

# Designing personalisation of European public service media (PSM): trends on algorithms and artificial intelligence for content distribution

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## Abstract

The migration of audiences to digital environments has motivated the media to develop a content distribution strategy that has a presence in these new spaces. In the case of European public broadcasters, they have strengthened their digital news services and have built video-on-demand platforms where they organise and screen their products. Even so, the overload of information and content reaching users forces corporations to look for new mechanisms to present an adequate, interesting and diverse offering to each of their followers. This research project analyses the use of artificial intelligence in the recommendation systems implemented by 14 European public broadcasters in 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) and Switzerland (RTS). The results reveal that there is no unanimity among the corporations with regard to the operation and origin of these systems, which vary between home-made developments, acquired from third parties, or collaborative solutions. Operators differentiate between news recommendation processes and those executed on their VoD platforms and aim to distance their systems from those of commercial media, for which they have already started working on a public service media (PSM) algorithm that includes traditional public media values, avoids filter bubbles, and pays special attention to the *European General Data Protection Regulation (GDPR)*.

## Keywords

Public service broadcasting; PSM; Recommendation systems; Artificial intelligence; AI; Public service media; Algorithms; Bubble filters; Video on demand; VoD; Journalism; Audiovisual communication; Content distribution; News; Trends; Europe.



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## 1. Introduction

In the age of digitisation, public service media (PSM) have been forced to look for new alternatives to remain relevant to their audiences, improve their experience and ultimately fulfil their public service mission. Competition with the private media and the services they offer have also prompted European public broadcasters to implement disruptive technologies to close the competitive gap with them. This is why they have chosen to implement content recommendation systems in their corporations, with which they achieve an effective distribution where users and their interests converge at a common point: Video on Demand (VoD) platforms or news apps.

The algorithms that feed these systems are mathematical models that work with huge amounts of data and have already penetrated the different spheres of everyday life (Thurman; Lewis; Kunert, 2019). However, the opacity of their operation sometimes limits the credibility of their internal processes, which, together with the accelerated implementation of resources based on artificial intelligence, points to three major challenges for democracy in relation to these technologies (García-Orosa, 2022):

- polarisation;
- fake news, deepfakes and astroturfing;
- echo chambers and bubble filters.

The *Reuters Institute* believes that AI will be the technology with the greatest impact on journalism in the coming years (Newman, 2021, p. 30). Internationally, these solutions have already been implemented and accommodated in newsrooms at all stages of creation and distribution, from the search for newsworthy elements and content analysis, to automated production, distribution and verification (Sanahuja-Sanahuja; López-Rabadán, 2022), which means that journalists inevitably need to become more technologically literate (EBU, 2019).

In the case of Public Service Media, they have traditionally worked with the aim of offering relevant content to the whole population (Sørensen, 2019), and although traditional algorithmic recommendation (also called collaborative filtering) optimises content exposure and protects the user from information overflow (Herlocker *et al.*, 1999), the application of intelligent tools that select, filter and distribute content is particularly delicate (Feiras-Ceide; Vaz-Álvarez; Túñez-López, 2022), as these mechanisms have to be aligned with the core values of these media (Aslama-Horowitz; Nieminen, 2017): universality, diversity, independence and distinctiveness (Unesco, 2001).

For effective use of recommender systems, PSMs must find a way to provide a critical mass of information sufficient to provide these personalisation engines with material to generate relevant product recommendations for each user.

This is expected to lead to changes in production routines and newsrooms, and some corporations may even decide to incorporate content from other media into their offerings (EBU, 2019).

Regarding news and media, there has always been a concern about the potential loss of diversity that algorithmic recommender systems could lead to (Napoli, 2011). Subsequently, the debate has centred on filter bubbles (Pariser, 2011) that would be caused by this collaborative filtering by omitting content of specific interest in favour of the most popular (Bozdog; Van-den-Hoven, 2015). However, it has been shown that algorithms are just as good at providing diversity as human editors (Möller *et al.*, 2018) and that the uncertainty of filter bubbles may have been overestimated (Zuiderveen-Borgesius *et al.*, 2016).

The use of recommender systems in PSMs has been discussed by Fields, Jones, and Cowlshaw from the *BBC* (2018) and also by Van-den-Bulck and Moe (2017), comparing the organisational strategies of European public corporations with respect to personalisation, and focusing their study on *VRT* in Belgium and *NRK* in Norway. Pöchhacker *et al.* (2017) analyse the incorporation of a recommender system in the German media ecosystem, discussed in depth by Schmidt *et al.* (2018). Sørensen, in 2013, analysed the first tests of personalisation in online services of PSMs, while Bodo (2018) and Kunert and Thurman (2019) studied the use and typologies of personalisation in both private and public media.

