The influence of internal factors on Absorptive Capacity of Brazilian small businesses

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**Abstract**

The purpose of this research is to measure the influence of internal factors on Absorptive Capacity of small-businesses participants in the Local Agents of Innovation SEBRAE program. In order to assess “absorption”, the indices of “innovation radar” will be ex ante and ex post compared. Hence, the most influential factors will be appraised.

**Keywords**: Absorptive Capacity (ACAP), Innovation Radar, Sectorial Innovation Degree

**Introduction**

Innovation is an important tool in ensuring enterprises’ competitiveness in a scenario characterized by fast and constant change, influenced largely by a technological and informational revolution. Although, as they are confronted with the challenge to innovate, companies might face internal conditions that limit their ability to innovate, therefore there is the need for incorporating external inputs to their innovation processes (Machado and Fracasso 2013).
Thus, companies that have greater ability to recognize the value of a new information from external sources, assimilating it and apply it with commercial purposes based on innovation, will tend to be more proactive, exploiting existing opportunities in the environment (Cohen and Levinthal 1990).

This ability to innovate from external inputs Cohen and Levinthal (1990) called Absorptive Capacity (ACAP). Thus, according to the authors, the higher the absorptive ability, the greater the company's innovative capacity. However, the company's internal conditions affect your ACAP and consequently its ability to innovate.

The present paper aims to measure the influence of internal factors on ACAP of Brazilian small businesses from Pernambuco state, participating in the SEBRAE – Serviço Brasileiro de Apoio às Micro e Pequenas Empresas (The Brazilian Service of Support for Micro and Small Enterprises, for English) program named ALI – Agentes Locais de Inovação (Local Agents of Innovation, for English).

ALI program is an initiative of SEBRAE in association with CNPq – Conselho Nacional de Desenvolvimento Científico e Tecnológico – (The National Council for Scientific and Technological Development, for English) in order to promote innovation in small businesses.

The ALIs gathered informations of the subject companies and disposed in Innovation Radar proposed by Sawhney et al. (2006) and adjusted by the GIS – Grau de Inovação Setorial (Sectorial Innovation Degree, for English) as methodology proposed by Oliveira et al. (2013).

In order to analyze whether happened absorption and innovation in companies, the indices of GIS was exante and expost compared of the action proposed by the ALIs. And to check which impacted of the internal factors on ACAP was used the methodology proposed by Machado and Fracasso (2012) operationalized by DEA model (Data Envelopment Analysis).

The findings point that firms with lower initial levels of innovation have major advances in the indexes after implementing the proposed actions by ALIs. The internal factors who have most influenced the ACAP and led these companies getting indexes of innovation were the Social and Organizational Capital.

Absorptive Capacity

The concept of Absorptive Capacity (ACAP) was first used by Cohen and Levinthal (1989). Initially, the authors have coined the term as the ability to identify, assimilate and exploit knowledge from the environment. Later, the concept was expanded to enterprise’s capacity on recognize the value of a new information, arising from external sources, on assimilate it, and on apply it, strategically and based on innovation, for commercial purposes (Cohen and Levinthal 1990).

The higher the levels of ACAP, the more proactive are the companies in exploring environmental existent opportunities; on the other hand, the companies that have a modest capacity tend to be reactive. Thus, the development and maintenance of ACAP is a critical factor to success and survival of a company in the long term, inasmuch as can reinforce, supplement or refocus organizational knowledge’s framework. (Cohen and Levinthal 1990).
In a processual perspective, effective internal knowledge sharing and integration are critical part of this capacity. Thus, the ACAP is a multidimensional construct consisting of a set of routines and organizational processes by which firms produce a dynamic organizational capacity (Zahra and George 2002).

Todorova and Durisin (2007) claim that the reconceptualization of ACAP proposed by Zahra and George (2002) as dynamic capacity raises important questions about the dimensions, the backgrounds, the contingencies and the results of ACAP, as shown in Figure 1.

![Figure 1 – A Refined Model of Absorptive Capacity by Todorova and Durisin (2007)](image)

Todorova and Durisin (2007) claim that the transformation of knowledge is not a consequence of assimilation, but represents a complementary or alternative process of that, since during a process of implementation of new knowledge the company may regress to previous knowledge structures.

Though, ACAP is influenced by the internal factors observed by Zahra and George (2002), Jansen et al. (2005).

**Factors Influencing Absorptive Capacity**

All the factors that influence the formation of ACAP are called background, i.e., the circumstances that must be present and be combined so that ability might arise in the company (Espinosa et al. 2007). As the concept of ACAP from Cohen and Levinthal (1990), external stimuli are needed for innovation. In this study the external stimulus that starts the whole process is the participation of companies in the program ALI from SEBRAE. Thus, all companies have the same external stimulus and are the internal factors that distinguish your ACAP.

