Big data in radio broadcasting companies: applications and evolution

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Abstract

The radio broadcasting industry is facing a process of profound digital transformation throughout which, over the last 20 years, the strategies to preserve the traditional business model have prevailed. The consolidation of platformization and datafication in the economic management of the media requires adaptation of the radio broadcasting sector's structures, management models, and corporate culture. Through an exhaustive bibliographic review, nonparticipant observation, and in-depth interviews conducted with heads of the systems, sales and marketing, content, and digital and innovation departments of the three leading Spanish companies (*Prisa Radio*, *Grupo COPE*, and *Atresmedia Radio*) and the state public broadcaster (*RNE*), we seek to identify the functional areas of the radio broadcasting company in which big data (BD) has a greater potential for application, trying to establish the differences in its utilization in the analogue and digital business model. The results revealed that the degree of BD implementation in the Spanish radio broadcasting industry was significantly different between the private sector –which within the last 2 or 3 years has begun to introduce, very incipiently, big data management, applied primarily to the analysis of digital audiences, these users' consumer behavior, and business management– and the public sector, which so far has not adopted these technologies on a systematic basis.

Keywords

Radio; Radio broadcasting companies; Big data; Business intelligence; Media management; Data management; Audio platforms; Podcasting; Podcasts; Audio communication; *Prisa Radio*; *Atresmedia Radio*; *COPE Group*; *RNE*.

1. Introduction

The radio broadcasting industry is facing an acceleration of its digital transformation, a process of change that, during the last decades, companies have tried to decelerate in an attempt to preserve the traditional business model –analogue– based on the coverage and power of frequency modulation (FM) stations, in their segmented service portfolio –by means of a limited range of program formats–and in the commercialization of their audience in the advertising market.

European radio broadcasting companies decided to indefinitely postpone the comprehensive digitization process that digital audio broadcasting (DAB) involved without considering the innumerable advantages that this change in transmission technology could have for their audiences and advertisers. This resistance to technological change is explained by the fear that the traditional entry barriers, represented by their broadcasting licenses in FM and in the residual medium wave (MW), would be broken down and by the rejection of possible status changes that could involve new operators in a renewed market structure based on digital emissions.

> It was found that the implementation of these BD and BI systems in the radio broadcasting companies analyzed presented a lower development than that observed in other case studies applied in the communication sector

Safeguarded by this conviction, the Spanish radio broadcasting sector demonstrated, despite its immobility, a remarkable ability to generate economic benefits, albeit always on a much smaller scale than television, with a management model based on cost control and advertising revenues from the exploitation of the national market –through network programming– and the local market –through regional broadcasting and local programming slots– capable of offsetting production costs and invested capital (**Martí**; **Martínez-Costa**; **Escobedo-Pareja**, 2019).

Even so, the evolution of "cyber radio" (**Cebrián-Herreros**, 2008), "r@dio" (**Gutiérrez-García**; **Barrios-Rubio**, 2019), "post-radio" (**Ortiz-Sobrino**, 2012), or "expanded radio" (**Kischinhevsky**, 2017) has been unstoppable. Through a gradual and progressive transformation process, the radio broadcasting market has been forced to reinvent and optimize production processes to meet the requirements of now digital, asynchronous, fragmented, interactive, and multichannel demand (audience and advertisers) (**García-Lastra**; **Pedrero-Esteban**, 2019) and face the increase in competitors in the digital ecosystem. In the analogue setting, radio broadcasting companies were competing, on an exclusive basis, for a share of the business, audience, and advertisers in a highly concentrated market; in the digital age, they face direct competition from new players such as aggregators, audio content distribution platforms, digital-native broadcasters, and independent podcasters. For all these reasons, and despite the fact that there are factors that assert the strength of the radio business model, the sector is already undergoing an unquestionable transformation process, which affects its value chain and calls for new competitive strategies.

Radio broadcasting companies have chosen to deploy convergence strategies, combining the broadcasting of offline content –conventional antenna– with broadcasting through online platforms and social networks, although traditional programming remains the main focus of their activity (**Bonet**; **Sellas**, 2019; **Gutiérrez-García**; **Barrios-Rubio**, 2019; **Pedrero-Esteban**; **Contreras-Pulido**, 2019). The experiences in the development of "transradio" formats and narratives (**Martínez-Costa**, 2015), with the aim of enhancing interaction with audiences through the different formats that allow multi-channel dissemination, are numerous. Many of these innovative strategies did not originate in the traditional radio broadcasting industry but were incorporated by it after the success achieved by the new players incorporated into the audio content market was noted. In any case, regardless of where the lever of action originated, in the last decade, notable changes that tend to favor efforts in the digital environment have been seen in a sector where the youngest and least loyal population is concentrated (**Edgerly** *et al.*, 2018; **Toff**; **Nielsen**, 2018; **Thurman** *et al.*, 2018; **Just**; **Latzer**, 2017; **Casero-Ripollés**, 2012).

The sector is aware that adapting to the hypermedia environment requires large investments in continuous, adaptive, disruptive, and transformative innovation (**Campos-Freire**, 2015). Against this backdrop, the only way to face these challenges with some guarantee of success is to orient all its processes toward the end customers (audience and advertisers) and to professionalize management to the maximum.

It is at this point that the incorporation of big data (BD) management and artificial intelligence (AI) in all of the radio broadcasting business's management processes, with the aim of improving business intelligence and the ability to make decisions conducive to leveraging the opportunities the new audio market offers, becomes particularly relevant.

The high potential for datafication of audiences' media activity in the digital environment becomes an important asset, one of the most consequential, along with brand value and credibility. Datafication, understood as the capture of all types of information converted into data to facilitate its reuse (**Mayer-Schönberger**; **Cukier**, 2013), combines two processes: the monitoring and quantification of people's lives through digital information and the generation of different types of value –economic, social, political– from the data generated (**Mejías**; **Couldry**, 2019). Data have come to be considered the currency that will feed the entertainment industry in the coming years (**Wolk**, 2015). **Lippel** (2016) points out three fundamental areas for the application of the BD in communication companies: products and services, customers and suppliers, and infrastructure and processes. BD, therefore, in addition to optimizing the internal processes of radio broadcasting companies, allows us to predict and obtain information about the consumption habits of their audiences and the interests of their advertisers. The implementation of data culture in the sector will determine future production, management, and distribution strategies for audio content.

Although, for years, the footprint of big data management has extended across all levels of media activity (**Stone**, 2014), the potential for getting a snapshot of their audiences takes up most of the efforts of media companies. The attention and methods by which the media seek to get to know their audiences in the digital environment have become more sophisticated in recent years (**Napoli**; **Roepnack**, 2018). However, the great evolutionary leap in the new paradigm of business management lies in the incorporation of internal data management and analysis departments. Since the second decade of the 21st century, companies that offer BD services for media corporations, such as *Amazon Web Services*, *Azure*, *Konodrac*, and *Luca*, from *Telefónica*, have taken off. In Spain's case, mainly television but also the press already have significant allocations for this purpose (**Sangil**; **Portilla**, 2021; **Gómez-Domínguez**, 2016; **Colle**, 2013) and apply

strategies based on BD that seek, at a first level, to get to know their audiences and improve their audiences' user experience (UX) (**Murschetz**; **Schlütz**, 2018; **Kelly**, 2019; **Gandhi**; **Martínez-Smith**; **Kuhlman**, 2015) in order to ensure stability in the market and the optimization of their revenue model. Radio broadcasting companies show less development in the application of data culture than other media sectors. The most remarkable experiences have been driven by parent companies with activity in the audiovisual sector.

