Virtual Business Communities to Improve Symbiotic Resource Sharing

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Abstract

Every day more than 3.6 million tons of industrial waste is generated worldwide, and most of it does not have a specific destination. Virtual Business Communities (VBC) can foster interorganizational collaboration, reducing this problem by connecting firms that are geographically near. Adopting a symbiotic approach, VBC could promote the exchange of information, resources, and disposable items. Only few studies approached this subject and it is important to understand how constructs that mediate collective actions such as collaboration, value, trust, and governance contribute to the development of a VBC. Industrial companies, intermediary agents, and public agencies from Southern Brazil formed the research field, and Design Thinking was our research method. Our main contributions are a better understanding of how do collective mediating factors such as collaboration, value, trust, and governance are perceived and defined by the field, and present suggestions to implement a VBC prototype based on a symbiotic approach.

Keywords

Virtual Business Community, Mediating elements, Resource sharing, Symbiosis, Design thinking.

Introduction

Reusing waste and disposable items is a broad and complex subject. Every day more than 3.6 million tons of industrial waste is generated worldwide, and in the BRIC countries, industrial waste reaches 150,000 tons in Brazil; 100,000 tons in Russia; 110,000 tons in India and astonishing 520,000 tons in China. World Bank projections indicate that in 2025 Brazil will generate 330,000 tons of industrial waste daily (Cruz 2014). In the current Brazilian scenario, small and medium-sized enterprises have no institutional representatives concerning the management of industrial solid waste, and local government has some information about this complex problem, but nothing ensures that industry and government are ready to work together.

Markus and Loebbecke (2013) discussed the importance of Virtual Business Communities (VBC), which are defined as networks of economic agents, including buyers, sellers, suppliers and other institutions, based in one or in different geographical areas, which are supported by a Digital Platform (DP). VBC are used to structure and increase interactions as well as to foster virtual proximity to develop interorganizational collaboration, with the objective of reducing transaction costs. Considering VBC, we assume that understanding the constructs collaboration, value, trust, and governance is important since these elements mediate resources sharing. Furthermore, adding collaboration, value, trust, and governance with perceptions of the main actors makes it possible to develop a DP that supports a community for symbiotic exchange of resources. Symbiotic exchanges occur between enterprises of a
geographically delimited region, comprising companies of the same or different industries, with the potential to add value by reducing costs and by improving the environment (Baas, 2011).

In our research, economic agents are industrial companies generating waste and disposable items, other companies that could make use of these resources, intermediary agents, and public agencies. Industrial waste is a complex problem and environmental regulations are difficult to implement by a single company. Sharing it with other companies should help to solve this problem. Sharing is symbiotic when disposable items produced by companies are useful to adjacent industrial processes, in a closed system model (Graedel and Allenby, 1995). And symbiotic sharing reduces the complexity of the problem and of a possible solution supported by a VBC.

Our literature review revealed that only a few studies approached this subject (Cruz, 2014). Therefore, our research question is the following: “how do elements that improve collective actions, such as collaboration, value, trust and governance, are perceived by economic agents when developing a VBC for symbiotic exchanges of resources?”

In order to answer this question, we present the theoretical foundations of our study, the research method based on Design Thinking, the case of waste and disposable items and the research setting, and our results and conclusions. As our main contribution, we highlight a better understanding of the fundamental dimensions of collective actions when implementing a symbiotic VBC.

Theoretical Foundations

Virtual Business Communities

A broad definition of virtual communities is that they are aggregations of Internet users who form webs of personal relationships (Spaulding 2010). More specifically, VBC are market organizations formed by networks of economic agents, including buyers, sellers, suppliers, financial agents and research and development institutions, located in different geographical areas and supported by DP (Markus and Loebbecke 2013).

The creation of value is fundamental to the development of these virtual communities. Amit and Zott (2001) structured a model to explain the sources of value creation in virtual business, grounded on four primary sources. The first source is efficiency, based on the concept of transaction costs. Williamson (1981) points out that efficiency increases when transaction costs fall. The second source is complementarity. By offering relevant products and services to the participants of some network, complementarity brings convenience and therefore adds value. The third source is continuity: as soon as new agents join the network, they will not feel compelled to leave it if procedures are used for their retention. The recognition of customer behavior characteristics and increased efficiency through customized interactions are important factors to create value in virtual environments. The fourth source is novelty: the creation of value occurs by connecting actors that were not connected before, eliminating inefficiencies in the buying and selling process, and using innovative ways to carry out transactions.

