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Using industry 4.0 tools for increasing competitiveness of Clusters in Western Paraná

Usando ferramentas da indústria 4.0 para aumentar a competitividade dos Clusters no Oeste do Paraná

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ABSTRACT
The goal of this paper is to identify the main Industry 4.0 production model characteristics and the main productive clusters of Western Parana State, as well as to perform a web sites analysis of the main cooperatives in this region. Industry 4.0 is a German concept which arose in 2011 as a part of the strategy of high technological development in the country manufacturing and it quickly spread throughout the world. Some of the main characteristics of this production model are the use of Internet of Things platforms, mobile devices, big data, augmented reality, cloud computing, cybersecurity, etc. As methodology, we used the Locational Quotient to identify the main productive clusters. We also present a case study on the new media tools used by some representative cooperatives in the region. The results showed that agriculture, livestock farming, and food industry are the sectors which presented the highest number of productive clusters. Regarding the new media tools, we conclude that the efforts and investments in implementing automation in the agriculture and livestock farming can strongly contribute to the regional development of the region. The conclusion is that there is a huge potential to incorporate the elements of Industry 4.0 into the main sector of Western Paraná.

Key words: Industry 4.0, Clusters, Agribusiness, Development, Western Paraná State

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RESUMO

O objectivo deste documento é identificar as principais características do modelo de produção da Indústria 4.0 e os principais clusters produtivos do Estado do Paraná Ocidental, bem como realizar uma análise dos sítios web das principais cooperativas desta região. Industry 4.0 é um conceito alemão que surgiu em 2011 como parte da estratégia de desenvolvimento tecnológico elevado no país fabricante e que se espalhou rapidamente por todo o mundo. Algumas das principais características deste modelo de produção são a utilização de plataformas Internet das Coisas, dispositivos móveis, grandes dados, realidade aumentada, cloud computing, ciber-segurança, etc. Como metodologia, utilizámos o Quociente Locacional para identificar os principais clusters produtivos. Apresentamos também um estudo de caso sobre os novos instrumentos de comunicação social utilizados por algumas cooperativas representativas na região. Os resultados mostraram que a agricultura, a pecuária e a indústria alimentar são os sectores que apresentam o maior número de pólos produtivos. Relativamente aos novos instrumentos de comunicação social, concluímos que os esforços e investimentos na implementação da automatização na agricultura e pecuária podem contribuir fortemente para o desenvolvimento regional da região. A conclusão é que existe um enorme potencial para incorporar os elementos da Indústria 4.0 no sector principal do Oeste do Paraná

Palavras-chave: Indústria 4.0, Agronegócios, Agronegócios, Desenvolvimento, Oeste do Estado do Paraná.

1 INTRODUCTION

Means of production have continuously suffered transformations since the beginning of human civilization. Some of these transformations marked 'eras' due to their impact on economy, culture and lifestyle. The current means of production are a result of a series of revolutions main catalyzed by technological evolution.

The First Industrial Revolution, which started at the end of the 18th century, was characterized by the introduction of machines, leading to the substitution of the handicraft in the productive sector. Mechanical methods and the use of steam energy were also introduced in this period. Afterwards, the beginning of the 20th century was marked by the Mass Production Era, known as the Second Industrial Revolution, in which assembly lines were introduced and developed in order to ensure a large scale economy production with low costs and standardized products. The emerging of electric energy and the division of labour contributed to this set of changes. In the 1970s, the automation and the implementation of Information Technology (IT) in the production process characterize the Third Industrial Revolution, also called as the "digital revolution" (FIRJAN, 2016).

Hence, various opportunities have occurred in the production model. Technological evolution strongly impacts on productivity, quality management, and reducing costs. Some of the main characteristics of this production model are the use of Internet of Things platforms, mobile

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devices, location detection technologies and smart sensors, big data, augmented reality, cloud computing, cybersecurity, and others. In other words, this is the Industry 4.0 era, also known as Forth Industrial Revolution (BARTODZIEJ, 2017).

Additionally, the location factor can also be highlighted in the innovation process due to its influence on collective actions. Regions specialized in a certain activity ensure a high level of competitiveness in a global perspective, in which their activity becomes a catalyst of a spillover effect in the whole region and supply chains. In other words, regions which were not related to the national economy in the past, with a specialization in a certain activity, could improve their production model in a targeted manner, contributing to the leverage of the organization and their stakeholders, consequently, reflecting their activity in the regional development and the formation of innovation clusters.

Industry 4.0 is a new approach of production which requires a detailed analysis to ensure an efficient implementation and development in organizations. Cluster formation in a certain sector of activity can stimulate the innovation process, pursuing this new production framework. The goal of this paper is to identify the main characteristics of the Industry 4.0 production model and the main productive clusters of Western Parana State, as well as to perform a web sites analysis of the main cooperatives of this region. We started publishing our research on these topics in Alves, Andreica & Alcantâra (2019).

2 LITERATURE OVERVIEW OF THE INDUSTRY 4.0 CONCEPT

The Industry 4.0 is a German concept that arose in 2011 as a part of the strategy of high technological development in the country manufacturing and it quickly spread throughout the world, mainly in Central European countries. The competitivity level of a country can be measured by analyzing its characteristic drivers and structure of production.

Hermann, Pentek, and Otto (2015) describe that German Federal Government announced the "High-Tech Strategy 2020 for Germany" initiative in 2011 aiming at improving the technological innovation leadership. Hence, the "*Industry* 4.0 Working Group" was developed as an association of representatives from academia, business and politics. Industry 4.0 is also known as Fourth Industrial Revolution, Advanced Manufacturing, Integrated Industry, Smart Manufacturing and Industrial Internet. The Federal Ministry of Education and Research of Germany (2014) highlights the impacts of the country's position as a future center for production and a leading provider for such technologies related to the interest of both companies and the labour market.

