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Automated news at the BBC

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Abstract

Automated news is a journalistic product that is generally understood as the automated generation of journalistic material through software and algorithms, without any human intervention except for the initial programming. While some media organisations made the choice to outsource the production of automated news to external content providers or decided to build their own in-house systems, the BBC picked an alternate way as it subscribed to an online platform, Arria Studio, which lets journalists design their own templates for automated news. In this paper, I describe five experiments with automated news conducted at the BBC in 2019, then detail the general direction that the broadcaster seems to have taken with regard to this type of product, and finally touch on the reconfiguration of journalistic roles that their design and implementation call for.

Key findings:

- The BBC resorted to a structured journalism approach when delineating baseline scenarios for automated news, but to a human-in-the-loop system when handling edge cases, which included dealing with the particular requirements of the 2019 general election in the United Kingdom.
    - When working out baseline scenarios, journalists could learn how to better engage with concepts of abstraction that are at the core of structured journalism by envisioning first what an ideal story would look like, and then breaking it down into smaller elements that can be reusable across many versions of that same story.
    - However, when dealing with edge cases as part of a human-in-the-loop configuration, journalists need to be cautious not to add too much extra details to the story and fall behind schedule.
- The design and implementation of automated news call for a reconfiguration of journalistic roles, first to address issues that relate to data quality and interpretation, then to set up algorithmic rules so as to embed the organisation's values into their conception.
    - On the data side, journalists should be encouraged to perform a sort of "quality control" over the data they are using and to think critically before arranging data pieces together as part of a process known as "building the story model."
    - On the processing side, setting up algorithmic rules for automated news illustrates the need for further discussions around how to embed editorial standards, journalistic codes of conduct and linguistic aspects into a programmatic language.

- This report brings forward the need to reflect on new guidance for journalism practice, which would take all the computational aspects raised by the deployment of automated news into account.

    - At the BBC, this could translate into a set of “computational journalism guidelines” that would take inspiration from the BBC’s Editorial Standards and Values, but also from the fairness, accountability, confidentiality, transparency and safety in information retrieval framework that is currently being developed as part of the BBC’s Machine Learning Engine Principles.

Additional key words:

Automated news, automated journalism, algorithmic journalism, computational journalism, digital media

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1 Introduction

In recent years, a journalistic development known as "automated journalism" or "automated news" has stirred up a lot of interest within newsrooms, with major organisations like the Associated Press, *The Washington Post* and the BBC resorting to this type of technology. Automated news is generally understood as the auto generation of journalistic material through software and algorithms, without any human intervention except for the initial programming (Carlson, 2015; Graefe, 2016). They are currently being powered by a basic application of Natural Language Generation (NLG), a computer technique in which algorithms fetch information on external or internal datasets to fill in the blanks left on pre-written text. As such, their conception resembles a little bit the word game Mad Libs (Diakopoulos, 2019a), as programmers and journalists need to come up with "templates" that include enough elements of the story that can be predicted in advance and that connect to a sufficient data flow. Because of the inherent limitations to this technique, only a small range of stories can be automated this way, for example election results, financial news or sports recaps. There is also a growing interest in using machine learning approaches to NLG production, but this remains very much of a work in progress[1] and is not considered here.

While some media organisations made the choice to outsource the production of automated news to external content providers such as Syllabs in France, United Robots in Sweden and Narrativa in Spain and in the United States, others decided to build their own in-house automated news systems, such as the *Los Angeles Times*' Quakebot to report on seismic alerts in California or the *Washington Post*'s Heliograf to cover the 2016 Rio Olympics and the United States presidential election (Schwencke, 2014; WashPost PR Blog, 2016a; WashPost PR Blog, 2016b). For its part, the BBC chose to take an alternate way as it subscribed to an online platform, Arria Studio, which lets journalists design their own templates for automated news using a type of No-code language that makes it accessible to editorial staff with little to none computing background. This is similar to what the automated newswire RADAR is doing with the use of the same platform for regional titles across the United Kingdom (Diakopoulos, 2019b), or to what other media are doing with alternative third-party tools such as Automated Insights' Wordsmith in the United States and AX Semantics in Germany (Mullin, 2015; AX Semantics, n.d.).

While basic data manipulation can be done within Arria Studio, the team in charge of developing automated news at the BBC found that more complex programming needed to be done outside the tool. The automated news system that the BBC built around the use of Arria Studio is referred to as SALCO, which stands for "Semi-Automated Local Content." Under the lead of BBC News Labs, the broadcaster's own incubator whose role is to test out new technologies for media production, five experiments were conducted in the span of just one year, each time resulting in further iterations that gradually became more elaborate.

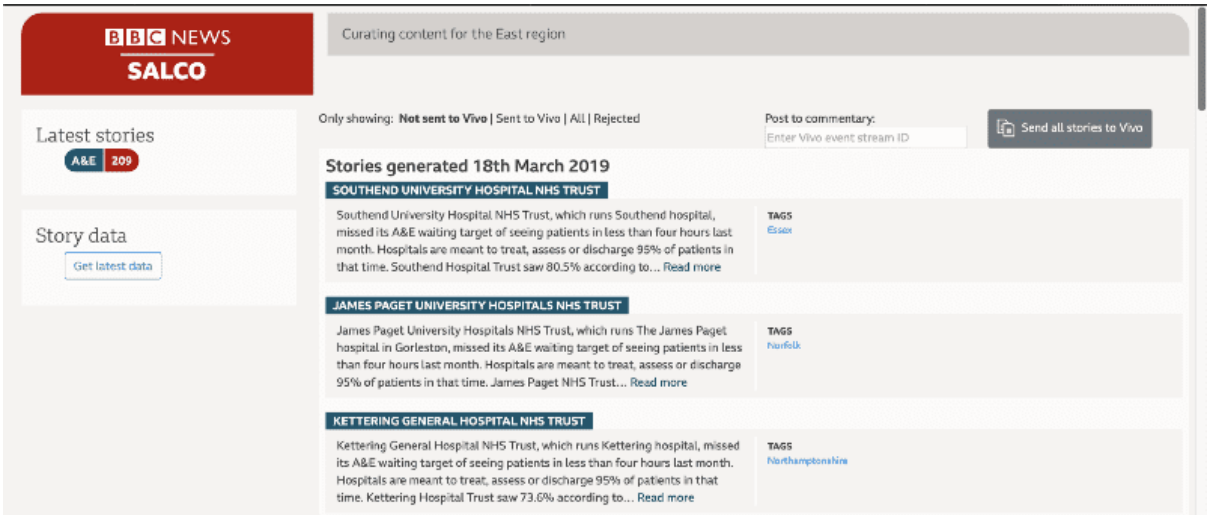
In this report, I will first describe each of these five experiments, then detail the general direction that the BBC seems to have taken with regard to automated news. Finally, I will touch on the reconfiguration of journalistic roles their design and implementation call for. My findings are based on eight semi-structured remote interviews with media practitioners and managers at BBC News Labs conducted between October 2020 and April 2021. I was also shown the main features of Arria Studio through a virtual walkthrough[2].