Value generation in virtual communities through collaboration is central to our study. Sharing personal values, mutual support, alignment of interests, and collaborative communication can generate the value required to work within the community, which in turn requires increased coordination and leads to satisfaction and commitment (Amit and Zott, 2001).

Sharing is symbiotic when waste and disposable items produced are exchanged between agents located nearby and when those resources are useful to adjacent industrial processes (Baas, 2011). Industrial symbiosis focuses on the relationships between industrial companies in a closed system model, in which waste and disposable items generated by one company become a resource to other industrial processes (Frosch and Gallopoulos, 1989; Graedel and Allenby, 1995).

Concerning the adoption of IT in supply chains (a type of virtual community), Chae et al. (2005) point out that confidence (trust), interdependence, long-term commitment to the relationship and sharing of information are four key dimensions to create interorganizational collaboration. We argue that these dimensions are very important to virtual communities that support symbiotic relationships.
**Collaboration**

Collaboration amongst companies is a common strategy to increase competitiveness. According to Verdecho et al. (2012), companies that collaborate with others need to define and use performance measurement and frameworks to facilitate the management of their activity. They also need to continuously monitor their strategies and processes.

Our approach to collaboration is based on a cross-enterprise setting, involving two or more companies working together to jointly achieve greater success than that attained individually. This approach opposes traditional business practices of keeping information under control and releasing information only on a need-to-know basis. In a time where firm-to-firm competition seems to be replaced by supply chain competition, firms need to find ways to collaborate if they want to survive in this environment. Without trust, no partner is willing to step out of its comfort zone to take new roles and responsibilities (Daugherty et al., 2006).

**Value**

Value for businesses and individuals has been intensively studied (Amit and Zott, 2001), and the theory of transaction costs is one of the main approaches to understand value. According to Williamson (1981), a transaction occurs when a good or service is transferred through different technological platforms and the reduction of transaction costs constitutes a source of value to companies. The author also states that value may be derived from the reduction of uncertainty, complexity, and information asymmetry. From the point of view of interorganizational relationships, business reputation and the experience obtained can also create value by reducing transaction costs.

Value is created by using differentiation in each stage of the value chain, focusing on the improvement of activities that reduce costs and increase the performance of purchasers of goods or services of a company (Porter 1985). According to this author, IT generates value by supporting differentiation strategies. Value may also be understood through intangible assets and is not necessarily limited to goods, services or money, including other resources such as time, energy and feelings (Kotler, 1972).

**Trust**

In the context of interorganizational relations, trust can be defined as the mutual belief that no party involved in a transaction will exploit the vulnerabilities of the other (Sabel 1993). Trust should be considered a critical factor to the success of interorganizational relationships, when considering institutionalization, governance, and the strengthening of ties between the actors of a collaborative network. One of the most important implications of trust to the structuration of interorganizational relationships is that the costs related to monitor and to regulate bargains between network members will be reduced by having a strong relationship of trust between them (Hill 1990).

Spaulding (2010) related trust issues to characteristics of virtual communities. Trust in transaction-oriented communities, created to bring together sellers and buyers, rely on the evaluation of the quality of the transactions (e.g. feedback scores). Trust in relationship-oriented communities, which focus on business relations, is based on the quality of the information provided by the participants.

From a sociological point of view, trust is an attribute of human relations and, therefore, can only be increased by strengthening relationships between the actors of the network. Social ties and the structure of the networks play an important role in this process of building trust (Granovetter 1985, 1992).

