Artificial intelligence strategies in European public broadcasters: Uses, forecasts and future challenges

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Recommended citation:

Fieiras-Ceide, César; **Vaz-Álvarez, Martín**; **Túñez-López, Miguel** (2022). "Artificial intelligence strategies in European public broadcasters: Uses, forecasts and future challenges". *Profesional de la información*, v. 31, n. 5, e310518.

https://doi.org/10.3145/epi.2022.sep.18

Manuscript received on June 28th 2022
Accepted on August 13th 2022

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Abstract

As artificial intelligence (AI) gains space in the media, public broadcasters are testing and experimenting with these technologies to raise their services to the new standards of the audiovisual ecosystem. From algorithms that help recommend the most suitable content for users, to others that detect news and automate some of the tasks of journalists, these tools are increasingly present in public audiovisual corporations. The data were obtained from semi-structured in-depth interviews with a convenience sample of 15 corporations from 12 countries. The results reflect a heterogeneous application of artificial intelligence in corporations, oriented towards the automatic creation of content from structured data, the improvement of audience interaction through chatbots, and personalisation or verification. The implementation of these technologies also poses major challenges. Firstly, the economic cost of adapting these systems to each corporation and the difficulties in hiring experts to develop AI solutions prevent a complete deployment of these tools in public broadcasters. As main conclusions, we have understood that AI as a "culture" is believed to be vital for the public audiovisual services of the future, although its application is still far from being a standard and generally does not occupy a relevant strategic position in the innovation departments of corporations.

Keywords

Artificial intelligence; AI; Algorithms; Media; Automation; Journalism; Innovation; Public service media; News; Broadcasting; Audiovisual; Technology.

Funding

This article is part of the activities of the project "Public audiovisual media in the face of the platform ecosystem: management models and evaluation of the public value of reference for Spain" (PID2021-122386OB-I00), funded by the *Ministry of Science and Innovation* (*Micin*, Spain), *Agencia Estatal de Investigación* (*AEI*, Spain), and *European Regional Development Fund* (EU). In addition to being integrated in the activities of the '*RTVE-USC* Chair on Public Service Media in Europe'.

The author Martín Vaz-Álvarez holds an FPU fellowship from the *Ministry of Science and Innovation* of the *Government of Spain* with the reference (FPU19/06204).

1. Introduction. The impact of AI on the media ecosystem

Since the *Quakebot* algorithm of the *Los Angeles Times* first published news on an earthquake in California in March 2014 (**Ufarte-Ruiz**; **Manfredi-Sánchez**, 2019), more than 30 leading international media have applied artificial intelligence (AI) in the automatic generation of news. The map of the impact of AI in the media drawn by **Fanta** (2017) has undergone a considerable update of small media that have followed the path opened by the *Associated Press* and *Reuters* agencies, and *The Washington Post*, which are pioneers in these techniques (**Rojas-Torrijos**, 2019).

AI, with its entry into media newsrooms and its application in news production processes, gives rise to what we know as 'automated journalism' (**Carlson**, 2015; **Graefe**, 2016), 'algorithm journalism' (**Diakopoulos**, 2019; **Dörr**, 2016), 'robot journalism' (**Oremus**, 2015) or 'artificial journalism' (**Túñez-López**; **Toural-Bran**; **Valdiviezo-Abad**, 2019), replacing certain tasks of information professionals through the use of algorithms; although the experience of recent years tells us that it should be considered as a tool that allows journalists to enrich storytelling based on natural language generators, which transform structured computational data into human language (**Dörr**, 2016; **Marconi**; **Siegman**, 2017).

The *European Broadcasting Union* (*EBU*) *News Report* (2019) concludes that only some of the tasks of journalism will be automated. However, it also indicates that the changes brought about by the application of this technology will, in one way or another, cut across many newsroom tasks so that journalists will inevitably need to become more technologically literate. In the current application of automated journalism, **Graefe**'s (2016) prediction that the profession is not at risk and that AI is not seen as a replacement for human journalists still holds true, but editors are highly likely to be assigned to 'higher value-added activities', complementing the mechanical work of algorithms (**Sirén-Heikel** *et al.*, 2019).

> According to the *EBU* report, the *Organization for Economic Co-operation and Development* has estimated that almost half of all occupations will disappear or be fundamentally changed in 15-20 years due to automation and machine learning. 'In the field of communication, we are experiencing the biggest transformation since the advent of traditional media. It is also the greatest social disruption since the Second World War' (*EBU*, 2021).

1.1. Automated solutions at all phases of journalism

Túñez, **Toural** and **Frazão** (2020) point to the use of AI beyond the creation of news, transcending nowadays to most journalistic tasks. In its current applications, AI is used in the creation of alerts and recommendations, in product verification and marketing and in the intelligent automation of workflows (**Rojas-Torrijos**, 2019). The *European Broadcasting Union* (2019) believes that the advancement of language technologies such as machine translation, speech recognition and speech-to-text generation will provide exciting possibilities for the media of the future.

Con la IA, las noticias se escriben automáticamente utilizando una biblioteca de narraciones. Bases de datos estructuradas permiten la producción de noticias con estructuras y códigos coherentes, lo que es suficiente para la cobertura común y rutinaria de eventos como las finanzas, la bolsa, los deportes o el tiempo. Esta cadena de producción acelera el uso de los datos para la verificación de la información en tiempo real, donde se cruzan cifras y declaraciones (**Hansen** *et al.*, 2017).

Table 1. Benefits of applying AI in the media. Source: *European Broadcasting Union* (2019).

Benefits of applying AI in the media
Detect trends in social networks
Get trend-breaking tips
Get story angles, images and people suggested through an online search
Fact-checking
Verify fake photos and videos
Checking for deep fakes
Finding email addresses connected to websites
Discovering bots on social networks
Audio transcription
Creating stories from structured data
Automatic text translation
Automatic text correction
AI assistance in video editing
Automated audio editing
Automating workflows
Predictive analytics to generate revenue and increase customer satisfaction
Chatbot creation
Data cleansing and filtering

With AI, news are automatically written using a library of narratives. These structured databases enable the production of news stories with coherent structures and codes, which is sufficient for common, routine coverage of events such as finance, the stock market, sports or weather. This production chain accelerates the use of data for real-time verification of information, where figures and statements are cross-checked (**Hansen** *et al.*, 2017).