[1] For instance, the EU-funded project EMBEDDIA (http://embeddia.eu/) is looking at incorporating elements of machine learning into automated news generated using pre-written templates, so as to make them less formulaic and more enjoyable to read. Likewise, the Czech news agency ČTK has been experimenting with machine learning techniques in order to generate the very templates that trigger automated news, based on previous reports that have been written on the Prague stock exchange (Stefanikova, 2019).

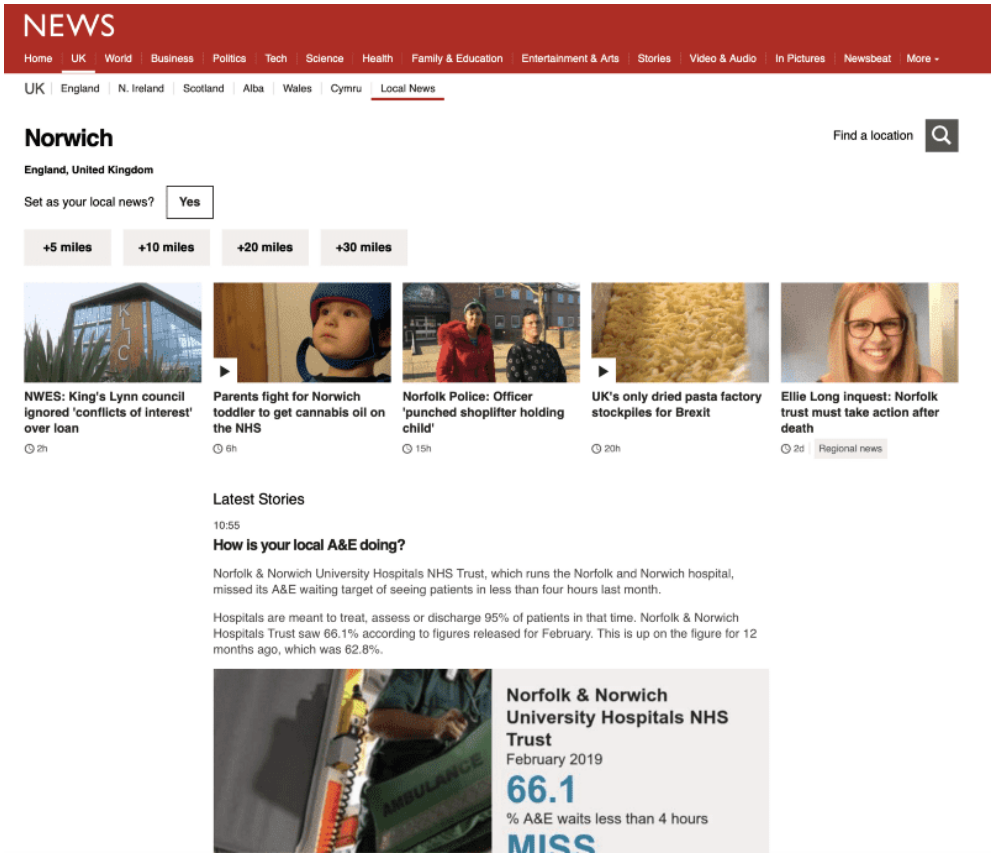
[2] Face-to-face interviews and observations on the ground were initially considered, but these had to be conducted remotely instead due to COVID-19 restrictions.

2 BBC's experiments with automated news

The first automated news project at the BBC started off as a feasibility check at the beginning of 2019, to see if the National Health Service data feed that is being used to run BBC's health performance tracker could be transformed into over a hundred automated stories every month, so as to inform readers on A&E waiting times in East Anglia trusts. The News Labs team set up a system that fetched information directly from data already garnered by the Visual and Data Journalism team, which creates interactive stories and information graphics at the BBC. These included the percentage of patients being taken care of within four hours of arrival at A&E and the last time the trust's target was met, or not, in a five-year period. Through the use of Arria Studio, the News Labs team prepared some narratives that could then be retrieved using a front-end interface and pushed to the BBC's content management system. They also arranged for automated visualisations to be created and displayed alongside each of these automated stories. Once the team was confident that the system they built was strong enough, they played out with different scenarios such as a breakdown in performances due to a winter flu outbreak.



Above: The front-end interface that journalists used to look up stories generated on A&E waiting times in East Anglia trusts, which could then be pushed to the BBC's content management system. (Source: BBC News Labs)



Above: An automated story on A&E waiting times for Norfolk & Norwich University Hospital Trust, along with an accompanying automated visualisation, which was published on Norwich local news feed. (Source: BBC News Labs)

The second project, an iteration of this initial version, took place shortly after, during the United Kingdom's local elections of May 2019. During this phase, the team tested out the potential to use the BBC's election results feed to generate automated news while focusing on a sample of 16 stories, to see if the infrastructure they built as part of the A&E waiting times project could be connected to a live stream that is manually filled by journalists on the ground. The team ran out of time to automate visualisations like they did with A&E waiting times stories, but they showed that the system they had in place for automated news could be successfully employed to report on election results.

13:46 3 May

Labour takes control of Calderdale Council

The Labour Party has won control of Calderdale Council after winning 10 of the 17 seats available, four more than it won the last time these seats were up for election in 2015.

Only 17 of the 51 seats on the council were up for election this year. The Labour Party won 10 seats, the Conservative Party won four seats, the Liberal Democrats won two seats and independent candidates won one seat. Including the seats that weren't up for election this year, the council is made up as a whole of 28 Labour councillors, 14 Tory councillors, seven Lib Dem councillors and two independent councillors.

A full breakdown of results for Calderdale will be available from the **council website**, and for full national results use the **BBC's live results service**.

This story has been generated using BBC election data and some automation.

