A Structured Approach for Implementing Virtual Organization Breeding Environments in the Mold and Die Sector – A Brazilian Case Study

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Abstract. This paper contributes with the general problem of how transforming classical industry clusters in Virtual Organization Breeding Environments (VBEs). Having into account reference frameworks and models, a structured approach for implementing VBEs has been proposed and its preliminary results are presented here. This approach has been preliminarily tested in a cluster of moulds and dies industries from Brazil where the main VBE's characteristics have been found. In the future, it is intended to use this structured approach as a concrete mean to systematize the implementation of any type of VBE.

Keywords: Virtual Organization Breeding Environment, Members Preparedness, Virtual Organization, VBE Implementation Methodology.

1 Introduction

Since late 1990s, Brazilian industry clusters started to create a more advanced strategic alliance over the country based on a so-called local productive arrangement concept. Despite of the benefits of this initiative, it has been realized that this form of alliance is limited to face some new business requirements, as volatility of economics, commercial barriers, global competition and innovation needs [1]. New forms of alliances have been recently arisen under the scope of the new organization paradigm called Collaborative Network Organizations (CNO).

Actually, there are several types of CNO manifestations. Considering the set of new requirements and taking the original goals of local productive arrangements into account, VBE has been seen as its natural evolution. Among other advantages, the transformation of local productive arrangements to VBEs has the potential to enhance knowledge sharing, to decrease costs and risks, and to augment competitiveness to reach new markets.

The establishment of VBEs is a very complex task, regarding the number of technical and non-technical aspects to embrace. Recently, a first attempt to answer this question has been proposed by Romero et al. [2]. They have devised a generic

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methodology to create VBEs based on a CNOs' reference model. However, it requires a derivation process when very particular VBE is desired to be built. Besides that, this work does not take into consideration VBE member candidates' preparedness. As stated by Afsarmanesh et al. [3], members' preparedness is crucial for the successful creation of VBEs. So, the problem is how to create VBE implementation methodologies that consider candidate members' preparedness in their specification?

This is the underlying research question of this paper, assuming a hypothesis that a more correct identification of preparedness aspects not only speed up the VBE creation process and decrease launching costs, but also create more confidence in the process by members and more correct preparation. In this sense, this paper presents a structured approach used for a more proper members' preparedness identification and then for further better VBE implementation methodology specification.

In this paper, section 2 presents the approach for implementing VBEs. Section 3 describes the VBE model specified to the cluster. Section 4 depicts characteristics for assessing cluster's members. Section 5 presents directives to create questionnaires. Section 6 shows the evaluation of cluster's members. Section 7 specifies the VBE implementation methodology. Section 8 presents some conclusions and future work.

2 Structured Approach towards VBE Implementation

This section presents the structured approach designed for implementing VBEs. This approach has been developed based on studies performed into a cluster of mould and die producers (see section 3). The approach is composed of the following steps:

1. VBE specification. In this step is specified the VBE model that represents every key-element to be considered when implementing a VBE for a particular cluster. The VBE model specification should be supported by a reference framework selected after a comprehensive literature review. This representation aim at providing a better understanding of all elements involved in the VBE.
2. Assessment description. Based on the model specified in step 1, this step envisages to describe the important characteristics that should be considered when assessing actual organizations' preparedness against VBE creation requirements. These characteristics should be classified according to some predefined perspectives.
3. Preparedness pre-evaluation. This step performs a preliminary evaluation of how prepared the cluster's members are to support the characteristics described in step 2. This activity mainly consists in the specification of assessment questionnaires to evaluate the organizations' preparedness degree.
4. Preparedness analysis. Having an individual mapping of the main weakness and strengths of each organization, this step compiles a comprehensive and precise view about the candidates' global needs that is going to be used to specify a more tuned VBE implementation methodology.
5. Methodology instantiation. This step is devoted to specify the methodology for implementing the VBE regarding the previously assessed group of organizations. This methodology identifies the activities, their relationships and the actors involved in the VBE implementation.

Next sections detail these steps.

3 VBE Specification

In order to better understand the whole set of characteristics involved in the construction of a VBE it is necessary to model this VBE using a reference framework. Several works have addressed the problem related to model CNOs. A comprehensive review of the state-of-the-art about such subject is found in Baldo and Rabelo [4]. In this work, the authors state that ARCON modeling framework is suitable enough to model VBEs and can be used to model a VBE for an industrial clusters. ARCON (*A Reference Model for Collaborative Networks*) [5] brings the possibility to model abstract representations for understanding the involved CNO's entities and the relationship among them. ARCON intends to be used as the basis for deriving models for any manifestations of CNOs. In general terms, this is made applying three inter-related perspectives: Life Cycle; Environment Characteristics; and Model Intents.