AI systems interpret, organise and produce news in a user-recognisable format through algorithms that first process the information, take pre-programmed news structures, select key aspects and insert new terms, statistics or pictures (**Anderson**, 2013). As a result, using these automatic language generation techniques, they transform the source data into journalistic products in which human intervention has been minimal (**Carlson**, 2015) and narrated autonomously (**Montal**; **Reich**, 2017).

In the area of distribution and interaction, the contributions of algorithms are also increasingly valuable for the media. *Yle Finland* was one of the pioneering public service media (in 2014) to experiment with personalisation through its personalised news application, *Yle NewsWatch*, which has become a benchmark for the media as a whole. This tool collects data from three sources: "the user's active choices, the behaviour of other users and editorial decisions". In addition, it incorporated the first intelligent personal news assistant (*Voitto*) that displays news recommendations directly on the lock screen. *Voitto* has also helped publishers in the coverage of events such as municipal elections or *National Hockey League* (*NHL*) games (*Yleisradio*, 2018).

Along these lines, European public broadcasters joined forces in building a platform where they share their data science and personalisation tools. This *EBU PEACH* (personalisation for each) project operates diversified algorithms, through which it tries to expand the user's content catalogue (*EBU*, 2019). Content recommendation is also valuable in the specific case of young audiences, bringing them closer to the formats with which they feel most recognised and are most interested. This can help to address the loss of relevance of television and public media for them, which is accompanied by a historical decline in the consumption of these spaces.

Regarding disinformation caused by the proliferation of fake news, this is one of the main threats to the media system. For this reason, automated solutions are essential to solve or speed up part of the routine verification work carried out by journalists. In this sense, artificial intelligence makes it possible to track keywords, cross-check information and analyse large volumes of data in record time. This decision allows information professionals to focus on specific testing, monitoring or logistical tasks in which they provide greater value (**Fieiras-Ceide**; **Vaz-Álvarez**; **Túñez-López**; 2022).

1.2. Debates in the application of AI: provenance of systems, limitations and possibilities in PSM, social responsibility, costs and privacy

In the application of AI tools, the media must decide how they approach the implementation of intelligent systems. The first is to create an in-house algorithm, which involves not only a large financial outlay but also serious difficulties in finding qualified personnel in the market with the skills to build and manage an AI infrastructure. The second option is to go to the market in search of third-party products, which may not be ideal, especially in the case of public service media (PSMs), because of their specific content and data processing needs (**Rojas-Torrijos**, 2019).

The media have undergone a restructuring with the advent of the internet; new platforms such as cybermedia have appeared, and new actors such as 'hypertextuality, interactivity and multimedia have been added to the journalistic profile' (**Túñez-López**; **Toural-Bran**; **Valdiviezo-Abad**, 2019). One of the challenges of this new context is that AI applications replace, in addition to the routine part of journalistic work, its cognitive part. To exercise this algorithm, journalists must also put themselves on the side of the technology, getting used to thinking like a machine (**Lewis**; **Guzmán**; **Schmidt**, 2019).

A parallel discussion on the application of AI can be found in the field of PSMs. Traditionally, these media are constituted with the mandate to guarantee a series of rights, such as access to information, diversity and universality, among others (**Aslama-Horowitz**; **Nieminen**, 2017). For this reason, the application of intelligent tools that select, filter and distribute content is especially delicate, understanding that the principles governing these mechanisms must be aligned with the public service values committed to by corporations, avoiding the creation of filter bubbles or the omission of relevant information for the construction of a democratic society.

However, the high cost of AI technologies, both in terms of technical deployment and recruitment of talent, is a limitation for many PSM in some of their most demanding or customised applications. Privacy management, on the other hand, is a major challenge for PSM in the use of these technologies. The need for data by algorithms in the execution of their functions raises some issues for public media, the most contentious being the legitimacy of holding and using personal audience data in the generation of new products.

PSMs are constrained by the rules of the *General Data Protection Regulation* (in force since 25 May 2018), which, among other things,

> "provides for the extension of users' rights to protect personal information, including the right to be informed about the processing of their data and the right to be forgotten" (**Sørensen**; **Van-den-Bulck**, 2018).

This regulation, while necessary, arguably represents a significant competitive disadvantage vis-à-vis media giants that use personal data on a more regular basis through their subscription services.

In 2021, *Tortoise Media* updated its global AI index, through which it analysed how 62 countries apply and evolve with respect to this technology. Its study is based on three fundamental sections: investment, innovation and implementation. The United Kingdom, the leading European nation and number three in the world after the US and China, is the third-best rated in terms of talent, behind only the US and India. Spain ranks eleventh outside the top 10 leading regions in Europe. Despite this, Spain's governance strategy is the fourth highest rated by *Tortoise Media*.

Table 2. European AI ranking. Source: *Tortoise Media* (2021)

Country	Talent	Infrastructure	Operational environment	Research	Development	Government strategy	Commercial	Global ranking
1. United Kingdom	3rd	23rd	24th	5th	11th	11th	4th	3rd
2. The Netherlands	6th	9th	10th	15th	8th	33rd	18th	8th
3. Germany	11th	13th	30th	6th	12th	10th	8th	9th
4. France	9th	14th	17th	16th	15th	5th	10th	10th
5. Ireland	8th	5th	31th	28th	7th	25th	25th	12th
6. Finland	16th	22nd	18th	17th	20th	8th	21st	13th
7. Denmark	13th	18th	11th	13th	32nd	18th	26th	14th
8. Luxembourg	18th	3rd	33rd	23rd	17th	30th	20th	15th
9. Switzerland	14th	11th	54th	3rd	13th	58th	9th	18th
10. Sweden	10th	17th	34th	11th	22nd	47th	22nd	19th
11. Spain	21st	19th	23rd	26th	29th	4th	28th	21st

More recent research on AI follows in the wake of older, but pioneering work (including **Kim** *et al.*, 2007; **Matsumoto** *et al.*, 2007; **Van-Dalen**, 2012; **Clerwall**, 2014; **Edge**, 2014; **Karlsen**; **Stavelin**, 2014; **Napoli**, 2012; **Lecompte**, 2015; **Dörr**, 2016; **Graefe**, 2016; **Fanta**, 2017; **Hansen** *et al.*, 2017; **Lindén**, 2017; **Marconi**; **Siegman**, 2017).