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Among the elements of the high-tech strategy, the Federal Ministry of Education and Research of Germany (2014) points to the priority challenges regarding: value creation and quality of life, networking and transfer, the pace of innovation in industry, innovation friendly-framework, transparency and participation. In order to achieve these challenges, the elements of the high-tech strategy are organized in six tasks, as follows: digital economy and society, sustainable economy and energy, innovative workplace, healthy living, intelligent mobility, civil security. The Information and Communications Technologies (ICT) are also linked to the Industry 4.0 concept, within which a successful development and integration of these tools plays a decisive role in the improvement of the production means.

The insight report of the World Economic Forum (2018) described the profile of 75 countries and classified them in respect with their structure of production (complexity and scale) and drivers of production (technology and innovation, human capital, global trade and investments, institutional framework, sustainable resources, demand environment) characteristics. The country archetypes are classified into four categories: Leading, Legacy, High-potential, and Nascent. According to this survey, most of the studied countries got a low level of readiness for the future of production (58%), including Brazil, indicating that investments are essential to prepare and capitalize them for opportunities towards their future production. The leading archetype represents 25% of the amount of studied countries, indicating that leader countries are occupying a competitive place and are also well positioned for the future production, being able to achieve a 'first mover's' advantage.

The Brazilian agenda for Industry 4.0 points out important impacts on productivity, cost reduction, management in the production process, production customization and a deep transformation of the manufacturing plants. The Brazilian Agency of Industrial Development (in Portuguese, *Agência Brasileira de Desenvolvimento Industrial* – ABDI) estimates that the development of the 4.0 concept in industries can lead to a total cost reduction of R$ 73 billion per year and an important relative growth in the GDP (Gross Domestic Product).

It is important to highlight that Industry 4.0 consists in a set of smart processes where some technological elements are essential to 'catalyze' the Smart Manufacturing. The results of this innovation are: digitization and integration of vertical and horizontal value chains, digitization of product and service offerings, digital business models and customers' access.

Industry 4.0 is stimulating the development of new technologies that are changing the global production system (WORLD ECONOMIC FORUM, 2018). According to PWC (2016), among its main characteristics, there are the use of Internet of Things (IoT) platforms, mobile devices, location detection, advanced human-machine interfaces, authentication and fraud detection, 3D printing,

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smart sensors, big data, multi-level customer interaction and customer profiling, augmented reality/wearables, and cloud computing.

Salkin et al. (2018) sustain that a coordinated system following the 4.0 concept allows a real time decision making and autonomy in the business processes. In other words, this model of production enables the establishment of added value networks through the integration of facilities, supply chain and service systems.

2.1 CLUSTERS OF INNOVATION

A cluster is an agglomeration of companies in a same geographic region, which acts in a common activity sector. North (1955) states that the success of a region is related to the activity that is its exportation base. In contrast, Perroux (1955) holds that regional development is manifested in different poles through some factors that are specific to a certain area. For both, clustering propagates through different channels, with different results in economy. Porter (1998) points out that clustering determines an outstanding characteristic of a nation, state, and region, and that clustering is not unique, but presents typical elements for a region, which differentiate it from other regions, such as knowledge, relationships and motivation. Thus, companies operating in a cluster have a greater competitive advantage compared to non-cluster ones. Hence, Porter (1989) mentions that the location choice is not only related to the costs of local factors, but also to conducted research and development, as well as access to specialized knowledge, and develops relationships with important customers, the country's conditions and the laws governing a region. Therefore, locational choices are motivated by the corporation strategy, research and development. The author also relates the competitive advantage to locational factors, in which, according to the author, the characteristics of the economic structure, culture, values, institutions and national history are elements which define the success of the region.

Friedmann (1956) highlights the importance of relationship networks in the innovation process, as well as of external international connections, connections with technical and scientific institutions, with the national education system, government policies, industrial relations, cultural traditions and various institutions. Souza (2009) describes that each region has its own economic dynamism, which influences the attraction (or repulsion) of production factors. Smart regions are spatially favourable territories for the development of a relationship culture and collective learning dynamics, within which the production of knowledge and innovation are strategic elements. This dynamic regional interaction reduces the risks and uncertainties linked to innovation, which stimulates regional development as a whole.

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Schumpeter (1997) describes that innovation can occur from the "destructive creation", i.e. the substitution of old products and habits with new ones. Therefore, the economic development becomes the result of a relationship among innovation and the creation of new markets and entrepreneurship actions. Porter (1989) describes that changes are necessary for the maintenance, enlargement and improvement of economic advantage, for acquiring sustainability and for exploring and identifying the market tendency.

Organizations seek innovations in order to reduce their production costs through the development of new technologies. When these transformations are effective in the production process, productivity and the quantity of products offered in the market increase. Thus, the early adopters of such innovation become more profitable. Over time, however, given the greater supply of products on the market, prices tend to fall, causing the excess profit to disappear. Therefore, latecomers, unable to innovate, will also be unable to remain on the market; this phenomenon is known as the Treadmill Effect (Vieira Filho, Fishlow, 2017).

3 METHODOLOGY

Brazil is a country of continental dimensions. The state of Paraná is located in the South region and is comprises 399 municipalities. The Western meso-region is formed by 50 municipalities, as shown in the Figure 1.

