



AI and Journalism • Intelligible Cloud and Edge AI (ICE-AI)

This briefing note gives an overview of artificial intelligence (AI) in journalism and focuses on application of AI in the news production process. It summarises the benefits gained and future opportunities identified alongside the issues observed and potential risks posed by AI in journalism. It considers the challenges to responsible, ethical and value-aligned adoption of AI by news organisations, including issues related to laws, regulations, professional norms and values and societal expectations.

that AI was “additional, supplementary and catalytic, not yet transformational” [2: p6]. Examples of use include smart systems that monitor and alert journalists to information, assist data and document analysis, automate the production of stories and profile audiences to drive news recommendations to them.

The impact of AI-driven systems on journalism is however broader than simply the newsroom applications. The wider media ecology in which journalism operates is shifting as AI-driven

Overview

- **News organisations** are using AI for newsgathering, production and distribution but relevant skills and technology are unequally distributed across the industry.
- **Machine learning** presents opportunities to augment journalism by automating routine tasks and enabling greater scale, speed and efficiency and has potential to help improve the depth, diversity and appeal of news.
- But concerns have been raised about **legal, ethical and professional implications** of its use in the newsroom due to issues of bias, ‘black box’ systems and value alignment.
- Assessments of the **impacts and implications of AI on journalism** to date are limited.

Background

Artificial intelligence (AI) is changing journalistic practices and processes and contributing to a more structural transformation of what it means to make news [1,2,3]. Various definitions of AI abound and use of the term ranges from describing speculative notions of sentient machines to routine applications of maths, statistics and data analysis but there is a general consensus that AI refers to systems that mimic intelligent human behaviour to perform tasks that usually require human intelligence [4], such as image or speech recognition and language translation.

There are numerous applications of AI in journalism, primarily using machine learning (ML) techniques that learn from past data by identifying patterns and correlations [5]. However, use of AI is unequally distributed across the news industry and remains in early or experimental stages in most organisations [2,6] and in many developing nations [7]. A global survey of mainly technologically expert staff within news organisations in 2019 found

technologies and companies contribute to the redistribution of market power, advertising revenue, and audience attention in particular via the filtering of news [8,9]. Additionally, as AI and algorithmic systems have become more prevalent in everyday life, journalists must now report on the growing influence they have in society – a challenging task given low levels of practitioner understanding of AI, coupled with lack of transparency from commercial providers and their extensive public relations efforts. This has so far mainly resulted in relatively uncritical industry-led coverage [10] and “shallow” engagement with AI ethics [11] except for a few specialist outlets and projects [e.g. 12,13] focusing on algorithmic accountability reporting [14].

There are clear advantages to using AI in news production (both potential, and to a lesser extent achieved) such as enhanced data analysis and improved data-driven and investigative reporting [15,16], enhanced accuracy, diversity and efficiency and increased engagement through tailoring content for user preferences. But there are also concerns over professional, legal, societal and democratic implications [17], which underpin debates about privacy, accountability, editorial



and organisational independence, filter bubbles, gatekeeping, bias and fundamental rights as well as more practical questions of impact on employment, job quality, content standards and audience experience. To-date there has been limited research actual gains, trade-offs and undesirable impacts [18].

which are differently valued and expressed across varied newsroom cultures. Unless otherwise funded, they must do this while operating as a business in a capitalist market environment while negotiating political pressures. Against this complex and contingent background, integrating AI - which acts to distribute cognition and control between humans and computational systems - causes disruption; alongside requiring reorganisation of resources and practices in order to open up opportunities to augment journalism,

4th Estate

- **Key drivers** of deploying AI include commercial pressure to be more efficient in a competitive market and aspirations to better serve diverse audiences, particularly through personalisation.
- **Common applications** of AI include automating repetitive tasks, increasing news output volume and speed, and improving relevance for, and engagement with audiences.