Studies by **Diakapoulos** (2019) have explained how machine learning and data mining have changed investigative journalism. **Saurwein** (2019), for his part, values 'distributed responsibility' in the design and application of algorithms in recommendations, classification, content production or decision making. In addition, **Soffer** (2019) reflects on variations of intelligent personalisation in communication flow theories, and **Gran**, **Booth** and **Bucher** (2020) raise the debate on whether talking about algorithmic knowledge level can lead to talking about the digital divide.

Yanfang (2019) draws a comparison between human-written and machine-constructed news, assessing the perceived objectivity and credibility of both journalistic products and corroborates that the conclusions of **Clerwall**'s (2014) analysis still hold, and audience reactions do not detect significant differences between human-written and machine-constructed news.

While **Wu**, **Tandoc** and **Salmon** (2019) draw on Bourdieu's work to explore how automation generated by external companies can be applied to the news environment. In this regard, **Dierickx** (2019) points to the vital need to incorporate journalists from the first phase of automating news creation.

2. Materials and methods

This research is descriptive and exploratory, with a blinded hypothesis. We chose to use qualitative methods and conducted in-depth personal interviews with the directors of innovation, strategy and AI of the public broadcasters of Germany (*ARD* and *ZDF*); Belgium (*VRT* and *RTBF*); Denmark (*DR*); Spain (*RTVE*); Finland (*YLE*); France (*France TV*); Great Britain (*BBC*); the Netherlands (*NPO*); Ireland (*RTÉ*); Italy (*RAI*); Sweden (*SVT*); Switzerland (*RTS*); as well as members of the *EBU*, in Delphi mode and in two rounds.

A purposive convenience sample was selected and expanded through the 'snowball' methodology based on contacts shared by the interviewees, and a second consultation was carried out to refine aspects of the information collected.

We worked with a semi-structured questionnaire that never exceeded 12 questions and in which specific questions were included, depending on the corporation interviewed. The main blocks were the application of AI, relative weight of AI in their innovation strategy, and forecasts and future challenges with respect to this technology.

Forty contacts were made, and the sample was finally validated, in which PSM from the three media models described by **Hallin** and **Mancini** (2004) were represented. The final panel of 15 interviewees is described in table 3.

> "The *BBC* has started experimenting with Object-based media, a new way of personalising content based on the user's situation"

Table 3. Purposive convenience sample of the study

Abbreviation	Name	Corporation	Position
(AM/*RAI*)	Alberto Messina	*RAI*	R&D Director
(AJ/*EBU*)	Atte Jääskeläinen	*EBU*	Professor at *LUT University* and consultant at the *EBU*
(BV/*NPO/EBU*)	Bob Van de Velde	*NPO/EBU*	Head of Data and Archives at NPO; Co-Director of AI at *EBU*
(DC/*RTVE*)	David Corral	*RTVE*	Head of content innovation
(JF/*DR*)	Jakob Faarvang	*DR*	Digital Product Manager
(JK/*YLE*)	Jarno Koponen	*YLE*	Head of AI and perosnalisation
(JA/*BBC*)	Jatin Aythora	*BBC*	Chief Architect, responsible for AI
(JL/*SVT*)	Johan Linden	*SVT*	Strategy Director
(JB/*BR/ARD*)	Jonas Bedford	*BR/ARD*	Innovation Leader at Bayerischer Rundfunk
(KB/*FranceTV*)	Kati Bremme	*France TV*	Artificial Intelligence Vision Director
(LB/*RTS/EBU*)	Léonard Bouchet	*RTS/EBU*	Data and Archives Lead at *RTS*; Co-Director of AI at *EBU*
(LV/*RTBF*)	Loïc de Visscher	*RTBF*	Innovation Director
(MM/ *VRT*)	Mike Matton	*VRT*	Responsible for international innovation partnerships
(RW/*RTÉ*)	Richard Waghorn	*RTÉ*	Director of Operations, Technology and Transformation
(RA/*ZDF*)	Robert Amlung	*ZDF*	Digital Strategy Director

Thus, by models, the polarised pluralist model is represented by *RTVE*, *FranceTV* and *RAI*; the corporatist-democratic model is represented by *VRT*, *RTBF*, *DR*, *RTS*, *SVT*, *ZDF*, *ARD*, *NPO* and *YLE*; and the liberal model is represented by the *BBC* and *RTÉ*.

Table 4. Correspondence between corporations/**Hallin** and **Mancini** model (2004)

Polarised pluralist	Democratic corporatist	Liberal	Other
FranceTV (France) *RAI* (Italy) *RTVE* (Spain)	*ARD* (Germany) *DR* (Denmark) *NPO* (Netherlands) *RTBF* (Belgium) *RTS* (Switzerland) *SVT* (Sweden) *VRT* (Belgium) *YLE* (Finland) *ZDF* (Germany)	*BBC* (United Kingdom) *RTÉ* (Ireland)	*European Broadcasting Union* (*EBU*)

Interviews were conducted between April 2020 and February 2022 via *Skype*, *Zoom* and *Google Meetings* platforms, with an average duration of over 40 minutes. The first round of contact to the broadcasters' corporate email addresses began on 1 March 2020, with a subsequent fine tuning and personal contact with each of the professionals of interest. The transcription and translation of the material were carried out in parallel to its collection, whereas the analysis of the results began after this period.

Methodological triangulation was achieved through a scan of the scientific literature on the application of AI and the importance of innovation in PSM and a review of the websites and web platforms of the corporations contacted to contextualise the questions and verify the answers of the interviewees.

The objectives set out in the development of this article can be divided as follows:

- Main objective: To draw an overview of the status and use of AI technologies in European PSM.
- Secondary objectives: To identify the different sections and production processes in which AI is used in corporations and to expose the challenges perceived by the consulted media regarding the use and implementation of AI in their companies.

These objectives were achieved through the following research questions proposed in the construction of the article:

- What are the processes in which European PSM are applying and plan to apply AI?
- What are the problems and challenges faced by European PSM in using these technologies?
- How do European PSM see the future with the implementation of these technologies in their various departments?

3. Results

The results obtained reveal a diverse picture of the use of AI in PSM. Although this technology is applied in a cutting-edge way in a few cases, examples demonstrate innovative attitudes to the use of AI in the media sector. These examples are led, as is to be expected, by corporations with the biggest budgets.

