

Algorithms, artificial intelligence and NLG in the production of Brazilian journalism

Lucas Vieira de Araujo

Cite this article:

de Araujo, Lucas Vieira; 2018. Algorithms, artificial intelligence and NLG in the production of Brazilian journalism . SET INTERNATIONAL JOURNAL OF BROADCAST ENGINEERING. ISSN Print: 2446-9246 ISSN Online: 2446-9432. doi: 10.18580/setijbe.2018.11. Web Link: <http://dx.doi.org/10.18580/setijbe.2018.11>

Algorithms, artificial intelligence and NLG in the production of Brazilian journalism

Lucas Vieira de Araujo, Assis Gurgaz College

Abstract — Technologies such as algorithms, artificial intelligence and Natural Language Generation (NLG) are present in several economic activities, essentially in the media field. However, the studies that discuss those facets are scarce in Brazil, notably the empirical studies that evaluate their applicability to the journalistic production. This work speaks about the scenario and possibilities of use for algorithms and NLG in the Brazilian media companies. An exploratory and descriptive research was performed, in which the administrators of the biggest communications companies in Brazil in national and local levels were interviewed. Amongst the achieved results, we can highlight the disbelief and skepticism regarding those technologies, with reduced prospects for their deployment in news production.

Index Terms — Algorithms, Artificial Intelligence, NLG, Journalism, Media companies

I. INTRODUCTION

THE communications field was one of the most affected by the expansion of technology. The innovations generated by new media companies altered the way that people get informed, communicate and exchange information. Also, the technological changes put in check the business model used by traditional communications media because the production, distribution and consumption of news are not the same as in the 20th century [1]. In the wake of technologies like algorithms, they become more dominant on the Internet for the most varied appliances, from search engines, digital social networks to content production [2].

The media field is one of the main appliances of algorithms as the mass media were massively automated with the evolution of technology. The search for the economies of scale and more processing speed raised criticism regarding ideological aspects [3], journalistic ethics [4], and transparency [5]. Studies showed that computing systems used by many media vehicles present prejudgments and hostile feelings as a consequence of the operation based on standards.

Furthermore, there is a margin for error, manipulation, commercial and political interests that may interfere in the task performed by algorithms at all times [6]. Studies have already shown that the human collaboration is indispensable as a way of preventing failures as well as the need to broaden the debate and the studies on mechanisms that

amplify the algorithmic transparency [7].

Despite the relevance of the subject and the many potential doubts, the discussions regarding algorithms are still very premature and secluded in Brazil. A keyword search was performed in August 2017 at Scielo, the main database for scientific publications in Latin America, for the terms “jornalismo” (journalism) and “algoritmos” (algorithm) and got none results. The result was the same for the keywords “algoritmo” (algorithm) and “transparência” (transparency). Despite the noticeable absence in the debate, Brazil stands out in the international media market. It is the third country in the world rank of most people connected to the Internet using smartphones, and forth in the world rank of the number of inhabitants connected to the World Wide Web. Also, Brazil is one of the biggest advertising markets in the world and is the home of Grupo Globo, which is 14th in the rank of the biggest media companies of the world [8]. Furthermore, studies that bring a retrospect of the market about specific technologies, as performed by reference [9], are rare. Many types of research evaluate the perspectives, functionalities and human aspects in relation to algorithms [10] but there is not much work on the opinion of media companies about this new technology. Therefore, the following question guides this article:

What the biggest media companies in Brazil, both national and local scopes, think about algorithms that produce content and which are the perspectives for this technology in this country?

II. METHODOLOGY

In order to answer that, reference [11] performed an exploratory qualitative and descriptive research based on semi-structured interviews with administrators from the biggest media vehicles in Brazil. This research used a qualitative questionnaire with general questions about i) the opinion of the administrators about the use of algorithms to produce content, and ii) the probability of using algorithms in the production of content in those companies they operate. Besides, Berg asked specific questions in relation to i) the practice of algorithmic journalism; ii) the use of Natural Language Generation (NLG) technology in the newsrooms. With all the data gathered from the interviewees, this article analyses the answers using the content analysis method [12]. In this type of analysis, the answers were evaluated mainly in the light of specialized literature, as well as the Brazilian and international realities in relation to the question in the research. With that, information was gathered on the companies’ sites and news

An agency of the Ministry of Education Capes (Personal Improvement Coordination) supported in part this work. L. V. de Araujo is PhD at communication and professor at Assis Gurgacz College, Brazil. (professorlucasaraujo@gmail.com).

on the media from the Internet, for a broader perspective of the current scenario in Brazil and abroad.

In order to perform the field research, the six biggest media groups in Brazil were selected: Grupo Globo, Grupo Folha, Grupo Estado, Grupo Abril, Sistema Brasileiro de Televisão (SBT) and Grupo Record (more information in Annex A). Also, in this group are the three biggest and oldest local communication groups in Brazil: Grupo RBS, Grupo RIC and Emissoras Pioneiras. The choice of using local groups results from two factors. Firstly, because Brazil is a country with continental dimensions and very accentuated regional diversity, including development, protection and amplitude of innovation [13]. Secondly, because the crisis in the media sector is even stronger in local companies, which have been being affected in a more accentuated manner by the effects of the decline in revenue: “people get their news online, but still gravitate most toward the websites of their local papers and television stations. Local press isn’t dead, but it’s fragmented and weakened” [14]. Therefore, it is imperative to analyze how the local media groups are dealing with technological innovations such as algorithms and NLG. We believe research that also comprises companies from the regional scope brings a more truthful picture of the Brazilian media corporations.