**Governance**

In interorganizational networks, governance is needed to ensure that participants engage in collective actions, where conflicts must be resolved and resources must be used efficiently (Provan and Kenis 2008). Governance includes the structure of power and the policies implemented to influence behaviors of individuals aiming to act collectively (Ostrom 1990). It is important to understand how the structure of power and the policies implemented by the actors influence these communities. Understanding the power and control structures helps to identify how governance supports more effective organizational arrangements, and helps to understand in what context it would be better to adopt shared governance...
Virtual Communities and Collaboration

between members or when governance led by a member or a group is more effective (Provan and Kenis, 2008). The effectiveness of each governance model depends on aspects such as confidence, number of participants and consensus.

Ostrom (1990) also refers to governance as a mechanism needed to confront individuals’ propensity to act on behalf of their own interests. Therefore the implementation of effective collective actions requires setting standards to access common resources.

**Conceptual Model**

Our conceptual model was structured to support the development of a virtual community that connects industrial companies, located in the same geographical region, to improve their collaboration when sharing resources like waste and disposable items (see figure 1).

The conceptual model consists of five elements (constructs) – virtual communities, collaboration, trust, value and governance - and the arrows symbolize the relationships between them.

Arrow A represents the value perceived by the agents who would collaborate. In its absence, agents do not engage in collaborative initiatives. If a collaborative arrangement has the potential of perceived value then agents will focus on arrow B that represents trust between community members. However, without the perception of trust, collaboration cannot occur in view of the fact that members become afraid of having their vulnerabilities exploited by others (Sabel 1993). Arrow C indicates the materialization of collaborative initiatives. Arrow D shows that, when using virtual communities, members form collaborative arrangements that generate value from a feedback process that encompasses transaction cost reductions resulting from virtual means: efficiency, novelty, lock-in and complementarity (Amit and
Zott 2001). Arrow E indicates that confidence among community members is increased when evaluation tools are used and the righteousness of their actions in the community is assessed. This mitigates fears that members behave opportunistically and increases the efficiency of transactions and the success of the community (Amit and Zott 2001).

Therefore, it is possible to see some priority between the elements. Everything starts with value, followed by trust, resulting in collaboration. Collaboration sustains a VBC which in turn reinforces value and trust to its members.

**Research Method**

**The Case of Waste and Disposable items**

Our study was carried out in the state of Rio Grande do Sul (RS), in Southern Brazil. According to data from the Brazilian Ministry of Environment (2013), 1,129,070 tons of industrial waste is produced in RS each year, and 77% thereof do not have a specific destination. In order to deal with this problem, the industry builds landfill sites or outsources the problem.

A study concerning RS reveals high product losses and waste generation related to inefficient production processes in small and medium-sized industries (Marion Filho et al. 2002). It also indicates that nearly 50% of these industries are facing problems with defective products, and more than 30% of them face a waste amount of at least 5% of the total amount of raw materials they use. This scenario is ideal for the application of a technological solution that can reduce waste through an interorganizational collaboration network in the form of a virtual community.

In the past, a few initiatives for sharing waste were analyzed. One of them was a Business to Business project that focused on the exchange of recyclables, performed by the Federation of the Industries of RS. Another concerned the analysis of the National Industry Symbiosis Programme (2014) developed in England. But these initiatives had no continuity.

**Methodological Foundations**

We adopted Design Research (DR) (Hevner et al. 2004) as a general guide to build the digital platform, and Design Thinking (DT) (Curadale 2013) to develop and to deepen concepts resulting from multiple points of view of different participants of the community. DR comprises six steps: identify, define, design, development, evaluation and communication. DT also comprises six steps: comprehend, observe, define, ideate, prototype and test, some of the steps being redundant in their purposes.

The fusion of DR and DT occurred to create better guidance for the development process of the DP, taking into account the complexity of the problem assessed during the first research step. The resulting methodology was formed by the steps identify, observe, define, ideate, prototype, and communicate (figure 2).
We operationalized the main constructs of our conceptual model to develop the questions of the research instrument used during the steps observe, define and ideate (see table 1).

