INDUSTRY 4.0 AS AN ALTERNATIVE OF COMPETITIVENESS OF CLUSTERS OF WESTERN PARANÁ, BRAZIL

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This study presents preliminary results that will justify the region and the analysis sector which will allow, later, to identify the characteristics of the industry 4.0 of the companies that form this sector.
The objective of this paper is to identify the main characteristics of industry 4.0 and the main productive clusters of Western Paraná State, Brazil.
Introduction and Literature review

First Industrial Revolution
- Introduction of machines
- Substitution of the handicraft
- Methods of mechanic
- Use of steam energy

Second Industrial Revolution
- Mass Production Era
- Assembly line
- Scale economy production
- Standardized products
- Emerging of the electric energy
- Division of labour

Third Industrial Revolution
- Digital revolution
- Automatization
- Information Technology (IT)

Forth Industrial Revolution
- Internet of Things
- Mobile devices
- Location detection technologies
- Smart sensors
- Big data
- Augmented reality
- Cloud computing
- Cybersecurity
Introduction and Literature review

Forth Industrial Revolution

- Internet of Things
- Mobile devices
- Location detection technologies
- Smart sensors
- Big data
- Augmented reality
- Cloud computing
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The Industry 4.0 consist on a set of smart processes in organizations. In order to achieve this model of production, there are some technological elements that are essential to catalyst the Smart Manufacturing.

- The results of this innovation are digitization and integration of vertical and horizontal value chains, digitization of product and service offerings and digital business models and customers access.

(Hermann, Pentek & Otto, 2015; Kennedy, 2015; Kurfuss, 2014; Salkin et al., 2018)
Regions specialized in a certain activity ensure a high level of competitiveness in a global perspective, in which activity is a catalyst of spillover effect, contributing to the leverage of the organization and their stakeholders, consequently, reflecting in the regional development and the formation of cluster of innovation.

Methodology

- Official data and a descriptive approach.

**Analysis tool:**

- The case study on web sites of Paraná cooperatives uses a qualitative methodology, applying the dedicated web site analysis guideline proposed in Andreica (2009). Within the analysis, we use dedicated website analyzers, which also include quantitative data and traffic analyses, such as Alexa.com, Websiteoptimization.com, Checkmycolours.com.

- **Locational Quotient (LQ)** – To show the more specialized sectors (it can be used to show potential cluster/sectors) in sector \(i\), region \(j\), with a reference region \(t\) (Paraná State)

\[
LQ = \frac{FE_{ij}/FE_{it}}{FE_{tj}/FE_{tt}}
\]
Preliminary Results
Results and Discussion

Added Tax Value, by sectors - 2016

Paraná State
- Primary Production: 21.38%
- Industry: 42.29%
- Trade and Services: 36.33%

Western Paraná State
- Primary Production: 37.93%
- Industry: 34.94%
- Trade and Services: 27.13%

Source: prepared by the author based on IPARDES (2018).
Results and Discussion

Diagram of Added Tax Value per municipality - 2016

Source: search research.
Results and Discussion

Total Formal Employee in 2017 = 352,963

By sector:

Primary Production = 13,683 (3.88%)
Industry = 101,481 (28.75%)
Trade and Services = 237,799 (67.37%)

Industrial Sector:

- Extractive Mineral = 0.38%
- Manufacturing Industry = 83.70%
- Industrial Utility Services = 2.42%
- Building = 13.50%
# Manufacturing Industry (83.70%)

<table>
<thead>
<tr>
<th>IBGE Subsetor</th>
<th>Micro</th>
<th>Small</th>
<th>Midsize</th>
<th>Large</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Metallic Mineral Prod.</td>
<td>1.859</td>
<td>937</td>
<td>254</td>
<td>-</td>
<td>3.050</td>
<td>3.59%</td>
</tr>
<tr>
<td>Metallurgical industry</td>
<td>2.391</td>
<td>1.167</td>
<td>-</td>
<td>-</td>
<td>3.558</td>
<td>4.19%</td>
</tr>
<tr>
<td>Mechanical industry</td>
<td>1.622</td>
<td>1.091</td>
<td>1.240</td>
<td>-</td>
<td>3.953</td>
<td>4.65%</td>
</tr>
<tr>
<td>Electrical and Com.</td>
<td>228</td>
<td>224</td>
<td>120</td>
<td>-</td>
<td>572</td>
<td>0.67%</td>
</tr>
<tr>
<td>Transportation Material</td>
<td>554</td>
<td>244</td>
<td>-</td>
<td>1.339</td>
<td>2.137</td>
<td>2.52%</td>
</tr>
<tr>
<td>Wood &amp; Furniture</td>
<td>2.070</td>
<td>852</td>
<td>1.090</td>
<td>-</td>
<td>4.012</td>
<td>4.72%</td>
</tr>
<tr>
<td>Paper and Graphic Ind.</td>
<td>949</td>
<td>342</td>
<td>134</td>
<td>-</td>
<td>1.425</td>
<td>1.68%</td>
</tr>
<tr>
<td>Rubber, Smoke, Leather</td>
<td>682</td>
<td>457</td>
<td>373</td>
<td>-</td>
<td>1.512</td>
<td>1.78%</td>
</tr>
<tr>
<td>Chemical industry</td>
<td>826</td>
<td>904</td>
<td>1.495</td>
<td>3.831</td>
<td>7.056</td>
<td>8.31%</td>
</tr>
<tr>
<td>Textile industry</td>
<td>1.793</td>
<td>3.302</td>
<td>1.437</td>
<td>635</td>
<td>7.167</td>
<td>8.44%</td>
</tr>
<tr>
<td>Footwear Industry</td>
<td>65</td>
<td>283</td>
<td>239</td>
<td>-</td>
<td>587</td>
<td>0.69%</td>
</tr>
<tr>
<td>Food and beverage</td>
<td>2.556</td>
<td>4.770</td>
<td>5.846</td>
<td>-</td>
<td>36.738</td>
<td>49.910</td>
</tr>
<tr>
<td>Total</td>
<td>15.595</td>
<td>14.573</td>
<td>12.228</td>
<td>42.543</td>
<td>84.939</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