In the groups Grupo Folha, Abril, RBS and RIC, the CEOs were the respondents in the research. In the other companies, the respondents were directors associated with areas such as programming and digital media (more information in Annex B). The interviews were conducted in person, by telephone calls or email messages in the months of March and May 2017. The interviews in person lasted approximately 30 minutes each.

III. ALGORITHMS, ARTIFICIAL INTELLIGENCE AND NLG

According to reference [15], algorithms are not necessarily a software; they are procedures coded to convert input data in the desired output, based on specified calculations. We can consider both the instructions to browse the web and the mathematical formulas necessary to predict the movement of a celestial body across the sky as algorithms. “Algorithms do things, and their syntax embodies a command structure to enable this to happen” [16]. Therefore, we can consider computers as algorithm machines, as they are designed to store and read data, apply mathematical procedures and offer new information as outputs.

Described as “a finite series of precisely described rules or processes to solve a problem” [17], algorithms operate using stages that transform the data inserted in the system. In most cases, all applications of algorithmic selection are described from a basic format of input-processing-output. After the detection and relevance assignment, there is an output under different forms, for example, rankings, music playlist, and texts. The output may further serve as an additional input in subsequent processes of algorithmic selection [17]. Neural network is the possibility of employing their own data to alter the decision-making process, labelled as an attempt to mimic the computing structure of neurons in the human brain [18].

Such networks are constituted by layers of algorithms randomly connected. A given set of inputs, which represents

a problem to be solved, generates a reaction in this network, which output provides an answer. For the most part, the answers are not accurate but contribute to the learning process of the machine, which adjusts the forces of each interneuronal connection [19]. Reference [20] thinks the diversity and intensity of the connections are, at the same time, the biggest virtue and the biggest problem of neural networks: “The time taken to calculate the error derivatives for the weights on a given training example is proportional to the size of the network because the amount of computation is proportional to the number of weights”. Another problem associated with neural networks is the obscurity embedded in the data processing in deeper layers. Unknown amongst the same scientists that built them, the information provided by those networks are extremely important to a series of commercial and human appliances, but we do not know for sure how they created them [21].

Aiming to improve the level of predictability, artificial intelligence interconnects many neural networks, a phenomenon classified by reference [22] as the ability of the machines to develop an intelligence similar to the human. Besides thinking and acting like humans, it demands other requirements from the machine with artificial intelligence: “i) Natural language processing to enable it to communicate successfully in English (or some other human language); ii) Machine learning to adapt to new circumstances and to detect and extrapolate patterns” [23].

Natural Language Processing (NLP) is the base to develop the Natural Language Generation (NLG), which raw material is gross data with meteorological numbers and cost sheets, which are used to produce texts [24]. Amongst the many appliances for NLG are the generation of textual meteorological forecasts using maps and graphs, in medicine and in communications. The mapping performed by reference [9] identified ten companies in the world that have NLG technology for journalistic appliances. NLG technology can do various roles, such as i) create short news videos (USA Today has been using the online service NLG Wibbitz to perform videos with journalistic narratives and adding machine voice); ii) prepare news for segmented local audiences (machines with NLG technology evaluate trending topics and write texts about them, which contributed to media companies producing more local content and diversifying the content); iii) keep the information up to date (NLG tools can track the progress of sporting events, elections, live shows, and thus automatically update published reports when new information arrives); iv) automatic generation of personal reports (machines with NLG technology have the possibility of generating copyrighted texts from data reports, a common use in the financial and capital markets) [7].

Amongst the ten companies that have conditions to use NLG in journalism, only Aexea from Germany elaborates texts using the Portuguese language. According to reference [9], this market division is a consequence of factors such as the complexity of NLG, limited availability of data, standardization of journalistic products, and the general view that journalistic products are not profitable by themselves. The data types and functions chosen determine the algorithms results. The quality of the data interferes directly with the product from algorithms because the inputs

decide the results possible to get. Google, for example, operates notably as a search engine. Thus, the algorithms employed are programmed to refine search engines, based mainly on keywords. In the other hand – although they also serve as a search engine for the user –, Facebook codes its algorithms mainly for programmatic mechanisms, which allow the crossing of users' information with other users that are not classified as companies. In both cases, the focus of the technology companies is that those algorithms serve both the marketing of products and services of the sponsors, as it shows reference [17].

For algorithmic selection applications, not only the various undisclosed algorithms but also the supply and the quality of selection elements and data signals are crucial for competitive advantages and economic success. There are different types of suppliers of selection elements: suppliers based on contracts who are financially compensated (e.g., music labels that license music for streaming services); customers who provide the data to service suppliers (e.g., police for predictive policing applications); and suppliers whose content is mostly used, some would say appropriated without approval and compensation (e.g., websites of newspapers).