Figure 1: Brazilian Federative Units, Paraná and the Western Mesoregion/Municipalities (Prepared by the authors)

This paper uses a descriptive approach; as methodology, we used the Locational Quotient (LQ) in order to identify the main productive clusters, using the number of formal employments as data source from RAIS (*Relação Anual de Informações Sociais*, 2018). Other data source as Ministry of Agriculture, Livestock and Food Supply (in Portuguese, *Ministério da Agricultura,*

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Pecuária e Abastecimento, 2018) and the Secretariat of Finance (in Portuguese, *Secretaria da Fazenda*, 2018) were also used for analyzing the results.

The LQ is an indicator which allows to identify the locational behaviour in a certain sector, as well as the activity specialization in a region (Alves, 2012). The number of formal employments, organized in 25 sectors of activity, (according to the Brazilian Institute of Geography and Statistic - IBGE classification) were analyzed in the Paraná State, set as the reference region. Equation (1).

$$LQ = \frac{FE_{ij}/FE_{it}}{FE_{tj}/FE_{tt}} \qquad (1)$$

Where FE_{ij} is the number of Formal Employment (FE) of a sector i in the municipality j; FE_{it} is the amount of FE of the sector i in the Paraná State; FE_{tj} is the amount of FE in the region j; and FE_{tt} is the total of FE in the Paraná State. The results of the equation (1) will vary in a range between zero and infinity, where values greater than 1 indicate that the studied sector has a high local importance, a specialization (cluster) of the corresponding sector.

The case study on web sites of Paraná State 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, Nibbler.silktide.com, Websiteoptimization.com, and Checkmycolours.com.

4 RESULTS AND DISCUSSION

Value Added Tax (VAT) is an index of economic accounting used by governments to calculate the value of product according to each stage of production or distribution. Using this indicator, it is possible to compare the economic structure characteristics among regions (Secretaria da Fazenda, 2018). The industrial sector is predominant in the State of Paraná, followed by trade and services and the primary production. However, the share of the economic structure of the Western Paraná State has a peculiarity compared to the rest of the State. The primary production, marked by the agriculture and livestock farming, generates almost 40% of VAT, indicating the high potential and the dependence of this sector. The secondary sector (industrial) is responsible for almost 35% of VAT. In contrast with the whole Paraná State, the trade and services sector occupies the third position, being a parcel of 27% of the economic structure of the meso-region under study. Figure 2 presents VAT data per municipalities.

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Figure 2: Diagram of VAT per municipality, 2017 (Prepared by authors)
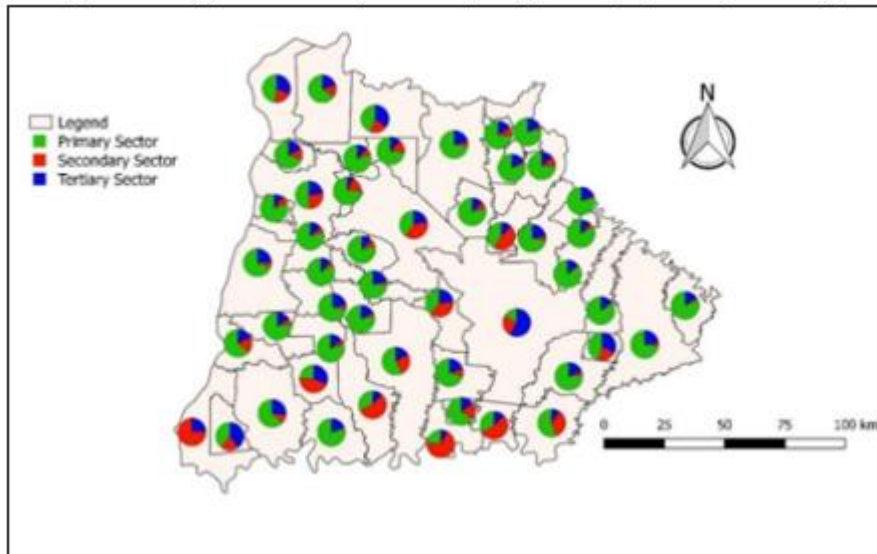
When analysing the total VAT, we can see that the majority of municipalities have the primary sector as the most important one. In some cases, the primary sector has more than 80.00% as share, like in Braganey, Campo Bonito, Iguatu, São José das Palmeiras, Diamante do Sul, Pato Bragado, Nova Santa Rosa and Iracema do Oeste. In few municipalities we can see the industrial sector as the first one, only in Foz do Iguaçu, Capitão Leônidas Marques, Matelândia, Boa Vista da Aparecida, Cafelândia, Medianeira and Toledo. Cascavel is the biggest municipality from the absolute population and VAT points of view and it is the only one with the tertiary sector as the biggest one. This city is the center of the region, the first one in the network of cities and a service center in the region. When we look into the formal employment as the analyzed variable, the results are different. We present the agglomerations (LQ>1) which stand out according to each economic sector.

4.1 THE PRIMARY SECTOR

Agriculture and livestock farming were the sectors which presented the highest number of agglomerations in Western Paraná, where 42 municipalities got LQ greater than one, ie, this meso-region has a high potential of specialization in this sector. The 42 municipalities displayed in green colour in Figure 3 presented LQ>1.

The LQ of the municipalities Cafelândia, Capitão Leônidas Marques, Cascavel, Foz do Iguaçu, Guaíra, Matelândia, Santa Lúcia and Toledo in the agriculture and livestock farming sector is lower than one. Therefore, it is possible to conclude that due to the dynamism of these municipalities, this is not the most relevant sector of their activity. However, it does not mean that

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these municipalities would have a lower importance in this sector. The higher number of formal employments in agriculture and livestock farming sector is in Cascavel (2,374 formal employment), followed by Toledo (1,552 formal employment).