The framework proposed by Machado and Fracasso (2012) indicates that the internal factors that must be present in order for the absorptive capacity develops are: human capital, organizational capital, social capital, technological capital, physical capital and relational capital.
However, for this study the variables “Technological” and “Physical” Capital are part of a single variable, the "Structural Capital", due to the proximity of the concepts and structure of data collected by ALIs.

Human Capital (HUC)

Human capital makes reference to tacit or explicit knowledge which employees possess, as well as their ability to generate it, which is useful for the firm, and includes values and attitudes, aptitudes and know-how (Martín-de-Castro et al. 2011). The ability of a company to access external knowledge also depends on the existence of a sufficient number of specialists, qualified technicians, scientists and engineers (Daghfous 2004, Schmidt 2005).

Organizational Capital (ORC)

The processes of communication and Human Resources Management have important implications for the ACAP, i.e. are the tools and practices of knowledge management selected by corporate administration, which allow the development of skills and greater efficiency of assimilation and transformation of knowledge (Daghfous 2004, Espinosa et al. 2007). Results from the combination of intangible assets that are both explicit and implicit, formal as well as informal, which in an effective and efficient way, give structure and organizational cohesion to the different activities and business processes developed into the firm. Also includes Organizational culture, values and attitudes (Martín-de-Castro et al. 2011).

Social Capital (SOC)

Is defined as the knowledge embedded within the firm, available through the interactions between individuals, workgroups and their networks, but without the formality and rigidity of organizational capital (Machado and Fracasso 2012, Subramaniam and Youndt 2005). The direct contact between employees of different departments and units should lead to a more efficient transfer of knowledge and points out a larger capacity of absorption (Schmidt, 2005). These factors are called often mechanisms for social integration and are used by the company to facilitate the sharing and dissemination of knowledge in the organization. For Zahra and George (2002) these mechanisms suggest relevant knowledge sharing among members of the firm and may facilitate the overcoming of barriers to this process.

Structural Capital (STC)

In this paper the structural capital is the combination of physical and technological capital, as was argued Machado and Fracasso (2012), the Structural Capital is owned and managed by the company. Refers to the combination of knowledge directly linked to the development of the activities and functions of the technical system of the organization, as well as the advancement of organizational knowledge framework required to develop future technological innovation of products and services Machado and Fracasso (2012). Includes Research and Development (R&D), technological infrastructure as acquisition of technology, as well as telecommunications’ information and technology. Also includes intellectual and industrial property, commercial secrets, trademarks, licenses (Martín-de-Castro et al. 2011).
Relational Capital (REC)

This capital comes from relationship processes held by the company with external agents (Hsu and Fang 2009), and gathers intangible assets obtained from successful networks with other environmental agents such as customers, suppliers or partners. Therefore, refers to the creation, maintenance and development of these relationships (Machado and Fracasso 2012).

Measuring Innovation in a Organization

The relevance of innovation in the growth of a nation, town or company is unquestionable, therefore the way to measure innovation is also very important. However, as observe Oliveira et al. (2013), a big difficulty is establish a measurement procedure and define a process of how to innovate. One way to generate innovation is through holistic proposal by Schumpeter (1984) in order to define dimensions to innovation. According to the author, innovation can arise under the dimension of a new product or process, by seeking new markets, development of new sources of raw materials or new market structures.

Beyond the four dimensions introduced by Schumpeter (1984), Sawhney et al. (2006) suggest increasing another 8 dimensions: Platform, Brands, Solutions, Relationship, Value Adding, Organization, Supply Chain and Network, propose a toll called Innovation Radar that relates the dimensions by which a company can look for ways to innovate. Bachmann and Destefani (2008) increased to the 12 dimensions of Sawhney et al. (2006) the concept of innovation-friendly environment.

Nevertheless, in accordance with Oliveira et al. (2013), by using the arithmetic average of the dimensions, the Innovation Radar does not consider the heterogeneity of each sector, which creates distortions and difficulties for comparisons. The solution pointed to by the authors is using the Sectorial Innovation Degree (GIS) to a sectorial analysis applied to small businesses and proposes a model for identifying potential innovation dimensions of the small businesses coming from different sectors.

Methodology

The data from this survey were collected by ALIs directly in companies participating of the Local Agents of Innovation program. The sample is composed of 56 small business from the Brazilian State of Pernambuco, which 4 are companies from the capital city and metropolitan area and 52 are companies from other areas of the state. Concerning the 250 companies initially available, on 56 of them, all the information required for the study were disposable.