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Operationationalization</th>
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<tbody>
<tr>
<td>Collaboration: activities and</td>
<td>Considering companies generating potentially useful resources to other companies located nearby, how do relationships between individuals influence the</td>
</tr>
<tr>
<td>achievement of common benefits.</td>
<td>structuration of collaborative ties?</td>
</tr>
<tr>
<td>Value: the ability to meet</td>
<td>Considering the waste and disposable items produced, which benefits motivate participant companies to take part in a community?</td>
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<tr>
<td>needs through products,</td>
<td></td>
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<tr>
<td>services or relationship</td>
<td></td>
</tr>
<tr>
<td>attributes.</td>
<td></td>
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<tr>
<td>Trust: the mutual belief that</td>
<td>Who is confident with IT solving the problem of collaboration between companies?</td>
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<tr>
<td>none of the parties involved</td>
<td></td>
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<td>in a transaction will explore</td>
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<td>the vulnerabilities of the</td>
<td></td>
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<tr>
<td>other.</td>
<td></td>
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<tr>
<td>Governance: the result of a</td>
<td>Where would participating companies be inserted and what are the abilities to influence or to be influenced by other institutions?</td>
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<tr>
<td>set of standards and</td>
<td></td>
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<tr>
<td>procedures used to regulate</td>
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<td>the relations of power and</td>
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<td>the decision-making processes</td>
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<td>within the community.</td>
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Table 1. Operationalization of the conceptual model

**Research setting**

Our research started with a literature review and with a visit to six industrial companies. The purpose was to **identify** (step 1) relevant aspects of the waste problem and of symbiotic exchanges of resources. Results turned out to be frustrating. The companies would not discuss the waste problem in detail and sometimes even denied the existence of such a problem. During this step contracts concerning collective actions were investigated and four of them emerged as relevant to analyse perceptions of a VBC from...
potential participants, namely collaboration, value, trust and governance. Initially we analysed these four constructs through a literature review.

As a consequence, we changed our research strategy. A new research setting was created in collaboration with a large global software company. The company fosters innovation and was interested in deepening knowledge concerning VBC, symbiotic sharing of resources and management of waste and disposable items. In this new setting we adopted DT, a more appropriate method to develop and deepen concepts resulting from multiple points of view of different participants.

During the Observe step, 50 small and medium institutions from different economic sectors - industrial, agribusiness, government and education - from a geographical region were invited to an event called Industrial Symbiosis Challenge. Twelve sent representatives to the event. Initially we explained the purpose of the study. Subsequently the 12 representatives were split into three groups representing different sectors: 1 - Manufacturing, Construction, Public Sector, and Agribusiness; 2 - Manufacturing, Services, Logistics, Higher Education; and 3 - Manufacturing, Public Sector, Services. Each group was coordinated by one DT coach, and two researchers supervised the adherence of each working group to the method. Participants were observed and their understanding of the constructs collaboration, value, trust and governance was collected. After consolidating their views, the three groups presented their suggestions, which were photographed and codified. The event lasted 8 hours.

The Define step sessions started only with the participation of five people (DT coach, developers from the software company and one researcher) and each one lasted 3 hours. In each session the group discussed one construct in order to synthesize the consolidated views from the observe step. As a result, four personas were built. Personas are imaginary companies that bring together participants' views following a more consolidated point-of-view of each construct.

During the Ideate step, new brainstorming sessions were performed, to generate potential innovative ideas that match the needs of the imaginary companies built in the define step. Formed by 5 to 8 participants (DT coach and developers), the group provided innovative ideas and assessed the ideas considering its feasibility to develop the prototype. The four discussion sessions lasted from 2 to 4 hours. One final session consolidated the entire ideation. It resulted in 14 potential ideas concerning the constructs collaboration, value, trust and governance. These ideas represented features to be included in the prototype.

During the Prototype step, the DT coach and developers made use of the ideas originated during the ideate step to create a DP prototype. Four sessions that lasted 3 to 4 hours resulted in a lower definition prototype and in additional 80 hours of software development activities. Once a concept of proof was obtained, the supporting company stopped raising funds for the project, which in turn made things difficult in order to test the obtained solution.

The Communication step was limited only to the participants and is not yet concluded.

**Results**

Results were obtained through a content analysis of the data collected during the Design Thinking steps performed: Identify, Observe, Define, Ideate and Prototype and Communication. Each step contributed sequentially to a better understanding of the dimensions collaboration, value, trust and governance in the context of a VBC for symbiotic resources sharing.