The gross value of Paraná's agricultural production (GVP) was R$ 70.2 billion in 2017 (12.1% of the total Brazilian production). Among the 399 municipalities in Paraná State, the gross value of Toledo's production was the highest in the State, R$ 2.2 billion, which represents 3.1% of Paraná's production. Cascavel occupies the second position, R$ 1.5 billion (2.2%).

Figure 3: LQ>1 of agriculture and livestock in Municipalities of Western Paraná State, 2017 (Prepared by authors)
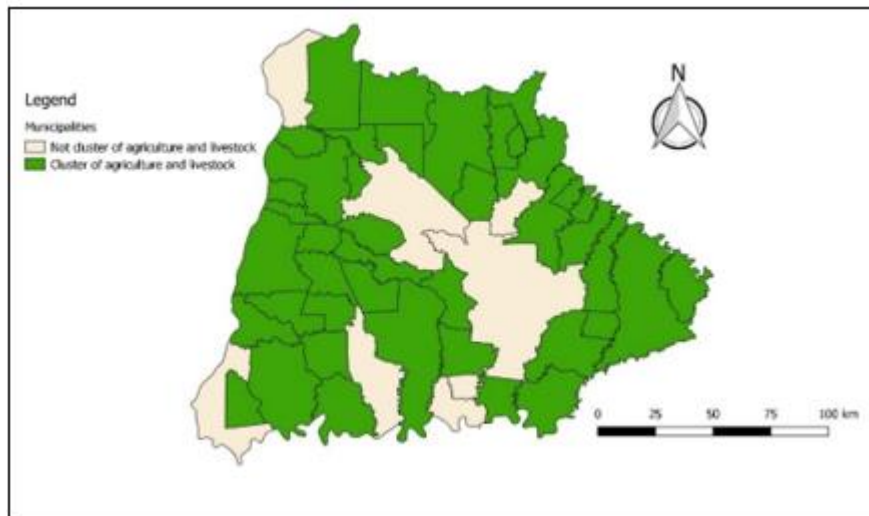

When analyzing the other six municipalities which also presented lower LQ in the agriculture and livestock sectors, Cafelândia occupies the 23rd position (0.8% of the total GVP of Paraná), followed by Matelândia (39th and 0.6%), Guaíra (98th and 0.4 %), Capitão Leônidas Marques (144th and 0.3%), Santa Lúcia (252nd and 0.2%) and Foz do Iguaçu (277th and 0.2%). In other words, the agricultural production of these municipalities is important in the State, but facing its formal employment dynamism, other sectors are also relevant in the region, which justifies the lower value of its LQ in the agricultural and livestock farming sectors when analyzing the employment variable.

4.2 THE SECONDARY SECTOR

Graph 1 presents the number of clusters which have the secondary sector (industrial activities) as a sector of activity. Among the industrial activities, the food sector is predominant in Western Paraná, as we can see when analyzing the share of these sectors in the secondary sector

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total number of employments. The potential of the food industry can be influenced by the agricultural sector, this being an example of the spillover effect.

Graph 1: Number of LQ>1 of Secondary sector in Western Paraná State, 2017 (Prepared by authors)
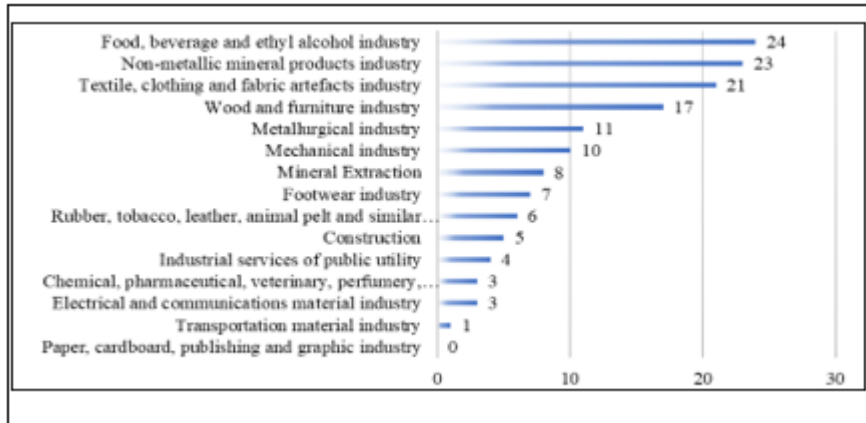
Costs of local factors in Western Paraná can be a competitive advantage, which justifies the consolidation of the food industry in this region. In 24 municipalities, the result of LQ shows that the food industry sector can be considered a cluster with a potential level of specialization. Figure 4 shows the municipalities whose LQ result is greater than one in the food industry sector.