The initial measure, $R_0$, was performed by accession of the company to the program ALI. The second measure, $R_1$, was carried out after implementing at least three actions proposed by ALI and the third measure, $R_2$, after implementing at least three more actions proposed.

The internal factors were measured from the average of its components. The Table 1 presents the number of components included in each of these Capitals and provides an example of these components.

The components of the internal factors vary on a scale of 1 to 4, where "1" is "irrelevant" and "4", "very relevant".
Table 1 - Internal Factors’ Components

<table>
<thead>
<tr>
<th>Internal Factors</th>
<th>Number of Components</th>
<th>e.g.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOC</td>
<td>4</td>
<td>Does the company holds conditions for implementing innovations? And does seeding to interested parties?</td>
</tr>
<tr>
<td>HUC</td>
<td>6</td>
<td>What employees percentage are dedicated to innovation?</td>
</tr>
<tr>
<td>STC</td>
<td>7</td>
<td>What annual revenue percentage is invested in innovation?</td>
</tr>
<tr>
<td>REC</td>
<td>9</td>
<td>The customer’s needs and expectations are known?</td>
</tr>
<tr>
<td>ORC</td>
<td>15</td>
<td>The company’s mission is set and is known by employees?</td>
</tr>
</tbody>
</table>

In order to verify whether there was variation in the ACAP was performed the difference between the contents of the GIS prior to and after implementing the actions proposed. The GIS is calculated from the Innovation Radar according to the methodology proposed by Oliveira et al. (2013) shown in Equation 1:

\[
GIS = \sum_{k=1}^{13} p_k D_{M-k}
\]  

(1)

Where \( D_{ik} \) is the value of the innovation’s \( k \) dimension to the company \( i \), \( D_{iM} \) is the innovation’s \( k \) dimension value for the sector. Since the weight of the innovation’s \( p_k \) dimensions is obtained by the following optimization model:

\[
Max \sum_{k=1}^{13} p_k D_{M-k}
\]

\[\sum_{k=1}^{13} p_k = 1 \quad p_k \geq 0.05 \, \forall \, k
\]  

(2)

Where \( D_{M-k} \) is the value of the innovation’s \( k \) dimension to M and the weight of the innovation’s \( p_k \) dimensions is obtained by optimization model declared in (2).

To check which impacted more internals on ACAP was used the methodology proposed by Machado and Fracasso (2012) operationalized by DEA model (Data Envelopment Analysis). The optimization model used was the variable scale return with emphasis on minimization of inputs.

Using DEA, the five inputs of the model were the internal factors and the two outputs were the variations of GIS\(_{(R_1-R_0)}\) and GIS\(_{(R_2-R_1)}\), added one to avoid negative values. The variation index “iGIS” was used to check for correlation among advances in GIS and internal factors.

**Results**

The sample was divided into two groups according to the initial level of GIS. The cutoff point is the average of the GIS in the initial moment (\( R_0 \)). The extract “\( R_0 < \bar{X} \)” was formed of twenty-seven companies and “\( R_0 > \bar{X} \)” of twenty-nine.
The Table 2 shows the average of the values of the internal factors (HUC, ORC, SOC, STC, REC), averages of GIS in R₀, R₁ and R₂, the averages of the variations of the GIS and the iGIS (General Index of Variation of GIS).

Table 2 - Results

<table>
<thead>
<tr>
<th></th>
<th>HUC</th>
<th>ORC</th>
<th>SOC</th>
<th>STC</th>
<th>REC</th>
<th>R₀</th>
<th>R₁</th>
<th>R₂</th>
<th>R₁-R₀</th>
<th>R₂-R₁</th>
<th>R₂-R₀</th>
<th>iGIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Sample</td>
<td>1.51</td>
<td>1.97</td>
<td>2.03</td>
<td>1.97</td>
<td>2.10</td>
<td>2.88</td>
<td>3.18</td>
<td>3.54</td>
<td>1.30</td>
<td>1.36</td>
<td>0.66</td>
<td>0.28</td>
</tr>
<tr>
<td>R₀&gt;2.88</td>
<td>1.60</td>
<td>2.20</td>
<td>2.08</td>
<td>2.10</td>
<td>2.30</td>
<td>3.47</td>
<td>3.56</td>
<td>3.96</td>
<td>1.09</td>
<td>1.39</td>
<td>0.49</td>
<td>0.15</td>
</tr>
<tr>
<td>R₀&lt;2.88</td>
<td>1.43</td>
<td>1.73</td>
<td>1.97</td>
<td>1.83</td>
<td>1.88</td>
<td>2.24</td>
<td>2.77</td>
<td>3.09</td>
<td>1.53</td>
<td>1.32</td>
<td>0.85</td>
<td>0.43</td>
</tr>
</tbody>
</table>

The average of the iGIS extract firms “R₀ ≤ X” is 54% higher than the overall average. Companies with the lowest initial innovation indexes had improvement on this index in higher rates than other companies, i.e., this group of companies had greater ACAP.