Figure 3 shows the matching between the research setting steps and the content analysis performed in order to define the constructs that mediate resource sharing. We started with a preliminary literature review on elements of collective actions. During the identify step the constructs of collaboration, value, trust and governance seemed more suitable to deal with the problem of resources sharing in a symbiotic setup. In sequence, these constructs constituted our base of discussion during the different research steps.
Collaboration

To participants, collaboration should arise as the result of a planned and transparent process of awareness of community members about the outcomes of the symbiotic processes. One scenario to achieve this goal could be the creation of a waste exchange fair with regular trading meetings, in order to strengthen the links between the members of the community, which is corroborated by Young et al. (2009).

Another way to improve collaboration emerged during the Define and Ideation step. It concerned the adoption of a technological artifact that recognizes the commitment of individuals to the community through the invitation of new participants using Linkedin and Facebook. This artifact makes use of the concept of gamification which adopts incentives, competition and differentiation in a playful way to solve real problems (Hamari et al. 2014) that could lead to collaboration. Gamification appeared in all stages of DT as a powerful tool that contributes to the development of the DP. Currently it is used in several applications, such as Waze.
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An important problem involving VBC is the sharing of information, particularly when the information is sensitive (e.g., waste and residues). A good example of sensitive information is the amount of waste companies produce everyday that discloses their lack of efficiency and affects companies’ reputation. This situation forces members to elaborate a governance structure to obtain legitimacy from the actual and potential participants. One example of such an arrangement is forcing all members to disclose information to the community. This situation enhances trust and diminishes opportunistic behaviors since the information now belongs to the community. And any kind of opportunistic behavior should result in banishment from the community (Dyer and Takeoka 2000).

**Value**

To participants, the value of a VBC is based on the increasing availability of resources by reducing production costs (a traditional concept). The development of virtual resource sharing could fit this benefit (Poddard and Donthu 2012). Also, the development of a standardized language and of appropriate definitions when identifying resources can increase the perception of value (e.g., identify something as a resource instead of waste and disposable items). One participant stated during the Identification step: “nobody trades waste, but everybody is willing to buy valuable resources”.

The community can improve its image and reputation in the society for its concern with the environment, an intangible value. Participants mentioned the possibility of extending this perception of value by creating a system formed by companies, universities, government and non-governmental organizations, making the society more aware of symbiotic collaboration aspects. Green Peace was mentioned as a good illustration of the efforts for increasing the awareness of environmental issues in societies. This is confirmed by Peloza and Shang (2011) and Walsh et al. (2009).

Data entry with standardized support in order to reduce information asymmetry could accelerate transactions, generating value. This is used in several supply chain collaboration tools as SAP Ariba, a cloud based B2B sourcing and procurement marketplacer where buyers and suppliers can do business within a single network structure. Participants also stated the adoption of search algorithms that effectively reduce the complexity of the transactions and predict best trading opportunities, based on market indexes and organized by geographical regions, as those carried out on stock exchanges. Kantardzic (2011) presents some examples of these algorithms. The development and implementation of a DP created in Brazil, as mentioned by participants, could have an impact due to innovation and could also influence other developing countries with similar waste problems.

**Trust**

Establishing trusted relationships between the members of a VBC includes setting up operational procedures and ensuring information security as well as clear business rules. Participants mentioned that the adoption of an artifact which reproduces the collaborative transactions and that emphasizes transparency concerning the results of operations could contribute to these relationships. Vangen and Huxham (2003) also studied this theme. And as stated by Spaulding (2010), feedback scores concerning transactions are an important trust issue for transaction-oriented communities.

One important aspect of symbiotic relationships is that once a symbiotic relationship is initiated in the community, all members involved in this relationship should ensure a flow of resources to preserve the gains obtained and to ensure trust (LI Liang-xian 2014).

The establishment of a reliability ranking for community members, the visibility of the amount of alliances or ties that each member of the community has and the ability to post testimonials about the quality of the negotiations attesting the trust of the members involved were features mentioned by participants, which are adherent to the concept of gamification (Bista et al. 2012).