Figure 4: Figure 4: LQ>1 of food industry and number of large size companies per municipality of Western Paraná State, 2017 (Prepared by authors)
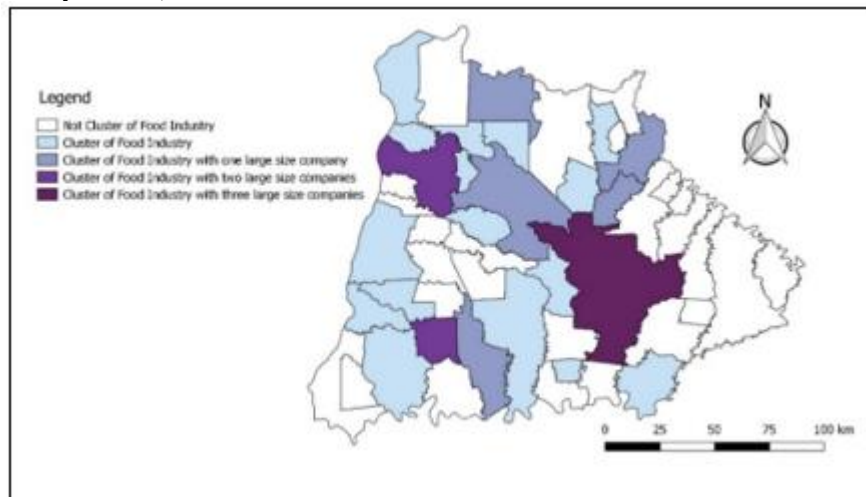
There are 750 food industries in Western Parana, of different sizes, which employ 49,910 people. Cascavel is the municipality which has the greatest number of food industry companies (177), followed by Toledo (138) and Foz do Iguaçu (84). When analyzing the presence of large establishments, we can notice the importance of this sector. Among the large size food industries with more than 500 employees, three are located in Cascavel, two in Medianeira, two in Marechal

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Cândido Rondon, and the others five are located in Toledo, Palotina, Matelândia, Nova Aurora and Cafelândia. These 12 large establishments employ 36,738 people, or 74% of the total food industries. Small companies are predominant in the region because almost half of the food industry companies (318) employ only about 1 to 4 workers per establishment.

4.3 THE TERTIARY SECTOR

The tertiary sector is related to commerce and service. Graph 2 presents the number of clusters with LQ>1 in the tertiary sector in Western Paraná State.

The highest number of LQ>1 of tertiary sector is direct and indirect public administration (40), followed by wholesale (30) and retail trade (26).

Graph 2: Number of LQ>1 of Tertiary sector in Western Paraná State, 2017(Prepared by authors)
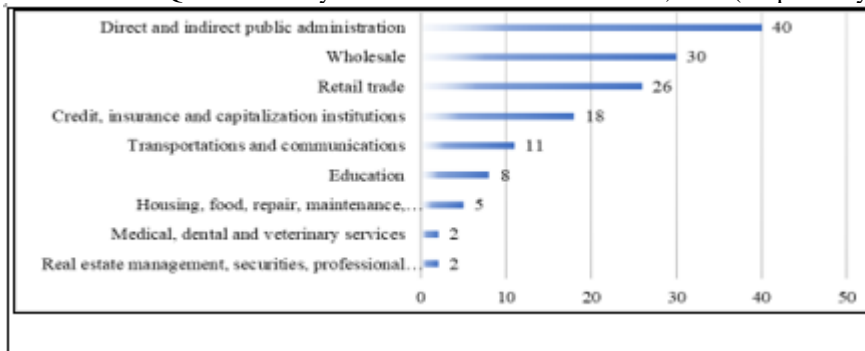

Figure 5 shows the municipalities of Western Paraná, where the ones which presented LQ over than 1 is highlighted in the blue colour. Red points indicate the municipalities in which the Formal Employment of direct and indirect public administration represents more than 25% of the total FE.

Figure 5: LQ>1 of direct and indirect public administration and Formal Employment (FE) higher than 25% per Municipalities of Western Paraná State, 2017 (Prepared by authors)

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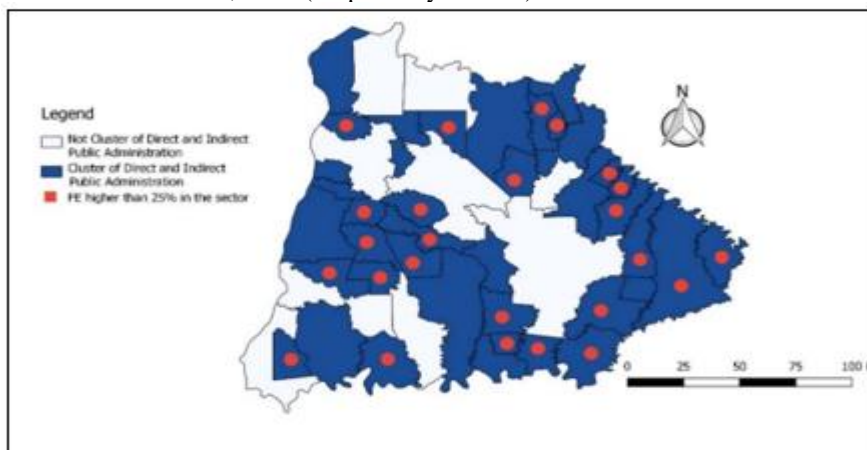
On one hand, it is noticeable that the public service is essential to stimulate the regional development. Thus, among the 25 analyzed sectors, agriculture, livestock farming, food industry and direct and indirect public administration are the most important sectors in Western Paraná, indicating a potential level of specialization. In addition, investments in these activities can also result in a spillover effect, contributing to regional development and the formation of innovation clusters due to the agglomeration of organizations and the advance of technology. The automation and the development of the 4.0 model of production in agriculture, livestock farming and food industry can improve the quality production, productivity, integration of chains, generating a competitive advantage on the global market.

5 CASE STUDY ON MAIN COOPERATIVE WEBSITES FROM PARANÁ STATE

Within the Industry 4.0 framework, ICT tools bring proficient advantages to companies. In this respect, sites are one of the most efficient promotion tools for companies in order to promote their products, services and attract clients. In this framework, we comparatively analyze the website efficiency of three important cooperatives from Paraná state (Alves, Andreica, Alcantâra, 2019).

According to a ranking performed in Paraná State, the three biggest cooperatives in Paraná are Coamo <http://www.coamo.com.br/site/> (with the central point in East Paraná and farms also in West Paraná), CVale <http://www.cvale.com.br/> and Lar <http://www.lar.ind.br/v4/>. We have maintained Coamo website in our study both since it is also located in Western Paraná and from comparative analysis reasons.