IV. CONTENT PRODUCTION AND JOURNALISM

NLG and algorithms are very versatile technologies, indispensable in digital communication as its appliance [17]. In regard to the content production, we can highlight the algorithmic journalism, defined as “the innovative processing that occurs at the intersection between journalism and data technology” [25]. Also named as computing or automated journalism, this type of journalism can be “the combination of algorithms, data and knowledge from the social sciences to supplement the accountability function of journalism” [26].

However, reference [27] believes that such definitions do not distinguish journalism from similar practices. A better classification in the opinion of the author is “a strand of technologically oriented journalism centered on the application of computing and computational thinking to the practices of information gathering, sense-making, and information presentation, rather than the journalistic use of data or social science methods more generally”. Reference [7] classify computing journalism as “finding, telling, and disseminating news stories with, by, or about algorithms”. Reference [28] highlights that computing journalism deploys algorithms with little human intervention to generate news for everything, from criminal reports to earthquake alerts and corporate profit reports.

Therefore, the automated journalism shall not be mistaken by data journalism and even less with Computer-assisted Reporting (CAR), which comes from the practice of using computers in the search for empirical data. Reference [27] reminds that the precision journalism created CAR, a technique developed by reference [29] in the 1960s. He gained notoriety after performing researches and statistical analysis based on data to obtain clearer answers to journalistic matters. Reference [30] highlight that data journalism represents the convergence of several fields and practices, being characterized as a hybrid form that encompasses the statistical analysis,

computing, visualization and web design, and reports. Therefore, reference [27] concludes that the social sciences methods and in the orientation of public matters of the investigative journalism are the roots of CAR. Data journalism is characterized by its participative openness and crossed hybridity while computing journalism is focused on the appliance of abstraction and automation in journalism.

In this way, the automated journalism represents a new frontier in the journalistic activity and a radical innovation in terms of news production and distribution [25]. In journalism companies, algorithms can prioritize, classify and filter information, as well as engage in journalism in several stages, including the distribution – as per search and public metrics results –, establishing topics they will address or even writing the stories [31]. Despite all those possibilities deeply alter the way that the press operates, the most abrupt change is, without a doubt, the possibility of a machine elaborating a text using NLG with reduced human intervention.

Reference [9] stresses out that there are few studies that evaluate the impacts of NLG in journalism, which usually are divided in a) bring together algorithmic journalism and other techniques based in number, such as data journalism; b) evaluate the news production by machines from an institutional prism of journalism; c) verify how readers evaluate the news made by algorithms; or even d) discuss ethical matters. Notwithstanding the variety of options to approach the subject, “communication science has not been able to supply a coherent model of NLG in journalism so far, as well as identifying the possibilities and limitations of this technology” [9]. According to reference [17], a major part of an investigation in social sciences on algorithms have been focusing on search engines and recommendation systems.

Reference [32] evaluate computing journalism in the newsrooms of Norway and concluded that they are not far from the traditional way of making journalism. The rooted cultural orientation in the journalism traditions reduced the possibilities of improving the efficiency of newsrooms, or of taking from journalists the simpler technical work. To reference [25], “the critical issue is the facilitation and development of an innovation-oriented mindset among the people working professionally in the field”. Therefore, the assignment of changes in the mindset does not apply solely to journalists but also to communication companies, which need to be open to changes.

The fear of changes, notably in relation to the appliance of technologies with the massive use of algorithms, was scientifically evaluated in an experiment performed by reference [33]. They studied an aspect of human behavior related to a feeling of rejection in relation to algorithms. The researchers affirm that despite several pieces of evidence of the superiority of algorithms in the ability to make judgements, “decision makers are often averse to using algorithms, opting instead for the less accurate judgements of humans”. The researchers highlight that people acknowledge a higher accuracy in predictions made by algorithms as they are notably based on evidence. However, scholars state “that people will use imperfect algorithms to make incentivized forecasts so long as they can slightly modify them” [33]. In other words, people are willing to use algorithms as long as they have the freedom to alter the decisions made by it.

V. THE VIEW OF BRAZILIAN COMMUNICATION COMPANIES (RESEARCH QUESTION)

Costs

The administrators from Brazilian communication companies that were interviewed for this work were skeptical and in disbelief concerning algorithms. They acknowledge that it is a promising technology with a great potential for growth, although they do not see a higher integration with the technology in a short-term. To the CEO of Grupo Abril, Walter Longo, "I believe the use of algorithms is spectacular not to find out what people want to consume but want to acquire. If I find out what people want to acquire using algorithms, it is a good way to sell more of a product or have more audience".

The interviewed people made a point of highlighting that the social networks algorithms, search engines and online stores play well the role of getting consumers and sellers together. However, this appliance is very limited when they get integrated to technologies to produce news, such as NLG. One of those limiting aspects is the cost. "Such technologies are usually from abroad, which generates elevated import costs. If this type of technology is developed in our country, probably will have lower costs, facilitating its appliance", said the superintendent of Grupo Record, André Dias. To the multi-platform director of SBT, Rodrigo Marti: "The binomial cost-benefits will determine if the NLG technology will or not be used. It will be necessary to find a value in this business that will not cost too much for the company".

