Spanish technological development of artificial intelligence applied to journalism: companies and tools for documentation, production and distribution of information

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Abstract

Artificial intelligence (AI) has been progressively expanding over the last decade, with its transversal application to the journalistic process and the engaging of media and technology companies in developing specific tools and services. This research offers a first catalogue of Spanish technological companies and institutions that develop AI systems applicable to journalism, with services and features grouped into three phases of the journalistic process: 1. Automated gathering and documentation of information; 2. Automated production of content; and 3. Information distribution and audience relations. The research uses a methodology of in-depth interviews with 45 innovation heads of Spanish-based companies and technological centres specialised in the development of AI ($N = 25$), and is supported by questionnaires to systematise four study categories: company profiles, tools, journalism-specific services and future trends. The results confirm a clear evolution of Spanish technological companies within the AI sector, with services and tools available for the whole journalistic process, mainly in the information gathering and content distribution phases related to monetisation; the automated news production phase is thereby overshadowed. The offering is diversified in terms of formats -textual, audiovisual, sound- and platforms, especially web and social media. The companies consulted testify to the profitability of its implementation and note a growing interest from the media, but warn of an uneven progress that reflects "slowness", "distrust" and "lack of knowledge" regarding the application of AI.

Keywords

Automated journalism; Artificial intelligence; AI; Algorithms; Natural language; Robots; Technology companies; Tools; Software; Applications; Communication; Automation; Newsrooms; Audiences; Information and communication technology; ICT; Journalistic production; Journalistic dissemination.

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1. Introduction

Artificial intelligence (from now on AI) has developed very rapidly in recent years, and, although its future is still uncertain, it has the potential to widely and profoundly influence the way news is produced and consumed (**Beckett**, 2019). The term "Artificial Intelligence" was first used in 1956 (**Russell**; **Norvig**, 2022), and since then its definition has evolved in parallel with its application, resulting in different conceptual approaches over the years (**Canavilhas**, 2022). Despite this, the most standardised and widespread definition is that which perceives AI according to its rational action, considering it to be the

> "study of agents that receive percepts of the environment and perform actions" (**Russell**; **Norvig**, 2022, p. 7).

That is, the attempt to understand and build intelligent entities (**Crawford**, 2021), or having computers carry out activities hitherto reserved for the human mind (**Boden**, 2017).

Technology has always been at the foundation of modern journalism, from its beginnings and evolution to the computerisation of newsrooms (**Vázquez-Herrero**; **López-García**; **Irigaray**, 2020). The emergence of new technologies in journalism has transformed the way information is accessed, consumed and interpreted (**De-Lima-Santos**; **Mesquita**, 2021). From this cross-over of technology and the professional practice of journalism has emerged what is known as hi-tech journalism; that is to say, new journalistic specialties and trends have appeared that employ state-of-the-art tools (**López-García**; **Vizoso**, 2021). Thus, in recent years, and especially in the last quarter of a century, the media have been transformed with the new digital era (**Salaverría**, 2019) and its rapidly developing technology, together with the emergence of new tools for the different stages of creating, producing and distributing news (**De-Lima-Santos**; **Ceron**, 2021).

Since the mid-2000s, AI has expanded rapidly in both academia and industry (**Crawford**, 2021), and is one of the fastest developing technologies internationally, growing progressively in different sectors (*Ministerio de Asuntos Económicos y Transformación Digital*, 2020). Therefore, as its use in companies becomes more common, tools and practices become increasingly sophisticated (**Chui** *et al*., 2021). Its application in the world of journalism has increased interest (**Calvo-Rubio**; **Ufarte-Ruiz**, 2021), and there has been a similar expansion in the international media sphere (**Rojas-Torrijos**, 2021), where research, albeit increasing, is still in the early stages (**Parratt-Fernández**; **Mayoral-Sánchez**; **Mera-Fernández**, 2021). From this cross-over of AI with this sector there emerges what is referred to as "automated journalism" (**Carlson**, 2015; **Caswell**; **Dörr**, 2017), also known as "robot journalism" (**Clerwall**, 2014) or "algorithmic journalism" (**Dörr**, 2015); this involves the automatic writing of news via a computer, with minimal or no human input (**Wu**; **Tandoc**; **Salmon**, 2018), by applying Natural Language Generation (NLG) techniques (**Montal**; **Reich**, 2017).

This emerging reality is not limited to news production, but occupies all stages of the production chain (**Diakopoulos**, 2019), that is, gathering, storing, processing, transmitting and consuming information (**Túñez-López**; **Fieiras-Ceide**; **Vaz-Álvarez**, 2021); this signifies a wholesale transformation of the journalistic process (**Rojas-Torrijos**, 2021).

The first applications of automated journalism were in the United States in 2014 –with the creation of *Quakebot*, to automatically report earthquakes– in *Los Angeles Times* (**Carlson**, 2015), and in *The Associated Press* reports on the *Automated Insights' Wordsmith* platform (**Graefe**, 2016), which also automatically writes sports articles (**Tejedor-Calvo** *et al.*, 2021). The same year, the French newspaper *Le Monde* used the *Data2Content* AI system to generate micro-news on election results (**Sánchez-Gonzales**; **Sánchez-González**, 2017).

During the last decade, the application of AI to news writing extended to news agencies (**Fanta**, 2017) and media from different countries in North America or Europe; such as *Forbes*, *Yahoo*!, *Thomson Reuters*, *ProPublica*, *Sports Illustrated*, *The Washington Post* or *The New York Times* in the United States; *BBC*, *The Guardian* or *The Telegraph* in the United Kingdom; *Der Spiegel* or *Berliner Morgenpost* in Germany and various European agencies; in Asian countries, with *South China Morning Post* or *The Shinano Mainichi Shimbun* in Japan; or in Latin America, such as *El Financiero* in Mexico or the Brazilian television *Globo* (**Túñez-López**; **Toural-Bran**; **Cacheiro-Requeijo**, 2018; **Essenfelder** *et al*., 2019; **Firat**, 2019; **Rojas-Torrijos**, 2019; **Ufarte-Ruiz**; **Manfredi-Sánchez**, 2019). Specialiseded companies such as *Narrative Science*,

Automated Insights, *Yseop* and *CBS Interactive* have also emerged with GLN systems for writing journalistic texts (**Vander-Kaa**; **Krahmer**, 2014).