We further present results regarding traffic analysis, qualitative indicators for the analyzed websites, download speeds and site readability data, analyses known as webanalytics. All these results aim at evaluating the quality of the analyzed websites, higher scores in these analyses being related to better results in reaching the promotion of their products towards the clients by means of electronic tools, a core activity of Industry 4.0

5.1 TRAFFIC ANALYSIS

According to Alexa traffic analyzer https://www.alexa.com/siteinfo/coamo.com.br accessed in November 2018, Coamo website ranked 1,183,934 worldwide and 33,203 in Brazil – see Figure 6.

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Figure 6: Overall traffic analysis on Coamo website - Author analysis using https://www.alexa.com/siteinfo/coamo.com.br accessed in November 2018.

The bounce rate – percentage of visitors who access the site but exit immediately without browsing is quite high: 60% (with a negative increasing tendency), the average number of pages visited daily by a visitor is 4.7 (with a positive increasing tendency) and the daily time spent on the site is 2.25min (with a positive increasing tendency). The analyzer also displays the main keywords in search engines, which are very important for search engine optimization purposes, in order to make the site more visible.

We further discuss the data provided by Nibbler analysis on Coamo website. The overall results are given in Figure 7, the overall grade of the website on a scale 1-10 being 6.9. We notice one of the weak points being the lack of integration with social media accounts. The highest grade is obtained for the accessibility of the site (a combined item including mobile access and other site accessibility characteristics): 7.5

Figure 7: Evaluation data provided by Nibbler analyzer on Coamo website - Author analysis in November 2018 using <http://nibbler.silktide.com/en_US/reports/www.coamo.com.br> tics): 7.5

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We further detail specific characteristics of the website, according to Nibbler analyzer. The social interest indicator counts the number of shares of the website pages in social media; the grade provided by Nibbler for this item is 6.9 (Figure 8). The amount of content is relevant for the content that is made available to the clients; the grade provided by Nibbler for this item is quite high: 7.8 (Figure 9).

Figure 8: Social interest item analyzed by Nibbler on Coamo website - Author analysis with Nibbler, November 2018

Figure 9: Amount of content item analyzed by Nibbler on Coamo website - Author analysis with Nibbler, November 2018

The site is adapted to mobile devices, the devices which are mostly used within the Industry 4.0 IT tools generation. This item is therefore very important, and the grade provided by Nibbler analyzer is the highest: 10 (Figure 10).

Figure 10: Mobile access item analyzed by Nibbler on Coamo website - Author analysis using Nibbler, accessed in November 2018

We further present the results obtained consequent to analyzing **CVale website**. According to Alexa traffic analyzer https://www.alexa.com/siteinfo/cvale.com.br, CVale website ranked 832,904 worldwide and 30,585 in Brazil, better ranked than Coamo (Figure 11). The bounce rate is fairly good: 35.7% (with a positive decreasing tendency), the average number of pages visited daily by a visitor is 2.6, lower than for Coamo (a positive increasing tendency) and the daily time spent on the site is 2.37min, fairly similar to Coamo (a positive increasing tendency). The analyzer also displays the main keywords in search engines, which are very important for search engine optimization purposes and site visibility.

We further provide the results obtained by using Nibbler analysis http://nibbler.silktide.com/en_US/reports/www.cvale.com.br on CVale website. The overall Nibbler results are given in Figure 12, the overall grade of the website on a scale 1-10 being 7.3, slightly higher than for Coamo. We notice one of the weak points being the lack of integration with social media accounts. Accessibility and technology combined items are – the best rated ones – are graded with 6.9, respectively 7. The site is not integrated with facebook and Twitter, even though the company has a Facebook page.

Figure 11: Overall traffic analysis on CVale website - Author analysis using https://www.alexa.com/siteinfo/cvale.com.br accessed in November 2018.

The mobile device adaptation has a very low grade 2.6 (Figure 13), showing no adaptation to mobile devices, item which should be improved since most users use nowadays mobile devices.

Figure 12: Evaluation data provided by Nibbler analyzer on CVale website - Author analysis using Nibbler, Nov. 2018

Figure 13: Mobile access item analyzed by Nibbler on CVale website - Author analysis using Nibbler, November 2018

The amount of content is relevant for user information, communication and interaction purposes. The grade provided by Nibbler for this item is not very good, 6, almost 2 points smaller than for Coamo – see Figure 14. Internal links also have to be improved with describing their destination for all links – the grade for this item is 6.6.

The promotion in social media is also very important, therefore the Facebook interaction indicator provides relevant data. The grade provided by Nibbler for this item is 7.3, only slightly higher than for Coamo – see Figure 15.

We further present the results obtained consequent to analyzing **Lar website**. According to Alexa traffic analyzer https://www.alexa.com/siteinfo/lar.ind.br, Lar website ranked 1,561,198 worldwide the lowest rank among the analyzed websites (Figure 16).

Figure 14: Amount of content item analyzed by Nibbler on CVale website – Author analysis using Nibbler analyzer, November 2018

Figure 14: Amount of content item analyzed by Nibbler on CVale website – Author analysis using Nibbler analyzer, November 2018

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The bounce rate has a very good value, the best among the analyzed websites: 18.2 % (with a positive decreasing tendency), the average number of pages visited daily by a visitor is 3.3 (positive increasing tendency), between the values of Coamo (best) and CVale and the daily time spent on the site is 4.19min (positive increasing tendency), the best among the analyzed websites. The same analyzer also displays the main keywords in search engines, which are very important for search engine optimization purposes and increasing the visibility the site.