The data presented in table 3, from DEA analysis, evinces that, when analyzed in a single group, none of the internal factors presents correlation with variations of the GIS. I.e., there is no evidence of the action of internal factors on the ACAP when all companies are parsed at the same time.

Table 3 - Correlation Among Internal Factors and variations in GIS (By DEA)

<table>
<thead>
<tr>
<th></th>
<th>HUC</th>
<th>ORC</th>
<th>SOC</th>
<th>STC</th>
<th>REC</th>
<th>(R₁-R₀)+1</th>
<th>(R₂-R₁)+1</th>
<th>(R₁-R₀)+1</th>
<th>(R₂-R₁)+1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Sample</td>
<td>0.12</td>
<td>0.23</td>
<td>0.16</td>
<td>0.31</td>
<td>0.21</td>
<td>0.14</td>
<td>0.14</td>
<td>0.31</td>
<td>0.21</td>
</tr>
<tr>
<td>R₀&lt;2.88</td>
<td>-0.04</td>
<td>-0.06</td>
<td>-0.01</td>
<td>0.03</td>
<td>0.15</td>
<td>-0.17</td>
<td>-0.17</td>
<td>0.15</td>
<td>-0.17</td>
</tr>
<tr>
<td>R₀&gt;2.88</td>
<td>-0.06</td>
<td>-0.21</td>
<td>-0.17</td>
<td>-0.08</td>
<td>0.46</td>
<td>-0.45</td>
<td>-0.45</td>
<td>0.46</td>
<td>-0.45</td>
</tr>
</tbody>
</table>

Notwithstanding, when the analysis is performed separately in the extracts “R₀ ≤ X” and “R₀ ≥ X”, it is possible to observe a weak positive correlation (31%) between HUC and GIS and also a weak positive correlation (44%) between REC and GIS, that after implementing the second group of actions proposed by ALIs (R₂), for the group of small businesses with the lowest initial levels of innovation.

Ergo, there is a weak positive correlation between HUC and ACAP, and a weak positive correlation between REC and ACAP, both in R₂ for the group of small businesses with the lowest initial levels of innovation.

Thereby for those companies of extract “R₀ > X”, there is a weak positive correlation (46%) between STC and GIS in R₁. However, in R₂, the correlations between SOC, STC and REC with GIS are weak and negative.

Thus, there is a weak positive correlation between STC and ACAP in R₁. In R₂ there are weak and negative correlations between STC and ACAP, between SOC and ACAP and between REC and ACAP, for the group of companies with the highest rates of innovation.

Table 4 presents the correlation of the inputs and outputs of the DEA with the efficiency in the use of resources.
Table 4 - Correlation among Internal Factors and Efficiency

<table>
<thead>
<tr>
<th></th>
<th>Efficiency</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full Sample</td>
<td>R₀ &lt; \bar{X}</td>
<td>R₀ &gt; \bar{X}</td>
</tr>
<tr>
<td>HUC</td>
<td>-0.58</td>
<td>-0.15</td>
<td>0.48</td>
</tr>
<tr>
<td>ORC</td>
<td>-0.72</td>
<td>0.56</td>
<td>-0.64</td>
</tr>
<tr>
<td>SOC</td>
<td>-0.27</td>
<td>-0.20</td>
<td>-0.37</td>
</tr>
<tr>
<td>STC</td>
<td>-0.33</td>
<td>0.38</td>
<td>-0.66</td>
</tr>
<tr>
<td>REC</td>
<td>-0.72</td>
<td>0.75</td>
<td>0.51</td>
</tr>
<tr>
<td>(R₁ - R₀) + 1</td>
<td>-0.10</td>
<td>0.02</td>
<td>-0.16</td>
</tr>
<tr>
<td>(R₂ - R₁) + 1</td>
<td>0.33</td>
<td>0.09</td>
<td>0.35</td>
</tr>
</tbody>
</table>

The three analysis showed negative correlations among internal factors and efficiency in the use of these factors to the results obtained in the GIS. When companies are analyzed all at the same time, ORC and REC have moderate to high negative correlation (-72%) with efficiency, while HUC and STC have moderate negative correlation (-53% and -55% respectively). For this analysis, the variation on GIS after implementing the second group of actions \((R₂ - R₁)\) presents weak positive correlation (33%) with efficiency.