It is worth highlighting the catalytic role played by subscription video on demand (SVOD) streaming platforms in this process. *Amazon Prime Video*, *HBO*, and *Disney+*, following in the footsteps of *Netflix* (**Neira**, 2020; **Carrillo-Bernal**, 2018; **Smith**; **Telang**, 2017; **Lindsey**, 2016), have stood out as examples of data-driven companies and models of the success of content consumption based on the logic of the catalog versus traditional programmatic grids (**Lotz**, 2017). Given their success, as well as that of other platforms such as *YouTube*, the media have strategically nurtured their own digital platforms, even creating business units specialized in paid streaming content –this is the case of *Atresplayer*. If the SVOD streaming platforms adopted a disruptive model, even embracing different business formulas (**Neira**; **Clares-Gavilán**; **Sánchez-Navarro**, 2021), in the press or magazines field, the news aggregators did the same with disparate income models and degrees of transparency, ranging from free for the user –which implies that the product is the user themselves and their data– to paid subscription (the case of *Apple News+*, for example). Along the same lines, the options in the music streaming market multiplied with platforms such as *Spotify*, *Apple Music*, *SoundCloud*, and *Amazon Music*, which was initially threatening for the record industry, which managed, nevertheless, to adapt and take advantage of a model based on the music single. Although the initial model was transparent, over time, music streaming platforms have refined using data and algorithms to suggest content to the user in the same way as their audiovisual counterparts, in the way that, for example, *Spotify* offers "discover weekly," "made for you," and "daily mix" playlists (**Eriksson**, 2020; **Siles** *et al.* 2020). As a testament to this trend, there are also certain advances in the radio broadcasting field in what has been termed the "platformization" process of the radio broadcasting industry; for **Sullivan** (2019), this is a process aimed fundamentally at greater utilization of the data capacity in the production, management, and marketing of content. This process has reached greater maturity in the podcast format –not necessarily linked to linear broadcasting– which, in addition to media websites and generic audio platforms (**Amoedo**; **Moreno**, 2021), is distributed in other platforms created ad hoc, such as *Podium Podcast*, *Podimo*, *Sybel*, and *Cuonda* in Spain, and which indicates the consolidation of this format as a solid and autonomous industry (**Terol-Bolinches**; **Pedrero-Esteban**; **Pérez-Alaejos**, 2021; **Legorburu**; **Edo**; **García-González**, 2021).

In any case, the reality is that the technological and corporate development of radio broadcasting companies with respect to BD management is very far from the level reached by television platforms. However, both its streaming broadcasts –through the different digital channels– such as podcasting and interacting with listeners on social networks and mobile apps, are very valuable sources of data for industry –especially in relation to audiences– that need to be exploited fully. In particular, podcasting is considered the most significant digital disruption for the radio broadcasting market, since it involves the implementation of asynchronous content consumption as opposed to the marketing model focused on programming schedules typically used thus far (**Moreno-Cazalla**; **Pedrero-Esteban**, 2020) and also increases the content offering and innovation of formats (**Moreno-Espinosa**; **Román-San-Miguel**, 2020)[1].

The incipient use of artificial intelligence opens up new possibilities for content personalization and enhances audience engagement (**Piñeiro-Otero**; **Terol-Bolinches**; **Vila-Fumas**, 2019).

A radio broadcasting company's objective should be to adapt the information and remaining content to the life experience of its listeners (**Ribes** *et al*., 2016). The radio broadcasting industry needs to complete a technological conversion that allows it to be ready to compete in the new data market at the time it becomes, as already happened with television, a medium of mass communication, but without being "simultaneously massive" ["*simultáneamente masivo*"] (**Neira**, 2015).

Paradoxically, no specific research has yet been conducted that addresses the application of BD in the radio broadcasting sector, in contrast with the various studies available on BD in the advertising management, marketing, and corporate communication fields (**Miklosik**; **Evans**, 2020; **Bustamante-Alonso**; **Guillén-Alonso**, 2017; **Selva-Ruiz**; **Caro-Castaño**, 2016; **García-Bonal**; **Papí-Gálvez**, 2015) or the very recent advances linked to the value chain of datafication in the audio industry (**Gallego**, 2021).

> The degree of BD implementation in the Spanish radio broadcasting sector registered significant differences between the private sector, which in the last 2 or 3 years, has very incipiently begun to introduce BD management, principally applied to the analysis of digital audiences, consumption behavior of these users, and commercial management, and the public sector, which thus far has not adopted these technologies in a systematic way

In general terms, the application of BD to the business environment is directly linked to the concept of business intelligence (BI) and involves the convergence of a set of management and socialization practices, as well as technologies that were developed in the last turn of the cen-

tury and have become established since 2010. Although the principles of knowledge and information management systems applied to the business field pre-date the recent emergence of BD, its implementation at present is indissolubly tied to the management of large amounts of data, characterized by what **Laney** (2001) summarized in volume, variety, and velocity. New characteristics such as velocity, value, viability, and visualization have been incorporated into these 3Vs. The entire process of applying big data and business intelligence starts with the identification of a business problem (**Fernández-Manzano**, 2017). The management of this data and its correct usage directly contribute to risk reduction when making business decisions and the increase, thereby, in its effectiveness (**McAfee**; **Brynjolfson**, 2012), which inevitably involves the modification of the management culture prevailing thus far. Companies operate in a new economy driven by data, defined as the

> None of the companies analyzed could be categorized as phase 5, of maximum maturity, since they had not managed to ensure that all their management and operational processes were fully based on data management

> "set of initiatives, activities, and/or projects whose business model is based on the exploration and utilization of existing database structures (traditional and from new sources) to identify opportunities for the generation of products and services." ["*conjunto de iniciativas, actividades y/o proyectos cuyo modelo de negocio se basa en la exploración y explotación de las estructuras de bases de datos existentes (tradicionales y procedentes de nuevas fuentes) para identificar oportunidades de generación de productos y servicios*"] (**Ontiveros**; **López-Sabater**, 2017).

By way of compilation, the company *Gartner* defines BD as

> "high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation." (*Gartner*, 2020)

The technologies that make up the architecture of BD enable the integration of structured, unstructured, and semi-structured data –or input– with the final objective of processing and contextualizing them to convert them into information –output– that can facilitate decision-making and become organizational knowledge (**Rodríguez-Pallares**; **Pérez-Serrano**, 2017). In this process, others, such as data warehouse, online analytic process, or data mining technologies (**Fernández-Sande**; **Martínez-Romero**, 2006), among others, are integrated as information systems (**Arjonilla-Domínguez**; **Medina-Garrido**, 2002; **García-Bravo**, 2000).

In short, for a radio broadcasting company to effectively integrate BD and BI systems into its management processes, it is not enough for it to have the necessary applications and technological tools; it is necessary to integrate the logic that underlies this management system into its corporate culture and its business logic, which also involves having appropriate professionals for this.