Figure 16: Overall traffic analysis on Lar website: Author analysis using https://www.alexa.com/siteinfo/lar.ind.br accessed in November 2018

We further provide the results obtained by using Nibbler analysis http://nibbler.silktide.com/en_US/reports/www.lar.ind.br on Lar website.

The overall Nibbler results are given in Figure 17, the overall grade of the website on a scale 1-10 being 7.9, the best among the analyzed websites. We notice that one of the weak points is the lack of integration with social media accounts. Accessibility combined item has the highest grade among the analyzed websites 8.5, while technology combined item is rated with 7.8 and experience combined item – with 7.7, the highest grades among the analyzed websites.

Figure 17: Evaluation data provided by Nibbler analyzer on Lar website, accessed in November 2018 – Author analysis using Nibbler

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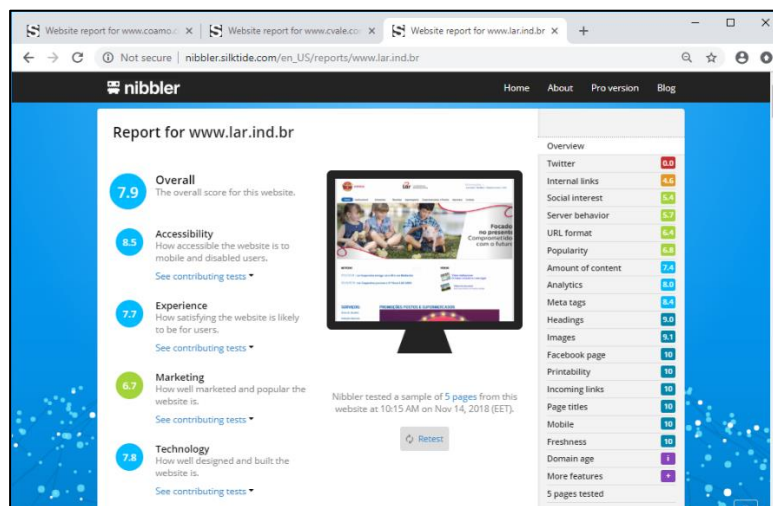
The Facebook page has a fairly low popularity, the lowest among the analyzed websites, rated with 5.4, see Figure 18, therefore it should be improved. The amount of content is relevant in order to promote the company's products towards the clients; for Lar website, this item has been rated with 7.4 (Figure 19), slightly lower than for Coamo and higher than for CVale.

Figure 18: Social interest item analyzed by Nibbler on Lar website – Author analysis using Nibbler analyzer, November 2018

Figure 19: Amount of content item analyzed by Nibbler on Lar website – Author analysis using Nibbler analyzer, November 2018

Integration and management of images (with defined sizes, contributing to a good display) is very good within Lar site, this item being rated with 9.1, a high grade (Figure 20).

Figure 20: Images item analyzed by Nibbler on Lar website – Author analysis using Nibbler analyzer, November 2018

Figure 21: Lar's facebook page analyzed by Nibbler on Lar website – Author analysis using Nibbler analyzer, November 2018

Figure 22: Mobile access item analyzed by Nibbler on Lar website – Author analysis using Nibbler analyzer, November 2018

Lar's Facebook page has a very good evaluation result, being rated with the maximum grade 10 (Figure 21), and Lar site adaptation to mobile devices is also very good, this item being also rated with the maximum grade 10 (Figure 22).

5.2 SIZE AND DOWNLOAD SPEED

We further analyze website size and download speed using Weboptimization analyzer: http://www.websiteoptimization.com/services/analyze/. For Coamo website, Weboptimization does not generate a full speed report, since the dimension of Coamo website is too large (which is not a good indicator, since it will be downloaded slowly). The same problem is encountered on CVale website: Weboptimization does not generate a full speed report, since the dimension of the C Vale's site is too large. Lar website has a dimension around 1.8MB and a loading speed of 18.8s on optical fiber, which is a rather slow download speed (Figure 23). The total numbers of HTML pages and external multimedia files are favourably evaluated, while there are warnings for the number of objects and images per page, the number of external scripts, total size of images and external scripts.

Figure 23 - Download times for Lar website, Author analysis using Weboptimization analyzer, November 2018

Connection Rate	Download Time
14.4K	1412.99 seconds
28.8K	711.09 seconds
33.6K	610.82 seconds
56K	370.17 seconds
ISDN 128K	119.75 seconds
T1 1.44Mbps	18.80 seconds

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5.3 COLOUR CONTRAST ANALYSIS

We present the contrast colour analysis of the three analyzed websites (Table 1).

Table 1 - Colour contrast analysis - Author analysis using Checkmycolours analyzer http://www.checkmycolours.com, November 2018

Website	Coamo	Coamo %	CVale	CVale %	Lar	Lar %
Number of tested elements	509	100	173	100	292	100
Luminosity contrast	257	50.49	38	21.97	48	16.44
Brightness difference	160	31.43	51	29.48	47	16.10
Colour difference	269	52.85	70	40.46	130	44.52

For Coamo website, the colour contrast analyzer has tested 509 elements, encountering luminosity contrast problems on 50% of the tested items, brightness difference on 31% of the tested elements and 53% of the tested items. For CVale website, the colour contrast analyzer has tested 173 elements, encountering luminosity contrast problems on 38% of the tested items, brightness difference on 51% of the tested elements and 70% of the tested items, the results being therefore less proficient than for Coamo. For Lar website, the colour contrast analyzer has tested 292 elements, encountering luminosity contrast problems on 16% of the tested items, brightness difference on 16% of the tested elements and 44.5% of the tested items, the results being therefore the best from the analyzed websites.