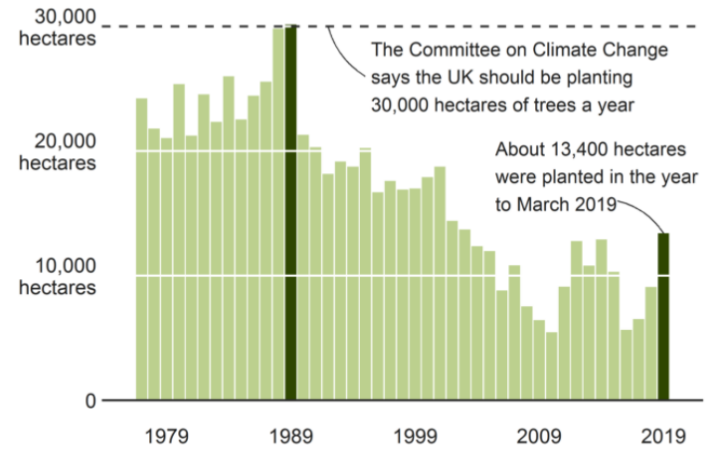
Above: A story generated for Calderdale during the United Kingdom's local elections of May 2019. (Source: BBC News Labs)

The third experiment conducted by the team at BBC News Labs looked at the use of automated news to produce over 300 localised stories on the rate of tree planting in England, which were generated as a complement to a larger scale data journalism piece published on 30 July 2019, which showed that twice as many trees were needed to be planted in the United Kingdom so it could meet its carbon emission targets. This initiative was made possible through a collaboration between News Labs and BBC England Data Unit – another team that uses data to tell and illustrate stories about England – while drawing data from the Forestry Commission as well as estimates from the United Kingdom's advisory committee on climate change. The Commission's dataset was uploaded to Arria Studio, so as to generate over 300 automated news pieces for each local authority district in England and for the city of London. All of these stories would then link back to the main data journalism piece, which provided a nationwide overview. The team also created additional templates using language suited to reading aloud, which covered different groupings of geographic areas. They distributed these to appropriate news outlets within BBC Local Radio, so that they could use them as they saw fit.

How much more woodland should be planted?

Tree planting rates in the UK

Experts want tree planting back at levels last seen in 1989



Note: A standard football pitch is about two thirds of a hectare - 1 pitch = 0.64 hectares

Source: Forest Research BBC

The CCC said 30,000 hectares (116 sq miles) of new trees are needed per year until 2050.

This is equivalent to filling more than 46,000 standard football pitches or a space about three-quarters the size of the Isle of Wight every year.

- **Tree planting: Your questions answered**
- **Can I plant trees anywhere?**

Ewa Kmietowicz, the CCC's transport and agriculture team leader, said: "The government needs to develop a strategy to meet the 30,000-hectare target and it needs to happen quickly."

18:29 2 Aug

91,100 government-funded trees planted in Aylesbury Vale in eight years

There have been 91,100 government-funded trees planted in Aylesbury Vale between 2010 and 2018, Forestry Commission data shows.

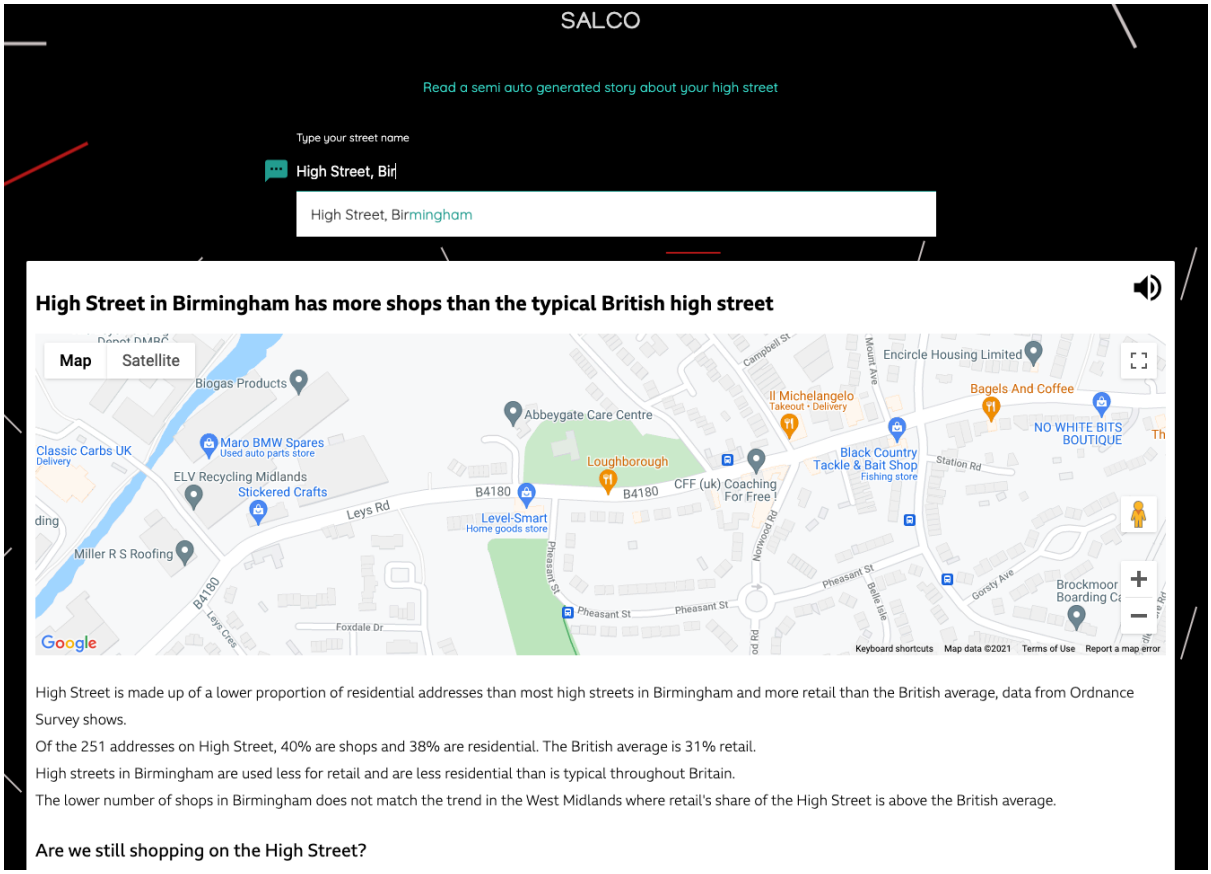
This works out at 465 trees per 1,000 people.

Between 2010 and 2018 the government funded about 15 million trees in England. Figures for trees planted with private funds or by local councils are not included and the data only covers new trees, not replacements for any that were cut down.