To reduce costs and make technologies such as artificial intelligence (AI) and NLG more accessible, reference [34] suggests that: "For custom-built AI, which is too expensive for smaller operations to afford, newsrooms should consider investing time in partnerships with an academic institution". The academic institutions could perform a basic research that helps to expand the knowledge about advanced technologies like AI and machine learning. Besides that, empirical researches in newsrooms would bring relevant insights into the applicability of machines in the journalistic routine. Those are some of the most delicate and difficult factors to be solved, as they depend on a close collaboration between the machine designer and journalists, and deepened knowledge of technology by journalists: "there is both a knowledge gap and communication gap between technologists designing AI and journalists using it that may lead to journalistic malpractice" [34].

The approximation with the academic field could help to solve another issue: the initiatives of artificial intelligence in the media companies usually get interrupted at the prototype level. A research performed in the United States shows that online media represents only 1.33% of investments in artificial intelligence, while platforms such as Facebook, Google and Amazon are leading the ranks with 32% [35]. The elevated costs in hiring experts in machine learning that are highly qualified, with time and competence to understand the issues of the news sector and coach machine learning apprentices to solve them are the cause for the reduced investment. Besides that, is not that simple or cheap to create a set of reliable data that could train the machines. Often it will be necessary to interfere in the work-flow of journalists to make room for automation, enable editorial teams on technology and management and still await significant results amidst several structural changes.

Concerned with immediate results and the maintenance of a business model already worn-out, media companies try to adapt to the technological innovations, showing a reduced success. In Brazil, the 11 biggest daily journals gained 88 thousand new digital subscribers in 2016 but printed editions registered a decrease of 162 thousand copies in the average daily run. Most Brazilian journalists adopted the pay-wall as a strategy to increase revenue. However, the increment of digital subscriptions is not being able to compensate the loss of the sector regarding advertisements of printed copies and the revenue with the digital advertisement is still too low [36]. Even in Europe countries, where there are more capitalized media groups and the news-consuming public has a different profile, the innovative projects in digital news are usually focused on: a) reaching new audiences; b) better serving existing audiences, and c) boosting digital subscriptions [37]. In other words, the transition of media companies to the digital world is often conditioned to the short-term financial results, which generates to the firms an imbroglio difficult to solve: as they do not take effective measures to develop new technologies, they do not get good financial results, and, without those results, they do not feel confident to invest in the development of new technologies.

In specific fields of the media industry, such as broadcast, the distancing in relation to algorithms, artificial intelligence and NLG is even bigger. Brazilian administrators already identified trends in Over The Top (OTT) services but without perspectives to the broadcast field. According to the Director of Programming of Grupo Record, Marcelo Caetano:

Whoever produces content will inevitably benefit from this technology. One example is the House of Cards series by Netflix, which was created from decisions made by algorithms using a database. Nevertheless, Brazil is taking the first steps in this field. As it is still in the beginning, we are not able to discuss financial or commercial viabilities. The evolution is gradual. We lack information on how it interferes in the broadcast business.

Algorithms and artificial intelligence are being used for now by cable TV and Internet for the recommendation, development of new products and sales from the patterns generated by user data. It is the same mechanism used by digital social networks, which distribute a great variety of videos created by third parties. This content hardly interferes in the journalistic production made by the broadcast, although reduces its audience. This is the reason traditional television watches the vertiginous growth of video on demand and social networks without performing substantial investments in technologies for journalism like NLG: "no one seems to have found the right recipe for online video news or IPTV News" [38].

Cultural and training aspects

Besides the elevated costs and the difficulties in applying NLG in the TV journalism, some interviewees showed concern with legal and cultural factors, as NLG substantially alters the news production system. In addition to the job extinction, the appliance of algorithms represents a change in the assignments for journalists and its own structure of roles in the newsrooms. Walter Longo believes that "the use

of technologies such as NLG is a point of no return. It will bring huge benefits in efficiency and gain of scale but also many problems like unemployment, which we do not know how to handle. Especially in a country like Brazil, with a very low educational level among its population”.

The deficiencies in the educational training are also present in the journalistic environment. Only 11% of journalists are prepared for a data analysis in the United States [39]. In Brazil, the scenario is even more severe given the problems faced in the professional training and precariousness of the occupation. Such factors certainly interfere in the acceptance and integration of innovative technologies like NLG. Studies already demonstrated that the organizational culture of many media companies did not internalize integration mechanisms between humans and machines for the news production [32]. They can perceive the same scenario in interviews, such as with the Chief Executive Officer of EPTV, Antonio Coutinho Nogueira: “We use none computing system to journalistic information capture and edition. We believe in the human potential to investigate and find the best and more updated information”. That explains, at least in part, why the interviewed administrators showed so much skepticism and disbelief regarding NLG.

The reluctance to machines, however, is harmful to the very same media companies, which evaluate algorithms, artificial intelligence and NLG as creators of fake news. They fail in realizing that the same press helped to create this issue when it tried to stop the advance of social networks. When the newsrooms focused on the use of machine learning by using algorithms, to present customized reading recommendations or segmented advertisements, they adopted a copy approach for the customization of editorial and commercial content. “Personalized communication may work for push notifications and special interest editorial content like weather, sports and entertainment, but personalizing general interest news can implode in filter bubbles” [40].