The fact that PSMs can offer personalisation options is an important value proposition, as well as a competitive alternative to other media. Even so, Sørensen (2019) argues that data analysts, programmers and data curators insist on the complexity of explaining these systems to editors and journalists, who struggle to understand the importance of generating quality metadata, which directly affects the recommendation outcome. Public service organisations also have a duty to explain to users the procedure of personalisation and use of their personal data, despite the complexity involved (Sørensen, 2019).

Regarding the provenance of these systems, most of the PSMs studied by **Sørensen** (2019) rely on open-source tools to develop them. Only the *DR* in Denmark opted for a proprietary solution offered by an external provider, as they argue that they should move away from the technology side and focus on content creation. Corporations, in general, opt to build their own systems in order to have more internal control over customisation, and for the tool to be tailored specifically to their environment, ensuring the technical independence of PSMs in the future (**Sørensen; Van-den-Bulck**, 2018).

*YLE* Finland was one of the pioneering PSMs (2014) to experiment with personalisation through its personalised news application, *YLE NewsWatch*. This tool collects data from three sources: “the user’s active choices, other users’ behaviour 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 editors in the coverage of events such as municipal elections or *National Hockey League (NHL)* games (*YLEisradio*, 2018).

For its part, the *BBC* has set itself the challenge of incorporating “public service” status into the algorithm. They are already segmenting their services for different audiences, so that the homepage of their website looks different depending on age and region of origin (*EBU*, 2019). The *BBC*’s news bots have been basic, do not use machine learning, and have rarely been integrated into news production. At the same time, the corporation is laying the groundwork for developing more interactive news formats, with a more conversational tone that emphasises greater personalisation (**Jones; Jones**, 2019).

In terms of international cooperation, European public broadcasters joined forces in building a platform through which to share their data science and personalisation tools. This *EBU* project known as *Peach* (personalisation for everyone) operates diversified algorithms, through which it attempts to expand the user’s catalogue of content (*EBU*, 2019). This initiative was inaugurated by the *Bayerische Rundfunk (BR)* in Germany, and later continued as a project of the *European Broadcasting Union* (**Sørensen**, 2019).

In the *Peach* project, the recommendation system is complemented by the work of editors in the news section. Editors can choose content by searching by category, news section, source, or date, and once the selection is complete, the final part of the process begins: publication on websites and apps (**Canavilhas**, 2022). The *EBU* (2021) summarises this initiative as ‘the right content at the right time for the right person on the right device’.

Through AI, this collaboratively developed, open-source technology seeks to adapt the information offer to the user’s interests, combining audience preferences with current news trends (**Canavilhas**, 2022). The *Peach* project includes algorithms for all types of content (text, sound, video, text), with some 20 million elements collected daily. Each content is transformed into a vector representation by means of previously trained machine learning models, aiming to associate similar pieces, even if their descriptors use different words (**Canavilhas**, 2022).

In parallel, the Belgian public service corporation *RTBF* developed another software project aimed at creating generic recommendation solutions for PSM, which, like the *Peach* project, addresses the much-needed diversity requirement in public media (**Sørensen**, 2019). With regard to the quality control of its content, the *Österreichischer Rundfunk (ORF)* identifies the most structured and comprehensive quality measurement and control system in Europe. The logic applied by *ORF* is simple: if the content offered matches the individual interests of a user, it will be more relevant to them. For public service media, this means that they must listen to the feedback of the algorithm in order to modify the offer, both in terms of topics and approach (*EBU*, 2019).

## 2. Methodology

This research is a continuation of a previous study by the authors analysing artificial intelligence strategies in European public broadcasters, which detects the incipient interest of these corporations in integrating, enhancing, and personalising their content recommendation systems (**Fieiras; Vaz; Túnñez**, 2022). Despite this growing interest, no previous projects have been identified that provide an overview of the use of these technologies in these broadcasters, the procedures followed for their implementation, or the perceptions of the professionals linked to them in relation to their operation.