Above: The main data journalism piece on the rate of tree planting in England and an accompanying automated story generated for the district of Aylesbury Vale. (Source: BBC News & BBC News Labs)

Soon after that, automated news was utilised for the fourth time in a lookup tool launched in October 2019, which gave access to nearly 7,000 hyperlocal stories trying to capture the extent to which people were still shopping on United Kingdom high streets, given the popularity of online sales. To do this, a News Labs journalist with a computing background managed to combine a geolocalised dataset from the Ordnance Survey, which

listed up retail information on every high street in the United Kingdom, with employment figures from the Office for National Statistics. The journalist wrote Python scripts to make calculations in order to compare the streets' numbers with economic data at the regional and national levels. In addition to this, he created a separate set of about 350 stories that focused on high street retail at a local authority level, which included quotes gathered in advance from a business representative who would provide two different types of answers depending on whether retail activity was higher or lower than average – an approach I discuss in more detail below. In the end these local authority stories did not figure in the final prototype, as the emphasis was rather put on the 7,000 high street ones.

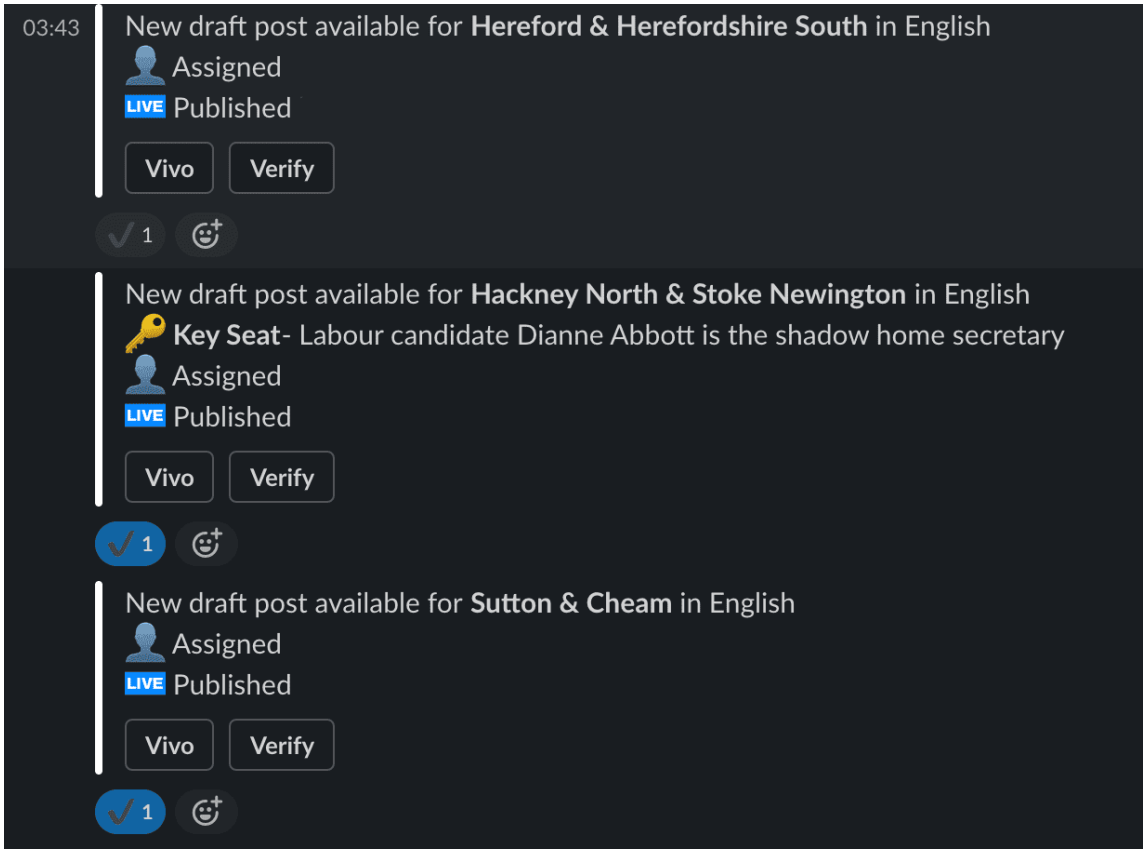


Above: The lookup tool developed by BBC News Labs, which gave access to close 7,000 hyperlocal stories trying to capture the extent to which people were still shopping on UK high streets, for instance here in Birmingham. (Source: BBC News Labs)

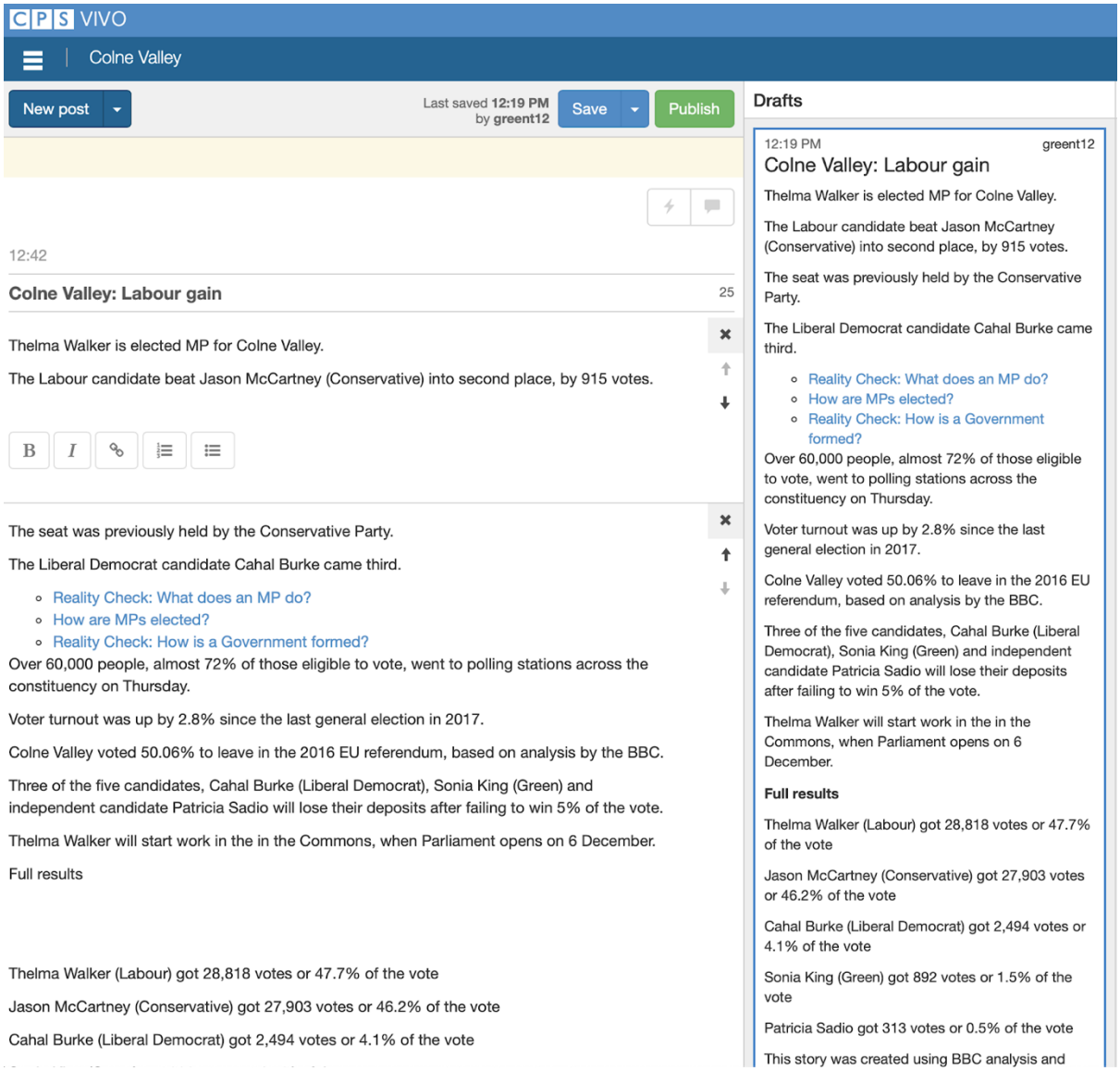
The last BBC's experiment with automated news, and by far the most ambitious, was the generation of close to 690 stories to cover the December 2019 general elections in the United Kingdom, which included 40 stories written in Welsh. The News Labs team built on the infrastructure they already developed during local elections, but this time reporters were directly involved in the process, as they were tasked with checking stories and adding any missing detail before publication. This team of a dozen journalists that spanned across the London, Cardiff, Glasgow and Belfast newsrooms was trained on the concepts behind automated news in the weeks running up to the election.