In the Spanish case, there are pioneering projects such as

- *Medusa*, from *Vocento*, which experiments with automated journalism to generate information on the situation of beaches and ski slopes (**Ufarte-Ruiz**; **Manfredi-Sánchez**, 2019);
- *El Confidencial's bot*, *AnaFut*, for the automatic writing of sports reports (**Rojas-Torrijos**; **Toural-Bran**, 2019); or
- *Gabriele software* created by the *Narrativa* start-up, to write journalistic texts automatically, and which collaborates with various Spanish media (**Ufarte-Ruiz**; **Manfredi-Sánchez**, 2019).

Other successful examples are *Agencia EFE*, which, together with *RTVE*, uses AI in database analysis, as well as other projects focused on news writing (**Bazán-Gil** *et al.*, 2021), and two intelligent news alert systems, *Dataminr* and *Social Media Radar* (**Tejedor-Calvo** *et al.*, 2021). In the case of political information, the *Politibot* project, a pioneering chatbot promoted by *El Español*, is a leading example (**Sánchez-Gonzales**; **Sánchez-González**, 2020).

The application of AI therefore extends to mass media, news agencies and service-generating companies, playing a fundamental role in journalistic workflows (**Barceló-Ugarte**; **Pérez-Tornero**; **Vila-Fumàs**, 2021). Its implementation in newsrooms is still considered to be in its early stages (**Graefe**; **Bohlken**, 2020), but it has begun to arouse business interest as regards seeking profitability and new business models (**Caswell**; **Dörr**, 2017). This initiative is also driven by non-journalistic agents (**Carlson**, 2014), since very often this technological disruption does not come directly from the media, but from external companies (**Salaverría**; **De-Lima-Santos**, 2020).

If, since its origins, technology has always influenced, limited and structured journalism (**Pavlik**, 1999), it is now more essential than ever in order to deal with the relentless expansion of AI in the communication sector. In an apparently slow and irregular evolution of the Spanish media towards automation, the academic environment has focused on an analysis that, albeit incipient, makes it possible to outline the situation by means of meta-research in the area of Communication (**Martínez-Nicolás**; **Saperas-Lapiedra**, 2011); this examines how the issue is investigated, from a definition of the problem, the search for information, organisation and analysis (**Gómez-Luna** *et al.*, 2014).

An approximate review of the state of the art in Spain, concerning fifty Communication journals –following the model of **Sánchez-García** *et al.* (2019)–, corroborates the initial academic interest in this country (**Parratt-Fernández**; **Mayoral-Sánchez**; **Mera-Fernández**, 2021). This involves a wide sample of 188 AI studies; of these, 42 articles published in just over five years focus on the application of AI in the media, with 28 offering examples of AI tools applied to media and focusing mainly on three approaches:

- The state of the newspaper industry, especially as regards perception by professionals, changes in the sector, and the creation of AI application maps in the media (**Salazar-García**, 2018; **López-García**, 2018; **López-García**; **Rodríguez-Vázquez**; **Toural-Bran**, 2019; **Tejedor-Calvo** *et al*., 2021; **Túñez-López**; **Fieiras-Ceide**; **Vaz-Álvarez**, 2021; **Túñez-López**; **Toural-Bran**; **Cacheiro-Requeijo**, 2018; **Túñez-López**; **Toural-Bran**; **Valdiviezo-Abad**, 2019; **Ufarte-Ruiz**; **Calvo-Rubio**; **Murcia-Verdú**, 2021).
- Case studies of the applications, with the clear predominance of chatbots and tools to combat misinformation, and several examples of news automation (**Bazán-Gil** *et al.*, 2021; **Flores-Vivar**, 2020; **Gómez-de-Ágreda**; **Feijóo**; **Salazar-García**, 2021; **Herrero-Diz**; **Varona-Aramburu**, 2018; **Cerdán-Martínez**; **García-Guardia**; **Padilla-Castillo**, 2020; **Rojas-Torrijos**, 2019; **Rojas-Torrijos**; **Toural-Bran**, 2019; **Sánchez-Gonzales**; **Sánchez-González**, 2017; 2020; **Segarra-Saavedra**; **Cristófol**; **Martínez-Sala**, 2019; **Ufarte-Ruiz**; **Manfredi-Sánchez**, 2019).
- An analysis of academic interest, such as training in AI offered in Spanish universities and the perception of teachers, as well as scientific literature in this area (**Calvo-Rubio**; **Ufarte-Ruiz**, 2020; 2021; **Lope-Salvador**; **Mamaqi**; **Vidal-Bordes**, 2020; **Parratt-Fernández**; **Mayoral-Sánchez**; **Mera-Fernández**, 2021; **Ufarte-Ruiz**; **Fieiras-Ceide**; **Túñez-López**, 2020; **Ufarte-Ruiz**; **Murcia-Verdú**, 2018).

This review of state-of-the-art technology accounts for the delimitation of our study to the unexplored perspective of technology companies that develop AI tools for the media, for which there are no prior studies or an official registry in Spain. This is confirmed by a report from the *Ministry of Economic Affairs and Digital Transformation* regarding a previous consultation for this article: "As of today there is no registry of Artificial Intelligence companies" (e-mail communication, February 9, 2022).

The study has a threefold research and transfer objective:

> O1. To locate the available technology for AI applicable to journalism that has been developed by technology companies and research centres based in Spain, whilst ascertaining the professional profile of their teams and their synergies between the Information and Engineering areas.
>
> O2. To produce and publish the first catalogue of multiplatform Spanish AI tools and services for the different stages of documentation, production, and distribution of information.
>
> O3. To solicit the opinion of companies and technological centres regarding the profitability of applying AI and its practical use by the Spanish media.

The research is based on the hypothesis that in Spain automated technological tools and services with AI applicable to different stages of journalism are available, but their implementation among the media is a slow one.

2. Materials and methods

The methodology employed in the study is based on in-depth interviews with heads of innovation departments in Spanish-based technology companies and research centres specialised in Artificial Intelligence, and with applications in the media. This is subsequently combined with a questionnaire, making it possible to systematise some of the answers from the interviews and integrating both techniques with the same objectives (**Thelwall**, 2006); these complement each other and provide a multi-reference perspective of a complex topic (**Martínez-Rodríguez**; **Benítez-Corona**, 2020).

2.1. Sample: technology companies and participating representatives

The lack of official records for companies that develop AI technologies applicable to journalism and means of communication has meant that the fieldwork was preceded by a complex search phase for such companies. Thus, samples have been obtained from initial contacts through previous consultation with media that already apply these technologies; this initiates a "snowballing" process (**Noy**, 2008) as a qualitative technique (**Cohen**; **Arieli**, 2011), in which the researcher's first contacts recommend others for participation, thereby increasing this initial sample (**Parker**; **Scott**; **Geddes**, 2019). This represents a cumulative, diachronic, and dynamic process (**Noy**, 2008), which is recommended in exploratory research (**Atkinson**; **Flint**, 2001) and when the sample is "small, limited and difficult to find" (**Sánchez-García**; **Redondo**; **Diez-Gracia**, 2021, p. 46); this also gives it value in itself, even if it is an approximation of existing research.