Journalism in society

Described as the 'fourth estate' to reflect its unofficial societal influence and power, the news media plays an important role in society. The history of journalism is heavily intertwined with that of technology [19,20] and in the digital age news producers have increasingly prioritised technical innovation to survive [21,22]. Journalism is conceived of differently around the world and each society's news production system reflects its political, economic, historical and socio-cultural context as well as normative ideals of journalism that conceptualise desired functions of the press. In modern western democratic societies such as the UK, these normative ideals include: factual accuracy, promotion of open debate, representation of diverse views, serving as a 'marketplace of ideas', fostering citizen inclusion and empowerment and protecting individual rights by acting as a watchdog that guards against government abuse of power [23,24].

Associated ideals of truthfulness, accuracy, impartiality, accountability, objectivity, fairness and representation find expression in professional frameworks and codes of ethics/conduct [25,26,27], enforcement through law and regulation [28] and are interpreted and transformed in everyday news production practices, which evolve and change [29,30]. Additionally, journalists must consider questions of quality, diversity, creativity and relevance,

it simultaneously risks destabilising established mechanisms for applying these values and threatens to undermine existing processes for ensuring responsible journalism. The risks are particularly acute for public service media (PSM), which are (usually) funded by taxpayers' money and held to high standards of accountability and public scrutiny and which are developing PSM-specific AI strategies in response [31,32,33].

Applications of AI in journalism

AI is being used across the full news production cycle for a host of tasks that contribute to newsgathering, production, and distribution, as well as for non-editorial tasks such as marketing [1-3]. Many systems designed specifically for journalism remain at the research and development or trial and evaluation stages but technology companies are increasingly serving this market [34]. Key drivers of newsroom AI are automation, propelled by commercial pressure to extract higher margins from dwindling resources [35] and personalisation, which relies on automation to profile individuals and segment audiences and offer them tailored news. AI forms a small part of a much broader suite of techniques and technologies now used not only in computational and data journalism specialisms [38,39,40] but in everyday journalism, following a



quantitative turn [36,37] and against a backdrop of the digitisation of media and public life. It is not always self-evident which systems deploy AI techniques as opposed to mathematical processes that elude the “polysemous and problematic” definition of AI [41 p.673]. The following section summarises recognised applications of AI in news production.

AI in newsgathering

AI is being used to automate, scale up, and speed up the identification, monitoring, classification and analysis of potentially newsworthy information.

- **ML powers** computational news discovery [42] to detect and monitor numerous source inputs (search engines, social media etc.) to identify breaking news [43,44].

regression, clustering, summarisation, dependency modelling and change and deviation detection, helps journalists find what is newsworthy in data [1].

- **NLP** is also deployed to aid document mining and analysis by enabling systematic search, summarisation, and visualisation, for instance by using tagging and clustering, as was the case in the Associated Press’ Overview project [50].

AI in news production

AI is being used to automatically generate stories, filter, discover and explore connections in data, as well as verify and fact-check information.

- **Automated journalism** (also termed ‘robot-journalism’) is the algorithmically-driven conversion of structured data into stories using natural language generation (NLG) [51]. It has

ML Systems

- **ML systems** ‘learn’ and improve from examples without their instructions all being explicitly programmed. They are trained to perform a task by analysing large amounts of training data and building a model to process future data.
- Recent advances in **ML techniques** - driven by improved computing power, increased availability of data, and reduced storage/ processing costs - have powered advances in other AI fields such as natural language processing/generation (NLP/NLG), facial recognition and machine vision.

- **Natural language processing (NLP)** has helped reporters find relevant tweets [45], extract and analyse them for sentiment analysis [46], and crowdsource input [47]. The growing interdependence between journalists and social media platforms has prompted concerns about problematic impacts resulting from such sourcing practices, from undue amplification, to fuelling mis- and dis-information and uncritically legitimating speech [48].

- **Machine translation** and transcription help journalists monitor and record events and translate reports for rapid global distribution - increasingly even for less well served languages that have been sidelined due to poor data sets [49].

- **Intelligent character** and word recognition systems have been used to digitise documents, which can then be indexed in databases and searched by keywords, thus scaling up capacity for investigation [1,34].

- **ML-driven data** mining, using classification,

been used primarily to convert financial and sports data into automated stories [52] and deployed extensively by news agencies [53] and trialled for election coverage [54]. These systems enable rapid story creation at scale and at relatively low cost [51, 55] but cannot undertake complex storytelling, a goal which remains in research and development [56].