The *BBC* has already started experimenting with the idea of 'object-based media', a new way of personalising content that considers the user's situation (geographical, postural, sensory) and automatically adapts content to different formats on demand. On a practical level, this can be understood through the following example: If you have a 15-minute walk to work every morning, you can ask the *BBC* app to summarise the main news of the morning in a podcast of that length (even narrating content that may have originally been conceived in text format); by contrast, if you commute 30 minutes on a train every day, you may be more interested in receiving that content in text format, audiovisual format, or a mix of both.

The *ARD* has already drawn a preliminary picture of the areas and operations in the corporation where AI will be applied. AI will play a leading role in content production, verification, recommendation, image recognition and even in internal operational aspects of the corporation through a novel strategy that even considers the use of these technologies for the calculation of its employees' bonuses.

In corporations as a whole, we can summarise the application of this technology in four different areas: production (news, automated production, metadata), content management (archive management, recommendations), verification and the extension of services (automatic translation of content, automatic subtitling for the accessibility of people with hearing disabilities).

No great homogeneity exists among European PSMs in terms of the specific software used, which reinforces the idea of AI as an ad hoc technology requiring a customised installation in each case, which is one of the reasons why it is highly costly and very difficult to scale. The case of AI is comparable to the use of internal management technologies in the field of broadcasting, which usually need customised technological solutions and not so often standard market products because of the particularities of their workflows and intranets.

In the following sections, the uses of AI in each of the European PSM that deal with these technologies in the exercise of their activities are described.

3.1. AI technology in European *PSM*

After analysing the 15 interviews with the 15 corporations and the *EBU* AI leaders, we confirmed that AI is a technology of great interest to corporations, constituting a relevant part of the innovation roadmap of European PSM.

Different interpretations of what AI means for these organisations are identified. Some of them, such as the *ZDF*, reject the term 'artificial intelligence' and opt for 'machine intelligence', given that, in their opinion, the procedures that generate value in this technology do not follow the usual patterns of the human mind.

All the corporations agree that AI has enormous potential that they are still beginning to understand and implement and are, therefore, still in what we could consider to be the first phase of experimentation. This phase is characterised by the proliferation of a multitude of pilot projects, but without scalable productions or with little strategic approach. However, considerable progress is expected in the short term. In the words of Alberto Messina, *RAI* Italy's director of development and innovation, they hope to 'reduce the amount of effort needed to produce certain content or create better content with the same effort'.

According to the results obtained, the prototyping and testing of AI tools are costly and complex, so inter-corporate collaborations are frequent, with private companies and start-ups, and in the case of PSM, with the *EBU* as a meeting point. Among the uses that public broadcasters make of this technology, the management of the corporations' internal archives and the metadata of the content hosted there stand out. This is seen as fundamental by all the professionals interviewed and is considered a first step in speeding up the distribution and creation of new products. Work on the accessibility of content, with automated subtitles as the protagonist, was another issue on which the corporations consulted were in agreement.

The general view in corporations is that misinformation is a long-lasting, complex problem against which the human factor will need to be applied. AI by itself is not expected to be sufficient to counteract the crisis of trust that PSM are going through, but it is projected as an enabler of verification at different stages of information production.

Among the challenges facing professionals in the application of AI is overcoming the cultural barrier to the technology. Although the perception of AI in newsrooms is beginning to show a positive trend, some reticence occurs, especially in corporations with a more traditional structure, regarding the use and presence of these technologies in certain processes. The internal reading that corporations make in this respect reveals two factors: on the one hand, the fear of professionals to hand over certain responsibilities that could lead to an eventual replacement of their functions, and on the other hand, the lack of technical knowledge, which distances the most experienced workers from potential new production processes.

Corporations such as *France TV* conduct AI literacy sessions with their employees with the aim of bringing their staff closer to the sensitivities and possibilities of these technologies, with a special emphasis on the complementary nature of AI in newsroom work. In other words, they seek to project the presence of these technologies as an opportunity for journalists to focus their time on the creative and reflective aspects of their work, eliminating the more tedious and mechanical aspects.

3.2. Specific uses of AI in European public broadcasters

Below are three tables of results showing the areas in which each European public broadcaster consistently applies AI. The corporations are grouped in the tables according to the media system, following Hallin and Mancini's paradigm. The most common processes where AI is used are in algorithmic recommendation engines, content creation, content accessibility, metadata and indexing, verification and audience interaction.

A number of common concerns are recognised among the corporations that merit future monitoring of their progress and impact. These include the difficulty of locating experienced professionals in the use of artificial intelligence in the media, which is coupled with the complexity of training their own employees. This issue, together with the high costs of implementing the systems, limits in many cases the implementation of intelligent solutions. Another issue that deserves to be monitored is the capacity of media organisations to develop large-scale AI projects within their structures and their capacity to adapt them to their specific needs, as ready-made applications often fail to fulfil the corporations' specific needs.

Table 5. Specific uses of artificial intelligence in polarised pluralist model corporations

Corporation	Application of artificial intelligence in polarised pluralist model televisions
RAI (Italy)	- Experimentation with *natural language processing* (NLP), *computer vision* and visual information analysis. - They work on content accessibility and automatic subtitling and in automatic voice recognition in news transcription, information retrieval and automatic recommendation of news material. - Data collection, cleaning and display (example: femicide project). - Automatic recommendation by algorithm.
RTVE (Spain)	- Subtitling of news programmes in regional languages. - Facial and voice recognition for metadata generation, both for cataloguing the archive and for new content (transcription of press conferences identifying interlocutors). - Intelligent realisation using a single camera to enable and improve the quality of certain broadcasts. - Automatic news generation with *Narrativa* and *EFE*.
FranceTV (France)	- Indexing. Speech to text and image recognition to add more and faster index content. - Automatic creation of articles in the newsroom on parties, electoral processes or the weather. - Creation of automatic football videos for broadcasting on social networks. - Recommendation algorithm.