The list of technology companies developing AI for the media, together with their catalogue of services and tools, is given here as a contribution to future studies. Therefore, it is appropriate to provide details of the selection procedure employed by these companies, the time frame of the interviews and questionnaires, and those responsible for participating. To obtain the sample, 28 companies and technological development centres were initially contacted; after the discarding of those which either failed to respond or were unsuitable for the object of study in view of their inapplicability to the media, a final sample limited to N=25 was chosen.

Data collection for the whole process was carried out between May 2021 and February 2022 –with a remarkable willingness and agility of response from the companies– via three contact channels:

- Contacts via media operating with AI tools: consultations took place via email and/or video call conversations with technological development representatives of the Spanish media or media groups such as *Prisa*, *RTVE*, *Muy Interesante* and *Vocento*. This phase allowed direct contact with technology companies that already work with the media or that have tools under development.
- Information obtained by means of tracking company websites, and especially the social network *LinkedIn*, by using its search engine with the keyword IA –in both its Spanish and English versions.
- The "snowballing" method, which is applied by interviewing company representatives included in the sample and requesting from them successive contacts from companies in the sector.

Once the companies had been located, a first contact e-mail was sent to them to arrange a video call interview with the person responsible for technological development chosen by the company. The conversations and interviews that were carried out involved a total of 45 representatives of different technology departments (Table 1).

2.2. Interviews and questionnaire

In the dual methodology employed the interview and questionnaire were complementary. First, the semi-structured interviews addressed to the representatives of the technology companies included questions which involved a non-directional and flexible approach, providing an overview of the object of study (**Taylor**; **Bogdan**, 1987) around three initial axes:

- main activity of the company;
- services and tools applicable to journalistic processes; origin and professional profiles;
- opinion regarding the evolution and innovation of AI in the media.

Subsequently, the questionnaire was used as part of the survey methodology (**Tafur**, 2020), addressed to the same companies and entities interviewed by means of a self-administered form sent by e-mail and answered by one or more of those responsible in each case. These were open-ended, multiple-choice and exploratory questions, an effective technique when seeking information without knowing all the answers (**Amérigo**, 1993; **García-Alcaraz** *et al.*, 2006) and one which has proven useful in previous studies with software developers (**Gómez-García** *et al.*, 2019) and experts in new technologies (**Rojas-Torrijos**; **Toural-Bran**, 2019). Eighteen questions were asked to expand and facilitate standardisation of previous interviews into four categories[1] that included analysis variables established in the research objectives:

- A description of the company or entity (C1). This included contact details, where and when it was founded, as well as the company's service and core sector.
- The development of AI tools (C2). Information was obtained regarding the activity and the main product or service of the technology company in connection with the study.
- The application of AI to Journalism (C3). This category focused on the type of technology developed by the companies surveyed and its specific application to the media. This represented a description of the tools or services developed, as

Table 1. Sample of interviewed technology companies and centres*

Company/centre	Participants / Position	Date
Airtouchmedia *https://www.airtouchmedia.com*	Armando Avila Kramis / CEO	18-11-21
Citius *https://citius.gal*	José María Alonso Moral; José Alberto Bugarin Diz; Pablo Gamallo Otero; Félix Díaz Hermida / Researchers	18-11-21
Dail Software *https://www.dail.es*	Jesús Cardeñosa / Founder of the *Instituto de Generación de Conocimiento*	28-07-21
Echobox *https://www.echobox.com*	Antoine Amann / CEO	10-01-22
Gamco *https://gamco.es/*	Roberto Galiana Giner / Business development	25-02-22
Graphext *https://www.graphext.com*	Brais Ramos / Head of Sales Victoriano Izquierdo / Co-founder and CEO	21-12-21
Hiberus *https://www.hiberus.com*	David Torres / Head of resources Mariano Minoli / Head of AI and data	03-02-22
Intelygenz *https://intelygenz.com*	José María Fernández / Head of R+D	15-10-22
Instituto de Ingeniería del Conocimiento *https://www.iic.uam.es/iic*	Guillaume Pivetta / Business development: Social Business Analytics	30-06-21
Knowledge Reuse *http://www.kr.inf.uc3m.es*	José María Álvarez Rodríguez / Teacher UCM Juan Llorens / Teacher: Systems Engineering	02-02-22
Lurtis *https://lurtis.com*	Luis Penya / CEO	13-12-21
Monoceros.Labs *https://monoceros.xyz*	Carlos Muñoz-Romero / CEO Nieves Ábalos Serrano / Co-founder and CPO	23-07-22
Narrativa *https://www.narrativa.com*	David Llorente / CEO Sofía Sánchez González / PR y Marketing	21-10-21
Newtral *https://www.newtral.es*	Marilín Gonzalo / Head of digital area Rubén Míguez / Head of technological development	17-12-21
OdiseIA *https://www.odiseia.org*	Richard Benjamins / Chief AI & Data Strategist David Corral / Head of *RTVE Innovation*	19-11-21
Optiva Media *https://www.optivamedia.com*	Iñaki Martínez Sarriegui / Head of R&I Joaquin M. López Muñoz / Product Management Sandra Grano de Oro / R+D promoter	06-07-21
Paradigma *https://www.paradigmadigital.com*	Antonio Trullás / Head of growth area Andrés Macarrilla / Tech Lead Tomás Calleja Valls / Cloud architect Patricia Prieto Longareda / Solutions Architect	19-01-22
PiperLab *https://piperlab.es*	Nacho Abad López / Business development Alejandro Llorente Pinto / Data Scientist	21-02-22
Prodigioso Volcán *https://www.prodigiosovolcan.com*	José Carlos Sánchez / Head of AI Carmen Torrijos / Computational Linguist	03-12-21
Sherpa *https://www.sherpa.ai*	Celestino García / Vice-president	18-03-22
Sngular *https://www.sngular.com*	José Luis Calvo Salanova / AI Director	13-12-21
Tools *https://toools.es*	Mario Ramírez Ferrero / Information Security Lead	22-10-21
Vass *https://www.fundacionvass.org*	Antonio Rueda Guglieri / Director Carlos Antón García / Manager with AI models Oliver Sanz Gallego / Natural Language	05-11-21
Voikers *https://voikers.com*	Roberto Carreras / CEO	21-10-21
Webedia *https://es.webedia-group.com*	Roberto Jiménez / Chief Editor Alberto Gago / PR Marketing Manager	24-01-22