2. Objectives and hypotheses

Based on the premise that BD and business intelligence systems allow substantial improvements in the management processes of information companies and constitute one of the main accelerators of competitive advantages in the new digital markets, this research aims to determine the degree to which the Spanish radio broadcasting industry implements them, taking as case studies the three main radio companies, which accumulate a large audience (*AIMC*, 2021) and sales volume:

- *Prisa Radio* (*Promotora de Informaciones S. A.*);
- *Grupo COPE* (*Ábside Media/Radio Popular S. A.*),
- *Atresmedia Radio* (*Atresmedia Corporación de Medios de Comunicación S. A.*);
- as well as the state public radio, *RNE* (*Corporación de Radio y Televisión Española S. A.*).

In particular, this study seeks to identify the functional areas of radio broadcasting companies in which BD and BI have the greatest application potential, attempting to establish the differences in their use in analogue and digital business environments. The following specific objectives (SO) are subordinate to this general objective:

SO1: Describe and analyze the design of BD systems and identify the main sources of datafication in the radio broadcasting business.

SO2: Identify the different functional areas –marketing, production/programming, systems, digital development– as well as the level of adoption for each of these, for which the information and knowledge generated by the BD and BI systems are available for their management.

SO3: Establish the differences in the models and degrees of maturity in the implementation of BD and BI systems throughout the primary Spanish radio companies.

SO4: Analyze the level of outsourcing for BD and BI systems in these radio broadcasting companies and identify the primary tools and applications used.

The following hypotheses have been made:

H1: The application of BD and BI systems in the management of radio broadcasting companies is at a medium–low level of development.

H2: Publicly owned radio broadcasting companies are lagging behind privately owned companies in adopting management systems based on big data.

H3: The culture of data management is not fully integrated into all functional areas of radio broadcasting companies.

H4: Radio broadcasting companies that have implemented BD technologies have opted to outsource these through consultancies and specialized suppliers..

3. Methodology

Adopting a qualitative approach, an "existential (nondeterministic) and constructivist" multiple case study that emphasized interpretation was carried out (**Stake**, 2007). The research techniques implemented to analyze the four corporations that made up the study sample were bibliographic review, indirect nonparticipant observation, and in-depth interviews.

In the first phase, a comprehensive bibliographic review was undertaken in relation to the factors related to the development of BD in the framework of business intelligence and its specific application in media companies. Next, we proceeded to carry out an indirect nonparticipant analysis of the four case studies to delve deeper into their corporate structures and identify the functional areas in which big data management has the greatest potential for value creation.

The selection of contacts eligible for interview was based on organizational responsibility criteria, so directors of the four departments that were considered priorities in the previous phase were identified for study in each of the cases analyzed: systems or IT, sales and marketing, content, and digital and innovation (the indicators varied depending on the case but coincided in responsibilities and competencies).

After first contact and in response to suggestions received from the companies analyzed, 13 names were included for interview. The interviews were conducted online, through the *Meet* platform –with the exception of the interview with the head of the commercial department of the *COPE Group* and one of the heads of *Prisa Systems*, Xavier Garrido, who responded to the questionnaire through email– between May 21 and June 7, 2021[2].

This time frame was deemed essential for trying to obtain, as accurately as was possible, a snapshot of a particular point in time. The duration of the interviews ranged from 15 to 60 minutes.

Semi-structured in-depth interviews were used as the main tool for the collection of information. The questionnaires included two sets of questions: one aimed at the main aspects of the phenomenon studied (BD) in relation to the radio broadcasting sector and the company, and another composed of questions about specific elements and applications in the interviewee's department/area of ascription. It was necessary to adapt this second set to the four areas identified as critical to the application of data management.

The interviews were videotaped and subsequently transcribed in order to carry out a content analysis that would allow an in-depth interpretation of the data provided in relation to the general and specific objectives of the research.

Content analysis through matrices was conducted with the assistance of *Atlas.ti* software, version 9.1.7 for Windows. *Atlas.ti* is one of the reference applications of computer-assisted qualitative data analysis (CAQDAS) for the systematic management and analysis of qualitative data.

This analysis process was carried out in several phases: logging of information from the interview transcription; codification of the data; identification of constructs/categories

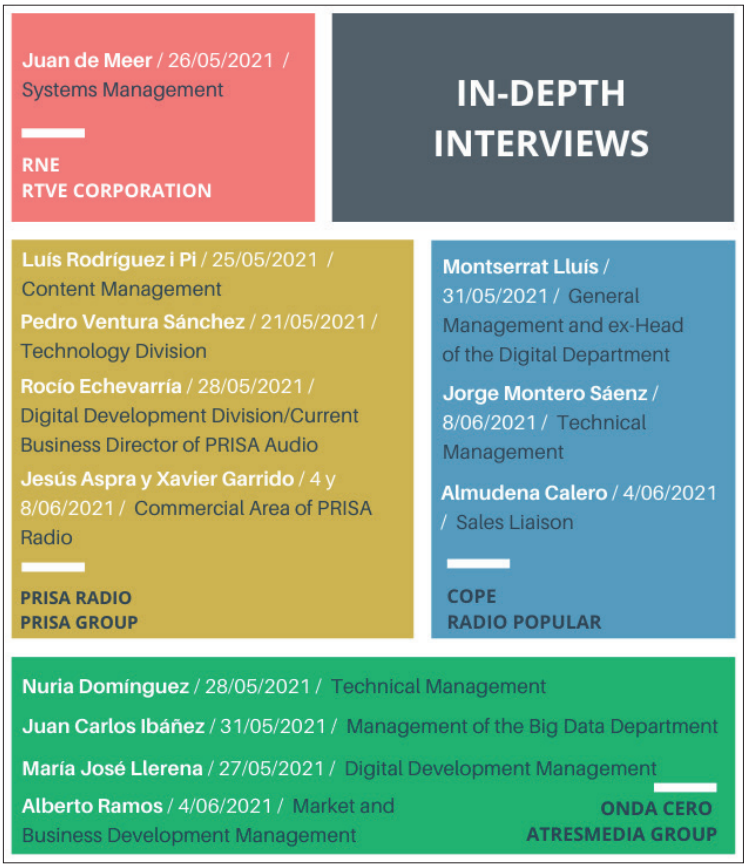

Figure 1. List of positions interviewed for the study

of the information collected on each of the aspects linked to the research objectives, that is, categorization; and final interpretation of the results obtained. To ensure the reliability of the results, a triangulation was applied in the analysis and interpretation of this information. The data codification and categorization were replicated and agreed upon by the two authors of this study in order to limit possible individual subjectivity and create a shared foundation for each code and category of analysis.

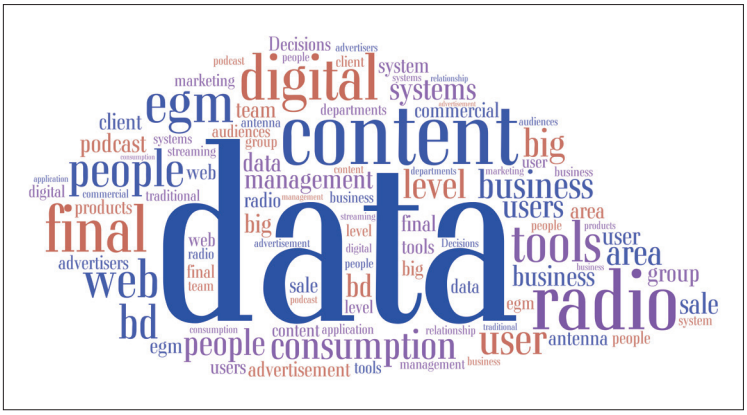

Figure 2. Identification of key concepts with *Atlas.ti*

The interviews conducted with the directors generated a large volume of qualitative information that appeared in different categories of analysis, which made it possible to synthesize and organize the main opinions expressed, based on the selected quotes, in relation to the research objectives.