On the night of the election, each of these journalists would receive an automated Slack notification informing them that new results were in with a link to find that story into the BBC's content management system. From there they could make edits or publish as-is. The

Slack notification also provided them with extra information on constituencies that required further attention, for instance those held by the prime minister, the leader of the opposition or the speaker of the House of Commons. The journalists were also handed a checklist to look up for potential mistakes, such as typos and phrasing that NLG could twist in an odd way. This way of combining automated news with a human input proved to be successful, with close to 690 stories being checked and published in about 10 hours. The only mistake that was spotted on the night was introduced by a journalist who wasn't part of the project, who replaced an MP's first name by his last name following the "Sir" prefix, whereas automated news generated the correct way of addressing a Sir by his first name.



Above: An example of automated Slack notifications informing journalists that new results were in, which also provided them with extra information on constituencies that required further attention, for instance here the shadow home secretary's. (Source: BBC News Labs)



Above: The Slack notifications included a link to find the story in the BBC's content management system. From there they could make edits or publish as-is, as shown here on this test story for Colne Valley. (Source: BBC News Labs)

Although the night was a success overall, the team at News Labs had to pare back on their initial ambitions because of the sudden call for a snap election made at the end of 2019. The team was initially working toward a fixed election date, with a three-step plan in mind: providing automated news before voters head to the polls under an explainer format, on the night of the election while covering the actual results, and once all the races have been called with more in-depth pieces. But because of the rush created by the snap election, the team had no other choice but to focus on the results.

In the next section, I will detail the general direction that the BBC seems to have taken with regard to automated news, which involved relying on a structured journalism approach to draft out baseline scenarios, but resorting to a human-in-the-loop system to handle edge cases. Then, I will explain why the design and implementation phases that I've observed at the BBC call for a reconfiguration of journalistic roles.

3 Planning out a successful automated journalism strategy

3.1 Structured journalism for baseline scenarios

The general pathway that the BBC seems to have taken with regard to automated news is two-fold: on the one hand, it involves resorting to a form of “structured journalism” to draft out baseline scenarios, and on the other hand, it stresses the importance of having to rely on a human-in-the-loop system when dealing with edge cases. Structured journalism, which is best understood as the process of “atomizing the news” so that narratives can be turned into databases (Caswell & Dörr, 2018; Jones & Jones, 2019; Anderson, 2018), comes together with a conceptual shift that implies thinking about a potential story not as an individual piece of news, but rather as a “mould” that can be used to generate many versions of the same story. “The skill that is kind of central to writing those templates is basically the ability to work with stories abstractly, instead of just in terms of the specific story,” said a product manager at BBC News Labs. An editor who sits on the same team specified that, rather than being perceived as a single act of writing, drafting out templates for automated news could be compared to an improvisational theatre technique known as “the story spine,” which consists in listing out a set of recurring storytelling elements – such as “Once upon a time...” and “But, one day...” – and then use them as prompts to come up with the story’s specifics (Adams, 2013).

However, some journalists seemed to have had a harder time than others to come to grips with the process of abstraction that is at the core of a structured journalism mindset. “Some journalists, you know, they think in terms of the specifics, not in terms of the patterns that emerge,” said the product manager at BBC News Labs. A senior software engineer with the same team also noticed that, in some of the trainings that were held to familiarise reporters with concepts of NLG production, some participants could easily engage with what he describes as a “complex tree of a story,” whereas others were reluctant to thinking in advance of all the possible permutations. As a matter of fact, journalists working for News Labs are hired based on their comfort to work with abstraction, and have to sit a small test before joining the team, according to the product manager.

Working out baseline scenarios for automated news through the application of a structured journalism method consequently involved taking a “top-down” approach, first by envisioning what the ideal story would look like, and then breaking it down into common elements that could be reusable across many versions of the same story. “If you didn't have any automation involved, what would be the story you, as a human being, would want to write, or what would be the elements of the story that you would want to write?” asked the editor at BBC News Labs. “Having established that, we then looked at what data we could get to fill that.”

As a demonstration of this process, a senior journalist with News Labs described searching for all the possible elements that could be thought of in advance in anticipation of the 2019 general elections in the United Kingdom: “You don't know in advance who is going to win the national general election, you don't know who is going to win each seat, but you know all the possibilities in advance,” he said. These could include, for instance, who could be winning the race, how close the victory margin could be as compared to last election, the possibility of a dead heat, whether it could be a gain or a loss for each party, the other candidates’ ranking as well as whether they may lose their deposit.