For the analysis with the extract "R₀ < \bar{X}", REC features moderate to high negative correlation with efficiency (-75%). Thus, the ORC and STC have moderate negative correlation (-50% and -58% respectively).

For the analysis with the extract "R₀ > \bar{X}", all Capitals showed moderate negative correlation with efficiency. Such fact denotes that this group of company has internal factors at levels above the necessary for performance in innovation achieved by them. I.e. there are conditions to improve performance in innovation.

The weak positive correlation between variation of GIS over \(R₂\) and efficiency in the use of internal factors might demonstrate that for companies with initial innovation rates higher than average, the second group of actions provides best results. This fact reinforces the assertion that, for these companies are necessary innovation efforts more "radicals".

Table 5 presents the correlations among internal factors and iGIS obtained by Pearson’s Correlation Coefficient

<table>
<thead>
<tr>
<th>Tabela 5 - Correlation among Internal Factors and iGIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>iGIS</td>
</tr>
<tr>
<td>Human Capital (HUC)</td>
</tr>
<tr>
<td>Organizational Capital (ORC)</td>
</tr>
<tr>
<td>Social Capital (SOC)</td>
</tr>
<tr>
<td>Structural Capital (STC)</td>
</tr>
<tr>
<td>Relational Capital (REC)</td>
</tr>
</tbody>
</table>

The SOC presents weak positive correlation with iGIS in all extracts and REC presents weak positive correlation with iGIS to the extract “R₀ < \bar{X}”.

The correlation between SOC and iGIS, even though weak, indicates that there is this internal factor influences in ACAP. I.e., the knowledge embedded within the firm, available
through the interactions between individuals, workgroups and their networks of relationships, direct contact between employees of different departments and units should lead to a more efficient transfer of knowledge and points out a larger capacity of absorption (Schmidt 2005, Subramaniam and Youndt 2005, Machado and Fracasso 2012).

In addition, as Zahra and George (2002), social integration mechanisms facilitate the sharing and dissemination of knowledge in the Organization and affects positively the ACAP.

The seven companies with the highest iGIS are among the twenty-one companies 100% efficient in the use of internal factors and belong to extract “R₀ < \bar{X}”. Of these seven companies, six have the highest rates of Social Capital of the whole sample. In addition, fourteen of the twenty and a 100% efficient companies have capital above the overall average. The seven companies with the highest iGIS are among the twenty-one companies 100% efficient in the use of internal factors and belong to extract “R₀ < \bar{X}”. Of these seven companies, six have the highest rates of Social Capital of the whole sample. In addition, fourteen of the twenty and a 100% efficient companies have capital above the overall average.

The action of Social Capital may be even more relevant for companies with initial low innovation indexes, as shown in table 6.

<table>
<thead>
<tr>
<th></th>
<th>HUC</th>
<th>ORC</th>
<th>SOC</th>
<th>STC</th>
<th>REC</th>
<th>(R₁ – R₀)+1</th>
<th>(R₂ – R₁)+1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Sample</td>
<td>-17%</td>
<td>-25%</td>
<td>-26%</td>
<td>-18%</td>
<td>-25%</td>
<td>37%</td>
<td>3%</td>
</tr>
<tr>
<td>R₀ &lt; \bar{X}</td>
<td>-11%</td>
<td>-15%</td>
<td>-25%</td>
<td>-14%</td>
<td>-17%</td>
<td>27%</td>
<td>3%</td>
</tr>
<tr>
<td>R₀ &gt; \bar{X}</td>
<td>-23%</td>
<td>-21%</td>
<td>-15%</td>
<td>-14%</td>
<td>-19%</td>
<td>0.4%</td>
<td>13%</td>
</tr>
</tbody>
</table>

Negative indexes indicate that all internal factors were underutilized to the results achieved.

**Conclusions and future trends**

Findings points out that, for the analyzed sample, analyzing internal factors singly explains only a fraction of ACAP variations. Social Capital (SOC) and Organizational Capital presented weak positive correlation with ACAP.

The small businesses who obtained the highest improvements had in beginning little dedication to innovation. Whereas that the ALIs’ initial proposed actions were of incremental nature, as predicted by the program briefing, concludes that companies with low indexes of innovation are better responsive to incremental innovation. Although, considering the companies who performs some innovation effort, greater results might outcome through innovation actions radicals.

For future researches, it is suggested expand the sample in order to get better matching accomplishments. It is possible, also, includes new internal factors to this work. Other suggestion is to analyze the internal processes of ACAP and the effects of radicals innovations.
Bibliography