* The companies and centres making up the sample are presented in alphabetical order. Following initial contact by email, semi-structured interviews were conducted via video-calls, and subsequently a questionnaire was sent out except in two cases: *Echobox*, from which the written response was obtained in English by e-mail, and *Sherpa*, with which an initial interview with those responsible could not be completed, the information being collected instead via mail, the *Prisa* group and the web.

well as the professional profile involved; whether they had hybrid teams and media experts; their design and rollout period; whether it was an in-house or external assignment; whether they could be extrapolated to projects other than the media; and whether their interface was developed at user level or if they needed specialised professionals to operate it.
- The AI tool or service offered and its usability in Communication (C4). Information was gathered on the tool offered on the market, whether or not it was multiplatform; its main function; its classification according to the proposed taxonomy (Information/Production/Distribution); the devices it was intended for; whether or not it was profitable for the company and the media; and the interest of the latter in developing these types of applications and tools.

The interviews and questionnaires were instrumental in formulating an approximate catalogue of AI technology already available for application, and in making a distinction between three possible automation stages of the journalistic process in accordance with previous studies; these are explained below and simplified in Table 2.

- Phase 1. Automation of information gathering (reporting). This includes the process of documentation, information search, trends, and informative topics, with a prior analysis of numerical, textual and audiovisual databases, completing the stages of documentation, contextualization and previous reports or infographics. This stage has been applied since the 1990s to the economic or meteorological area (**Graefe**, 2016; **Dörr**, 2015; **Linden**, 2017), and has expanded to other phases of the informative process (**Nakov** et al., 2021) such as verification.
- Phase 2. Automated content-information production (production). Writing and creating content. This level, which is more complex than the previous one, is capable of generating news (**Ufarte-Ruiz**; **Manfredi-Sánchez**, 2019; **Ufarte-Ruiz**; **Fieiras-Ceide**; **Túñez-López**, 2020) for all types of formats and platforms. It also includes the visualisation and final production of data graphics and infographics.
- Phase 3. Distribution of information and relationship with the audience (distribution). Dissemination of information content and reception analysis. It encompasses selecting the content based on algorithmic prediction and applying machine learning with recommender systems that personalize reception (**Robles-Morales**; **Córdoba-Hernández**, 2019; **Kotras**, 2020; **DeVito**; **Gergle**; **Birnholtz**, 2017; **Saranya**; **Sadhasivam**, 2012). It is based on information and consumption data gathered on the web and social networks, including sentiment analysis; this makes it possible to improve the company's efficiency in subscription and monetisation. This dynamic

  > "not only increases visit frequency, which increases revenue through advertising, but also improves engagement" (**Zihayat** *et al.*, 2018, p. 15).

  This phases three, includes the creation of informative chatbots that enhance the journalistic narrative to enrich the account, collect information about the audience or disseminate content with the automated sending out of newsletters (**Veglis**; **Maniou**, 2019).

Table 2. Stages of applying artificial intelligence to journalism

Stage 1. Automated gathering of information and documentation (*reporting*) Search for documentation, context and data, extracting, classifying and verifying content prior to generating information
Textual, audiovisual, web data and social network analysis: field search, documentation, reports, infographics and verification of sources or topics
Stage 2. Automated content-information production (*production*) Drafting information and generating content with different formats and platforms
Textual news, audiovisuals, audios, infographics
Stage 3. Distribution of information and audience relations (*distribution*) Automated information and content dissemination for greater personalised recommendation and reception analysis on platforms and networks
Content curation, newsletters, information and personalisation recommenders, chatbots and wizards, audience data analysis on the web and networks, sentiment analysis, subscription-monetisation, post-informative verification

Source: based on *Prodigioso Volcán* (2020).

3. Results

The research on the technology companies and research centres consulted has enabled us to outline an unprecedented approximation of the Spanish "technological muscle" that develops services or tools applicable to automated journalism. The results make it possible to meet the objectives of analysing the technology available and presenting a first catalogue and business profile of AI services applicable to journalism; this is complemented with the opinion of experts on its evolution in the sphere of the media. The combined quantitative and qualitative data obtained from the interviews and questionnaires are combined in order to provide an understanding of the results.

> "The implementation of AI in newsrooms is still in its early stage, but it has begun to arouse business interest linked to profitability and new business models"

3.1. Catalogue of Spanish technology companies developing AI for the media

The Communication sector in Spain has begun to incorporate AI in the last decade, and this has increased particularly in the last five years. As a result, it has aroused the interest of technology companies in terms of developing specific services and tools for the sector, even before these are requested by the media. From the interviews conducted, it is clear

that most of the companies specialising in AI and data analysis diversify their efforts in different strategic economic sectors (especially, banking, insurance, healthcare, transportation, etc.), and have services they consider equally applicable to the communications sector (Table 3); in some cases, these are start-ups created by and for the newspaper industry. Below is the first catalogue of companies developing AI in Spain. This should be considered a non-definitive and original approximation, since there are no similar records that can serve as a reference for the media.