Florence Eshalomi has been elected MP for Vauxhall, meaning that the Labour Party holds the seat with a decreased majority.

The new MP beat Liberal Democrat Sarah Lewis by 19,612 votes. This was fewer than Kate Hoey's 20,250-vote majority in the 2017 general election.

Sarah Bool of the Conservative Party came third and the Green Party's Jacqueline Bond came fourth.

Voter turnout was down by 3.5 percentage points since the last general election.

More than 56,000 people, 63.5% of those eligible to vote, went to polling stations across the area on Thursday, in the first December general election since 1923.

Three of the six candidates, Jacqueline Bond (Green), Andrew McGuinness (The Brexit Party) and Salah Faissal (independent) lost their £500 deposits after failing to win 5% of the vote.

This story about* Vauxhall *was created using some automation.

Above: An automated story generated for Vauxhall constituency during the 2019 general elections in the UK. It includes details that could be thought of in advance, such as by how many votes the leading candidate has won and how it compares to last election, voter turnout and which candidates lost their deposit. (Source: BBC News)

Once all these possibilities have been set out, they constitute a starting point for scenario planning and contribute to building the logic that goes behind the construction of each template. The senior journalist explains that this process eventually leads up to elaborating six to seven fundamental sentences that constitute the “bare bones” of the story, which can be reusable across many versions of it. To connect each of these sentences to election data, a software engineer with BBC News Labs said that he used the same “top-down” approach while looking at all the possible scenarios in advance, which to him was similar in a sense to programming routines: “I looked at it (...) as a program, from top-to-bottom, to go down the right route I want, based on the certain conditions. And it's writing those conditions that makes it go the correct way,” he said. Although the vast majority of these “routes” were relatively easy to set up, some others resembled something more of a “zigzag,” he added.

Taking a "bottom-up" approach instead

Alternatively, taking a "bottom-up" approach to delineate baseline scenarios for automated news is also possible. In the high street project, for instance, the senior journalist at BBC News Labs first analysed the database that compiled information on every high street in the United Kingdom, so that he could find out the most interesting scenarios to work with. The journalist said that this process of getting familiar with the data helped him have a clearer picture of what was at stake. "Say I got a trove of data from some power supplier and I wanted to see where it is, like, the least efficiently consuming power or where it is the most, and so on. I would just query that dataset to try and build what I would think will be a news story out of it," he said to illustrate his point.

3.2 Human-in-the-loop for edge cases

Aside from using a structured journalism approach when delineating baseline scenarios for automated news, the BBC also engaged with a human-in-the-loop configuration when dealing with edge cases. According to American scholar Meredith Broussard (2018, p. 177), "human-in-the-loop" computer systems are generally being implemented on the grounds that "there are things that a human can see that a machine can't." As far as automated news are concerned, the product manager at BBC News Labs underlined that special case stories that fall outside of the anticipated formula are usually not a good fit for this type of product: "How to use this form of journalism is recognising that it's for routine formulaic stories, it's not for the special cases," he said. Involving a human in the loop thus became necessary to cover the 2019 United Kingdom general election with automated news, as there were many peculiarities that were unique to the political context at the time.

A journalist with the News Labs team explained that the election was called primarily for reasons to do with Brexit. As a result of that dominating issue, he continued, it meant that there were severe oddities going on. These included situations such as when some constituencies that have been Labour for decades were likely to turn Conservative or where candidates changed party, changed seat, left their party to run as independent, or when there were legal proceedings going on. To identify all these "high risk" cases, the News Labs team closely collaborated with the BBC's political research unit, which produces briefs and analyses for the news service. "We basically talked through all of these edge cases, which for this election there were like... dozens," recalled the News Labs journalist. "Oh my God, there was so many edge cases," he said with a laugh.

The editor at BBC News Labs then pointed out that an interesting debate ensued over whether it was worth adapting each of these individual situations into the templates they were making for all of the other regular scenarios, as opposed to simply flagging them up to journalists on the night of the election. According to the journalist on his team who was heavily involved in writing these templates, these situations felt "extremely specific to that moment in political time," and therefore could not be reused over time. "If you are building a template and you're only ever going to use it once, you should probably question why you're building a template for that," he said.

Based on all these considerations, the team decided to experiment with a form of "combined journalism" (Wölker & Powell, 2018), through which a sub-editing part would be added to the automated news publication process. As part of this new workflow, journalists would make sure that automated news are accurate before publishing them, but also that extra information is added to these special case stories, so that they are editorially fit. Although the process of verifying stories went without any noticeable hitches, the product manager observed that human intervention was necessary when dealing with these edge cases, as only journalists could "recognise the weirdness of the situation" and step in. According to one

of the journalists on his team, “There were moments of such complexity that basically we just gave that information to the journalist on the night and said, ‘Just be aware of this, you might have to rewrite some of this because it's, like, weirdly complicated.’”

To prepare for handling these types of scenarios, information on the seats that were considered to be “highly volatile” or “high profile” was gathered in collaboration with the BBC’s political research unit. On the night of the election, these extra bits of information were provided to journalists through an automated Slack notification which featured a “key” symbol, so as to alert them about these important elements to add in their story. “We knew that we were dealing with journalists at 3:00 AM, 4:00 AM, 5:00 AM in the morning, and therefore you want to be as explicit as possible,” said the journalist at BBC News Labs. The original idea behind these notifications was to help journalists move quickly through these special case situations, and then go on to the next story to check.

However, some of the journalists tasked with editing these pieces indicated that they lingered on some of the details, as they started polishing them up. This resulted in some automated stories having more details than planned, but also caused delays to the overall publication schedule. For instance, a junior software engineer with a journalism background who contributed to editing these stories on election night remembered that, in the early morning, she started being slower in processing the results because, as a journalist, she wanted to have “somewhat of an understanding of what this means for this constituency.” The editor at BBC News Labs also mentioned that he spent about 10 minutes adding in extra details about his own constituency, which he was knowledgeable about, instead of publishing around 10 automated stories on other constituencies. “Where you put a human being into the loop, the temptation is for the human being to go, ‘Oh, I could make this even better,’” he said.

Dealing with local context

According to the editor at BBC News Labs, ensuring that journalists from all the BBC’s national and regional newsrooms participated in the process of publishing automated news was vital to making sure that they didn’t miss any important local context. In Scotland, Wales and Northern Ireland, journalists used their expert knowledge of the political situation to build on the automated drafts quite considerably before publication. In England, the core London team was supposed to be prioritising speed of publication, leaving regional newsrooms to add details and local knowledge later.

