeneity of the topic.

Some papers use the concept of virtuality [8] [9], others use the concept of preparation [10] as a pre-condition for entry into the VBE-type ecosystem. Others claim that preparation is a process internal to the organization, while readiness refers to the organization's relationship with its external environment [11].

In another concept, preparation is a stage, preceded by character and character-related preparation conditions, while readiness combines preparation, willingness to collaborate, aptitude for competence, and affective and empathetic relationships [12], in this case, preparation is a precondition for readiness. The preparation was further studied, in two ways, as a pre-condition for participation in ecosystems, and post-adhesion to be part of temporary networks [13].

## 2.2 Organizational Maturity Assessment Models

There are many different models for assessing readiness in a collaborative network, whether it is decision making for admitting network partners [14], or for organizations, following an individualized assessment guide [7].

Establishing criteria is important in this assessment for organizations to become members of collaborative networks, with guidelines to continually improve their readiness for collaboration. Competence assessment, past performance, market, processes, resources, organization, information, knowledge, and culture [7] [10], behavior patterns, character and disposition [12], network cooperation, integration, trust, and use of ICT [9], are some of the individual criteria.

There are criteria for aligning readiness with a business strategy such as strategic needs and required capabilities [8], strategic, operational, cultural, and commercial synergies [15], motivation, and interoperability [16], partnership structure, information system architecture, process architecture, and coordination [17].

Competency profiles are dynamically determined according to requirements. These definitions represent a sequence of steps based on some opportunity for collaboration, to adjust the competencies of each organization and those necessary to meet expectations [18].

These criteria, instruments, methods, and studies were engaged in analyzing the problems related to maturity to compose collaborative networks. There is no predominant study or even replication of studies, some authors deployed the models, others also applied them empirically. These studies helped to make the basis for the development of this paper.

## 3 Research Methodology

This research uses a mixed research method, which enables a better understanding of a research problem or question [19]. Qualitative data represent attributes of some object and these can be quantified [20].

The research was divided into two phases (1. qualitative research and 2. quantitative research). Phase one was subdivided into two steps, step 1 consisted of a systematic review of the literature, with planning, execution, and reporting [21], the following search string was used in four databases (Scopus, WoS, Ebsco, and Science Direct):

- ("virtual network\*" OR "virtual organization\*" OR "virtual corporation\*" OR "virtual enterprise\*" OR "collaborative network\*") AND ("readiness" OR "preparedness" OR "maturity").

After applying the filters in the research, 95 papers remained, which were analyzed individually to identify theoretical gaps regarding the topic. Step 2 of the qualitative approach consisted of research with a focus group, which is a convenient way to collect data, such as beliefs, opinions, and views of several people simultaneously, whose group interaction is part of the method [22]. This group was composed of 12 members (2 moderators and 10 members), characterized as market professionals, with training in the areas of administration, accounting, electrical and chemical engineering, with experience in managing public and private organizations.

The objective was to establish the criteria for evaluating the organizational maturity to compose collaborative networks, the information generated by the systematic research was presented, familiarizing the members with the subject, and instructing about the research interests, each member suggested criteria according to their area of knowledge and contributed to the debate with the other criteria suggested by the other members.

Next, phase 2 of the research (quantitative approach) consists of establishing scales of importance for the dimensions, categories that make up the dimensions, and the four levels in each category.

These scales are established based on the multicriteria decision-making method that considers more than one aspect in the analysis, in which each criterion represents a mathematical function, and measures the performance of the aspect concerning the others, enabling the simultaneous optimization and transitivity established by the order of preference among the criteria [23], that is, it allows defining a road map for the organization, which intends to improve its general level of maturity.