This is why the central objective that marks the beginning of this research is the following: to extract a complete radiography of the current situation of the use of recommender systems in European public broadcasters, paying special attention to the functioning of these systems, their origin, the teams in charge of their maintenance and implementation, and the concept of public service algorithm. To this end, the following research questions are posed, which are progressively addressed in the results sections:

- Q1. What is the perception and intention of corporations in relation to these algorithmic recommender systems?
- Q2. What is the concept of a public service algorithm, and what is the procedure proposed by the corporations for its construction and implementation?
- Q3. Do the recommendation systems used by these broadcasters come from external companies, collaborative projects, or are they developed by their own internal teams?
- Q4. How is content recommendation executed in each of the systems of the corporations studied?

In order to achieve the central objective of the research and to answer the questions posed, qualitative methods were used and personal in-depth interviews were conducted with the innovation managers, strategy and artificial intelligence 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*) and Switzerland (*RTS*); in Delphi mode and in two rounds.

A purposive convenience sample was selected, which was expanded in snowball mode based on the contributions of the interviewees, and a second consultation was carried out to clarify details of the information collected. We worked with a semi-structured questionnaire that never exceeded 8 questions and in which specific questions were included depending on the corporation interviewed.

Even so, the main blocks in all of them were: digital strategy of content distribution; application and origin of recommendation systems; public service algorithm; and data privacy and regulations. Thirty-three contacts were made and a convenience sample was finally validated in which PSMs from the three media models described by **Hallin** and **Mancini** (2004) were represented. The final panel of 14 respondents consisted of:

Table 1. Purposive convenience sample of the study

Abbreviation	Name	Corporation	Position
(AM/RAI)	Alberto Messina	RAI	R&D Director
(BV/NPO/EBU)	Bob Van de Velde	NPO/EBU	Head of Data and Archives at NPO; Co-Director of IA 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 personalisation
(JA/BBC)	Jatin Aythora	BBC	Chief Architect, responsible for IA
(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 IA 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*, *France TV* and *RAI*; the corporatist-democratic model by *VRT*, *RTBF*, *DR*, *RTS*, *SVT*, *ZDF*, *ARD*, *NPO*, and *YLE*; and finally the liberal model with the *BBC* and *RTÉ*.

Table 2. Correspondence between corporations/Hallin Mancini model (2004)

Polarised pluralist	Corporatist democratic	Liberal
<i>France TV</i> (France) <i>RAI</i> (Italy) <i>RTVE</i> (Spain)	<i>ARD</i> (Germany) <i>DR</i> (Denmark) <i>NPO</i> (Netherlands) <i>RTBF</i> (Belgium) <i>RTS</i> (Switzerland) <i>SVT</i> (Sweden) <i>VRT</i> (Belgium) <i>YLE</i> (Finland) <i>ZDF</i> (Germany)	<i>BBC</i> (United Kingdom) <i>RTÉ</i> (Ireland)

Interviews were conducted between 11 December 2021 and 25 November 2022 via *Skype*, *Zoom* and *Google Meetings*, with an average duration of over 30 minutes. The transcription and translation of the material was carried out in parallel to its collection, while the analysis of the results began after the end of this period.

### 3. Results

#### 3.1. Recommendation systems in European public broadcasters

The corporations studied agree that the linear services they offer will be maintained in the future and will be complemented by their growing digital offer, which will gain a progressive relevance that will end up imposing itself as reference content in their structures. These media prioritise the establishment of a differentiation with the usual recommendation systems of private operators, in which revenue generation, keeping the user in front of the screen, and where, according to the professionals contacted, “it does not give the sensation of being assisted by people, but by machines”, take precedence.

Regarding the construction of public service algorithms, there are discrepancies among corporations. Some, such as the *NPO*, explain that, in the creation process, they try to relate the PSM values to numerical codes, so that the system can interpret it and apply it in the subsequent recommendation. However, the *BBC* or the *DR* state that they do not see it possible to define what public service really is, so they emphasise giving diversity, plurality, accountability and transparency to the algorithm to fit its mission and avoid filter bubbles.

“ The lack of data and engineering skills, forces, on most occasions, corporations to turn to suppliers to provide them with the algorithms ”

The lack of data and engineering skills, and of professional profiles that can carry out these systems, forces, on most occasions, corporations to turn to suppliers to provide them with the algorithms and then adapt them to their structure. However, at *YLE*, *VRT*, *RTBF*, *NPO* or *SVT*, they practically develop all this technology in house with the contribution of their employees.

In cases such as *ARD* or *RTS*, they use the common open solution proposed by the *EBU*, even though the results, at least in the last of these corporations, have not been entirely favourable. In the short term, the *BBC* intends to replace the third-party algorithms it owns with its own algorithms over which it has full control and which fully meet its needs.