4 Reconfiguring journalistic roles for automated news

4.1 Addressing issues around data quality and interpretation

Now that I’ve described the general pathway that the BBC seems to have taken with regard to automated news, I will go into more detail and explain why the design and implementation of these products call for a reconfiguration of journalistic roles, first to address issues that relate to data quality and interpretation, then to set up algorithmic rules to embed the organisation’s values into their conception. On the data side, a key element to take into consideration revolves around data quality, as journalists should always critically investigate the data source they are using. “A naive approach to natural language generation is to assume the data is somehow, you know, useful or accurate. The data might not be accurate, and it might not be useful and it might be biased,” said the product manager at BBC News Labs. To prevent any mistake from creeping in, he suggested adding a data “quality control”

step to the automated news workflow, so as to make sure that the data that is being used meet the organisation's standards and to act as a safeguard prior to writing templates.

As a way to ensure that the data is accurate, the senior software engineer with BBC News Labs recommended having an institutional knowledge of any data source that is being used on a regular basis. "It's not entirely unusual with some of these datasets that they are withdrawn or they are amended and republished," he said, adding that the team included this assumption into the way they designed automated news. For instance, in their first automated journalism project on A&E waiting times, he said that they would leave new data coming out "breathe" for a bit, so as to perform a series of extra checks on them. One of these checks involved running an algorithm against the most recent database to check whether new data were any different from those already published, so as to avoid pushing the same story twice.

In another example of this form of troubleshooting process, the software engineer with News Labs reported finding issues when merging together two datasets that contained some of the candidates' details: "There could have been some instances where a candidate was matched by the number and they weren't the same candidate, or there could have been situations where there's a candidate with the same name, but they weren't the same person." The senior journalist at BBC News Labs experienced similar problems when running a test based on historical data: "What we actually discovered was that a couple of MPs changed their name on the register between elections," he said. "The reason I found it was the Brexit secretary, Steve Barclay, was down as Stephen Barclay in 2017, and Steve in 2019. So it said conservative gain in this test headline when actually it was a hold."

Another process that was important to the team was data curation in order to select items for inclusion in automated news, a procedure that they referred to as "building the story model." This consisted in creating a table in which each column would stand for an aspect that was deemed to be newsworthy for the story. In practice, it involved parsing through a single or several datasets in order to filter out and refine data, and then run some analysis on them to detect trends. The product manager at News Labs described this whole process as essentially being an intermediary stage between data acquisition and template writing: "It's not data, template, story," he said. "It's data, story model, template, story."

That being said, there are also a few caveats associated with this process. For instance, the journalist at News Labs warned against the risk for readers to infer meaning just because two data pieces are put next to each other. "Sometimes it would just be not appropriate to put those two pieces of information next to each other. And the story that you're kind of suggesting is probably not valid or not useful or not accurate," he said. As a matter of fact, the team initially considered using the Brexit results in the automated stories they were generating on the 2019 general elections, after they managed to obtain some constituency estimates[3]. However, the team decided not to pursue this idea.

health_trust_code	name	region	nation	date	ae_figure	ae_over_4_hours	ae_12_months_ago_figure	ae_target_achieved	ae_rank	idt_uuid
RJ1	Guy's & St Thomas' NHS Trust	London	england	01/01/2019	87.5	2255	92	Jul-15	32 of 131 trusts	548c0638-36a1-11e9-bea6-06a3ab30b7c4
RQX	Homerton University Hospital NHS Trust	London	england	01/01/2019	92.5	829	94.2	Nov-18	11 of 131 trusts	548c11be-36a1-11e9-bea6-06a3ab30b7c4
RYJ	Imperial College Healthcare NHS Trust	London	england	01/01/2019	86.7	3382	85.1	Jun-15	38 of 131 trusts	548c1b96-36a1-11e9-bea6-06a3ab30b7c4
RJZ	King's College Hospital NHS Trust	London	england	01/01/2019	71.9	6921	77.7	Jun-15	116 of 131 trusts	548c2546-36a1-11e9-bea6-06a3ab30b7c4
RAX	Kingston Hospital NHS Trust	London	england	01/01/2019	86.8	1475	87.3	Apr-16	35 of 131 trusts	548c3054-36a1-11e9-bea6-06a3ab30b7c4
RJ2	Lewisham & Greenwich NHS Trust	London	england	01/01/2019	83.8	4247	83.3	Jun-15	59 of 131 trusts	548c3a68-36a1-11e9-bea6-06a3ab30b7c4
R1K	London North West Healthcare NHS Trust	London	england	01/01/2019	85.6	4656	83.6	Not in the last five years	43 of 131 trusts	548c4404-36a1-11e9-bea6-06a3ab30b7c4
RAP	North Middlesex University Hospital NHS Trust	London	england	01/01/2019	80.9	3135	75.5	Jul-15	78 of 131 trusts	548c4da0-36a1-11e9-bea6-06a3ab30b7c4
RAL	Royal Free London NHS Trust	London	england	01/01/2019	85	3691	86.1	Oct-15	47 of 131 trusts	548c58cc-36a1-11e9-bea6-06a3ab30b7c4
RJ7	St George's University Hospitals NHS Trust	London	england	01/01/2019	84.2	2413	83	May-15	58 of 131 trusts	548c629a-36a1-11e9-bea6-06a3ab30b7c4
RAS	The Hillingdon Hospitals NHS Trust	London	england	01/01/2019	80.7	2789	80.8	Sep-15	79 of 131 trusts	548c6c36-36a1-11e9-bea6-06a3ab30b7c4
RRV	University College London Hospitals NHS Trust	London	england	01/01/2019	83.3	2026	86.1	Jul-15	62 of 131 trusts	548c75c8-36a1-11e9-bea6-06a3ab30b7c4
RKE	The Whittington Hospital NHS Trust	London	england	01/01/2019	86	1343	86.5	Sep-15	40 of 131 trusts	548c8112-36a1-11e9-bea6-06a3ab30b7c4

Above: The "story model" used to create the A&E waiting times stories. In this table, information needed to calculate performance targets has been selected. (Source: BBC News Labs)

[3] Brexit voting areas were based on local authority districts, not on parliamentary constituencies.