4. Results

The results revealed a divergent situation in the level of technology and datafication in the Spanish radio broadcasting sector. BD management processes and tools tended to be implemented in media groups; that is, at best, the scope of these management models was transversal and involved all media business units of the parent companies of the radio broadcasting brands studied.

Prisa Radio

At *Prisa Radio*, they did work with BD, although they did not have a comprehensive system in which all the information was centralized; they worked with the aim of using a data-centric system that helped with making decisions on the basis of data at a transversal level. As a result of an architecture and data governance consultancy, the parent group, *Prisa*, selected *Azure* as its main BD project management software in the cloud environment, toward which all its initiatives were geared. However, they worked with other players such as *Google*, *Amazon*, and *Oracle*. The directors interviewed affirmed that the acceleration in the implementation of BD in the company's management structure occurred at the end of 2019.

The technical and system supports were managed at the parent company level, so all *Prisa* media brands were served. In this sense, the group had specialized technicians in different functional areas (advertising, customers, infrastructures, content, etc.), but all implemented data management. However, for large-scale projects, external specialists were often called upon to collaborate. Therefore, there was no department responsible for BD, but the management of large amounts of data in each area of specialization had been standardized, and they had management systems for it. For the radio broadcasting business line, audience information sources were limited to the most common ones*, Adobe Analytics* and *Triton* for streaming and audio-on-demand analysis and AI for offline consumption metrics. With a base very similar to that of its competitors, they launched a project three years ago that integrated dashboards, the portfolio management system of all offline radio, and the audience metrics of analogue radio into a data lake in an attempt to datify and simplify decision-making in the offline environment. The directors interviewed agreed that digital distribution and consumption has a much greater capacity to generate data than offline consumption. Within the digital business, the podcast environment was the most difficult to measure, since between 60% and 75% of the consumption of *Prisa Audio* podcasts occurs through external channels –aggregators and platforms– with a significant "loss of traceability of users," which obstructed the possibility of replicating communicative impacts in that audience (Aspra, *Prisa Radio*). *Prisa Radio* sought to improve agreements with platforms regarding the commitment to the sharing of content consumption data, while developing strategies to enhance listening in their own environments, aware of the strategic and economic value of the datafication of their audiences. This strategy of digital multi-distribution resulted in a profound difficulty with the generation of accurate data on audiences and their consumption.

In the digital field, BD models were implemented to achieve greater clusterization or targetization of users to increase the sales appeal of advertising space for the advertiser and reduce interruptions for audiences. The monetization of BD occurred in complementary systems, such as data management platforms (DMPs), enabling the activation of the information collected at the advertising level. Jesús Aspra, Chief Digital Officer at *Prisa Brand Solutions*, believed that data are increasingly important in advertising management with two major areas of application:

> "Within the internal sphere to make products based on the information we are obtaining and to maximize the impact on that user" ["*Desde el ámbito interno para hacer producto en base a la información que estamos obteniendo y para optimizar los impactos a ese usuario*"] (Aspra, *Prisa Radio*).

The recent incorporation of specific professional roles, such as data analysts, into the teams of the PBS department was a clear sign of the implementation of data culture in the *Prisa Group*'s digital advertising management. Among the

challenges for the future of the radio broadcasting business, Aspra pointed out the strategic value of having a greater amount of data reported by *Prisa Radio*'s users themselves through registration systems.

On the media content production and dissemination side, they were working on pilot projects on algorithmization that sought to emulate the content recommendations of the on-demand audiovisual sector by means of artificial intelligence. Pedro Ventura Sánchez, Director of Technology in Data and Monetization at the *Prisa Group*, understood that *Tecnocast*, *Prisa*'s AI application project, implied a qualitative leap in data management in the radio broadcasting business, since it was

> "a content recommender, based on an analysis of what is being consumed in order to make a content recommendation (...) They are pilot projects. We have developed an initial part, but we are aware that we have to develop all those recommendation systems much more so that, in the end, effectively, the teams that are generating content can create what the user is looking for" ["*un recomendador de contenidos, a partir de una analítica de lo que se está consumiendo para poder hacer una prescripción de los contenidos (…) Son proyectos piloto. Tenemos desarrollada una parte inicial, pero somos conscientes de que tenemos que desarrollar muchísimo más todos esos sistemas de recomendación para que, al final, efectivamente, los equipos que están generando contenido puedan crear lo que el usuario está buscando*"] (Ventura Sánchez, *Prisa Radio*).

This director put *Prisa Radio*'s level of implementation of BD technologies at 60%, although he predicted that the next phases will be more complex:

> "We have begun to make processes for the integration of data, of data transformation, we have begun to create these repositories of common information, but that 40% I am sure will take much longer than the initial phase" ["*Hemos empezado a hacer procesos de integración de datos, de trasnformación de datos, hemos empezado a generar esos repositorios de información común, pero ese 40% seguro que lleva mucho más tiempo que la fase inicial*"] (Ventura Sánchez, *Prisa Radio*).

Prisa Radio's BD application in the content creation field, despite the merits of the aforementioned pilot project, was very limited or practically nonexistent at the moment. *Prisa Radio*'s content director at the time the fieldwork was carried out, Lluís Rodríguez Pi, explained that they have very little qualitative data on the consumption of their content,

> "we do not work with big data, we work with data that are strictly quantitative basically" ["*no trabajamos con big data, nosotros trabajamos con datos que son estrictamente cuantitativos básicamente*"] (Rodríguez Pi, *Prisa Radio*).

Although all functional areas were likely to use BD applications for decision-making, at that time, the marketing and advertising departments at *Prisa*, also *Prisa Radio*, were those that showed a clearer flow, that is, they used the data managed by these systems more frequently; to a lesser extent, the production department required consumption data for the optimization of the resources presented, as in all the cases analyzed, in dashboards that allowed the visualization of data and its analysis by nontechnical professionals. The visualization tools used were *Power BI* and *Tableau*. The departments that developed financial, administrative, and human resources management had a lower level of development in BD implementation. The complexity of the organizational structure, which characterized a large radio broadcasting group such as *Prisa Radio*, with more than 60 management centers and a great heterogeneity of internal processes, implied a strong demand for the application of a comprehensive BI system. At the time of the study, the company was considering the need to change the application –*Smart GAP*– used to support its management centers.

Rocío Echevarría, current Business Director of *Prisa Audio*, believed that his company was beginning to monetize data management, although this was still an incipient process:

> "Data have to not only provide us with information, but also help us work as purely digital companies work, as *Apple* works, as *Spotify* works, as *YouTube* works, as everyone works. (…) What do we aspire to? Absolute personalization, so that the user, when he enters our services, has specific content for him, specific advertising for him, so that we know who he is" ["*El data nos tiene que no solo aportar información, sino también ayudarnos a trabajar como trabajan las empresas puras digitales, como trabaja Apple, como trabaja Spotify, como trabaja YouTube, como trabajan todos. (…) ¿A qué aspiramos? A la personalización absoluta, a que el usuario, cuando entre en nuestros servicios, tenga contenido específico para él, publicidad específica para él, que sepamos quién es*"] (Echevarría, *Prisa Audio*).