In evaluating these algorithms, corporations claim to employ quantitative methods such as A/B testing, alongside qualitative methods such as real user testing and interviews. The most common systems are based on collaborative filtering, which is based on user characteristics and offers content based on what similar profiles have consumed; and content-based filtering, which has the product at the heart of the recommendation. European PSMs insist on differentiating between the procedures for generating suggestions in VoD platforms and in news apps, where they stress the need to return to a journalistic emphasis.

Striking is the case of *YLE*, with its intelligent assistant for the *Voitto* news app, which recommends content directly to the user's lock screen if the user allows it. Multimodal audio, video and text recommendations are a growing trend that corporations have not yet mastered but which is identified in their roadmap for the coming years.

On user consent on notifications, data usage and other actions that may infringe on user privacy, there is considerable interest from PSMs. In addition, there is concern about the attitude of part of their audience, who are indifferent to sharing their personal information with any type of platform. In this regard, the importance of maintaining ethics and transparency in the recommendations is emphasised. Specifically, the *YLE* publishes several annual reports in which it explains exactly how it uses data, the type of data it collects and the benefits that these systems bring to users.

In terms of current regulations, corporations agree that they are not pressured by their respective governments, but that they follow the guidelines carefully. At the European level, they highlight the *General Data Protection Regulation (GDPR)*, whose reinterpretation recently forced a change in the functioning of cookie-based systems and led the affected corporations to look for alternatives in subscription portals and log in formulas.

### 3.2. Concept, construction, and implementation of the public service algorithm

VoD services offered by European PSMs are gaining relevance by leaps and bounds. Even so, as *ZDF* points out, in their case, they are suffering significant losses in linear services that are not compensated by the *Mediathek* (online services). This decline is mainly among young audiences, so it is essential to renew services to capture their attention. One issue on which there is no unanimity among corporations is their position on third party platforms such as *YouTube* or *Facebook* to distribute their content.

On these social media, *SVT* Sweden limits itself to reporting on its programmes and maintaining an ongoing dialogue with the audience. They choose to publish products only on their own sites, want to have full control of their signals and shy away from any payment schemes that may arise in these spaces. However, other broadcasters do not hesitate to upload their pieces to these platforms as they understand that part of their users browse them, which they see as a strategic opportunity.

(*JL/SVT*) “One of our decisions is not to publish full content on *YouTube* or *Facebook*. We use third platforms to report on programmes and dialogue with young audiences. We have to be free and free for all, if you have to pay for a *YouTube* subscription to watch us without ads, we are no longer fulfilling that. We also want to be 100 percent in control of our signals and publishing.”

(*LV/RTBF*) “We made the decision to be on *YouTube*, *Facebook* or *Instagram*. We have a mission to bring public service values to all citizens, so we must have a presence on *YouTube* to bring information to young people. We want to be relevant in the future.”

Corporations agree that the PSM algorithm is necessary to appropriately target content to the population. The media have an offer that is impossible to concentrate on their homepage, so they need to incorporate the recommendations for a satisfactory user experience. Moreover, the audience is routinely adapting to this new presentation of individualised content, so that rather than a differential value, it has already become an indispensable requirement.

The *EBU* points to the complexity of “estimating what news is important to people.” In the exceptional context of the coronavirus, there was a central event that was newsworthy on a global scale, but in everyday life there is not usually news that is relevant for everyone.

(RA/ZDF) “The idea of personalisation in PSM is to target content. We have a lot of content, it is impossible to put everything on the front page and we have to offer a better user experience. Users have *Netflix* and *Amazon* accounts, they are getting used to this kind of content presentation, we have to react.”

“The most common systems are based on collaborative filtering, which is based on user characteristics, and content-based filtering, which has the product at the heart of the recommendation”

To build this public service algorithmic recommendation system, it must be as unbiased as possible so that it improves accessibility issues and allows corporations to reach those populations they do not usually find. *SVT* uses the algorithm to assist publishers. They explain that it should reflect “all parts of the country, the diversity of geography and perspectives.” Meanwhile, *DR* is working on a new service that allows users to create lists of content and then run recommendations based on them.

(JL/SVT) “It’s hard to know how the public service algorithm manages to offer personalisation without being annoying or creating filter bubbles. We don’t operate with it now; we use it to help publishers.”