Having selected the reference framework used to model the VBE, it is necessary to collect information for modeling the specific VBE. For the NuFerJ particular case, it has been used information collected mainly from the cluster itself and from an educational institution that has performed some studies inside NuFerJ. Concerning NuFerJ characterization, it can be said that NuFerJ (*Group of Moulds and Dies Industries of Joinville*) is a cluster founded in 1993 that has about 50 members. Several members are competitors with each other and their main customers are automobile and household appliance companies. Moulds and dies are very unique parts that are produced only once and each one of them uses to be very complex to manufacture [6]. Considering the increasing and extreme hard world-wide competition, NuFerJ has been looking for an alternative model which allows its members to better and more effectively prepare themselves for the new reality.

Taking into account ARCON modeling framework, a NuFerJ VBE Model has been created. This model classifies every element necessary to design the NuFerJ VBE, which in turn will guide the work towards its implementation. Baldo and Rabelo [4] presents the VBE model created specifically for NuFerJ, considering all involved elements in the Endogenous and Exogenous ARCON's subspaces [7].

4 Assessment Description

Taking into account that to implement a VBE it is necessary to know quite well the target cluster and its members, a way to perform such recognition is doing an assessment of the cluster members. This assessment evaluates the cluster members' preparedness to be part of a VBE. Conceive assessment strategies, e.g. questionnaires, base of the information available at the VBE model is to complex due to its broad coverage. So, to overcome this obstacle it is proposed to extract from the VBE model the relevant characteristics and to organize them into perspectives of assessment. Table 1 shows a sample of the identified characteristics. It is important to highlight that to assess the actual industries' preparedness degree is crucial because best practices showed in the literature stated that one of the main fails of VBEs is caused by industries not prepared in terms of: culture, governance, interoperation, etc.

Table 1. Perspectives and Characteristics for NuFerJ Members' Assessment

Perspective	Characteristic
Business Process	- Production planning process - Production control process and performance data collection - Purchase process
Organizational Structure	- Departments well-defined and structured - Functions and responsibilities defined - Low accumulation of functions per employee
Resources (human and ICT)	- High utilization of ICT - Enterprise resource planning system - Collaborative systems utilization (e-mail, chat, wflow, forum, etc.)
Organizational Culture	- Resource utilization optimization - Quality prioritization - Standards and norms utilization (technology and process models)
Market	- Target market well-defined - Customer interaction (post-sales) - Long-term planning

5 Preparedness Pre-evaluation

The characteristics contained in those perspectives mentioned in section 4 can be used as guideline to specify questions for evaluating how prepared an industry is to be part of a VBE. Thus, each identified characteristic, where a sample of them can be seen in Table 1, has been written as a question in order to ask for each candidate if it presents or not such VBE requirement. However, when appropriated, some characteristics have been combined into a single question due to their intrinsic correlation. The final version of such questionnaire has 45 questions divided among the five perspectives as follows:

- **Business Process**: 9 questions;
- **Organizational Structure**: 4 questions;
- **Resources (human and ICT)**: 14 questions;
- **Organizational Culture**: 13 questions;
- **Market**: 5 questions.

Each question on the questionnaire was conceived in a way to estimate the level of preparation of an industry concerning a specific characteristic. This level is estimated through a scale of possible values on which the industries should fit in one of them. This scale is composed of the following values: excellent, good, not good and bad. Besides that, each question has two verification options containing yes and no values, respectively. These options are necessaries in situations where a question is not applied for a specific industry or the industry does not have any manifestation of such characteristic stated in the question.

6 Preparedness Analysis

Having the questionnaire prepared it is time to start the interviews. The questionnaire has been applied to six industries that participating in the NuFerJ cluster. The

selection of those six has been supported by a senior manager that knows pretty well most of the industries. During the selection, it has been chosen medium size industries with high automation and organizational degree, as well as small size industries with low automation and organizational degree.

The results obtained through the interviews have been first charted and afterwards analyzed and graphically plotted. In order to chart the obtained data the scale presented in the questionnaire (see section 5) has been converted as follows: "excellent" → 4; "good" → 3; "not good" → 2; "bad" → 1; "no" → 0.