It was estimated that 9-12% of *Prisa Radio*'s total audience comes from the digital environment and approximately 6% of the group's total revenue is generated by digital content. In 2021, in *Prisa*'s radio broadcasting business model, consumption and sales from analogue/traditional channels still very clearly prevailed, although Echevarría pointed out that

> "the growth capacity of digital audio in the coming years will be extreme because traffic is increasing" ["*la capacidad de crecimiento del audio digital en los próximos años será brutal porque el tráfico se está multiplicando*"] (Echevarría, *Prisa Audio*).

Prisa Audio –which brings together the group's nonlinear audio content– ended 2021 with a total of 412 million downloads and 800 million listening hours (*Prisa Audio*, the world's first Spanish-language audio producer, 2022).

COPE Group

The *COPE Group* did not indicate a BD system that centrally integrates and makes use of the data obtained from different functional areas of the company. As in most of the cases analyzed, there were different decentralized management systems, for example, economic-financial management or advertising management systems. They also had a software as a service (SAS) system, where management and operating data were aggregated (financial data, human resources data, advertising data, semiautomated invoices, etc.) and which had an internal projection that resembled, if not completely, in part a BI model. Additionally, in digital environments they retrieved information related to the user and their consumption of streaming and podcast content, but the ability to datify audiences for monetization and the development of a personalized offering were not being exploited. The company monitored various data on the digital consumption of its content such as information on visits, connection time, unique users, or type of device used for digital listening. Differentiated analyses between the on-demand and online environment metrics were applied. The group believed that this wealth of digital consumption data related to a very small segment of the total audience of its brands, which were mainly analogue channels. Therefore, it is understood that these data could even introduce interpretative biases, despite the fact that digital metrics were more accurate and continuous than the statistical estimates provided by *EGM*. *COPE* executives estimated that around 40% of the digital audience of their general radio content and 30% of the digital consumption of their music content is produced through aggregators or platforms, that is, through external channels. The company had very little data on this part of the digital consumption. The *COPE Group* was very cautious about collaboration with large platforms. They understood that they could offer opportunities to scale their audiences and monetize content, but also that it could lead to a loss of control of their own product.

Jorge Montero, Technical Director of the *COPE Group*, considered the size and turnover of the company to be key in assessing the cost–benefit ratio that implementation of a comprehensive BD system would require.

> "They are perhaps less significant investments in terms of what the radio broadcasting needs, it is not the same in telecommunications, an *Amazon*, a *Google*, etc." ["*Son inversiones a lo mejor menos significativas en lo que al mercado de radio necesita, no es lo mismo en telecomunicaciones, un Amazon, un Google, etc*."].

In recent years, the possibility of incorporating more elements and expanding the BI system had been raised. The current level of development of the application of big data systems in *COPE* was assessed to be at a level of 20-30% (Montero, *COPE Group*).

> "The technology ecosystem of the BD tools used by Spanish radio broadcasting companies was characterized by a high level of outsourcing. Companies did not have the capacity to develop exclusive internal tools, which would also have had a high cost that would be difficult to make profitable at the current stage of development of the digital business"

The Technical Department at *COPE* was organized into four major areas: computer and systems, broadcasting and high frequency, audio and video production (web, radio, and television environment –with *Trece TV*), and a fourth of a transversal nature focused on communications. The tools used for data management were not developed in-house, since *COPE* did not have a team of digital/technical solution developers; either they were purchased independently from the market, or they were offered by companies that advised them on the basis of their needs. On the whole, they were usually standard tools, rarely customized to their requirements as a broadcaster. These tools included *SAP Giga* for user registration, *DocuWare* for billing management, *Salesforce* for customer relationship management (CRM), and *Chartbeat* as a dashboard that centralizes digital consumption analysis, complemented by the use of *Google Analytics*.

As in the advertising cases analyzed, *COPE* was at an incipient stage in terms of datafication. Its short- and medium-term objectives revolved around the mainstreaming of data management and, as in the most advanced cases in this sense, the main driver for the implementation these high-cost technologies was to make them profitable based, fundamentally, on the optimization of the services aimed at users and customers in the field of personalization of media or advertising content. *COPE*'s sales department had an information system composed of different bases and tools that manage data from various sources. Their strategy prioritized the application of qualitative, individualized criteria by a team, which uses audience data, coverage of broadcasts and business management of advertisers. Big data application was perceived as an important element but not relevant in decision-making in business management. Almudena Calero, Commercial Director of the *COPE Group*, believed

> "that the decisions made strictly on the basis of data would equalize criteria and the differential values that make a consumer identify with a brand would disappear" ["*que las decisiones tomadas estrictamente con el dato igualarían criterios y desaparecerían los valores diferenciales que hacen que un consumidor se identifique con una marca*"] (Calero, *COPE Group*).

The tools and data sources most used by this department were *EGM* and *Comscore*, *Salesforce*, *Audicsa*, *Arce*, *TOM Micro*, and *Galileo*.

COPE executives understood that the considerable effort made by the company to enhance its multichannel digital strategy, which was part of the digital transformation process started in 2018, had not yet achieved significant monetization for the company's economy, despite the fact that they had managed to increase website traffic and consumption data very significantly through mobile applications. The group's executives estimated that only 2.5% of the total revenues of their radio broadcasting brands came from the digital environment, although there was strong year-on-year growth. The development of greater capacity for datafication of its audiences was a priority objective for the new phase of its expansion strategy in the digital market. Montserrat Lluís, CEO of the *COPE Group*, affirmed that the company would start a new process that would include a wider application of BD:

> "We will be able to monetize and work with that data that we are starting to have, also with advertising and audience interests because knowing our audience will help us to impact them much better through our programming and through our digital content, there we are aware that we have an important area of growth" ["*vamos a ser capaces de monetizar y trabajar esos datos que empezamos a tener, también con intereses publicitarios y de audiencia porque conocer a nuestra audiencia nos va a ayudar a impactarle mucho mejor en nuestra programación y en nuestros contenidos digitales, ahí sí somos conscientes de que tenemos un ámbito de crecimiento importante*"] (Lluís, *COPE Group*).

For the time being, the *COPE Group* has not developed any artificial intelligence or application of logarithms for the design and distribution of its contents. To generate this type of interaction, they considered it necessary to achieve a greater amount of self-administered data from users through some type of online registry.

Table 1. Snapshot of the BD models at *Prisa Radio*, *Atresmedia Radio*, and the *COPE Group*.