(JF/DR) “We have been working on a new proposition, *FlexyBlocks*, where we allow the user to create lists of content. We analyse your decisions and recommend you around it. This is our best guess for using recommendation in a public service.”

In the process of creating the PSM algorithm, Bon Van de Velde, head of data and archives at *NPO* and co-director of AI at the *EBU*, points out that the first step is to represent the content input, determine the independent variables and dummies, this is called feature space. Then, the algorithm maps this area, so the input-output set must be quantitative.

The last part includes the evaluation criteria, “whether or not people see this content on recommendation, if they click on it to search for it”, where there must be some kind of score to conclude if it works. In the first step, values can be included, and this is where the introduction of the public service fits in.

(BV/NPO/EBU) “The utility must be introduced in the first step, where features such as values can be included. This algorithm can only optimise one numerical feature. If you do survey research you know that there are many things that can be put in the numbers, so that’s how we represent this public service value.”

### 3.3. Provenance and evaluation of recommendation algorithms in European public broadcasters

European public broadcasters have not followed the same roadmap when building or acquiring their algorithmic recommender systems. In the cases of *YLE*, *VRT*, *RTBF*, *NPO* or *SVT*, they develop their own concepts and core technologies, although they combine them with resources from suppliers to finalise their operation. *YLE* says that in selecting these one-off collaborations, they choose the company carefully, in the same way they would a worker, as they need them to understand the fundamentals of delivering on their mission and values. The *BBC* is looking at and working on migrating from third-party systems to in-house solutions, as they need better “control, understanding and transparency.”

(JK/YLE) “In all our systems we combine resources, but the concept and the basic principles all come from in-house, we need to understand the systems thoroughly, it’s how they really work. There are always two things we try to do: to deliver and respect our values, mission, and objectives; and to carefully select our technology partners so that they do so as well.”

(JA/BBC) “Our top innovation priority is algorithm-driven recommendation engines. We want to build them all in-house and move away from third-party systems, we are in that transition to have better control, understanding and improve transparency.”

Other corporations such as *RAI* decided to go directly to suppliers that provide a solution that only needs to be customised. The Italian organisation did not go as far as to develop a build strategy, as they needed to have the technology immediately and did not want to spend “human resources, time or money” on the development team. The RD explains that many of his colleagues at PSM think that off-the-shelf solutions do not work and are difficult to control. Yet, they claim that they have always been successful.

(AM/RAI) “We go to suppliers. They basically sell their solution, and you customise it. We decided to do it this way because we wanted to have something ready as soon as possible and not to have to spend human resources, time or money on setting up a development team.”

(JF/DR) “We used machine learning for personalisation. We created a platform for news where you can customise whatever you want. In conversations with colleagues from other PSMs they think we buy solutions that we cannot control, yet it has worked well for us. The news where the editorial factor is important is sorted by humans, while the rest is sorted by the algorithm.”

Corporations such as *RTVE* or *France TV* complain about the lack of professionals specialised in data or engineering and architecture to be able to create these intelligent solutions. This is why *Radiotelevisión Española* follows the trend

of contracting services through public tenders, as they did at the beginning of 2020 with the *EFE* agency and the company *Narrativa* in the area of automatic news creation.

Regarding *France TV*, they are working with startups and are starting to hire staff with more technological profiles. They are in the strategic design phase, cleaning their data to optimise results and deciding what kind of algorithm they want for their system. Another alternative way of working is the one followed by *ZDF*, which takes advantage of synergies in its relationship with other corporations or with specialists from universities.

(DC/RTVE) “We don’t have a team of engineers to design the algorithms, our profiles are what they are. We do not have a data analyst to make user profiles for us. As we have done with *EFE* and *Narrativa* with respect to news, the trend is for this service to be contracted through a public tender.”

(RA/ZDF) “We have some internal knowledge. But we do not know enough to create the algorithm completely in-house. We are partnering. We have a good network formed by other European PSMs, specialised people from universities and with commercial companies through public offerings.”

Corporations such as *RTS* or *BR* use the customisation engine offered by the *EBU* to all public broadcasters, the *Peach* project. However, in the particular experience of the Swiss broadcaster, they are not fully satisfied with the results and are trying to define a new alternative.

For them, the most important thing is “the overall experience, perception, quality and relevance of the experience”, which they will try to improve in relation to the results obtained with the *EBU* technology. The *ARD*’s *BR* created its own system from this project, which is still operational and is not the same as the one used in the central corporation.