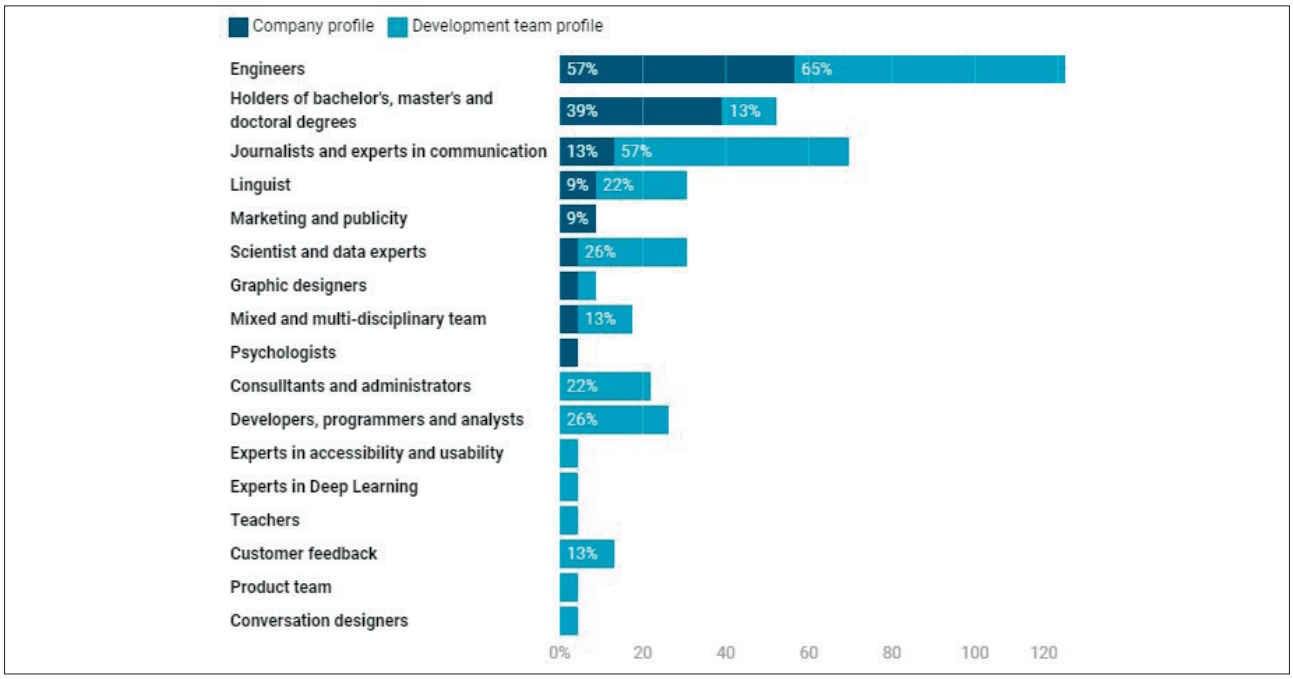
The catalogue includes two sections: a specific service or tool available to the media – some with a commercial name and others without – together with a description of its main features, which are then grouped in the authors' taxonomy (Graph 4).

Table 3. Catalogue of technology companies with AI applications in journalism, tools, and features*

Company/centre	Tools, services and clients	Main features
Airtouchmedia *https://www.airtouchmedia.com*	AI Consulting (*Alexa*)	Subscriber support, e-commerce and audience data
		Design of virtual wizards and chatbots
Citius *https://citius.gal*	*Linguakit*	Linguistic analysis and data extraction, interactive dialogues and sentiment analysis
		Automatic generation of previous reports
Dail Software *https://www.dail.es*	*Leo Robot* *Full Tak* *Agora* *Datability*	Automatic news production
		Intelligent chatbots, linguistic analysis and e-commerce
		Active audience listening on social networks
		Extracts company information and audience analysis
Echobox[2] *https://www.echobox.com*	*Echobox newsletters* and *Social* (*El País*, *La Razón*, *RTVE*, *El Español*)	Automation of publications distribution
Gamco *https://gamco.es*	*Cates* (semantic categorisation)	Text classification, labelling and personalising of viral topics and trends for the journalist
Graphext *https://www.graphext.com*	*Graphext*	Complex data analysis
Hiberus *https://www.hiberus.com*	*SAC* (*Subscription accelerator content*) (*Diario de Navarra*, *Henneo*; *La vanguardia*, *20 minutos*)	Monitoring of reader-subscriber behaviour Automatic learning; semantic analysis; monetisation
		Application of AI to internal content managers
Intelygenz *https://intelygenz.com*	*Konstellation* *graf+IA* (*Prodigioso Volcán*)	Content recommender / personalisation AI for APPs, graphics, document search
		Production of infographics
Instituto de Ingeniería del Conocimiento *https://www.iic.uam.es/iic*	*Lynguo*	Sentiment analysis, personalisation of content
Knowledge Reuse *http://www.kr.inf.uc3m.es* *(Universidad Carlos III)*	*Social Media Radar* automated information generation (*RTVE*)	Active listening of social networks for journalists: topic, audiences and sentiment analysis
		Automated news generation
Lurtis *https://lurtis.com*	Data and linguistic analysis	Digital consultancy for implementing AI
		Recommender systems and customer profiling
		Text analysis for real-time alerts
Monoceros.labs *https://monoceros.xyz*	*Monoceros*	Voice wizards and chatbots
Narrativa *https://www.narrativa.com*	*Gabriele* (*El Confidencial*, *Sport*, *El Español*, *El Periódico*, *El Independiente*, *RTVE*)	Generating news content text
Newtral *https://www.newtral.es*	Claimbot (*WhatsApp*) Claimhunter (networks)	News fact-checking
		Filtering of verification queries via *WhatsApp*
		Analysis of political discourse on *Twitter*
		Audiovisual discourse analysis
OdiseIA[3] *https://www.odiseia.org*	AI ethical analysis	Algorithm ethics analysis and dissemination
Optiva Media *https://www.optivamedia.com*	*MediaWatcher*	Analysis of the level of social responsibility of audiovisual media algorithms
Paradigma *https://www.paradigmadigital.com*	*Tailorcast*	Podcast recommenders
		Audience data analysis
		Digital consultancy for implementing AI

Company/centre	Tools, services and clients	Main features
PiperLab *https://piperlab.es*	Audience analysis (*Prisa*, *Vocento*, *El Economista*)	Audience segmentation / personalisation
		Analysis of content distribution on networks and comparison with competitors' audiences
Prodigioso Volcán *https://www.prodigiosovolcan.com*	*Clara* *graf+IA*	Digital consultancy for implementing AI
		Linguistic analysis via machine learning
		Development of automated infographics
Sherpa *https://www.sherpa.ai*	AI Consulting / user privacy (*El País*)	Improvement in publicity ROI
		Increased customer satisfaction
		Content recommendation engine
		Enhanced engagement and CTAs
Sngular *https://www.sngular.com*	Wizards (*Prisa Radio-Alexa*)	Digital consulting and software development
		Chatbot for employees
		Social media sentiment analysis
		Automated image and video tagging
		News recommenders
		Wizards
Tools *https://toools.es*	*OTTforyou*	Curation, audience segmentation, recommender, data verification and validation
		On-demand digital technology consulting
Vass *https://www.fundacionvass.org*	*Herramienta KL 30* *Smok*	Content Accelerator with internal documentary dictionary to enhance news
		Content personalisation, social login
Voikers *https://voikers.com*	Audio player	Voice wizards
		Automated news reading
Webedia *https://es.webedia-group.com*	Analysis of topics and audiences	AI in digital entertainment: topics, trends, and audiences for strategy recommendation