4.2 Encoding editorial standards, journalistic codes of conduct and linguistic aspects

The reconfiguration of journalistic roles that is made apparent through the design phase of automated news also involved setting up algorithmic rules, in an attempt to embed editorial standards, journalistic codes of conduct and linguistic aspects into a programmatic form. When it comes to embedding editorial standards, for example, the product manager at BBC News Labs noticed that the most challenging part had to do with articulating the very specifics of these rules. Whereas these standards are generally well described in journalistic style guides or other associative guidelines, encoding them into a programmatic format requires very detailed instructions. To work through this process ahead of the 2019 United Kingdom general election, the team at News Labs sat down with experts at the BBC's political research unit, so as to determine the exact rules around using a specific form of language. The editor at BBC News Labs remarked that, in a sense, the political experts felt a bit surprised when asked to codify some of their thinking rather than "going with their gut on the night."

In the end, the actual implementation of automated news on the night of the election showed that there was still room for better embedding these editorial rules into a programmatic form. As an illustration of this, the junior software engineer with a journalism background, who contributed to publishing these stories, stressed that she felt the need to correct some of the headlines, as those were only mentioning a win with over 50 % of the votes when the winning party scored over 75 %. She mentioned being aware of "how complicated election coverage is" and "how frequently the BBC is accused of bias," which made her cautious about "an under-reporting of the margin of victory to be, like, taken as bias."

Another aspect that has to do with setting up algorithmic rules for automated news relates to having to rethink journalistic codes of conduct. For example, in the high street project, the senior journalist at BBC News Labs managed to get quotes in advance from a business representative, who provided him with two different types of answers depending on whether high street retail activity was higher or lower than average, in each English local authority district. "So basically they were able to give me a quote for both scenarios. So places where the high street had more kind of activity or retail than before (...) or where it was declining. And based on which scenario matched the streets, it would then use the correct quote in the template," he said. He pointed out that, as far as he knows, this is the first attempt at using quotes in advance to set up automated news. To him, this practice is best suited to covering performance-oriented stories, for instance hospital, police station or waste collection targets. "You have a certain number where, you know, they have met the target or they haven't met the target. So you say, 'If they haven't met the target, what are the typical reasons for that?' And they would give you their analysis," he said.

Gathering quotes in advance was also considered for the BBC's first experiment with automated news, for instance by asking a professional association such as a doctors' union to comment on A&E waiting times. But the senior software engineer who was overseeing the project at the time deemed that this raised an important editorial difficulty: "How do you include a quotation that's attributed to a person if they haven't actually responded to the thing that happened? They basically hypothetically responded," he observed. That being said, the senior journalist who worked on the high street project underlined that this can be editorially valid, as long as journalists are being transparent and explain to their interviewees the exact logic behind using quotes in advance: "It's just making sure that you're not going to misquote the person by putting it in in the wrong scenario or context," he said, which would make them look "like they don't know what they're talking about."

Finally, as an organisation that operates in multiple languages, the BBC also needs to take into consideration linguistic aspects when setting up algorithmic rules for automated news production, as this was the case with Welsh-language stories during the 2019 general elections. According to an assistant editor at BBC Wales who helped the News Labs team adapt the English templates into Welsh, this was probably the first time that automated news were produced in this language. To make this happen, she collaborated with two members of the News Labs team to encode linguistic rules that are proper to Welsh into the algorithms that trigger automated news. She describes this as an operation that "wasn't just a matter of simple translation."

Over the course of adapting these templates, the trio came to realise that, multiple times, an extra programming command was needed for Welsh. This could involve having to change the order of elements in a sentence or having to modify the beginning of a word depending on whether the corresponding noun is feminine or masculine, similarly to French or Spanish for instance. This last point turned out to be particularly troublesome for the team, as the data stream they were using did not include the candidates' gender. While the templates could be written gender-free in English, this created an extra layer of complexity in Welsh. "Whether the candidates, the winning candidate, was male or female, we would have to construct the sentence differently," specified the assistant editor.

5 Conclusion

This report illustrated how the BBC resorted to a structured journalism approach when delineating baseline scenarios for automated news, but to a human-in-the-loop system when handling edge cases, as this proved to be the case during the 2019 general election in the United Kingdom. When working out baseline scenarios, journalists could learn how to better engage with concepts of abstraction that are at the core of structured journalism, first by envisioning what an ideal story would look like and then breaking it down into smaller elements that can be reusable across many versions of that same story. But when dealing with edge cases as part of a human-in-the-loop configuration, they need to weigh adding extra details to the story against polishing it too much and fall behind schedule. This report also looks at the reconfiguration of journalistic roles brought on by the design and implementation of automated news. On the data side, journalists are encouraged to perform a sort of "quality control" over the data they are using and to think critically before arranging data pieces together as part of a process known as "building the story model." On the processing side, setting up algorithmic rules for automated news shows the need to further discuss embedding editorial standards, journalistic codes of conduct and linguistic aspects into a programmatic language.

The conceptual shift that journalists need to undergo to be more familiar with abstract thinking could be addressed as part of a revamped journalism curriculum[4], in which students would be taught about elements of "computational journalism," in other words the ability to solve problems in a newsroom setting through the use of computing skills (Diakopoulos, 2011; Stavelin, 2013; Gynnild, 2014). Such efforts are already being made in data journalism classes introducing students to the basics of computer programming or under a new form of teaching that looks at the influence that algorithmic structures hold on society[5], which encourages them to engage with a new type of investigation known as "algorithmic accountability reporting" (Diakopoulos, 2015). At the same time, it is also worth pondering on

[4] On this point, Caswell and Dörr (2018, p. 492) note that "a primarily reason for journalists to learn to code may not be so that they can code, but so that they can learn to think about journalism in the same way that software developers think about code."

[5] As an example of this, the Computational Journalism class delivered at Columbia Journalism School examines "the ways in which data, code and algorithms are reshaping systems of power in the world, training students to be better reporters and to hold the people and institutions behind these systems accountable."

how existing journalistic norms and routines could be linked back to these very same concepts of abstraction. Indeed, filling out templates based on scenarios that are prepared in advance could be no different than journalists writing “prep copies” ahead of an important event or “advance obits” to anticipate a famous person’s death.

Perhaps the main takeaway from this report, though, is the need to reflect on new guidance for journalism practice, which would take all of these computational aspects into account. For instance, this could translate into a set of “computational journalism guidelines” that would take inspiration from the BBC’s Editorial Standards and Values, but also from the fairness, accountability, confidentiality, transparency and safety in information retrieval framework (Olteanu et al., 2021) that is currently being developed as part of the BBC’s Machine Learning Engine Principles (Macgregor, 2021). This course of action is likely to take the form of a back-and-forth process over the coming years, as journalists and programmers gradually run into issues that are located at the intersection of computer programming and journalism know-how, and sit together to determine which rules apply to them.

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