As much as the hidden bias of machines is something that needs to be constantly confronted to establish an ethical journalism and for the public service [34], human beings, especially the administrators of Brazilian media companies, must notice the benefits that NLG and algorithms can bring to journalism. There is no doubt about that machines also make mistakes; however, it is necessary to know how to handle it.

Amongst all administrators of Brazilian media companies, only the Executive Editor of Digital Content of Grupo Estado, Luis Fernando Bovo, showed optimism towards the idea of using machines in the editorial department:

I do not think it is bad to have a technology like NLG producing news that is commodities. It makes little sense in using a journalist to perform this task for information, which is solely gathering data, producing a text and distribute. I will assign the journalist to what is really important: perform an analysis, synapse and contextualize factors. The journalism is increasingly going towards this direction: more analytical and less worried about simply relaying information.

Although Bovo has been the only one amongst the

interviewees with ideas favorable to integrating NLG in the newsrooms, his opinions comply with the view of other administrators on the new directions of journalism. For most of the interviewees in this research, such as the CEO of Grupo RIC, Leonardo Petrelli: “it is necessary to separate information from journalism. It is possible to gather data and create a commodity information, such as the weather forecast and capital market. But when we build the news, we need to have the human sensitivity and perception to prevent mistakes as the lack of ethics”.

Potential incompatibilities between journalism and NLG

Many administrators think journalism and NLG are incompatible. The CEO of Grupo RBS, Eduardo Melzer, believes that algorithmic technologies “are adequate for simple information and feedback. They are not adequate for the serious, professional journalist production that demands discernment, investigation, plural view, and social responsibility”. The CEO of Grupo Folha, Maria Judith Brito, thinks similarly about NLG: “it has limited use. The journalism production with quality and of depth analysis require qualified reporters’ teams, experts, and writers”.

Besides cognitive and cultural factors, the difficulty in bringing it closer to newsrooms causes the negative view predominant in media companies about the integration between journalism and NLG. Although there are no empirical studies that tested the level of acceptance of NLG technology in Brazilian media companies, is fully possible to infer that the reasons pointed out as causes for the low efficacy and some rejection observed in international studies can apply to Brazil’s reality.

In the algorithmic journalism, technology is not only a support but part of the news production process. Cognitive technologies like NLG impose new skills for journalists necessary for the integration between man and the new apparatus of machines with intelligence. One of the most important competencies in this new context is the computational thinking, characterized by a cognitive process instead of a practice necessarily performed by a computer [27]. Administrators and journalists create a mentality grounded in processes and practices in which the machines play a role of support in the news production. The new technologies like NLG have put this new history of the machine’ subservience to human disposal in check. If we had all the news production under human control, now it is possible to produce types of news with very little human interference. Without a doubt, there are many obtuse points in his regard such as ethical aspects, but the future certainly has a place for it. As stated by the Chief Executive Office of EPTV: “We do not intend to use this [NLG] technology in the near future but it is obvious that we must follow the evolution of systems”.

The perspective of Brazilian administrators complies with the results of the research performed by reference [37] with European media companies. As in Brazil, the European interviewees are proud of the past and present of their organizations but are aware that the media environment is changing faster than most news organizations. However, unlike in Brazil, European firms are investing in several new digital news projects in the attempt of promoting organizational and cultural changes that facilitate the

adaptation and innovation. While being aware that this is a slow process and demands an effort that originates from superior hierarchical layers, European media companies are searching for the short-term return “but equally often towards ‘innovation for innovation’s sake’ – attempts to change the very organization and culture of a given newspaper or broadcaster” [37].

However, many startups around the world are already producing news from the integration between human work and machines, as in the generation of visualizations guided by data. One example is The Pudding, which uses algorithms to elaborate interactive graphs and allows the readers to choose which subjects they want to be informed about. An empirical research performed by reference [41] developed a software based on artificial intelligence that facilitates the data calculation and identifies opportunities for new reporting. The use of algorithms can be relevant especially to the reporting, notably with predictive models and descriptive statistics. An opinion shared by reference [40]: “there is a strong case for letting machines do the tedious research and get better at fact-checking, as well as automated news writing based on structured data sets”.

Is content the most relevant factor?

Although the startups and academic projects do not face all peculiarities and challenges of the market, they usually indicate trends, many times based on empirical results. Reference [42], for example, concluded that the main reason for the abrupt fall in the revenue of newspapers in the United States was the loss of 74% of the values received from classifieds between 2000 and 2010. Although the classifieds were not the main source of revenues, they contributed substantially for the reduction in the number of website readers because “while the economics of news depends on attracting readers one by one, the economics of classifieds is about connections between buyers and sellers. A network effect”. To reference [42], the Internet did not finish with the news. The Internet destroyed the subsidies from classifieds. Media companies from the printed field did not make a mistake in producing content but did in not protecting an important source of revenue.

This observation also derives from good results achieved by other media companies. One of them is the Scandinavian conglomerate Schibsted Group. The journal Svenska Dagbladet, one of the main journals in Sweden and part of this group, fully integrated the use of algorithms into the news production, distribution and featuring. The journal has a robot that projects the website homepage, using algorithms to distribute content and even manage online ads, without using the services from Google and Facebook. In addition, applied NLG in the news production.