**Governance**

The insights and interpretations referring to the constructs collaboration, value and trust were meaningful and showed to be part of a common understanding of the participants. However, discussing governance, participants faced difficulties when trying to figure out which actors, institutions and political levels could influence the community. “Ask yourself about how many layers of rights, duties and
institutions are regulating your activities in this exact moment” is an example of this difficulty. Participants corroborate that being a member of a community requires some kind of admission and operating rules. However they also found it difficult to identify which should be the command and control rules or to what authority members would be submitted, which was also proposed by Stoker (1998).

The analysis and the discussions that resulted from the working sessions on governance did not bring productive insights. All participants started from the same theoretical concept. However, they failed to achieve a level of abstraction to structure a model of governance and to propose actions that could be relevant in practice. But some participants mentioned that an effective governance should include the management of public and private interests aiming to close the "life cycle" of resources (e.g. waste), using public transportation and hospitals as examples. This was also proposed by Shea and Graham (2009).

Participants also mentioned the creation of an independent company to leverage the formation of the community and to create a list of third parties that could foster the collaborative process.

**The Digital Platform**

Our prototype included the operationalization of the concepts described above. During the DT process it became clear that building a DP for a symbiotic VBC, the concepts of collaboration, value, trust, and governance should be understood from the point of view of potential users and of people able to solve the problem. And to get a good adherence of potential users, it was important to invite them to participate in the customization of the DP information services. As an example: to streamline the communication and to enhance the potential to perform deals, participants highlighted the importance of creating a unified dictionary that comprises the business language and standards referring to waste and disposable items and products.

It is worth to mention that our prototype was build and was used as a proof of concept (PoC) to leverage further development. The most important contribution of this prototype was revealing relevant elements and concepts necessary to implement symbiotic connections through the adoption of VBC.

**Conclusion**

In this article we emphasized the understanding of characteristics and features of a VBC for symbiotic exchanges of resources by potential members.

Our intended conceptual contributions concern the adoption of context-appropriated elements when dealing with dimensions such as collaboration, trust, value and governance. Understanding the appropriation process of these elements was possible while using Design Thinking. It allowed us to highlight the inclusion of incentives and competition (based on gamification) to support collaboration. It supported us when adopting context-appropriated definitions dealing with value and intangible value. It also supported us during the analysis of the relation between transparency of information and trust, as well as during the analysis of the ambiguity of governance in interorganizational settings based on volunteer adhesion.

These contributions can support further studies concerning VBC. To develop the governance dimension, further studies based on the framework of Ostrom (1990) and Stoker (1998) seem to be helpful. As gamification in VBC are not yet well researched, new studies adopting the framework of Deterding (2012) and Werbach (2014) could be relevant. Finally, concerning transparency, studies as Vangen and Huxman (2003) may be supportive.
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One of the practical implications of our study concerns the creation of virtual collaboration groups even before having an artifact ready to use. Ostrom (1990) corroborates this idea of building institutions collectively. Another concern is the development of a transaction history record on the VBC, enabling the community to implement control measures to mitigate opportunistic behaviors. Such a mechanism contributes to an ongoing collaborative relationship (Daugherty et al. 2006). A third implication would be the development of a symbiosis dictionary in order to unify technical terms and to give access to this knowledge to all members of the VBC (Rigoni et al. 2013). Finally, considering the type of resources studied and how societies perceive waste, a stronger involvement of government representatives is required, leveraging the DP based on symbiotic principles (Shea et al. 2009). This could result in public incentives to develop a VBC, following a similar strategy as the one used to foster industrial clusters. This scenario demands a good understanding of the legal and environmental impacts when adopting virtual platforms to trade waste and disposable items.

Our research used resources (human, infrastructure) from a software company. Consequently, other technology platforms and research methodologies were not considered. This relationship between researchers and the software company also delayed the final development step - communication of the results. Therefore, the field validation of the prototype, which relies on the development of VBC success indicators, and its operational improvements are still to be completed. But considering the promising results obtained and the challenges faced during the DT process, researchers and the software company are still working on a funding project to support the development of an usable prototype that could be field validated. This project also could bridge the gap between research and the development of a platform able to fit business standards of the industrial companies potentially engaged and the software company.

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