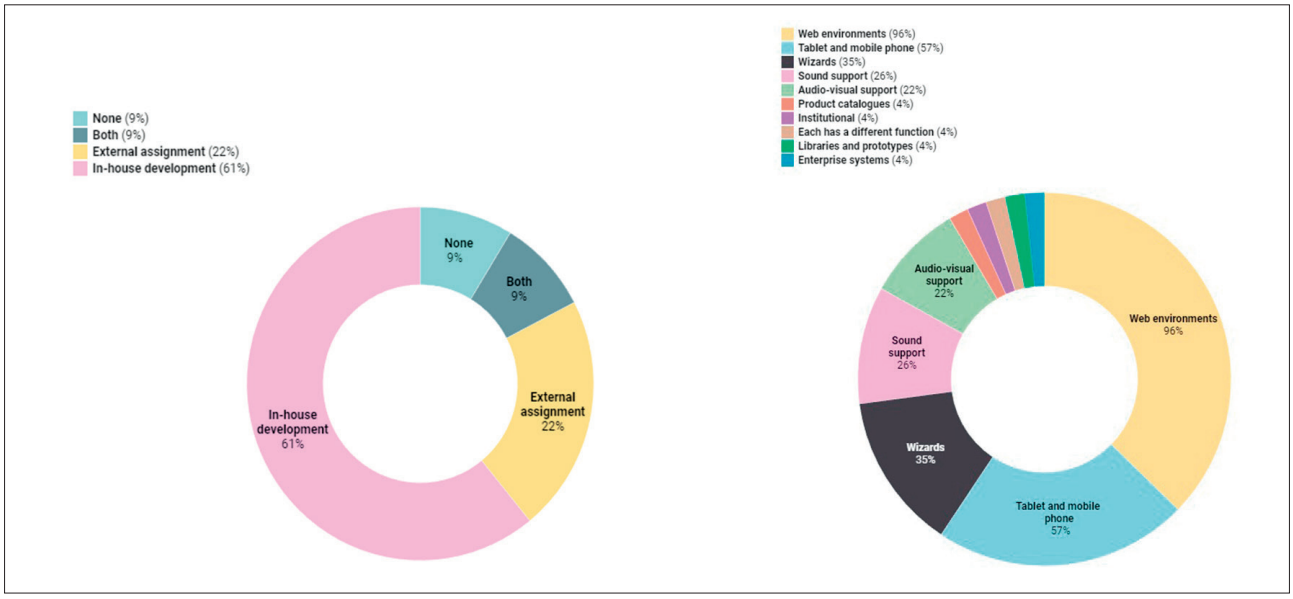
The interviews and the systematised responses via questionnaires made it possible to obtain the results set out in the objectives described below. Regarding the profile of the companies (O1), it was found that in Spain there is a relatively recent AI technology network, and that this has expanded, principally in the form of start-ups, in the last decade; most are based in Madrid (78.26%) and are focused on different development sectors. Two types of profiles can be distinguished: those that represent the whole company, and those that comprise the specific development team for the AI tools offered to the media (Graph 1).



Graph 1. Professional profile of the companies and teams developing AI tools

In both cases, the integrated technical profiles focus on Telecommunications or Computer Engineering, among other specialities. The tools applicable to the media are designed with the collaboration of experts in Communication and Marketing, and business consultants or computational linguists, with the adaptation of the team to development needs. In this regard, profiles in engineering (65.21%) and journalism (56.52%) predominate, with a greater presence in the development of tools than in the general profile of the companies (13.04%).

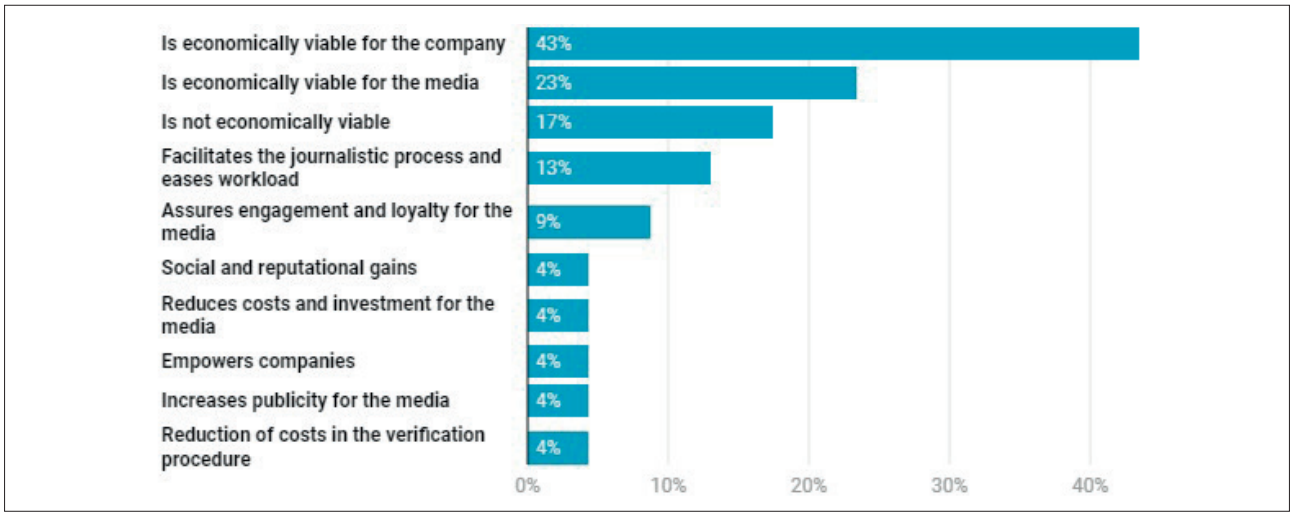
With respect to AI application platforms (Graph 2), the companies confirmed that the tools and services are developed on their own initiative (60.86%) for subsequent supply to the media, while a minority (21.73%) are applications commissioned by the media. Likewise, they are aimed at a multiplatform market, with application in web environments (95.65%), tablets and smartphones (56.52%), technological wizards (34.78%) and audio (26.08%) or audiovisual (21.73%) aids. The interface has a user-level design (69.16%) and can be employed without prior knowledge or with basic learning (8.69%), a specialised professional being required in very few cases (4.34%).



Graph 2. Type of development and platform targeted by AI tools

The companies surveyed highlight the adaptability of these digital tools, which can be extrapolated to other projects (86.95%) and adapted to the needs of each medium. Some can even be applied to other areas, "such as the e-commerce (...), administrative (...) or pharmaceutical sector" (*Narrativa*). The period of development is variable, depending on the features required, and ranges from one month to several years, or a continuous updating process.