	Systemized BD solutions	**Place in the corporate structure**	**Centralized services**	**Main area of operation**	**Main technologies and sources used**	**Externalization/service providers**
Prisa Radio	Yes	Technical and systems support depended on the parent company, *Prisa Media*, not on the different business departments	No	Sales and marketing departments	*Adobe Analytics*, *EGM*, *Triton*, *Power BI*, and *Tableau* (visualization); *Smart GAP* (financial management); *Salesforce* CRM (business department)	On-premise management and first and foremost on the *Cloud*: *Triton*, *Azure* (primarily), *Google*, *Amazon*, *Oracle*
Atresmedia Radio	Yes	They had their own a BD department that depended on the parent company *Atresmedia*	Yes	*Atresplayer*, *Atresmedia* television, marketing, and business management departments	*Amazon Web Services* (*AWS*), *Microsoft Power BI* (visualization); *EGM*, *Comscore*, *Dynamics 360* CRM (business department); *Chartbeat* (audience metrics)	Each new project was directed from *Atresmedia*, but some external consulting was done, like *Bluetab* or *TCM*. The BD department had five people.
COPE Group	No, but yes for certain datafication and data integration	The systems and IT departments depend on the technical department, which reports directly to *COPE*'s management	No	Economic–financial management and commercial management	*SAP Giga*, *DocuWare*, *Google Analytics*, *EGM*, *Audicsa*, *Arce*, *TOM Micro*, and *Galileo; Salesforce* CRM (business department); *Chartbeat* (audience metrics)	Digital management and measurement services were entirely externalized; there was no technical department specialized in the digital area

Atresmedia Group

The *Atresmedia Group* has had a BD department since 2019, which was at this time composed of five analysts. The aim of the department was to offer transversal services to the different divisions and products of the media group. In this first phase of implementation of BD management in business operations, it had focused mainly on the development of *Atresplayer –Atresmedia*'s Internet and television on-demand video streaming service –and on websites; the department had also begun to provide service to the group's radio broadcasting businesses. BD management in this company had four main axes: descriptive analytics, diagnostic analytics, predictive analytics, and prescriptive analytics. This whole system was already being implemented intensively in the customer/content management of digital television content, as well as in commercial management. The *Atresplayer* service moreover had artificial intelligence systems applied for the algorithmic recommendation of content.

The managers of *Atresmedia*'s BD and *Atresmedia Radio*'s Digital Development departments believed that the level of application of big data management in the company's radio broadcasting business is in an incipient phase, which has begun with a greater utilization and depth of the analytics of digital audiences and commercial management, but they expected that before the end of 2022 the application of prescriptive analytics, with personalized recommendations, will begin in the audio content based on user clusterization. To date, they had not yet achieved fully efficient interactions between the radio broadcasting business departments and that of BD to achieve an agile development of analysis tools

that support decision-making in areas such as content and commercial management. Nuria Domínguez, Director of Systems at *Atresmedia Radio*, explained these deficiencies in the ability to apply data to their processes:

> "The changes we had made on our website, we wanted to know if people were liking them more, because the typical usability tests were carried out, but no data has been taken to identify whether users like the no model more or not. From the BD department we understood that they could give us an answer. What the BD department always tells us is that for there to be a good response there has to be a good question because otherwise anything could happen. They tell us that we are not asking the right questions at present (..) There was no model, as BD says, that they could have defined to extract this data (...) We have a business mentality, we only know what we want and not how to put it into those [technical] terms" ["*Los cambios que habíamos hecho en nuestra web queríamos saber si estaban gustando más a la gente, pues han hecho las típicas pruebas de usabilidad, pero no se han tomado datos para identificar si les gusta más el no modelo a los usuarios o no. Desde el área de BD entendíamos que nos podían dar respuesta. Lo que siempre nos dicen desde el área de BD es que para que haya una buena respuesta tiene que haber una buena pregunta porque si no puede salir cualquier cosa. Nos vienen a decir que no estamos haciendo bien las preguntas por ahora (..) No había un modelo, como dicen desde BD, que pudiesen definir para extraer estos datos (…) Nosotros tenemos mentalidad de negocio, solo sabemos lo que queremos y no cómo plantearlo en esos términos (técnicos)"*] (Domínguez, *Atresmedia Radio*).

These difficulties in integration and communication between the BD management department –which operated mainly with different data programming language– and the business departments were paradigmatic in the initial stages of incorporating data management into corporations. *Group* executives saw the advantages in incorporating professionals specialized in data analysis into business departments to achieve greater synergy with the company's BD department.

The *Atresmedia* group also perceived consumption through platforms and aggregators outside the group as a great difficulty in the datafication of their digital audiences. They estimated that this consumption could account for 30-40% of their total audio traffic. A challenge for the coming years will be to get more information as to what is heard through those channels. Streamed listening until just a couple of years ago was considered a mere bolster for the antenna; at present, listening through this channel –which they calculated to be around 10% of total consumption– is understood as a new line of business, with increasing sales capacity. With regard to on-demand listening –on-demand podcasts and radio– the group managers were aware that they need to generate more data in order to make more precise decisions in the management of such content. In general, they perceived that growth in these digital audiences increases the need for application of big data in radio broadcasting business management systems. Juan Carlos Ibáñez, Director of the Big Data Department at *Atresmedia*, explained that they were currently trying to cross-check and compare the data of the fundamentally analogue audiences, provided by *EGM*, with the digital consumption they monitored through various tools. He foresaw that in the future the generation of audience data of the radio broadcasting business will develop this hybrid model –integrating the analogue and digital data– as already applied in the television medium (Ibáñez, *Atresmedia*). María José Llerena Fernández, director of digital development at *Atresmedia Radio*, believed that

> "the *EGM* methodology does not address these new habits of fragmented consumption, therefore, the picture it offers you is perhaps not real, the methodology has not been adapted enough" ["*la metodología del EGM no atiende a estos nuevos hábitos de consumo fragmentado, por lo tanto, la foto que te ofrece no es quizás real, la metodología no se ha adaptado los suficiente*"] (Llerena, *Atresmedia Radio*).

The commercial management of *Atresmedia*'s radio broadcasting business was supported by the BD department for the generation of data that feeds the DPM (digital product manager). Once the managers and professionals of the commercial department were able to detect segments that may be of interest to the advertiser, the BD department could try to fine-tune the information about segmentation variables. The commercial area worked with *Dynamics 365*, a CRM tool for customer management. The data between the different bases with which each manager worked could be cross-checked, but at present they were still not unified. Alberto Ramos, Director of Market and Business Development and Marketing at *Atresmedia* Advertising, found it difficult to sell the targeting that enables BD to radio advertisers because they were not yet willing to pay for it, although he predicted that in the future he would tend to value the impact and effectiveness of advertising based on qualitative data more,

> "for the moment the main sales tool for radio audiences is *EGM* (...) you don't go into as much detail [as big data can give]. You associate types of programs with types of people. You can create specific packages for people interested in certain topics" ["*por el momento la principal herramienta de venta de las audiencias de radio es el EGM (…) no bajas tanto al detalle (que puede aportar el Big Data) Asocias tipologías de programas a tipos de gente. Puedes crear paquetes específicos para gente interesada en determinados temas*"] (Ramos, *Atresmedia* Publicidad).

The commercial department of *Atresmedia Radio* in Madrid had an area specialized in the digital environment– which included TV, radio, and websites –and another in analogue radio. The volume of revenue from the sale of digital audiences had not even reached 10% of the total sales of the radio broadcasting business. Currently, the commercialization of *Atresmedia Radio*'s radio broadcasting content, as explained by María José Llerena, was structured in four main sales lines: (1) special sales, created ad hoc for the client, with a significant weight of branded content; (2) local advertising

sales; (3) sale of direct campaigns; and (4) programming sales. Data management needed to be adapted to the characteristics and needs of each of these sales lines (Fuller, *Atresmedia Radio*).