(LB/RTS/EBU) “We are part of the *Peach* project. It is a customisation engine for all *EBU* projects. We are not completely satisfied with it, so we are taking another route now that offers more individualised results.”

(JB/BR/ARD) “In *BR* we now have our own recommendation system that we built within the *EBU Peach* project. We still have it implemented today.”

To assess the correct functioning of the recommendation algorithms, the PSMs use both quantitative and qualitative methods. Regarding the former, they are doing A/B testing, which consists of running different alternatives for the same use and measuring the results. On the qualitative level, the *YLE* conducts “real user tests and interviews” to get feedback and improve the system based on the information collected.

An important question is the opinion of corporations on their preference to include editorial decisions in the algorithm or, on the contrary, to teach the algorithm to make editorial decisions. The conclusion is that these are complementary options that are being implemented jointly by European public broadcasters.

(RA/ZDF) “You have to train the algorithm to make editorial decisions and include these decisions in the algorithm. You really need to do the training at the machine level. Feed it data that is given in a public service context. And then, as with any recommender system, you need to interpret the results. This is human work.”

(MM/VRT) “As a researcher I would say we want to explore including editorial decisions in the algorithm and teaching the algorithm to make editorial decisions. Still, I think we will be more successful if we create a hybrid approach where you feed the recommender system, but of course you give more personalisation of the recommender system to the user.”

### 3.4. Description of the functioning of the recommendation systems of European PSMs

The recommender systems implemented by European PSMs have different strategic origins. One of them is technologies based on collaborative filtering, in which contributors (users) are analysed to establish profiles and recommend products based on the similarity between these profiles. These are the most common and understand that if one user ‘x’ is interested in ‘x’ content, another with similar behaviour will also like it.

On the other hand, there are systems that are based on content and that implement recommendations based on content. Below are two tables of results from the interviews carried out, in which each corporation is listed with a brief description of the recommendation system it applies. In the first table, broadcasters with a provider algorithm are grouped together, while in the second one, media with home-made systems or from collaborative solutions are grouped together.

VoD services offered by European MSPs are gaining in importance by leaps and bounds, but sometimes this increase does not cover the losses suffered in linear services

European public broadcasters have not followed the same roadmap when building or acquiring their algorithmic recommender systems

Table 3. Description of the recommendation system of corporations with supplier algorithms

Corporation	Recommender system (purchased)	Source
RAI	Content-based filtering. Mix between editorial packaging and automatic recommendation. Editorial line still takes precedence.	3 <sup>rd</sup> party
RTVE	Collaborative filtering. Algorithm that is fed by the information provided by the user through the subscription portal.	3 <sup>rd</sup> party
France TV	Recommendation by algorithm built by startup.	3 <sup>rd</sup> party
BBC	Multimodal audio, video, and text recommendations through algorithms. They work to provide a “universal recommendation.”	Currently third-party algorithm, but they intend to switch to home production.
DR	Content curation. They mainly make recommendations with algorithms, but also include editorial decisions on news stories.	3 <sup>rd</sup> party
	They bought analytics systems for the streaming platform; about news, they bought in the company <i>Cxense</i> . Their service does not require registration, it is powered by cookies.	
	<i>FlexyBlocks</i> : new personalisation proposal, the user creates lists from which they select the most relevant content for each moment.	
RTÉ	Recommendation algorithms together with editorial decisions, no personalisation. They do not have mandatory registration in VoD, an element of personalisation “which is not meaningful” acts on users accessing the log in.	3 <sup>rd</sup> party

Table 4. Description of the recommendation system of the corporations with a home-made algorithm or from common solutions

Corporation	Recommender system (in-house or collaborative)	Source
VRT	Collaborative filtering, content curation	In-house
RTBF	Collaborative filtering and content-based filtering. Mix between “home-made PSM algorithm” and editorial decisions.	In-house
SVT	Collaborative filtering, filtered playlists. Editorial decisions assisted by a simple home-made algorithm fed by cookies/user IP number. No log in.	In-house
NPO	Content-based filtering. They use several simple algorithms for personalisation. Work with educational research institutes. They have subscription on the VoD platform.	In-house
RTS	They are part of the <i>EBU's Peach</i> project.	<i>Peach</i> project (EBU)
YLE	Different recommendation methods. Both in VoD and in their news system they use algorithms.	They combine resources, but the concept and ideas come from their in-house team.
	In the news, they use their <i>Voitto</i> intelligent assistant. This offers personalisation from the mobile screen based on interests and location. Editorial decisions overwrite the algorithm, they are above it.	
	The streaming service acts differently, with more weight given to the user's story and the action of the algorithm. Even so, they want to give diversity to the recommendations.	
BR/ARD	At <i>BR</i> they use a shared system through the <i>Peach</i> project of the <i>EBU</i> . In the <i>ARD</i> they use their own independent system.	<i>Peach</i> project (EBU)
ZDF	Mix between algorithm recommendation and editorial decisions. The algorithm analyses users and collects information about them, but it is humans who interpret.	They have some in-house expertise, but mainly draw on partnerships with other entities.