%                | 18.36% | 17.16% | 14.40% | 50.09% | 100.00% |
Results and Discussion

Locational Quotient (LQ) of agriculture and livestock in Municipalities of Western Paraná State - 2017

Legend
- Municipalities
- Not cluster of agriculture and livestock
- Cluster of agriculture and livestock

Source: search results.
Results and Discussion

Number of Locational Quotient (LQ) of Secondary sector of Western Paraná State - 2017

- Food, beverage and ethyl alcohol industry: 24
- Non-metallic mineral products industry: 23
- Textile, clothing and fabric artefacts industry: 21
- Wood and furniture industry: 17
- Metallurgical industry: 11
- Mechanical industry: 10
- Mineral Extraction: 8
- Footwear industry: 7
- Rubber, tobacco, leather, animal pelt and similar products and miscellaneous industry: 6
- Construction: 5
- Industrial services of public utility: 4
- Chemical, pharmaceutical, veterinary, perfumery, soap, candles and plastics industry: 3
- Electrical and communications material industry: 3
- Transportation material industry: 1
- Paper, cardboard, publishing and graphic industry: 0

Source: search results.
Results and Discussion

Locational Quotient (LQ) of food industry and number of large size companies per municipality of Western Paraná State - 2017

These large size companies create strong production chains, concentrating the transformation of production in these municipalities, and generating linkages based on the demand for raw materials from surrounding municipalities.
Results and Discussion

Number of Locational Quotient (LQ) of Tertiary sector of Western Paraná State - 2017

<table>
<thead>
<tr>
<th>Category</th>
<th>LQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct and indirect public administration</td>
<td>40</td>
</tr>
<tr>
<td>Wholesale</td>
<td>30</td>
</tr>
<tr>
<td>Retail trade</td>
<td>26</td>
</tr>
<tr>
<td>Credit, insurance and capitalization institutions</td>
<td>18</td>
</tr>
<tr>
<td>Transportations and communications</td>
<td>11</td>
</tr>
<tr>
<td>Education</td>
<td>8</td>
</tr>
<tr>
<td>Housing, food, repair, maintenance, broadcasting and television services</td>
<td>5</td>
</tr>
<tr>
<td>Medical, dental and veterinary services</td>
<td>2</td>
</tr>
<tr>
<td>Real estate management, securities, professional technical services, economic activity auxiliary</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: search results.
Results and Discussion

Locational Quotient (LQ) of direct and indirect public administration and Formal Employment (FE) higher than 25% per Municipalities of Western Paraná State - 2017

In many of these municipalities the city hall is the largest “company”
New media tools used by some representative large companies
Case Study on Main Cooperative Websites from Paraná State

- According to a ranking performed in Paraná State (Ranking, 2018), the three biggest cooperatives in Paraná are:
  - **Coamo** - [http://www.coamo.com.br/site/](http://www.coamo.com.br/site/) (with the central point in East Paraná and farms also in West Paraná)
  - **Lar** - [http://www.lar.ind.br/v4/](http://www.lar.ind.br/v4/)
Results and Discussion

Locational Quotient (LQ) of food industry and number of large size companies per municipality of Western Paraná State - 2017

Legend
- Not Cluster of Food Industry
- Cluster of Food Industry
- Cluster of Food Industry with one large size company
- Cluster of Food Industry with two large size companies
- Cluster of Food Industry with three large size companies

4,785 (CVale)
5,599 (Lar)

Source: search results.
# NEW MEDIA TOOLS

<table>
<thead>
<tr>
<th>Feature</th>
<th>Coamo Website</th>
<th>CVale Website</th>
<th>Lar Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Rank</td>
<td>1,183,934</td>
<td>832,904</td>
<td>1,561,198</td>
</tr>
<tr>
<td>Rank in Brazil</td>
<td>33,203</td>
<td>30,585</td>
<td>-</td>
</tr>
<tr>
<td>Traffic from Brazil</td>
<td>100.0%</td>
<td>97.7%</td>
<td>-</td>
</tr>
<tr>
<td>Bounce rate</td>
<td>60.0%</td>
<td>35.7%</td>
<td>18.20%</td>
</tr>
<tr>
<td>Daily page views per visitor</td>
<td>4.7</td>
<td>2.6</td>
<td>3.3</td>
</tr>
<tr>
<td>Daily time on site (min)</td>
<td>2:25</td>
<td>2:37</td>
<td>4:19</td>
</tr>
</tbody>
</table>

Bounce rate: the percentage of visitors who navigate away from the site after viewing only one page.
Conclusion

- The region has a high potential of specialization and productive chains.
- The analysis indicates that the agriculture and livestock farming is the “driving force” of the region.
- The development of food industry can be related to improvement of agriculture and livestock farming.
- The efforts and investments in implementing automation in the agriculture and livestock farming can strongly impact the regional development of the Western Parana State.
Next steps:

- Characterize the large food and beverage industry according to the use of technology and verify whether they use elements of industry 4.0, or industry 3.0 or earlier.
  - By application of questionnaires and interviews with company administrators.

- According to the potential use of the elements that characterize industry 4.0 we want to verify the possible impacts that the region may feel in terms of employment and income.
  - This methodology has not yet been developed.
Thank you for your attention!

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