The four levels in the categories follow a linear scale of importance, placing each organization based on indicators for each level. The actors present in the environment in which the networks are formed jointly determine the scales of the criteria, based on the judgment of the importance that each one has on a scale from 0 to 10. The grades given by the actors are converted into percentages of model explanation, based on equation 1. Where  $x$  represents the percentage rate,  $n$  is all grades assigned by the actors, and  $n_i$  is the criterion grade to be converted into a percentage rate.

$$x = \frac{n_i}{\sum_{n=1}^n n} \times 100 \quad (1)$$

Thus, it is possible to measure the maturity of an organization to take part in collaborative networks, whose indicator will be established by equation 2 [23].

$$V(a) = W_1 \cdot V_1(a) + W_2 \cdot V_2(a) + W_3 \cdot V_3(a) + \dots + W_n \cdot V_n(a) \quad (2)$$

Where  $V(a)$  corresponds to the maturity index,  $V_1(a)$ ,  $V_2(a)$ , ...,  $V_n(a)$ , correspond to the values of the organization's positioning levels for each criterion, and  $W_1$ ,  $W_2$ , ...,  $W_n$ , refers to the percentages established for each criterion.

## 4 Results

For this study, the focus group was defining the criteria for assessing organizational maturity for participation in collaborative networks, these were subdivided into dimensions, and these were subdivided into categories. The dimensions identified were: 1. assets; 2. knowledge; 3 people; 4. trust; 5. finances; 6. innovation; 7. marketing; and 8 connectivity.

The complementarity, sharing, and coupling of "assets" is a factor in the development of partnerships among companies, contributing to the use of idle capacity and risk dilution, whose management is a crucial factor [24].

The exchange of "knowledge" between organizations contributes to collaborative networks, familiarizing partners with the information that companies have, accessing different bases, improving knowledge of the organization, and contributing to the knowledge of the network, increasing collective knowledge [25].

"People" are considered a very valuable organizational resource, they are responsible for carrying out projects, processes, and routines in companies. Aspects such as experience, flexibility, innovation, knowledge management, mobilization, and internationalization of the people who make up companies can favor the formation of networks among organizations [26].

The "trust" dimension refers to the aspects present in the company's environment and in the relationships among organizations that enable the exchange of information, sharing of resources, and collaboration. That limits opportunistic attitudes, reduces costs, facilitates problem-solving, contributes to the construction of flexible and efficient partnerships [27].

About "finance", participation in collaborative networks favors access to funding sources, investment sharing, cost savings, and increased revenue, mediated by transparency [8].

The "Innovation" turns new ideas into opportunities that have a wide practical use, capturing value from them. Through collaborative networks, companies seek partnerships to complement resources and skills to innovate, sharing the risks of these initiatives [28].

"Marketing" manages relationships and involves customers in business, aiming to attract, maintain and increase the number of customers, delivering value and satisfaction, understanding their needs, developing, distributing, and promoting products and services to the market with value and prices suitable [29].

The "connectivity" dimension represents processes, norms, and agreements that enable connections among organizations in a collaborative network, such as interoperable infrastructure, sharing, interaction, operating rules, cooperation agreements, and appropriate trust level [30]. From these eight dimensions, the categories were established, a total of fifty-five categories were identified, as shown in table 1.

**Table 1.** Criteria for organizational maturity assessment for participation in collaborative networks

<b>Dimensão</b>	<b>Categoria</b>	<b>Cód.</b>
Assets	Production capacity	A001
	Idle capacity	A002
	Reliability	A003
	Asset control	A004
	Depreciation, amortization, and depletion	A005
	Operational availability	A006
	Flexibility	A007
	Asset management in the strategic plan	A008
	Maintenance	A009
	Monitoring	A010
	Asset system	A011
	Lifetime	A012
Knowledge	Organizational learning	B001
	Knowledge management	B002
	Schema	B003
	Gatekeepers	B004
People	Learning and innovation	C001
	Coupling capacity	C002
	People management	C003
	Processes	C004
	Results	C005
	Systems	C006
Trust	Commitment	D001
	Trust signals	D002
	Governance	D003
	Reputation	D004
Finance	Funding	E001
	Financial management	E002
	Economic and financial planning	E003
	Transparency (visibility of Financial Statements (FS's))	E004
Innovation	Strategy	F001
	Dynamics	F002
	Adaptive interfaces	F003
	Promote new products, services, or processes	F004
Marketing	Analysis of the quality of products or services concerning the competition	G001
	Uncertainty assessment	G002
	Search for opportunities	G003
	Competitors	G004
	Strategy/business model	G005
	Competition analysis	G006
	Product customization study	G007
	Norms and rules study	G008
	Portfólio and roadmap	G009
	Target segments of activity	G010