The companies consulted evaluated the profitability of AI in means of communication (Graph 3), both for them (43.47%) and for the latter (23.33%). Although they do not represent a majority, some say that these tools do not contribute monetary benefits (17.39%), but rather that they optimise journalistic functions and the relationship with audiences, such as a reduction in workload (13.04%) and costs (4.34%), increased engagement, loyalty (8.69%) and advertising (4.34%), among others.



Graph 3. Profitability of firms and media in the use and development of AI tools

3.2. Catalogue of AI application in three phases of the journalistic process: information-production-distribution

The AI tools offered can be applied to the entire information and business process of a means of communication, grouping services and tools in a new catalogue, highlighted in the second objective (O2), and focusing on the three main phases of the journalistic process already described:

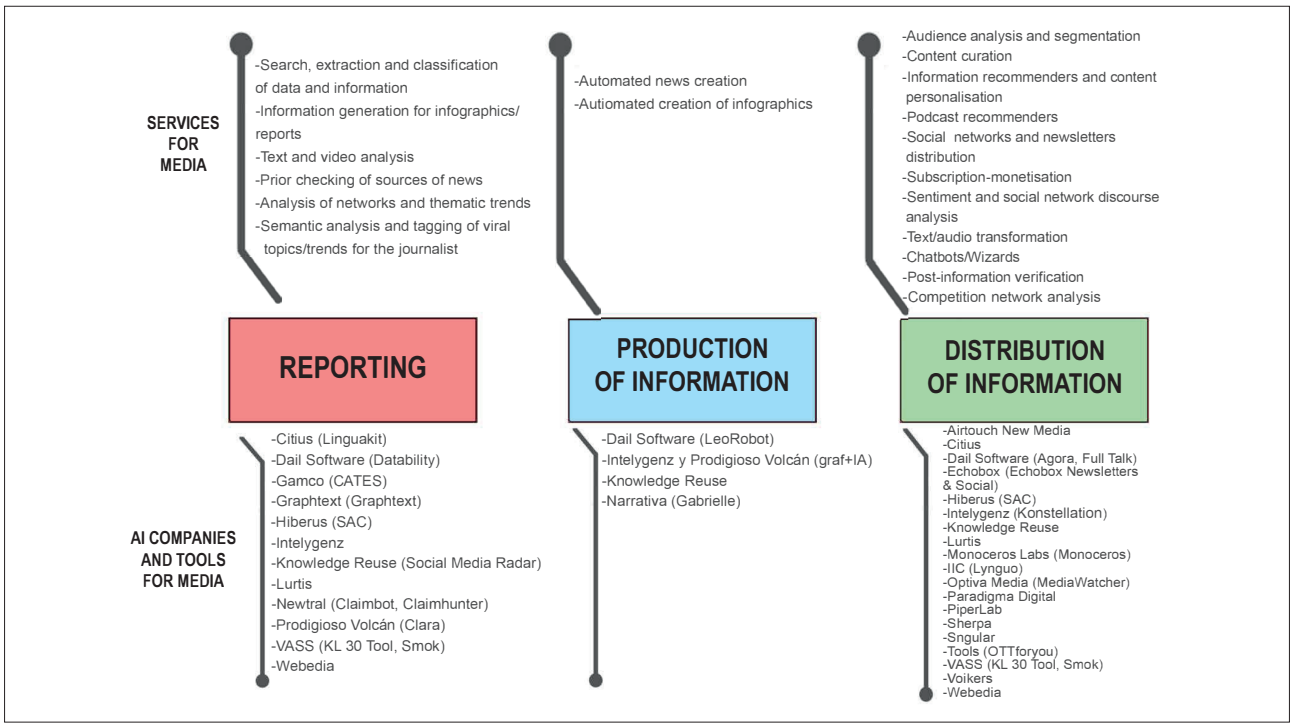
- automated gathering of information;
- automated content production;
- distribution of information and audience relations.

The taxonomy resulting from consultation with technological and research centres (Graph 4) reflects the diversified AI availability in formats –textual, audiovisual, sound– and platforms, especially on the web and social networks.

The greatest number of benefits are related to distribution and audience engagement (Phase 3), followed by information gathering (Phase 1) and, to a lesser extent, automated news production (Phase 2). That is, AI and the resources are applied more to how segmented and potentially interested audiences are reached. Up to 20 of the companies focus on this phase, offering varied services such as audience segmentation analysis, curation and recommenders, social network analysis, subscription, or competitor trend analysis, among others.

In the case of the information gathering phase, there are tools or services aimed at journalists themselves, which facilitate prior preparation by searching for information for documentation, contextualisation and data verification. In this case, almost half of the companies (12) include tools which search for, extract and classify previous data, document reports and infographics, analyse texts and videos, and provide prior verification of sources or semantic analysis and thematic trends, among others.

Finally, the automated news production stage shows only four companies with services such as the automatic generation of news and infographics, making this the least developed speciality.



Graph 4. Artificial intelligence in three stages of the journalistic process

3.3. Opinion of technology companies regarding AI in the media: "slowness", "distrust" and "lack of knowledge"

A combined analysis of in-depth interviews and questionnaires involving the representatives of innovation and technological development in the participating companies and centres has allowed us to gauge their opinion; this complies with the third objective (O3) regarding the evolution and interest of the Spanish media in applying AI. These coincide in terms of three main ideas attributed to the sector: "slowness", "distrust" and "lack of knowledge". The idea of "slowness" is linked to economic difficulty, since

> "the media have a very strong funding problem that limits them" (Brais Ramos, *Graphext*).
>
> "They are technologically very backward, and although they have evolved positively, their current struggle is how to monetise their digital content and they are not yet willing to invest in AI" (José María Fernández, *Intelygenz*).

There is a "clear reluctance of publishers" (Antonio Rueda, *Vass*) and there are two trends in the sector:

> "media that show concern about data and that has been increasing; and sceptical media" (David Torres, *Hiberus*).

They describe a resistance to change

> "for fear of losing their jobs, especially journalists" (Jesús Cardeñoso, *Dail Software*).

But experts clarify that AI

> "needs a lot of human work and what it offers to journalism is support to journalists and new services to the audience (...) The professional feels threatened, but, in reality, it allows him to dedicate himself to high-value tasks" (José María Alvarez, *Knowledge Reuse*).

A threat to labour that "is not real because automation does not eliminate jobs" (Sofía Sánchez, *Narrativa*) and contributes to "greater production and supervision of the entire process" (Roberto Jiménez, *Webedia*). The reality is one of "rejection and ignorance of the media" (David Corral, *OdiseIA*).