Therefore, journalism does not lose validity or leave its principles aside when human beings work together with machines. In the same manner, journalistic content continues to be extremely relevant in innovative journalistic companies. From the statements made by Anand, what we can highlight is how much the deployment of algorithms and technologies like NLG can contribute in the news production, distribution and consumption. Such aspects meet the demands from communications sciences [9] and from media companies, which must find alternatives with

the better monetization of the news due to the loss in revenue.

Researches indicate that the artificial intelligence applied in NLG form, for example, allow journalists to examine large quantities of data, texts, images and videos. Such possibility not only makes the work more efficient but also allow a better communication and collaboration between journalists and the public. The networks formed inside and outside the newsrooms bring more audience and reduce the incidence of fake news as they increase the reach of the journalistic news. Therefore, networks and journalism are complementary, not dissonant. As well as the algorithms and NLG technology that are tools that can aid journalism and not the responsible for the crisis of trust that harms the field.

VI. CONCLUSION

Despite the appliance of algorithms in journalism is still unknown amongst the Brazilian press, it might reach the segment soon, as it happened with other technologies in the past. As this is inevitable, it is more appropriate for Brazilian media companies to take a leading role in this process rather than simple adaptation. For that, it will be required to invest in innovative projects, as European and North-American firms are already doing. As much as the Brazilian and Latin American reality is different, there is no other way but experimentation, and the interviews of the European media administrators also made it clear [37]. The search for innovation from artificial intelligence by voice, essential in the broadcast sector, should begin with machine learning in newsrooms, brainstorming between journalists and the public, and also with research and development. Since NLG did not reach the Brazilian newsrooms, it is necessary to start as soon as possible.

For decades that established companies, such as those in this study, are reluctant to innovate and tend to inertia in the face of past good results. However, the adaptability to innovation may be a competitive advantage over long-term. Future studies could evaluate to what extent this adaptation is taking place in media companies and what would be the most promising projects. As reference [9] stated, the communication science needs to bring answers to the concerns of the area regarding algorithmic journalism, which has altered the way people do journalism. Thus, new exploratory or descriptive studies about the challenges and opportunities of this new technique in Brazilian newsrooms are recommended.

APPENDIX

Appendix A

National companies

Grupo Folha: It controls the newspapers with the widest circulation and influence (Folha de S. Paulo), the largest Brazilian company of internet content and services (UOL), the news website 1 with the most audience (Folha.com) and the largest commercial printing company in Brazil (Plural). It also publishes three newspapers: “Agora” the leader among the popular diaries in the State of São Paulo, “Valor Econômico”, released in 2000 in association with the Globo

Organizations, and “Alô Negócios”, the widest newspaper from the capital of the state of Paraná in number of ads.

Grupo Estado: It owns the newspaper O Estado de São Paulo, one of the oldest periodicals in activity in Brazil, founded in 1875, and among the largest in circulation in the country. The group also manages one of the largest and oldest news agencies in Brazil, the Agência Estado, Rádio Eldorado, and an advertisement company addressed to small and medium-sized enterprises, Serviços Planeta Digital.

SBT: the “Sistema Brasileiro de Televisão” (SBT) is the major groups of communication in Brazil, but it does not invest in other media segments as many organizations in the sector do. The company owns the open transmission TV channel SBT, which is present in a big part of Brazil.

Grupo Record: The company has the Rede Record, open transmission TV station vice-leader in audience in Brazil and the oldest country’s TV in operation; Record News, an exclusive news channel with an open signal; R7, online content portal; four printed newspapers; three radio stations.

Grupo Abril: It is one of the largest and most influent groups of communication and distribution in Latin America. The company operates based on two business segments: Abril Media, which concentrates the business of Abril Publishing company, Gráfica Abril and CasaCor; and DGB, the holding company of distribution and logistics. Abril Mídia has on the Board of Directors representatives of the South African media group Naspers Group.

Grupo Globo: 14th-largest media company on the planet, the group is a collection of Brazilian media companies that reaches all national territory. The group is constituted by shares in a variety of media, including the Globo (a leader in open TV in Brazil), Globosat, Globo.com, Editora Globo, InfoGlobo, Rádio Globo, Som Livre, Globo Filmes and ZAP.

Local Companies

Grupo RBS: It is one of the largest multimedia company groups in the country. Within Brazil, they operate through e.Digital Bricks, Fund for investments of companies in the digital sector. In addition to an affiliate of Globo TV in the state of Rio Grande do Sul, it owns six radio stations, two content portals and three printed Newspapers. All of them are market leaders in the field they operate.

Grupo RIC: It is the largest communication group in the Southern region in Brazil and the second largest group of local communication in Brazil. The company operates in the states of Paraná and Santa Catarina, which reaches 16 million people. It is TV Record affiliated in 11 TV stations, and still controls 3 internet portals, 4 radio stations, 2 printed newspapers, 2 publishers of magazines and a multimedia platform.

Emissoras Pioneiras: They are part of the group of four Rede Globo affiliates; a newspaper; three radio stations and a news portal. The companies are installed inside the states of São Paulo and Minas Gerais. The area covered by the group is of 11 million inhabitants in 371 municipalities.