The *Atresmedia Group*'s BD platform had been designed with the *Amazon Web Services* (AWS) platform. The main analytical visualization tool for business users was *Microsoft Power BI*. Predictive and prescriptive analytics were developed with free software tools with the application of languages such as Python and Spark with *Scala*. In the group's BD architecture, they combined relational databases –especially applied to manage customer information– with much more effective *NoSQL* databases for solving particular problems, such as analytical columnar databases, documentary databases for the management of content and metadata. For the development of specific projects applied to business, *Atresmedia* used external companies that were coordinated by the BD department, including *Bluetab* –a consultant specializing in data management. For monitoring digital consumption, the applications used were *Chartbeat*, *Adobe Analytics*, and *Comscore*. The department's analysts were not specialized by media or support, with a transversal approach prevailing to ensure that the management of big data became an enabler of the business strategy of the different divisions.

Although the application of BD in *Atresmedia*'s radio broadcasting business was in an initial phase, it had been observed that the *Atresmedia Radio Group* had a potential competitive advantage in the application of BD owing to the synergies generated with the group's television division. Juan Carlos Ibáñez, Director of the Big Data Department, believed that it would be easy to apply prescriptive analytics systems, developed for digital audiovisual content, to audio content (Ibáñez, *Atresmedia*).

RNE

There was, however, a particularly anomalous case owing to the absence of systematized data utilization: *RNE*. The radio broadcasting unit of the publicly owned *Corporación de Radio y Televisión Española* recognized a very notable disparity between data management linked to television and that linked to radio (De Meer, *RNE*). At the time of this study, *RNE* stations had systems for monitoring digital audiences from the web and other listening devices, but they did not have a tool that integrated and generated analytics of that data. The head of *RTVE*'s systems expected that in the medium term –1 or 2 years– some advances could be made in datafication of this public corporation's radio broadcasting division. For economic reasons or owing to resistance to change, public radio had less resources for datafication, which obviously translated into a management process whose decisions were not based on the analysis of large amounts of data generated by the unit itself and by its users. The argument that justifies this passivity in the fact that both public television and public radio do not need to profile their audiences in the same way due to the suppression of advertising since the enactment of the *Law 8/2009, of August 28 on the Financing of the Spanish Radio and Television Corporation* does not hold water if, as attempts have been made to demonstrate on several occasions, *RTVE* is seeking to meet the needs of an increasingly digital, demanding, and fragmented audience.

5. Discussion and conclusions

The level of application of BD in the management of the radio broadcasting company showed less development than in other communication industries, such as television or digital press. The greater consistency of the traditional radio broadcasting business model explains this deceleration in two processes with strong interdependence: digital transformation and the implementation of BD systems in business management. Despite the fact that conservative strategies have prevailed in the sector, in recent years there has been a technological and business inflection, in which the gradual integration of data management into management processes stands out.

It was found that the implementation of these BD and BI systems in the radio broadcasting companies analyzed presented a lower development than that observed in other case studies applied in the communication sector. **Sangil** and **Portilla** (2021) verified that the Spanish publishing group *Unidad Editorial* had an intensive application of BD at different levels: monitoring of audiences in real time, trend discovery for product and advertising personalization, predictive power, monetization of data –especially in digital advertising, and transformation of advertising and work management systems, including the development of new lines of business from BD. Spanish radio broadcasting companies were in a clearly earlier stage in four of these five levels; only in the area of digital audience metrics had there been significant development like *Unidad Editorial*'s discussed above.

In the sphere of media agencies, large international agencies, in 2015, were already applying BD management and demonstrating the ability to develop their own technological tools (**García-Bonal**; **Papí-Gálvez**, 2015). However, it was in the audiovisual sector, in particular in large television companies and global distribution platforms for on-demand content, where BD and BI were at leading levels for any area of business activity. One of the most studied cases was that of *Netflix* (**Fernández-Manzano**; **Neira**; **Clares-Gavilán**, 2016; **Izquierdo-Castillo**, 2015), which has managed to turn data management into its main competitive advantage and structuring element.

Among the maturity models most applied to assess the level of development of the BD in companies was that of **Davenport**, **Harris**, and **Morison** (2010), adapted to Spanish by **Curto-Díaz** (2016). The analysis matrix –also known as the *DELTA* model– of these authors was composed of six success factors that determine the maturity phase in which the company can be placed in relation to BD application. The proposal included five possible phases of maturity:

- phase 1: which is characterized by the analytical incapacity of companies;
- phase 2: application of analytics in a localized manner;
- phase 3: aspiration by conversion into an analytical company –the company begins to coordinate functions and tasks of BD;
- phase 4: analytical company –companies that have managed to provide themselves with effective coordination in all data analytics processes;
- phase 5: competition based on analytics, in which those companies that have a strategy coordinated and aligned in analytical processes could be located (**Curto**, 2016). Table 2 presents the application of the *DELTA* model to each of the radio companies in this study.

Table 2. *DELTA* maturity model applied to case studies

Success factors	*RNE*	*COPE Group*	*Prisa Radio*	*Atresmedia Radio*
Data	**Phase 1** The data were considered inconsistent in the radio broadcasting field, and their organization and management was poor and insufficient	**Phase 2** There were different decentralized management systems, for example, economic-financial management or advertising management, not applied to the radio broadcasting business department	**Phase 3** Despite the fact that there was no BD department or a single data warehouse, data was managed transversally, with systematized criteria	**Phase 4** Although the BD department dedicated many more resources to the television area, the idea is to centralize the data in the same repository
Organization	**Phase 1** There was no department responsible for the application of BD solutions in *RNE*	**Phase 1** Although there was a certain degree of decentralized datafication, neither a department nor managers trained in the management of BD for strategic or business purposes was identified	**Phase 3** BD management was carried out from the systems and IT area, but there was integration of professionals in different areas of production and management activity that point to a global integration model	**Phase 4** Despite the differences in investment of resources in each business unit, data management, technology, and key analysts were concentrated in the BD department, whose competences extended to all business areas of the *Atresmedia Group*
Leadership	**Phase 1** There was no awareness of the influence of datafication on business strategy, which was manifested in the absence of departments and actions linked to BD	**Phase 2** Leadership in the datafication processes was very incipient; it was not systematized, and it was not transversal, it existed only at the function or process level.	**Phase 3** Although the implementation of solutions and tools linked to BD was evident, the absence of an ad hoc department for this purpose indicated that leaders and management are in an incipient phase of recognizing their impact	**Phase 4** There was support for analytical competence, as evidenced by the identification of a transversal BD department
Objectives	**Phase 1** There were no objectives linked to datafication	**Phase 2** Multiple objectives linked to the data were identified, but decentralized, not systematized, and disconnected	**Phase 4** Analytical activity focused on certain key areas, such as marketing and the commercial area, was identified	**Phase 3** Analytical activity centered around certain key business units was identified, in particular, free-to-air or subscription television. It cannot be considered an advanced level in radio
Technologies	**Phase 2** The only data handled, mainly linked to audiences, came from external sources	**Phase 2** The data that was handled, at the audience, commercial management, and marketing levels, came from external sources and tools	**Phase 3** A clear deployment of initiatives at the corporate level that affect the area of *Prisa Radio* in its entirety and in all its branches of activity were identified	**Phase 4** Even with the prioritization of the television area, the coordination of common technologies was used in certain areas of activity, such as commercial management, marketing, and audience analysis
People	**Phase 1** Analytical capabilities were limited and linked to audiences	**Phase 1** Although there were groups of analysts, they were decentralized, do not apply transfer systems or data systematization, and focus on specific functions	**Phase 4** Highly trained and organized analysts were identified, who weave their actions into a network, specialize in areas of activity and report to the same departmental area	**Phase 4** There were analysts widely trained in BD, located in a transversal department that supported all areas of the group's media business
Overall maturity phase	Phase 1	Phase 2	Phase 3, advanced	Phase 4 at corporate level, limited in radio

Source: Based on **Davenport**, **Harris**, and **Morrison** (2010) and **Curto-Díaz**'s adaptation (2016).