- **Discrete production** tasks are also being automated, for instance suggesting headlines and topics [59], semantic tagging of content [60] and proofreading.
- **ML techniques** enable automated verification of information [61], such as classifying witnesses [62] for credibility and veracity and debunking fake news [63] as well as aiding fact-checking [64,65].
- **Speech-to-text/text-to-speech software** and NLP and NLG systems automate the re-packaging and re-versioning of content using the same fundamental elements of a story to create multiple representations, for example



turning audio to text, text into video, or one language into another [66].

- Plans to use **AI to drive object-based media approaches** to creating variable and flexible edits of news are also at the research stage as part of the BBC's move towards personalisation [57,58].
- **ML-driven summarisation** tools are being used to add context to stories and make use of 'evergreen' content [67] and to vary presentation of a story's key points for different audiences [68].
- **ML modelling** is fuelling a growth of predictive journalism [69] including data-driven election coverage and modelling Covid-19 pandemic projections and which is enabling more sophisticated prediction of aspects of social life [70].

AI in distribution & audience interaction

AI is driving news personalisation, recommendation engines, curation of stories, communication and engagement with audiences, and news analytics.

- **Recommendation engines**, often driven by content-based and collaborative filtering, are being deployed on websites, in apps and for newsletters to match news content to audience members [71]. AI is also used to identify audience segments to target and to drive curation systems which generate suggestions for, or automate the allocation news stories to web indexes and front pages. A survey of digital leaders in news organisations reported that they saw automated recommendations as the most important use of AI in the short term [8].
- **News curation** apps and social media companies also use ML models to profile audiences and deliver algorithmically-filtered content using gatekeeping logics over which news providers have no control [72,73], impacting news consumption habits and users' perceptions of news [74].
- **'Communicative AI'** such as conversational agents or 'chatbots' and social robots have been designed to engage with audiences, functioning as communicators rather than simply mediators of communication [75].
- **News organisations** are also developing

voice assistants [76] and other services for smart speakers [77]. China's Xinhua News Agency has experimented with an AI-powered synthetic news anchor [78].

- **AI-powered systems** are used to analyse audience questions and expressed needs/ desires [47], which can then be fed back into story generation.
- **ML classifiers** are being used to moderate reader comments on news websites [79] and across the digital ecosystem where news stories appear [80].
- **Editorial analytics** are widespread across the industry [81,82]. They increasingly exploit predictive ML techniques in an effort to improve audience engagement [83], for example by testing headlines and images, and are feeding into the construction of news agendas [84].
- Finally, there are also now also examples of content management systems that integrate AI throughout the entire production process [85] such as Chinese news agency Xinhua's 'Media Brain' [86].

Non-editorial use of AI

Beyond the editorial process of news production, news organisations are using AI for business and marketing, for example to optimise paywalls for revenue [7], by predicting when a reader is likely to subscribe [87]. There have also been experiments in tackling bias in the newsroom [88] and analysing news output to gauge and improve representation of sources in articles [89,90].

Benefits to journalism

The advantages and opportunities of AI for journalism are often described in terms aligned with operational and business goals such as efficiency, scale, speed, and cost savings and some leaders in the field are reporting success against these metrics [1-3]. We are yet to see whether, and in which contexts across the broader industry, investment will equate to gains, what levels of resource allocation will be needed in the long-run, and what unanticipated impacts may arise, for instance in relation to news quality and serving journalistic ideals. A central hope in the profession is that



automating tasks will free up more time for creative and investigative work [91] and there are reported examples of exactly this, for instance the Associated Press described how automating basic earnings reports allowed journalists time to digest and contextualise the information, and seek deeper analysis [3,92]. This does however depend heavily on how managers and newsrooms decide to reallocate any newly available resources and whether investment in procuring, developing and managing AI offsets those gains. For example, 27 jobs were lost after Microsoft introduced AI-driven curation to manage its website [93]. Evidence suggests use of AI can remove or reduce repetitive tasks for newswriters but may also generate new forms of 'mundane labour', for example through the need to oversee the activity of AI-driven machines as an 'algorithmic-editor-in-the-loop' able to override AI decisions [94]. It is clear that some new creative roles have been made to oversee newsroom partnerships [89] and bridge product development, editorial, and engineering [95]. Estimates have suggested only about 15% of reporters' time and 9% of editors' time is automatable using current technology [96]. However, as the implementation of AI is not yet large-scale or pervasive across the industry, whether it leads overall to job cuts or job degradation is unclear. There is also evidence that AI can be put to use to improve quality, breadth and relevance and to highlight human bias such as lack of source diversity, gaps in news coverage [1-3,97] and ultimately contribute to democratic goals and editorial missions [17,98].