Appendix B

List of Interviewees

National Companies

- André Dias, National Director of Affiliates, Grupo Record
- Luis Fernando Bovo, Executive Editor Digital Content, Grupo Estado
- Rodrigo Marti, Director of Multi-platforms, SBT
- Antonio Guerreiro, Superintendent of Multi-platform Strategy, Grupo Record
- Walter Longo, CEO, Grupo Abril
- Marcelo Caetano, Director of Programming, Grupo Record
- Washington Theotônio, Director of Innovation in Communications, Grupo Globo
- Maria Judith Brito, CEO, Grupo Folha

Local Companies

- Leonardo Petrelli Neto, CEO, Grupo RIC
- Eduardo Melzer, Chairman and CEO, Grupo RBS
- Antonio Carlos Coutinho Nogueira, General Director, Emissoras Pioneiras (EPTV)

ACKNOWLEDGEMENT

I thank all the interviewees who kindly shared some of their time and knowledge to carry out this research.

REFERENCES

- C. Anderson, E. Bell, & C. Shirky. “Post-Industrial Journalism – Adapting to the present”. New York: Columbia Journalism School, 2012, pp. 14-28.
- T. Bucher. “Want to be on the top? Algorithmic power and the threat of invisibility on Facebook”. *New Media & Society*, v. 14, no 7, pp. 1164-1180, Apr. 2012.
- A. Mager. “Algorithmic ideology: How capitalist society shapes search engines”. *Information, Communication & Society*, v. 15, no 5, p. 769-787, Mar. 2012.
- L. V. De Araujo. “News production by machines and ethics: possible implications”. *SET Internacional Journal of Broadcast Engineering*, v. 4, no 5, pp. 1-6, Aug. 2016.
- N. Diakopoulos. “Algorithmic accountability: Journalistic investigation of computational power structures”. *Digital Journalism*, v. 3, no 3, pp. 398-415, 2015.
- N. Diakopoulos, S. Friedler. “How to hold algorithms accountable”. *MIT Technology Review*, v. 17, no 11, p. 2016, Nov. 2016.
- N. Diakopoulos, M., Koliska. “Algorithmic transparency in the news media”. *Digital Journalism*, v. 5, n. 7, pp. 809-828, Oct. 2017
- L. O’Reilly (2016, May). The biggest media companies in the world. *Business Insider* [Online]. 31(1), pp. 1. Available: <http://www.businessinsider.com/the-30-biggest-media-owners-in-the-world-2016-5>
- K. N. Dörr. “Mapping the field of Algorithmic Journalism”. *Digital Journalism*, v. 4, no 6, pp. 700-722, Feb. 2016.
- N. Just, M. Latizer. “Governance by algorithms: reality construction by algorithmic selection on the Internet”. *Media, Culture & Society*, v. 39, no 2, pp. 238 – 258, July 2016.
- B. Berg. “Qualitative research methods for the social sciences”. Boston: Pearson Education. 2004, pp. 51-98.
- R. A. Stebbins. “Exploratory research in the social sciences”. London: Sage, 2001, pp. 34-57.
- E. Rocha, S. Dufloth. “Análise comparativa regional de indicadores de inovação tecnológica empresarial: contribuição a partir dos dados da pesquisa industrial de inovação tecnológica”. *Perspect. ciênc. inf.* [online], v. 14, no. 1, pp. 192-208, Jan. 2009.
- K. McLaughlin (2017, January). The big journalism void: The real crisis is not technological, it’s geographic. *The Guardian* [Online]. 30 (1), p. 1. Available: <https://www.theguardian.com/media/2017/jan/30/the-big-journalism-void-the-real-crisis-is-not-technological-its-geographic>