Table 6. Specific uses of artificial intelligence in corporations in the democratic corporatist model

Corporation	Application of artificial intelligence in democratic corporatist model television stations
VRT (Belgium)	- Subtitling using the speech recognition engine. - AI-based recommendation engine. - Chatbots for audience interaction. - Tools for news verification. - Real-time sports statistics (provided by suppliers)
RTBF (Belgium)	- Automatic tagging of metadata for the archive and new content. - Analysis of the post-production process. - Conceptual evidence of content summaries and highlights. - Small projects with start-ups - Content recommendation.
SVT (Sweden)	- Creation of graphic solutions. - Creation of journalistic content. - Content recommendation algorithm.
DR (Denmark)	- Machine learning for personalisation. - Analytical systems, also for customisation. - Metadata generation (with *Media Distillery*)
NPO (Netherlands)	- Live subtitles, real-time translation. - Use of AI throughout the media chain (production, aggregation and dissemination). - Metadata generation. - Analysis of usage data and user data. - Creative applications (e.g. music, lyrics). - Automatic generation of trailers and promos. - Experiments generating sports news and election results from structured data. - Search for information in large databases by means of automatic searches.
YLE (Finland)	They divide AI innovation into four areas: 1. Understanding of content, data and metadata. 2. Content creation with smart tools. 3. Content distribution and personalisation. 4. Analysis. -They are also creating metadata to use systems that can recognise images. -They experiment with content creation using automated systems that generate images and illustrations.
ZDF (Germany)	-*Machine learning* (not used to generate automatic content, such as texts). -Video analysis or machine translation.
RTS (Switzerland)	- Generation of metadata and searching of the archive through it. - Voice recognition. - Creation of customised classifiers.
ARD (Germany)	- Creation of texts from regional data. - Verification. - Transcription and automation of routine tasks. - Image and text recognition for metadata and file enlargement. - Algorithmic recommender systems. - In the near future: AI strategic plan to automate administrative operations (e.g. calculation of workers' capital gains).

Table 7. Specific uses of artificial intelligence in corporations in the liberal model

Corporation	Application of artificial intelligence in liberal model televisions
BBC (UK)	- Content recommendation. - Ethical dimension of AI. - Partnerships with other entities against disinformation. - Implementation of AI machine learning for journalistic work. - Small specific tests in audiovisual content creation but no large-scale or chain creation. - In the future: object-based media (automation of the production of flexible multi-platform content personalised to the user's personal situation).
RTÉ (Ireland)	- Microsoft indexer for content indexing. - Creation of metadata. - *Machine learning* for automatic database analysis.

The PSMs agree in highlighting the value of AI in the management of their archives, opening up the possibility of turning it into a 'live' system capable of retrieving information more efficiently and in turn feeding the archive with new content generated from previous ones. In some cases, this is done by applying facial or voice recognition systems based on AI that manage to tag the contents (identification of people, interlocutors, contents and themes), making them more easily identifiable and retrievable. Despite this consensus on the usefulness of the technology, most corporations have not catalogued, classified or tagged their archives with metadata, making them difficult to access and disorganised. The Swiss *RTS*, in particular, not only performs speech-to-text transcription but also manages to differentiate between male and female voices.

> "We work with various facial or voice recognition applications to preserve the archive, the only way to keep it alive is to catalogue it through metadata. These tools are made in collaboration with the *EBU*, they are very expensive tools, and it is necessary to unify resources" (DC/*RTVE*).

> "We have several tools that we are pioneering. I think we have the only metadata video archive in the world" (LB/*RTS*).

Accessibility of content is another priority issue for European public broadcasters. AI is useful in bringing content closer to people with limitations, for example, hearing impairments and through automatic subtitling with voice recognition and transcription systems. Such real-time AI systems are becoming increasingly common, and in corporations such as VRT, it was the first AI tool to be integrated into content.

> "We use AI for subtitling in the different languages recognised by the State, in the news, for example" (DC/*RTVE*).

> "The first area where we applied AI was in subtitling, the speech recognition engine has been with us for more than 10 years and, for a long time, it was the only resource where we used machine learning. Now, we are also using it in chatbots and verification systems" (MM/*VRT*).

> "On one of our channels, where we cover all the debates, we do real-time subtitles. This is based on an AI system that understands the speech, translates it into text and even translates it live" (BV/*NPO*).

The perception of European public broadcasters using AI is that they are able to expand their content coverage while improving the quality of their content. *RTVE*, for example, is working on the implementation of a smart camera system that will allow it to produce live coverage with a single device. For its part, the *BBC* has tried creative alternatives and has even tried important management tasks, such as the automated direction of the programming and content of one of its channels.

> "Big advances expected by corporations are related to the technical side, with specific tools that allow them to be more efficient and increase the quality of specific tasks"

> "We are applying AI in camera systems. When you can't move a whole team, if one camera can provide intelligent live production with different shots, it allows us to extend our coverage" (DC/*RTVE*).

> "Last year, we ran *BBC Channel 4* entirely powered by AI, we ran programming and content successfully because of it. We have a lot of specific use cases, but we don't have large-scale production cases yet" (JA/*BBC*).

In terms of their relationship with their audience, PSMs also take advantage of the benefits of AI, both in their interactions with the audience through chatbots and in the personalisation of their content offer. Algorithmic recommendation systems are one of the solutions that European public broadcasters apply to bring relevant products to the user and thus fulfil one of their public service missions. However, Atte Jääskeläinen (*EBU*) explained that private broadcasters are much more advanced in these services.

> "Digitalisation has brought about major changes. There is now a lot more information, so personalisation can channel the situation and offer relevant content for the user and add value to the public service. Still, private media are ahead of PSM. While public corporations worked cautiously trying not to make mistakes, *Google*, *Facebook* and *Twitter* have developed high-quality services" (AJ/*EBU*).

3.3. Future prospects and challenges for European *PSM* in relation to AI

The main challenge for European PSMs lies in the learning and deep cultural implementation of the technologies to exploit the benefits of the technology while analysing and managing the various problems (workflow, corporate culture, organisation and professional profiles and ethics) that may arise from its use.

In the field of verification, deepfake, through which a speech or image of a character can be synthetically falsified, is another of the great challenges identified by corporations in the use of AI. *RAI* proposes that this can be used constructively to revive characters from the past, for example.

> "An interesting topic is deepfake. It is dangerous if it is used to make things appear to be what they are not, but it is already being used in the reconstruction of characters from the past" (AM/*RAI*).

Another common forecast is the creation of mixed human-machine teams, so that their correct adaptation will give added value to the entire product development chain. This also responds to a prophylactic need to always supervise and accompany the activity of machines with the presence and editorial criteria of human professionals, as specified in the AI white paper published by the *European Commission* in 2020.