Challenges

The challenges AI poses are at times unique to the technology but also sit within a broader set of challenges related to data, algorithms, and applied mathematics and statistics in social domains. Similarly, many of the challenges of AI in journalism map to broader concerns but others are unique to journalism or take on unique expression in the profession [99,100]. From an industry perspective, the self-reported biggest challenges to adopting AI in journalism are:

- **Cost.** AI development and procurement can be expensive and a lack of financial resources is

prohibitive in a climate of shrinking newsrooms and revenues [101]. Smaller, often local news providers, and those in less affluent nations are voicing concern over being left behind [2]. This may risk worsening digital divides and increasing inequalities in news coverage and quality.

- **Limited knowledge and skills.** Most journalists have little knowledge, critical understanding, or proficiency with AI-driven tools or experience working collaboratively with those that do. This deficiency risks restricting the quality of their coverage of AI and algorithms in society as well as their ability to ensure use of AI in the newsroom is safe, responsible and aligns to their ideologies and goals. Journalists report wanting more AI training than news organisations are providing [51].
- **Cultural resistance.** There is significant pushback against automation and AI in the newsroom, often driven by the fear of losing jobs, of changing work habits, and hostility to new technology [2]. Journalists may feel like they risk losing control or the denigration of their work or may want to avoid risks due to lack of confidence using AI. Previous studies have described how earlier technological innovations in the newsroom had a de-skilling effect [102] and an increase in pace and pressure, leading to less opportunity to explain context [103].
- **Maintaining public trust.** In the current environment in which mis- and dis-information is rife, deepfakes and synthetic manipulation are on the rise, and populations increasingly get news through social media, maintaining public trust and confidence is a challenge. It is still unclear how audiences feel about increasing integration and visibility of AI in news. Reaction to automated and semi-automated news for instance appears mixed - some research suggests limited impact on credibility perception [104], other studies improved credibility [105,106], others that it is descriptive and boring but objective [107]. As profiling, personalisation and voice intelligence rise, ensuring trustworthy privacy and data practices will be vital [108].

Challenges to adoption however only touch the surface of the array of issues and questions AI poses for journalism. These include whether certain types of AI should in fact be used at all,



whether they are right for specific contexts, and considerations of how to integrate them responsibly, ethically, and in ways aligned to a professional journalistic ethos and its varying instantiations.

- **Law and regulation.** The news media carry duties and responsibilities towards users and society [109] and have a responsibility to use AI in ways that are conducive to the fundamental freedoms and values that characterise their markets and policies [17]. As algorithmic selection has become a growing source of social order and shared social reality in information societies [110, 111], concerns have been voiced about potential negative implications for democracy, particularly of recommender systems [112]. These include filter bubbles, polarisation, and fragmentation of the public sphere [113,114] and difficulty holding algorithms accountable [115]. Specific ethical and juridical issues also arise in relation to automated journalism [96,116,117], particularly concerning the legal status of automated speech and where responsibility and liability lies [117], for instance in cases of data rights, privacy and copyright breaches, as well as defamation, contempt of court and 'libel by algorithm' [118,119].
- **Value-aligned AI.** The role AI plays in journalism is clearly not simply a technical question - it is deeply social, cultural, political and economic. This raises normative questions of what one 'should' or 'ought to' do and in this case, which moral obligations pertain in the development and use of AI in journalism and how to apply ethics in practice. Value judgements are expressed in and through AI systems via data, rules, knowledge bases and optimisation decisions [120]. This presents an opportunity and a challenge to news organisations that want these systems to reflect their journalistic ethos and intentions because they must be able to a) articulate and explicate the judgments, ethical codes and values in their professional ideology b) develop appropriate mechanisms for embedding them in design and engineering decisions, including devising measurable proxies for high-level aims and c) review and updating them once these 'systems that learn' are live and evolving. Different contexts will prioritise different sets