- [15] T. Gillespie. The relevance of algorithms. In: T. Gillespie, P. Boczkowski & K. Foot (Eds). "Media Technologies". Cambridge, MA: MIT Press, pp. 167–194, 2014.
- [16] A. Goffey. Algorithm. In: M. Fuller (Ed.). "Software studies: A lexicon". Cambridge, MA: MIT Press, pp. 15-20, 2008.
- [17] M. Latzer, K. Hollnbuchner, N. Just, & F. Saurwein. "The economics of algorithmic selection on the Internet. Handbook on the Economics of the Internet". Zurich: University of Zurich, 2014, pp. 21-45.
- [18] R. Kurzweil. "The age of spiritual machines: When computers exceed human intelligence". New York, Penguin, 2000, pp. 45-60.
- [19] J. Holland. "Genetic algorithms". *Scientific American*, v. 267, no.1, pp. 66-72, 1992.
- [20] G. E. Hinton. "How neural networks learn from experience". *Scientific American* September, pp. 144-151, 1992.
- [21] W. Knight. "The dark secret at the heart of AI". *MIT Technology Review*, May/June 2017.
- [22] A. Turing. "Computing machinery and intelligence". *Mind*, v. 59, pp. 433-460, 1950.
- [23] S. Russel, P. Norvig. "Artificial Intelligence A modern approach". New Jersey: Prentice-Hall, 1995, pp.38-54.
- [24] E. Reiter, R. Dale. "Building Applied Natural Language Generation Systems". *Natural Language Engineering*, v. 3, no. 1, pp. 57-87, 1997.
- [25] A. Gynnild. "Journalism innovation leads to innovation journalism: The impact of computational exploration on changing mindsets". *Journalism*, v. 15, no 6, pp. 713-730, Sep. 2014.
- [26] J. T. Hamilton, F. Turner. (2009, July). Accountability through Algorithm: Developing the Field of Computational Journalism. Behavioral Sciences Summer Workshop, Stanford [Online]. Available at: <http://web.stanford.edu/~fturner/Hamilton%20Turner%20Acc%20by%20AIg%20Final.pdf>
- [27] M. Coddington. "Clarifying journalism's quantitative turn: A typology for evaluating data journalism, computational journalism, and computer-assisted reporting". *Digital Journalism*, v. 3, no 3, pp. 331-348, May 2015.
- [28] A. Graefe. "Guide to Automated Journalism". New York: Columbia Journalism School, 2016, pp. 11-19.
- [29] P. Meyer. "Precision Journalism". Bloomington, IL: Indiana University Press, 1973, pp. 65-79.
- [30] P. Bradshaw (2010, October). How to Be a Data Journalist. *The Guardian* [Online]. 1 (10), p. 1. Available: <https://www.theguardian.com/news/datablog/2010/oct/01/data-journalism-how-to-guide>
- [31] M. Carlson. "The robotic reporter: automated journalism and the redefinition of labor, compositional forms, and journalistic authority". *Digital Journalism*, v. 3, no 3, pp. 416-431, Oct. 2015.
- [32] J. Karlsen, E. Stavelin. "Computational journalism in Norwegian newsrooms". *Journalism Practice*, v. 8, no 1, pp. 34-48, Feb. 2014.
- [33] T. Uskali, D. Nordfors, J. Sandred (2008, May). The Experiences of the Innovation Journalism Fellowship Program 2004–2008. International Association for Media and Communication Research, Stockholm, Sweden.
- [34] M. Hansen, M. Roca-Sales, J. Keegan, & G. King. "Artificial Intelligence: Practice and Implications for Journalism". New York: Columbia Journalism School, 2017, pp. 41-59.
- [35] A. Naimat. "The New Artificial Intelligence Market: A Data-Driven Analysis of Industries and Companies Adopting AI". Canada: O'Reilly Media, Inc, 2016, pp. 33-43.
- [36] M. Estarque (2016, November). Por que jornais brasileiros batem recorde de audiência, vendem assinaturas digitais, e ainda assim estão em crise? *Journalism in the Americas* [Online] 14 (11), p. 1. Available: <https://knightcenter.utexas.edu/pt-br/blog/00-17762-por-que-jornais-brasileiros-batem-recorde-de-audiencia-vendem-assinaturas-digitais-e-a>
- [37] A. Cornia, A. Sehl, & R. Nielsen (2017). "Developing Digital News Projects in Private Sector Media". Oxford: Reuters Institute for the Study of Journalism, 2017, pp. 1-4.
- [38] R. Nielsen, R. Sambrook. "What is happening to television news? Digital News Project 2016". Oxford: Reuters Institute for the Study of Journalism, 2016, pp. 12-27.
- [39] J. Wihbey, M. Coddington. (2017, April). Knowing the Numbers: Assessing Attitudes among Journalists and Educators about Using and Interpreting Data, Statistics, and Research. *International Symposium on Online Journalism*. Spring 2017, Vol. 7 Issue 1, p5-24. 20p
- [40] C. Gamulea (2017, July). It's Expensive to Be Poor. A Business Case for AI in the Newsroom. *B&B Stories* [Online]. 2 (10), p. 1. Available at: <https://medium.com/bakken-b%3%A6ck/its-expensive-to-be-poor-a-business-case-for-the-ai-powered-newsroom-f2b63408b373>
- [41] M. Broussard. "Artificial intelligence for investigative reporting: Using an expert system to enhance journalists' ability to discover original public affairs stories". *Digital Journalism*, v. 3, no 6, pp. 814-831, Jan. 2015).
- [42] B. Anand. "The Content Trap: a strategist's guide to digital change". Random House, New York, 2016, pp. 102-149.



Lucas V. de Araujo PhD in Communication from the Methodist University of São Paulo (2018). He made the first study on innovation in communication in Brazil that identified, characterized and analyzed the main innovation initiatives in startups, media companies and investment funds and organizations promoting innovation. He holds a degree in Journalism (1999) and Masters in Literature (2008) from the State University of Londrina (UEL). For 16 years he was an editor, reporter and Journalism Manager of Rede Globo, Rede Record and the RBS Group in Paraná and São Paulo. In the public area, he was a communications adviser to the Presidency of the Agronomic Institute of Paraná (Iapar) and the regional head of the Secretariat of Agriculture of Paraná (SEAB). He has been a professor for 15 years with passages from the University of Northern Paraná (Unopar) and Pitágoras College. He is currently an assistant professor at the State University of Londrina (UEL), at Cáspér Líbero College, at the University of Cascavel (Univel) and at Assis Gurgacz College (FAG) in postgraduate courses.

Received in 2018-03-02 | Approved in 2018-09-25