Considering the business process perspective, in general terms the industries are not much prepared reaching 2.28 as average. It means that they do not have a good systematization of daily performed business processes. This has a direct impact in the VBE implementation process. Concerning the organizational structure, the industries have gotten a better level of preparation, reaching an average of 2.63. This result has been obtained because most of the industries are well-structured in departments physically separated, and their employees have well-defined functions. This characteristic is essential for industries that want to be part of a VBE because it supports the inter-organizational communication. Regarding the human and ICT resources, it can be verified that the industries utilize them in an moderated way, reaching 2.38 as average. However, assessing each industry separately it could be verified that there is a considerable difference among them, where some of them are highly automated while others are poorly automated. This discrepancy impacts negatively in the VBE implementation process because everyone needs to have a minimal ICT bases to collaborate. Considering the organizational culture, it could be observed that most of the industries do not stimulate neither internal nor external collaboration. This low preparedness, with 2.15 of average, represents the main problem to implement the VBE for NuFerJ because to slight improve this perspective it is necessary a deep change in institutional and organizational principles, and this takes time. About the market, this perspective reached the lowest average among all the perspectives evaluated, which is 1.87. This has been caused mainly because the industries are not habituated to make strategic planning. For instance, several industries do not have budget planning longer that one year. It is strong recommended to improve this aspect before allowing an industry to be part of a VBE.

7 Methodology Instantiation

The last step of the structured approach is to design the VBE implementation methodology. This methodology aims at identifying all the activities, as well as the sequence of their execution, necessary to cope with the main aspects modeled in the NuFerJ VBE Model. The activities' position inside the methodology is guided by the preparedness assessment done previously (see section 6). The methodology specified identifies which steps should be done within each VBE life cycle phase [3]. Next paragraphs detail the proposed methodology.

VBE Creation (*Foundation*): This phase is mainly devoted to define the VBE mission and goals, its strategies in terms of marketing, political, economical issues, and the operating rules and duties. Although it may vary, a VBE usually begins with the so-called strategic members, whose selection can be accomplished by a sort of

commission. Business processes, ICT infrastructure and governance structure definitions complete the list of activities in this phase. Considering industries' market preparedness assessment done before, it can be noted that the definition of market and economical strategies will be the bottleneck.

VBE Creation (*Initiation & Recruiting*): This phase is concerned to recruiting the VBE members (the industries themselves) and the VBE supporting institutions (e.g. educational, financial, R&D institutions). Considering the VBE members, the envisaged competences should be firstly specified in order to invite the right members. Every candidate should be empowered with basis knowledge on how to work in a VBE, which includes the aspect of trust, governance, etc. Once the industry is ready, its ICT infrastructure is prepared. Having all this prepared, the VBE can be launched. Based on the organization culture preparedness it can be identified that the establishment of trust will take time.

VBE Operation (VBE management): VBE management comprises the activities related to full the operation of the VBE and its main business processes. In NuFerJ the processes of Membership management and ICT infrastructure management should be firstly introduced. Profile and Competence Management activity comes after that and includes the deployment of a system to register and maintain the information related to VBE members. A number of activities can start in parallel after this: Financial, Marketing, Performance, Acquisition, Trust, VE inheritance and Customer Relationship. Considering the resource assessment done previously, acquisition management is critical for NuFerJ because it has a tremendous impact on the final cost of the mould, so it can represent to win or lose the business.

VBE Operation (VE creation): VE creation encompasses activities devoted to the creation and initiation of new VEs. The Opportunity Identification is the first one to be deployed. This seems natural as it is responsible for brokering business. The Opportunity Quotation is the next one to be deployed. Based in the business process assessment, this is another critical task that must be paid attention because wrong quotations can imply on high financial losses. To deploy the partners selection it is necessary first the deployment of performance and trust management. The remaining activities are deployed in sequence: Contract Negotiation (among VE members), VE Planning (to specify which partners will do what and when), VE Registration (to prepare the VBE's repositories to store VE's information), and Launching management (to coordinate the VE starting).

8 Conclusions

This paper presents a structured approach devised to implement VBEs for mould and die industry sector. Its main contribution is to systematize the whole process that concerns the implementation of a VBE. Besides that, it also presents the first results of an ongoing research, which has been based on a case study where the devised approach is being applied for more than one year.

This work is essentially based on the ARCON reference model, applying a top-down approach to derive comprehensive instances of VBEs. This modeling of VBE not only facilitates the VBE scalability and change management, but also supports the

VBE implementation methodology specification as the model considers most of the possible elements involved in the VBE.

Even being a concrete methodology, the implementation itself of its several structured steps naturally depends on the particularities and preparedness level of the involved cluster's members. This means that such steps can present different complexity and take different times to be implemented.

Next steps are concerned to a deeper evaluation of the approach considering a larger number of NuFerJ's members as well as its further validation as long as the process of VBE creation proceeds.

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