> "With AI, we will be more creative to be able to target different audiences in the perfect way with the right programme, but all those tasks should be done hand in hand with humans. Not just robots, and not just people, really working together creates something useful and valuable" (KB/*France TV*).

Big advances expected by corporations are related to the technical side, with specific tools that allow them to be more efficient and increase the quality of specific tasks. These algorithms and systems affect all phases of the production chain until they reach a point where AI generates parts of their content. For the moment, many of them have only worked on prototypes and proofs of concept, but the results are positive, and their intention is to continue innovating with AI as the main actor.

> "Editing systems will have artificial intelligence plugins to enhance the image; or in distribution, we will have technologies that can encode our content more intelligently and find the right files for the end user. All of that is done with algorithms" (BV/*NPO*).

> "We explore AI solutions to generate some summary, some highlights, in short, to generate new content. At the moment, what we are doing is testing conceptual projects. I think in 5 years, it is possible that AI will generate some parts of our content" (LV/*RTBF*).

Among the challenges that European PSM identify in the implementation of AI, the cultural barrier to technology and the ethical dimension, privacy and management of user data, especially relevant in the field of public service, stand out among the challenges that European PSM identify in the implementation of AI.

Many journalists still fear that this new technology will replace them in their jobs. Along this line, corporations are trying to communicate that machines will only replace people in routine tasks in which the contribution of human value is not essential to be able to devote their efforts and time to creative areas that are fundamental to the final result. *France TV* is emphasising this point by organising sessions to make its journalists aware of the advantages that AI will bring to them.

> "We create automated content from structured data, but it's complicated. Journalists are afraid of having their work taken away from them, so we do sessions to explain to them that AI will do the stupid tasks so they can focus on doing the smart ones" (KB/*France TV*).

> "We are working on how public service broadcasters should be cautious in their use of data and privacy management. We have guidelines and principles that we adhere to every time we develop any kind of machine learning or AI" (JA/*BBC*).

PSMs are concerned about building mixed teams because they cannot find professionals specialised in building smart technologies. This is partly due to the lack of economic incentives in the public sector compared to the supply and economic resources that exist in the private sector. This makes it very difficult to incorporate new professional profiles and, therefore, to renew the internal culture of companies and the implementation of innovative technological initiatives.

Another challenge is funding. Public service broadcasters stress that they must claim and strengthen their relevance and the trust of the audience to avoid falling into a delegitimisation that would compromise their future survival. In the short term, AI can play an important role in this sense, given that the strategic decision for corporations to be mediated by external technology for budgetary reasons can generate problems in the medium term, not only because this would mean being dependent on third-party technology but also because it implies a de facto lack of control and capacity for the specific design of this technology for public service use. Against this background, whether to opt for in-house technological development or for a mixed solution may mark the future of corporations.

> "We can summarise the application of AI in four areas: production, content management, verification and the extension of services"

> "One of the challenges is to defend the relevance of public service media for generations to come. This goes hand in hand with the challenge of funding: if we are relevant it will be more difficult to make cuts, if we are not, they will. The main challenge is trust, adaptability, resilience, adaptability, and I think we still have a lot to learn in that respect" (LB/*RTS*).

> "I think the biggest challenge is people. There is strategic scenario planning from which we conclude that if nothing is done with AI, our services will be very irrelevant in the future. There are 3 possible scenarios: our service will be mediated by the internet technology giants, in that context our services and values will not be relevant; we focus only on our own services, without being mediated, so we would need huge expertise; the third is that we do nothing, and if we do this we will have no idea whether our services would still be relevant" (JA/*BBC*).

All corporations understand AI as a cross-cutting issue. In fact, this position is expected to be maintained in the future, as the creation of dedicated AI teams is generally not considered essential. However, AI-related proposals are commonly worked on in multidepartmental innovation labs.

> "Firstly, I don't think there will be an AI learning department. I think AI will be the culture of all our engineering activities at the *BBC*. Secondly, I think the focus for us will be more on training models, on ensuring knowledge of the technology, and then on the services that can be offered on top of them" (JA/*BBC*).

> "We have no innovation or AI department. Nor will we have either in five years' time. As I said at the beginning, they really need to be in all parts of the company. We need to make the whole company more flexible to be able to not only produce good linear products and some add-ons. Really the core of the company has to be able to adapt to digital, to be able to innovate, to be an agile organisation using the AI tool" (RA/*ZDF*).

4. Discussion and conclusions

AI is identified as the technological proposal par excellence to which European public broadcasters are turning and plan to turn in the near future. Some of them, such as *ZDF*, have decided to use an alternative term (machine intelligence) because of the differences between their procedures and those of the human mind. None of the corporations, except Finland's *YLE*, have specific departments dedicated to AI, nor do they plan to incorporate it in the near future. Even so, all corporations consider it a cross-cutting element across all departments and employees, and a large number of them are already experimenting with its future applications in their respective innovation labs. In the coming years, it will be key to analyse whether AI management and development becomes independent in new departments or is integrated transversally into already existing sections.

Comparing the budgetary capacity of the different corporations with their interest in and deployment of AI, we can see that the size of these PSM is of relative but not decisive importance. The *ARD* and the *BBC*, with the two largest budgets in the sample analysed, are, at the same time, the corporations with the greatest foresight and ambition (at least, and at this stage, at a theoretical level) regarding the use of these technologies. However, other media, such as the Swiss *RTS* or the Finnish *YLE*, with moderate budgets, have some of the most advanced technologies, particularly in archive management and automated news production, respectively. However, it is not yet clear whether talent will be enough to accomplish successful results in the application of AI, or if the biggest differences will be marked almost exclusively by the corporations' financial resources.

Corporations have been intentionally grouped according to the media system models proposed by Hallin and Mancini, with the intention of testing for the presence of any relationship between this classification and the perceived uses and challenges of AI, particularly those referring to corporate culture and uses that may have a deeper ethical dimension. At this level, no notable differences were observed. Hence, we can understand, at least preliminarily, that the application of AI is not directly influenced by the political particularities of each region and media system.

Expectations for this technology are high, yet European public broadcasters are still in the early stages of experimentation and implementation, with various projects, more of a voyeuristic attitude than a firm strategic approach, and no large-scale proposals. The PSMs agree that developing prototypes based on AI is costly and complex. Therefore, they resort to cooperation with other media, private companies, start-ups, universities or the *EBU*.