After the analysis carried out, the four initial hypotheses of the research can be considered to be verified: the degree of BD implementation in the Spanish radio broadcasting sector registered significant differences between the private sector, which in the last 2 or 3 years, has very incipiently begun to introduce BD management, principally applied to the analysis of digital audiences, consumption behavior of these users, and commercial management, and the public sector, which thus far has not adopted these technologies in a systematic way. Digital business areas were much more conducive to leveraging real-time data sources. The digital transformation of the sector needs the incorporation of data as a real asset in its value chain. The analogue radio broadcasting environment, which continues to generate about 90% of the sector's revenues, had less potential for datafication of audiences and consumption, which hindered the so-called business metamorphosis (**Schmarzo**, 2014) that would lead to the generation of real competitive advantages and monetization from BD systems with predictive power. The radio broadcasting companies most advanced in BD incorporation in Spain –*Prisa Radio* and *Atresmedia Radio*– had not yet achieved full integration of analogue and digital data sources –which reflect the two-dimensionality of a business– for their products and consumption, which at this time weakened the reliability and scope of their analytics. Everything points to the fact that, if this integration is achieved, the repercussion for the business models of radio broadcasting companies would be evident in the terms proposed by **Ontiveros** and **López-Sabater** (2017): increased knowledge of the listener will save production costs and optimize the offering, facilitate decision-making linked to the creation of new linear or asynchronous audio products, and of course, allow income diversification; in parallel, the internal management of large amounts of data will increase the efficiency of management processes.

> "In the Spanish radio broadcasting industry, comprehensive BD systems applicable in all functional areas and business decision-making processes have not been developed, although there is a growing interest in the use of datafication in business operations"

The technology ecosystem of the BD tools used by Spanish radio broadcasting companies was characterized by a high level of outsourcing. Companies did not have the capacity to develop exclusive internal tools, which would also have had a high cost that would be difficult to make profitable at the current stage of development of the digital business. They opted for the contracting of applications and components offered by various service providers for BD, with a growing tendency to generate data management infrastructures in the cloud. In some cases, they opted for the possibility of customizing certain modules or elements of the applications to improve their efficiency in the management of specific processes. In the coming years, it is foreseeable that there will be an intensification of the dependence that audio production and distribution companies have on technology service providers, a trend that will not change until the radio broadcasting industry sees beneficial effects of the implementation of their own tailor-made models of BD in its accounting expressions.

In the Spanish radio broadcasting industry, comprehensive BD systems applicable in all functional areas and business decision-making processes have not been developed, although there is a growing interest in the use of datafication in business operations. None of the companies analyzed could be categorized as phase 5, of maximum maturity, since they had not managed to ensure that all their management and operational processes were fully based on data management. There were various areas in which the application of data management is still very tangential. Radio broadcasting companies have not been able to finalize, based on data analytics, predictive processes applicable in the management of content and audiences that have had a significant impact on monetization. Beyond a project in its pilot phase that had been developed at *Prisa Radio*, in 2021 artificial intelligence and algorithmization were not yet being applied in the radio broadcasting business field. At the companies *Prisa Radio* and *Atresmedia Radio*, the BD systems started from a transversal service aimed at the different business units, in which audio had had a secondary role thus far, although there were signs that an acceleration could occur in the coming years in the transformation of the radio broadcasting business. There were substantial differences in the development and maturity of the BD and BI systems of these two companies compared with the *COPE Group*, which was in an earlier phase, characterized by objectives related to the management of more decentralized and unconnected data and by the absence of departments or units that centralized the BD and analysts integrated into the different management areas.

In the design of its BD architectures, there were significant differences between the three private companies: *Prisa Radio* enhanced the transversality of data management from the systems department of the parent group. They had not created a centralized BD department or a specific area for the radio broadcasting business. A significant strength, and an element of maturity of the model, was its ability to develop and integrate professional profiles specialized in analytics in the different business units considered key. This increased interaction between analysts –skilled in the language of data but also familiar with the business aspects– and specialists in the corresponding functional area –digital development, commercial, content, etc.– facilitated the incorporation of data management into the value chain. For its part, *Atresmedia* had opted for greater centralization of its data scientists in a specific BD department that provided its services to its entire media conglomerate, although with priority attention to television support. In this company, coordination elements had been reinforced but without integrating analysts into the business departments, which led to a certain loss of interaction between the two departments. The *COPE Group* did not have a specific department to centralize BD management, the different management processes linked to datafication were distributed in different functional areas. The Technical Department was ultimately responsible for the IT and systems area, in which the technological design of BD could be located.

The experience of the parent companies of private communication groups in the television and digital press markets may generate a gap in the ability to create value from data in the audio business, as well. It can be concluded that the radio broadcasting companies integrated in large multimedia communication groups are in a better position to achieve significant competitive advantages and synergies in BD management in the coming years. *RNE* is an exception to this trend, since, despite being part of a publicly owned multimedia corporation, with a strong role for its television division –which is considered an incentive for the implementation of BD solutions due to the greater capacity to generate revenue that comes with visual as opposed to audio– it had not considered implementing a datafication system to its business model. However, it is believed that the fundamental reason that explains this immobility was linked to the deficiencies of its current management system, reflecting the inability to articulate a strong public media model in Spain. These structural conditions made *RNE* an audio services provider that does not compete with equal intensity to stand out, through differentiation, against private competition.

> "The utilization of BD in the business dynamics of radio will become more relevant in the coming years, in parallel with its digital transformation process"

The utilization of BD in the business dynamics of radio will become more relevant in the coming years, in parallel with its digital transformation process; once it achieves a higher degree of maturity, it will be able to establish itself as an important differentiator in the strategic positioning of a sector that, despite its traditional reluctance to change, is being pushed into a gradual process of reconfiguration of its business model.

6. Notes

1. Moreover, this model, which had an unparalleled success in the United States with *Serial* as the archetypal case, has been exploited for some time in business contexts far from the media to build loyalty among its members – internally– or as a marketing strategy to optimize its corporate image –externally (**Bonini**, 2015).

2. On September 12, 2021, *Prisa Media* went public with a new organizational structure based on seven transversal platforms across the group's media business units: Commercial, Digital and Technology, Operations, Human Resources and Talent, Legal, Audio, and Marketing and Audiences. These in-depth interviews were conducted with the heads of the departments prior to this reorganization of resources.

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