> "The services and tools of the companies consulted make it possible to specify, organize and group the technological offer of AI in Spain in three phases of the journalistic process: information, gathering, content production and content distribution"

Newtral, a company specialised in fact-checking, shows that the application of AI has managed to shorten time and resources by 30%. In other words, "it does not mean reducing staff, but simplifying the process", since a robot will never carry out fact-checking, but "the criterion is always that of a journalist", argues Marilín Gonzalo, adding that more journalists have been hired. Thus, while other sectors are advocating the introduction of AI,

> "the media believe that it is not something that is going to help them, but something that is killing them. And in this they are wrong, they need to change their mentality" (José María Fernández, *Intelygenz*).

At the moment, "the media are reticent and focus more on spreading the word about AI than on applying it" (José Carlos Sánchez, *Prodigioso Volcán*).

This "slowness" and "distrust" is reinforced by the "lack of knowledge" shown by the media in not making use of their data to improve their efficiency, as Moisés Martínez from *Paradigma Digital* explains:

> "The media are not clear about how to apply AI or the economic profitability of their investment (...). They have not kept internal databases, they are behind schedule and have a lack of knowledge".

Other media

> "have been concerned about internalising data analysis, but they have directed them more to the visualisation part, not so much to AI" (Alejandro Llorente and *PiperLab*).

Experts warn that journalism must reinvent itself: "it needs a boost in AI" (Pablo Gamallo, *Citius*).

When asked about the challenges of the future, they highlight the need to assume the change in audiences, who are "more polarised and emotional" (Armando Ávila, *Airtouchmedia*), and

> "understand well the algorithms of the audience platforms that mark the relevant changes" (Roberto Jiménez, *Webedia*).

They also point out the challenge of data verification to

> "assume the huge amount of disinformation that moves in networks. Without technological support it is impossible for these media to carry out their verification work" (Rubén Míguez, *Newtral*).

In addition, they even point out that one of the challenges is to promote a

> "predictive journalism in which AI is used through metrics of reality, giving recommendations to establish future needs. That would be to opt for a current, scientific and sensory journalism" (Armando Avila, *Airtouchmedia*).

Furthermore, there is the ethical approach, which involves tackling "algorithm bias" (David Corral, *OdiseIA*) and data privacy.

In short, the experts consulted depict an irreversible reality, in which "quality technology favours quality journalism" (David Torres, *Hiberus*), and warn that

> "it will be an obligatory change, because it goes beyond the sector itself, it is a technological and social transformation" (David Corral, *OdiseIA*).

4. Discussion and conclusions

The research concludes with an approximate catalogue of Spanish technology companies and research centres with AI tools and services applicable to journalism, and a taxonomy of the different phases of the journalistic process where they can be implemented.

The study confirms the initial hypothesis substantiated by the companies and experts consulted, with their data and interviews revealing that in Spain the technological offer of AI applicable to journalism contrasts with its slow incorpora-

tion by the media. Likewise, although there is a growing interest and a continuous expansion of AI in all sectors (*Ministerio de Asuntos Económicos y Transformación Digital*, 2020; **Chui** *et al.*, 2021), there is still a disparate progress between its business-technological development and its actual application in the media.

> Companies point to an increased interest in developing tools for audience distribution and metrics, driven by the relevance of profitability and content monetization

Through in-depth interviews and questionnaires involving 45 representatives of technological companies and research centres (N=25), three main conclusions are obtained regarding the available tools, and the current implementation and trends of AI in the Spanish media.

Firstly, the overview of the Spanish technology companies and research centres available confirms the development of AI in Spain during the last decade, and especially during the last five years; this coincides with the international context (**Firat**, 2019), and the existence of services and tools provided by service-generating companies (**Túñez-López**; **Toural-Bran**; **Cacheiro-Requeijo**, 2018). In most cases, the number of engineers and technicians is larger than that of journalists, with the exception of teams developing specific AI tools for the media, where the Engineering and Journalism profiles are more similar.

Secondly, the research offers an innovative catalogue of companies and technology centres with their AI tools and services applicable to journalism and in diverse formats –textual, audiovisual, audio– and platforms, especially the web and social networks. In addition, by means of a taxonomy we designed, it is shown that the technological availability of AI is grouped around three phases of the journalistic process: information gathering, production of content-information and distribution. This analysis confirms that the use of algorithms occurs in all stages of the production chain, integrating the gathering, storage, creation, transmission, distribution and consumption of information (**Diakopoulos**, 2019; **Túñez-López**; **Fieiras Ceide**; **Vaz-Álvarez**, 2021). However, the proposed taxonomy reflects a greater technological offer in the journalist's information search and documentation processes (Phase 1), and information distribution (Phase 3); this contrasts with a more limited offer in the automated news and content production phase (Phase 2). This can be partially explained by the search for AI profitability being more related to content distribution and audience engagement in terms of monetisation and loyalty. The process is optimised on the basis of consumption studies, trends and news personalisation. In other words, the media are more interested in how to reach segmented and potentially interested audiences.

As a final conclusion, the assessment carried out by the experts consulted corroborates the reluctance of the media to face and assume the inevitable expansion of AI, with companies undertaking the championing of the technological disruption process (**Salaverría**; **De-Lima-Santos**, 2020). The technology companies consulted confirm that, compared to other sectors more advanced in AI, the media sector reflects "slowness", "distrust" and "ignorance", which they blame on issues of financial difficulty, fear of labour restructuring and short-sightedness regarding profitability. Such an appreciation seems to be less common among large media groups that have begun to apply AI, especially that linked to the analysis of internal and audience data.

Despite the limitations of a small sample which is not easy to pinpoint and a sphere that is still developing, which makes it difficult to establish study variables or 'fixed' results over time, it can be appreciated that there is a disparate interest on the part of the Spanish media in applying AI; meanwhile, Spain's technological offer is in place and available for a change that experts predict as inevitable. Services and tools transformation, as well as the updating of the catalogue presented, will require ongoing research to investigate the new applications of these technologies, the renewal of journalistic models and their audiences, as well as their ethical challenges.

> The experts consulted describe an "irreversible" technological reality; a "forced change" which, however, is received by the media with "slowness", "distrust" and "ignorance"

5. Notes

1. The content of the questionnaire can be consulted at: *https://figshare.com/s/e92a047c39ddbcb26b86*

2. It is the only company participating in this study that is not of Spanish origin. We have chosen to keep it in the sample because of its direct collaboration with numerous Spanish media organisations.

3. This is the only organisation in the study that does not develop technology, but it has been included in view of its comprising AI experts who advise the media and offer training and ethical dissemination in AI.

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