In terms of applications that are currently recognised, tools for the automatic creation of simple content from structured data, intelligent audiovisual production of programmes, those related to improving interaction with the audience through chatbots, the generation of summaries, the personalisation and recommendation of content and the verification and fight against fake news stand out.

The weight and importance given to the generation of metadata to keep their archives alive, considered the heritage of their respective countries, gains relevance through the interviews. The need to broaden access to content, particularly with the expansion of their competences and public service duties in using this technology to reach new groups of people or to facilitate consumption and reception for population groups with greater difficulties, is also a major consideration.

> "Corporations are still in a first phase of experimentation characterised by a proliferation of pilot experiences"

Corporate practitioners do not believe that AI will be sufficient to counter the crisis of trust in PSM, or at least that this solution will not come simply through technology, but will inevitably have to be accompanied by an extensive exercise in public education and media literacy.

> Corporations recognise the difficulty of locating professionals with experience in the use of AI in the media, coupled with the complexity of training their own employees

Some corporations with more traditional schemes or a lower incidence of AI in their media and technology ecosystems also face a greater challenge: overcoming the cultural barrier to technology, maintaining audience trust, surviving budget cuts and managing data, privacy and the ethical dimension of everything related to AI.

In terms of future forecasts, PSMs agree on the need to make their structures more flexible, on the construction of journalistic profiles that are more technologically trained, on the growing relative weight that Video On Demand platforms will have in their companies and on the generational differences that will be recognised in these changes. This fact opens up a discussion and a larger question: Should PSM, also to looking for ways to reach young audiences, also look for ways to rejuvenate themselves from within? At the intersection of AI, journalism and public media, the professional profiles that dominate these fields are scarce and often beyond the hiring capabilities of corporations.

Furthermore, changes are expected in the relationship with its audience; a new two-way relationship in which the suggestions of users and for which chatbots can play a leading role must be considered.

Finally, the challenges that European public broadcasters expect to face in the coming years are linked to technological re-adaptation, budget cuts, cultural barriers within and outside the organisations, maintaining the trust and attention of audiences and, in short, maintaining their capacity for innovation.

In this sense, in line with the current deployment of IA in European media public corporations, we can determine that it has a long, multidimensional and polyvalent path in these corporations, solving part of the difficulties related to operability and efficiency, but which promises to add important challenges in the cultural, budgetary and aptitudinal aspects of the different corporations.

5. References

Anderson, Christopher W. (2013). "Towards a sociology of computational and algorithmic journalism". *New media and society*, v. 15, n. 7, pp. 1005-1021.
https://doi.org/10.1177/1461444812465137

Aslama-Horowitz, Minna; **Nieminen, Hannu** (2017). "Diversity and rights. Connecting media reform and public service media". *Scientific journal of information and communication*, v. 14, pp. 99-119.
http://icjournal-ojs.org/index.php/IC-Journal/article/view/385/341

Carlson, Matt (2015). "The robotic reporter: Automated journalism and the redefinition of labor, compositional forms, and journalistic authority". *Digital journalism*, v. 3, n. 3, pp. 416-431.
https://www.tandfonline.com/doi/abs/10.1080/21670811.2014.976412

Clerwall, Christer (2014). "Enter the robot journalist. Users' perceptions of automated content". *Journalism practice*, v. 8, n. 5, pp. 519-531.
https://doi.org/10.1080/17512786.2014.883116

Diakopoulos, Nicholas (2019). *Automating the news. How algorithms are rewriting the media*. London, UK: Harvard University Press. ISBN: 978 0 674976986

Dierickx, Laurence (2019). "Information automatisée et nouveaux acteurs des processus journalistiques". *Sur le journalisme*, v. 8, n. 2.
https://doi.org/10.25200/SLJ.v8.n2.2019.408

Dörr, Konstantin-Nicholas (2016). "Mapping the field of algorithm, journalism". *Digital journalism*, v. 4, n. 6, pp. 700-722.
https://doi.org/10.1080/21670811.2015.1096748

Edge, Abigail (2014). "Ophan: Key metrics informing editorial at The Guardian". *Journalism.co.uk*, 2 December.
https://www.journalism.co.uk/news/how-ophan-offers-bespoke-data-to-inform-content-at-the-guardian/s2/a563349

Fanta, Alexander (2017). *Putting Europe's robots on the map: Automated journalism in news agencies*. University of Oxford; Reuters Institute for the Study of Journalism.
https://goo.gl/wBfuQs

Fieiras-Ceide, César; **Vaz-Álvarez, Martín**; **Túñez-López, Miguel** (2022). "Verificación automatizada de contenidos en las radiotelevisiones públicas europeas: Primeras aproximaciones al uso de la inteligencia artificial". *Redmarka. Revista de marketing aplicado*, v. 26, n. 1, pp. 36-51.
https://doi.org/10.17979/redma.2022.26.1.8932

Graefe, Andreas (2016). *Guide to automated journalism*. Broadway, USA: Columbia Tow Center for Digital Journalism.
https://doi.org/10.7916/D80G3XDJ

Gran, Anne-Britt; **Booth, Peter**; **Bucher, Taina** (2020). "To be or not to be algorithm aware: A question of a new digital divide?" *Information, communication & society*, v. 24, n. 12, pp. 1779-1796.
https://doi.org/10.1080/1369118X.2020.1736124

Hallin, Daniel C.; **Mancini, Paolo** (2004). *Comparing media systems: three models of media and politics*. Cambridge, UK: Cambridge University Press. ISBN: 978 0 511790867
https://doi.org/10.1017/CBO9780511790867

Hansen, Mark; **Roca-Sales, Maritxell**; **Keegan, Jonathan M.**; **King, George** (2017). *Artificial intelligence: Practice and implications for journalism*. New York: Tow Center for Digital Journalism; Brown Institute for Media Innovation.
https://doi.org/10.7916/D8X92PRD

Karlsen, Joakim; **Stavelin, Eirik** (2014). "Computational journalism in Norwegian newsrooms". *Journalism practice*, v. 8, n. 1, pp. 34-48.
https://doi.org/10.1080/17512786.2013.813190

Kim, Jong-Hwan; **Lee, Kang-Hee**; **Kim, Yong-Duk**; **Kuppuswamy, Naveen-Suresh**; **Jo, Jun** (2007). "Ubiquitous robot: A new paradigm for integrated services". In: 2007 *IEEE International conference on robotics and automation*, pp. 2853-2858.
https://doi.org/10.1109/ROBOT.2007.363904