5.4 ANALYSIS SYNTHESIS AND RECOMMENDATIONS

Within this paragraph, we synthesize the previously described website analysis results. We synthesize the traffic and download analyses results in the tables below.

Table 2 - Alexa.com analysis – Author analysis using Alexa analyzer

Feature	Coamo Website http://www.coamo.com.br/site/	CVale Website http://www.cvale.com.br/	Lar Website http://www.lar.ind.br/v4/
Global Rank	1,183,934	832,904	1,561,198
Rank in Brazil	33,203	30,585	
Traffic from Brazil	100%	97.7%	
Bounce rate	60%	35.7%	18.20%
Daily page views per visitor	4.7	2.6	3.3
Daily time on site (min)	2:25	2:37	4:19
Dimension	3,015,076 bytes	3,420,474 bytes	1,811,220 bytes
Speed (download time) Weboptimization			18.8 s

Consequent to our analysis, we can conclude that, among the analyzed sites, the most accessed site is CVale, ranking 30,585 in Brazil, followed by Coamo, ranking 33,203 in Brasil and Lar; CVale also has a small percentage of traffic outside the country, which is a good point.

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The bounce rate (entering and exiting the site) is lowest on Lar website - 18.20%, followed by CVale website 35.7%. Coamo has quite a high rate of traffic bounce – 60%. The average time spent by a user on the site is the highest, among the analysed sites, for Lar – 4: 19min, followed by CVale website – 2:37min and Coamo website – 2:25min. The smallest dimension, therefore the highest download speed among the analyzed sites has Lar website – 1,811,220 bytes and 18:8s download time. CVale and Coamo websites have quite large dimensions, and, therefore, lower download speeds.

Table 3 - Nibbler analysis – Author analysis using Nibbler analyzer

Feature - Scale 1 (low) -10 (high)	Coamo Website http://www.coamo.com.br/	CVale Website http://www.cvale.com.br/	Lar Website http://www.lar.ind.br/
Overall grade	6.9	7.3	7.9
Accessibility	7.5	6.9	8.5
Experience	6.4	4.7	7.7
Marketing	5.5	5.9	6.7
Technology	6.6	7	7.8
Facebook page	0	0	10
Twitter	0	0	0
Internal links	0	6.6	4.6
Meta tags	2	10	8.4
Server behaviour	3.4	7.8	5.7
Headings	5	10	9
Popularity (using Alexa)	6.6	6.9	6.8
Social interest (using Google+, Facebook)	6.9	7.3	5.4
Amount of content	7.8	6	7.4
URL format	10	4.8	6.4
Printability	10	0	10
Images	10	10	9.1
Incoming links	10	10	10
Page titles	10	10	10
Analytics	10	10	8
Mobile	10	2.6	10
Freshness	10	10	10

According to Nibbler analyzer, the best of the three analyzed sites is Lar website, with an average grade of 7.9, followed by CVale website – with an average grade of 7.3 and Coamo website – 6.9. Detailed analysis figures are given in Table 3.

Checkmycolours analysis: From the colour readability point of view – see Table 1, CVale and Lar websites have the best results.

The studied companies should improve their sites in respect with the recommendations that were outlined in order to provide a better experience and IT quality services for their clients.

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6 CONCLUSIONS

Industry 4.0 is a new concept of production which arose in Germany in 2011 and has been spreading throughout the world in a quick way ever since. The results of these innovations are digitization and integration of vertical and horizontal value chains, digitization of product and service offerings and digital business models and customers access.

The Fourth Industrial Revolution has been developing rapidly and can be considered a new technological 'race'. Moreover, innovation and locational factors are essential in order to ensure a competitive advantage. On one hand, organizations which do not adopt this new model of production can lose an important market parcel and will encounter a reduction of their profit. This is the consequence of the Treadmill Effect. On the other hand, the development of organizations which use innovation and technological tools following the Smart manufacturing approach can stimulate their development and can also generate benefits to the region, stakeholders and the hole supply chain. This is the consequence of the Spillover Effect.

When analyzing the three economic sectors of activity, agriculture, livestock farming and food industry and direct and indirect public administration presented the highest number of productive clusters among the fifty municipalities of Western Parana, indicating that the region has a high potential of specialization and productive chains in these sectors.

Our analysis indicates that the agriculture and livestock farming is the predominant sector in Western Paraná, being considered the "driving force" of the region. The potential of this sector stimulates a Spillover Effect in the region, stakeholders and supply chain. Thus, the development of food industry can be related to the improvement of agriculture and livestock farming. We conclude that the efforts and investments in implementing automation in agriculture and livestock farming can strongly contribute to the regional development.

Regarding the website evaluation case study, we analyze the website of the biggest three cooperatives in Paraná: Coamo, CVale and Lar. Taking into account the traffic analysis, performed using Alexa.com analyzer, we can state that among the analyzed sites, the most accessed site is CVale, ranking 30,585 in Brazil, followed by Coamo – ranking 33,203 in Brazil and Lar. According to Nibbler analyser, measuring various qualitative websites indicators, the best of the three analyzed sites is Lar website, with an average grade of 7.9 (on a scale 1-10), followed by CVale website – with an average grade of 7.3 and Coamo website – 6.9. Lar also has the best loading speed.

The studied companies should improve their sites in respect with the recommendations that were outlined in order to provide a better experience and IT quality services for their clients. The

conclusion of all analyses is that there is a huge potential to incorporate the elements of Industry 4.0 into the main sector of Western Paraná.

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