Corporations differentiate between the processes of building recommendations for VoD platforms and those for news apps. The former follows a similar pattern to companies like *Netflix* or *Amazon* where personalisation is completed based on the IP number, while news pieces have higher production rates and the procedure is different. PSMs avoid mixing suggestions for one and the other space.

(JL/SVT) “It is important to differentiate between recommendation in the VoD service, which is very similar to *Netflix*, and news. News has much higher production rates, thousands of stories are created. In VoD services we personalise through the IP number, we try to do that as much as we can without going over that integrity threshold. That is done transparently, and the user can decide to turn it off if they want to.”

(LV/RTBF) “The recommendations we make on the player are not breaking news, that's what we have our news site for. They are usually about new fiction that we co-produce and we want them to gain relevance. If you look at our platform, it is less about breaking news than entertainment content.

Relevant to the study of personalisation processes in news apps is the analysis of *YLE's* platform. The Finnish broadcaster uses “different algorithmic systems for both VoD recommendation and news piece services.” There are two use cases



that act completely differently. On the news side, they stress the importance of returning to the journalistic emphasis. Users can use the app without personalisation or with the use of their *Voitto* smart assistant, which delivers two different types of notifications directly to the locked screen: some based on location and some based on their interests.

(JK/YLE) “We are very human-centred, so the user can always decide the level of personalisation. At the end of the day there must be a really big story for the newsroom to think it’s so important that as many people as possible should know about it. That overwrites the algorithm. So, we’re focused on making sure that these journalistic principles are also built into the core of our algorithmic recommendation engine.”

PSMs aim to “open the minds” of users with their recommendations. Filter bubbles are one of the cornerstone problems of public service media, which is why they should focus their efforts on implementing systems that advocate diversity and plurality of content. This is also one of the premises of the public service algorithm. However, this is not about recommending content that is totally opposed to the user’s interests, but about doing so in a gradual, logistically sensitive way, and with results that allow the audience to reach relevant content that they would not go to in their usual behavioural patterns.

(LV/RTBF) “On the VoD platform we have a recommendation engine that was built in-house, we created it to establish an algorithm that we call the PSM algorithm. The goal was to generate a filter that didn’t do the bubble effect.”

(BV/NPO) “You shouldn’t recommend the opposite of what people are seeing because people are not interested in that, so you have to do it very gradually. But if you come up with something that is not in their normal viewing pattern, you still get a little bit of additional diversity.”

Not all corporations include user registration procedures in their systems. In the case of *SVT* they decided to dispense with log in, as they understand that public services should not monitor audiences, so they focus exclusively on cookies to build recommendations. The misuse that *Facebook* and other large companies make of these logs is what makes people believe that they are a threat, when in the opinion of the Swedish public broadcaster this should not be the case. At *RTÉ*, the service offered after registration is improved, although it is not a mandatory requirement for using the platform. *YLE* even personalises the cover images of content that users see on its streaming site.

(JK/YLE) “We are experimenting with the automatic creation of images that are used in recommendation systems. For example, in our audio-visual services or in our streaming service we are using different images for different people when we recommend audio-visual content.”

European PSMs are already working on the next generation of recommendations, multimodal recommendations, which combine text, audio, and video. The *BBC* calls them “universal” and says there is still “a long way to go” to master them, but they understand that they will be of great value to users. For their part, the *DR* says they have seen poor results in their attempts, but they are not giving up on trying in the future. They point out that their metadata structure does not work correctly for all types of content, so they will have to work on them to polish this new form of recommendation.

(JF/DR) “We couldn’t get our multimodal recommendations to work. It was like telling the user to read your economists’ magazine, then watch an episode of *Peppa Pig* and then listen to a podcast. We couldn’t make it work, but we haven’t given up on it.”