Dimensão	Categoria	Cód.
Connectivity	Network access	H001
	Easy access to the supply chain	H002
	Product collaboration with customers, suppliers, competitors, research institutions, test institutes, Universities	H003
	Sharing competencies with other organizations	H004
	Sharing organizational goals	H005
	Forming permanent alliances and partnerships	H006
	Forming temporary alliances and partnerships	H007
	Promotion of multiple internal and external communication channels	H008
	Promotion of work in physically distant teams	H009
	Promotion of work in physically close teams	H010
	Prospection	H011

The complete model is accessible from the link: <http://bit.ly/organizationalmodel>. The criteria established in table 1 are applied to the actors present in the ecosystems to identify the importance of each criterion for the formation of collaborative networks, whose grades of importance are converted into percentages, as mentioned in the methodology. Then, companies are classified in this model in one of four levels for each of the categories, as shown in fig. 1, according to indicators.

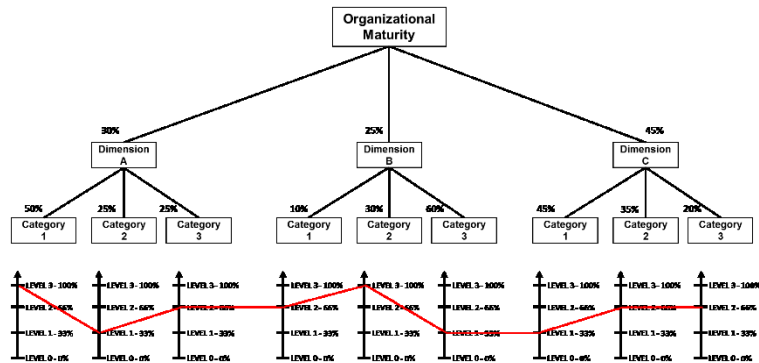


Fig. 1. Hypothetical example for assessing organizational maturity.

The gathering of all the categories calculated according to equation 2, showing in the methodology, will form the organization's maturity, which for the hypothetical example in fig. 1, the resulting index is 0.595425.

This analysis will make it possible to identify the main points in which the company needs to improve, constituting a road map to collaborative networks preparedness, among the different areas of improvement, which would have the greatest impact and should undergo intervention first. For example, should it improve first, from level 1 to level 3 in category 3 of dimension B or category 1 of dimension C?

In the first case, the resulting index would be 0.695925 and in the second case, the index is 0.7311, in this case, there would be a maturity gain of approximately 5% with



the best choice, the other interventions can follow the order of impacts, from the biggest to the smallest. However, certain organizations may have greater restrictions to promote changes and some criteria, in which case they can opt for changes in other criteria with less impact, but which does not negatively affect the organization.

Managers and brokers will have criteria to select and advise the necessary improvements in the companies. However, the collaborative networks formed will be supported by scientific and practical criteria aiming at the success of these intentions.

## 5 Conclusions and Further Research

This paper aimed to propose an organizational maturity assessment model for participation in collaborative networks, providing elements that enable a conscious business analysis, exploring all the benefits existing in these types of business arrangements.

The literature review showed the existence of many studies on the subject, however, it also showed many differences between them, resulting in scientific gaps.

This paper proposed a different model, scientific and practical, supported by organizational, physical, human, organizational, and technological resources that are integrable and shareable among organizations that are part of the network.

To measure organizational maturity, the multicriteria decision-making method was used, which establishes an index for each company, the higher the index, the more prepared it will be to participate in collaborative networks.

This study presents an advance in the subject, to contribute with researchers and practitioners in the establishment of organizational maturity assessment. New research is needed for the application of the instrument among ecosystem actors to establish measures evaluation for each criterion based on its importance degree, and application in companies to determine its maturity assessment, based on the criteria showing in this study.

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