- of values, depending for example on their conceptions of democracy and the role of media within it [17,18,32]. For example, PSM will need to decide on ways of using data about audiences that meet their standards of trust and accountability - that will likely differ from other news providers, which may be opaque about use of personal data or use it to make money. Different applications of AI will raise different sets of questions about how to prioritise and operationalise values and may necessitate different trade-offs between these values - all of which demands discussion and debate within industry. News organisations will need to confront broader ethical questions too. These include growing concern about the environmental impact caused by the computational power needed to run AI [121,122] as well as how developments may play into existing inequalities of news accessibility that create 'digital divides' reflecting geographic and wealth disparities, and the economic dynamics the have left some communities lacking access to quality news as seen in local 'news deserts' in the USA [123].
- **AI ethics and safety.** The question of how AI can be used ethically has led to a range of ethical principles and guidelines [124,125], including in the public sector [126,127,128] that highlight how misuse, abuse and poor design of AI systems risks causing potential harms and unintended consequences. These include bias and discrimination; denial of autonomy, recourse and rights; invasion of privacy; isolation and disintegration of social connection; and outcomes that are not transparent, explainable or justifiable, or that are unsafe and unreliable [126]. But high-level principles often hide deep political and normative disagreement [129].
 - **Intelligibility.** A fundamental challenge here is understanding AI, as this underpins many other issues. The UK House of Lords Committee on AI called for the development of AI systems that are "intelligible to developers, users and regulators" [130]. AI systems can be 'black-boxes' and opaque even to experts designing and deploying them (e.g. deep learning) or they can lack scrutability for non-experts, including journalists, due to technical complexity and incorporation of third-party proprietary software. This can engender a lack of agency



in relation to ML and risk introducing and perpetuating bias, disrupting journalistic expertise and judgment, and undermining processes of accountability. This in turn threatens to compromise journalistic authority and legitimacy in the eyes of the public.

▪ **Transparency and accountability.**

Transparency is a basic journalistic value but AI can challenge how it is applied in practice. This has prompted questions about how transparent news organisations can or should be about code and algorithmic processes behind stories, how best to explain this and how explaining it may impact audience trust, and which information is best disclosed, such as human involvement, data model, inferencing and algorithmic presence [131]. There are currently no agreed standards around attribution of AI automation. Full transparency may not be possible when using proprietary or complex systems, may be unnecessary or undesirable, or may conflict with other values, leading to trade-offs or a rebalancing of which values are prioritised. For instance, profit and scalability may conflict with transparency when the effort and resource needed to make data public - anonymising, formatting, and hosting data sets - is accounted for [132]. Moreover, protecting sources is a fundamental principle in journalism but it is unclear how this might work in relation to the transparency of data sources in automated processes [116]. What algorithmic transparency looks like in journalistic practice therefore is more complicated than simply 'looking inside the black box' [133] and equating such an ability to see with the power to hold accountable and govern [134].

▪ **Data governance and management.**

Accountability in data-driven systems necessitates rigorous recording of data collection and processing. The quality, accuracy and integrity of data is crucial to automated journalism as is the need for legal and ethical data collection but questions remain about the objectivity of datasets and how open to manipulation and distortion they may be [135]. This may pose risks to the credibility of news organisations. There is also a problem of 'fact-belief' discrepancies where auto-generated content is technically objectively true, but constructed in such a way that the reader may draw conclusions

leading to an objectively false impression [51]. These issues have prompted calls for monitoring and validating procedures [99] and auditing AI and training data sets, for example for undesirable bias. Selecting data sets and deciding how to interrogate and use them is an editorial decision in this context and therefore falls under existing standards of impartiality, non-discrimination and fairness. New levels and types of editorial and institutional oversight, disclosure policies and mechanisms, and collaborative working practices will be needed to tackle these issues.

Advancing AI capabilities are likely to lead to unanticipated conflicts or ambiguities of control, power and social responsibility in relation to journalism. More work needs to be done towards delineating the risks that matter for journalism and assessing the impacts already in evidence.



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