Lecompte, Celeste (2015). "Automation in the newsroom". *Nieman reports*, 1 September.
http://niemanreports.org/articles/automation-in-the-newsroom

Lewis, Seth C.; **Guzman, Andrea L.**; **Schmidt, Thomas R.** (2019). "Automation, journalism, and human-machine communication: Rethinking roles and relationships of humans and machines in news". *Digital journalism*, v. 7, n. 4, pp. 409-427.
https://doi.org/10.1080/21670811.2019.1577147

Lindén, Carl-Gustav (2017). "Algorithms for journalism: The future of news work". *The journal of media innovations*, v. 4, n. 1, pp. 60-76.
https://doi.org/10.5617/jmi.v4i1.2420

Marconi, Francesco; **Siegman, Alex** (2017). *The future of augmented journalism: A guide for newsrooms in the age of smart machines.*
https://www.ap.org/assets/files/2017_ai_guide.pdf

Matsumoto, Rie; **Nakayama, Hideki**; **Harada, Tatsuya**; **Kuniyoshi, Yasuo** (2007). "Journalist robot: Robot system making news articles from real world". In: 2007 *IEEE International conference on robotics and automation*, pp. 1234-1241.
https://doi.org/10.1109/IROS.2007.4399598

Montal, Tal; **Reich, Zvi** (2017). "I, robot. You, journalist. Who is the author? Authorship, bylines and full disclosure in automated journalism". *Digital journalism*, v. 5, n. 7, pp. 829-849.
https://doi.org/10.1080/21670811.2016.1209083

Napoli, Philip M. (2012). "Audience evolution and the future of audience research". *International journal on media management*, v. 14, n. 2, pp. 79-97.
https://doi.org/10.1080/14241277.2012.675753

Oremus, Will (2015). *No more pencils, no more books*. Slate. New Mexico: Public Service Aliance.
http://publicservicesalliance.org/wp-content/uploads/2015/10/Adaptive-learning-software-is-replacing-textbooks-and-upending-American-education.-Should-we-welcome-it.pdf

Rojas-Torrijos, José-Luis (2019). "La automatización en las coberturas deportivas. Estudio de caso del bot creado por The Washington Post durante los JJ.OO. de Río 2016 y Pyeongchang, 2018". *Revista latina de comunicación social*, n. 74, pp. 1729-1747.
https://doi.org/10.4185/RLCS-2019-1407

Saurwein, Florian (2019). "Emerging structures of control for algorithms on the Internet". In: Eberwein, Tobias; Fengler, Susanne; Karmasin, Matthias. *Media accountability in the era of post-truth politics. European challenges and perspectives*. Abingdon, UK: Routledge. ISBN: 978 1 351115780

Sirén-Heikel, Stefanie; **Leppänen, Leo**; **Lindén, Carl-Gustav**; **Bäck, Asta** (2019). "Unboxing news automation: Exploring imagined affordances of automation in news journalism". *Nordic journal of media studies*, v. 1, n. 1, pp. 47-66.
https://doi.org/10.2478/njms-2019-0004

Soffer, Oren (2019). "Algorithmic personalization and the two-step flow of communication". *Communication theory*, v. 31, n. 3, pp. 297-315.
https://doi.org/10.1093/ct/qtz008

Sørensen, Jannick-Kirk; **Van-den-Bulck, Hilde** (2018). "Public service media online, advertising and the third-party user data business: A trade versus trust dilemma?". *Convergence: The international journal of research into new media technologies*, v. 26, n. 2, pp. 421-447.
https://doi.org/10.1177/1354856518790203

Tortoise Media (2021). *The global AI index*. London: Tortoise Media.
https://www.tortoisemedia.com/intelligence/global-ai

Túñez-López, José-Miguel; **Toural-Bran, Carlos**; **Frazão-Nogueira, Ana-Gabriela** (2020) "From data journalism to robotic journalism: The automation of news processing". In: Vázquez-Herrero, Jorge; Direito-Rebollal, Sabela; Silva-Rodríguez, Alba; López-García, Xosé. *Journalistic metamorphosis. Studies in big data*, v. 70. Springer, Cham.
https://doi.org/10.1007/978-3-030-36315-4_2

Túñez-López, José-Miguel; **Toural-Bran, Carlos**; **Valdiviezo-Abad, Cesibel** (2019). "Automation, bots and algorithms in newsmaking. Impact and quality of artificial journalism". *Revista latina de comunicación social*, n. 74, pp. 1411-1433.
https://doi.org/10.4185/RLCS-2019-1391en

UER (2019). *EBU news report 2019. The next newsroom: unloking the power of AI for public service journalism*. Geneva: EBU, European Broadcasting Union.
https://www.ebu.ch/publications/strategic/login_only/report/news-report-2019

Ufarte-Ruiz, María-José; **Manfredi-Sánchez, Juan-Luis** (2019). "Algoritmos y bots aplicados al periodismo. El caso de Narrativa Inteligencia Artificial: estructura, producción y calidad informativa". *Doxa comunicación*, n. 29, pp. 213-233.
https://doi.org/10.31921/doxacom.n29a11

Van-Dalen, Arjen (2012). "The algorithms behind the headlines". *Journalism practice*, v. 6, n. 5-6, pp. 648-658.
https://doi.org/10.1080/17512786.2012.667268

Wu, Shangyuan; **Tandoc, Edson C.**; **Salmon, Charles T.** (2019). "A field analysis of journalism in the automation age: understanding journalistic transformations and struggles through structure and agency". *Digital journalism*, v. 7, n. 4, pp. 428-446.
https://doi.org/10.1080/21670811.2019.1620112

Yanfang, Wu (2020). "Is automated journalistic writing less biased? An experimental test of auto-written and human-written news stories". *Journalism practice*, v. 14, n. 8, pp. 1008-1028.
https://doi.org/10.1080/17512786.2019.1682940

Yleisradio (2018). *The first of its kind in the world: Yle NewsWatch's smart Voitto assistant shows recommendations directly on the lock screen*. Helsinki: Yle.
https://yle.fi/aihe/artikkeli/2018/10/12/the-first-of-its-kind-in-the-world-yle-newswatchs-smart-voitto-assistant-shows