(JA/BBC) “The future is in universal recommendations, in multimodal, multi-modal, audio, video and text recommendation experiences. We still have a long way to go, we’re still pretty much driven by editorial value and manual curation.”

## 4. Conclusions

The role of public media has historically occupied a special position in the media landscape, since in exchange for public funding they have had the arduous task of contributing to social inclusion and cohesion, of reinforcing local culture, and of fostering democratic processes with plural and diverse content (Sørensen, 2019).

Recommender systems have established themselves in this sense as a fundamental tool for individualising attention to each user, providing them with content that best suits their tastes and interests. Even so, the socio-political contexts of each country make it impossible to establish a common model for all of them, even though, in order to comply with the premise of offering each viewer what they need, all public media must guarantee the principles of diversity of exposure and surprise in their proposals (Fields; Jones; Cowlshaw, 2018).

In the case of European public broadcasters, corporations agree that their linear services will be maintained in the future, but insist on the growing relative weight of VoD platforms and digital news applications. They also insist on the need to implement effective recommendation systems to offer viewers the content they want, without producing the isolation of filter bubbles. It will be interesting to monitor the coming years to identify whether this upward forecast is consolidated in the next media stage, and whether the recommendation systems of public media will definitely manage to broaden the field of vision of society without incurring in the isolation typical of private operators’ recommenders.

Corporations agree that the PSM algorithm is necessary to appropriately target content to the population

In this study, corporations from the three media models described by **Hallin** and **Mancini** (2004) have been analysed, without obtaining coinciding results between corporations belonging to the same blocks, so it is concluded that their particular characteristics do not affect the approach, construction and implementation of their recommendation systems. The main results collected from the research questions formulated at the beginning of this research are presented in Table 5 below.

Corporations differentiate between the processes of building recommendations for VoD platforms and those for news apps

Table 5. Results obtained for each research question in this study

Research question	Results of the study
Q1. What is the perception and intention of corporations in relation to these algorithmic recommender systems?	They see them as a prerequisite for optimising the user experience and offering an individualised and tailored service.
	They seek differentiation from private operators' systems.
	They intend to establish recommendations with different guidelines on their VoD platforms and news sites.
	They maintain a rigorous control of GDPR compliance.
Q2. What is the concept of the public service algorithm, and what is the procedure proposed by the corporations for its construction and implementation?	Algorithm integrating traditional public media values.
	Necessary to appropriately target content to the population.
	It should be a pluralistic algorithm reflecting all parts of the country of origin, geographical diversity, and diversity of perspectives.
	The utility values must be represented by numerical codes in order to enter them in the construction of the system.
Q3. Do the recommendation systems used by these broadcasters come from external companies, collaborative projects, or are they developed by their own internal teams?	It is essential to establish valid evaluation criteria that analyse their functioning from the outset.
	There is no unanimity on the origin of the systems. Most often they are purchased from third parties.
	The EBU's <i>Peach</i> project is the most widely used collaborative solution.
	The lack of specialised data or computer engineering professionals in corporate teams hampers home-grown developments.
	The long development times and cost also motivate corporations to turn in the first instance to off-the-shelf solutions to adapt them to their infrastructures.
Q4. How is content recommendation executed in each of the systems of the corporations studied?	Corporations are putting a lot of effort into cleaning and organising their metadata, as it is the central input to the recommendation.
	Collaborative filtering is the most used method, although content-based recommendations are also common.
	The system employed (collaborative or content-based) is always supported by the editorial decisions of the professionals involved.
	Avoiding filter bubbles is one of the main objectives of broadcasters.
	Multimodal recommendations (text, audio and video) mark the new line of work of these corporations.

The PSM's efforts to translate its traditional values into numerical scoring codes to be introduced in the creation phases of the systems will form the basis of the public service algorithm models that will begin to be implemented in these corporations. For this reason, the testing of these solutions to check their validity and effectiveness, in comparison with the results obtained from commercial proposals, is consolidated as a line of study. It will also be interesting to monitor whether these media decide to hire more professionals with technological profiles to dedicate themselves to these processes internally, or whether they will continue to rely on external companies for most of the tasks.

As the most promising initiative, multimodal text, audio, and video recommendations represent a new dimension in the task of personalisation, understanding the particular situation of each user at the specific moment when the viewer requests content, in order to offer the piece that is most needed at that moment. This is why the most technologically advanced corporations will be the first to polish and establish these solutions on a permanent basis, which will guide the rest of the operators to propose a model that is expected to be the protagonist in the coming years.

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