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Use of audio editors in radio production

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ABSTRACT

Audio editing is performed at scale in the production of radio, but often the tools used are poorly targeted towards the task at hand. There are a number of audio analysis techniques that have the potential to aid radio producers, but without a detailed understanding of their process and requirements, it can be difficult to apply these methods. To aid this understanding, a study of radio production practice was conducted on three varied case studies - a news bulletin, drama and documentary. It examined the audio/metadata workflow, the roles and motivations of the producers and environmental factors. The study found that producers prefer to interact with higher-level representations of audio content like transcripts, and enjoy working on paper. The study also identified opportunities to improve the workflow with tools that link audio to text, highlight repetitions, compare takes and segment speakers.

1. INTRODUCTION

The process of creating radio programmes has evolved over nearly a century amid a rapidly changing technological landscape. Outside of the radio industry, the production process is not well understood and it can be difficult for those who want to learn more to gain access. Books [1] and studies [2] on radio production have been written, but as they focus on editorial concerns, they do not reveal much about practical issues that producers face. The lack of available information can make it difficult for researchers and designers to understand the real-world challenges and needs of radio production.

Although most radio content is broadcast live, a significant proportion of programmes, such as documentaries, are created offline using audio editing software. The audio editing tools used by radio producers are often very basic in the features they offer and where more advanced software is used, it is typically designed for production of music rather than speech.

There are many semantic audio and user interface technologies that have the potential to improve the production environment. Automatic segmentation algorithms for speech/music discrimination [3] and speaker diarization [4] are relatively mature and have already been applied to radio [5]. Experiments into the use of higher-level representations like text are starting to appear, such as the video editors from Loviscach [6] and Hyperaudio [7]. However, without a detailed understanding of the production workflows, it can be difficult to know which of these technologies have the most potential, or how they can be integrated into the workflow.

In order to gain a better understanding of the radio production process, a study was conducted at BBC Radio in London. Section 2 outlines the methodology behind the study, Sections 3, 4 and 5 present the results of three case studies, Section 6 outlines the results and Section 7 presents the conclusions.

1.1. Production system

The vast majority of radio production work in the BBC uses a networked audio production system called *dira!* [8]. It is colloquially known as 'VCS', which is the former name of the company that sells it. All audio content is kept on distributed storage and the system is accessed using various pieces of software: 'StarTrack' is a multi-track audio editor, 'Orion' is an audio recorder and single-track editor and 'Highlander' is used to browse recordings and metadata.

2. METHODOLOGY

Previous studies of professional broadcast environments have focused on how producers collaborate during live production [9, 10], by using video recordings to analyse the interactions between producers. The scope of this study was much wider and covered the production of programmes over a number of weeks. As such, an ethnographic approach was taken so that all aspects of the production could be considered.

2.1. Objective and scope

The objective of the study was to discover how radio programmes are created, in order to identify opportunities for assisting or improving the process using technology. Although the focus was on production tools, the entire production workflow was considered so that use of tools could be understood in context. Due to the scale and variety of the radio operations at the BBC, it would be impossible to cover all production genres and techniques. Instead, a representative but varied selection of programmes that use pre-recorded content were considered. Three case studies were chosen – a news bulletin, a drama and a documentary.

2.2. Data collection

Information was gathered by observing and interviewing the producers in their normal work environment. Each team was observed for long enough to gain a full understanding of each person's role, the environment they work in and each step of the production process. The observation took between half a day (for the news bulletin) and four days (for the documentary). The interviews were unstructured and conducted during 'down-time' between observations. Typed or hand-written notes were taken throughout the observation and interviews.

Participants were recruited individually by contacting them through a number of studio managers who had worked with the authors in the past.

2.3. Analysis

The objective of the analysis was to uncover the challenges producers face in the production process, and to identify how technology can be applied to meet those challenges.

The information collected from each case study was first categorised into the producers' roles, the environment they work in and the production workflow from beginning to end. Challenges and opportunities that emerged from these were then identified, and potential technology-based solutions were considered. These were examined to find any strong themes that were common across the three case studies, or any significant opportunities that resulted from them.

3. NEWS BULLETIN

The summaries team at BBC News (known just as "summaries") create hourly news bulletins for the national radio networks[1]. The team was observed during a morning weekday shift. The pace of work in the team is extremely fast so most of the observation was passive.

[1] Except for Radio 1, 1Xtra, Asian Network and Radio 5, which are handled by separate teams.

3.1. Roles

Summaries is run by an *assistant editor* who leads a number of *broadcast journalists*. The team work on rolling shifts to help keep track of developing news stories. The role of each journalist is to select and write short text summaries of news stories for a particular network. They must find and edit audio clips to accompany those stories and construct them into a bulletin of a set length. The assistant editor performs the same role as the journalists, but is also responsible for assigning the bulletins to the team, deciding which stories to prioritise, and to read and approve each news bulletin. The finished bulletins are read out live by a *presenter* in a radio studio.

Summaries work closely with other news teams to gather audio content. The '*intake*' team set up and record live incoming feeds from *reporters* in the field. They notify summaries of the incoming feeds so that they can listen-in and provide instant feedback. The '*newswire*' team provide curated clips of both BBC and user-generated content. Summaries also work with individual *reporters* who are commissioned to record clips for the bulletins. These are recorded and edited by the reporters themselves and provided to the team directly.

3.2. Environment

The team sit together at a large desk in the BBC newsroom (see Figure 1), which also houses teams from around the BBC News division. The working environment is configured to facilitate fast flow of communication, which is reflected in the design of the newsroom and the equipment on the desks. Each space at the desk has a PC, telephone, intercom, TV monitor and headphones. The intercom is used to communicate with other teams in the newsroom, and the TV monitor displays the BBC News channel. However by design, most communication is face-to-face.

Most of the work is based at a desktop PC and primarily done on the Electronic News Production System (ENPS). This is an industry standard software package for writing scripts and compiling news bulletins. It integrates with the *dira!* radio production system using a plugin called Media Object Server (MOS). This allows users to browse and edit audio clips within ENPS (see Section 3.3.2).

3.3. Workflow

Each journalist produces one bulletin per hour, each between two and five minutes long, depending on the network and the time of day (e.g. midday bulletins are longer). Even if the stories being covered are the same, the bulletins for each network are written separately so that they suit that network's audience. This is done by varying the number of items, the amount of detail and the level of assumed knowledge. The team aims to finish bulletins 15 mins before they are aired.

Fig. 1: The newsroom in BBC New Broadcasting House.

3.3.1. Scripts

Using ENPS, the team write text summaries of the current big news stories and compile them into a bulletin. The information comes from a variety of sources, but mainly from the news wires (e.g. Reuters) and BBC reporters. The finished bulletin must fit an exact time slot, so much of the work and skill is in knowing how long the text will take to read and being able to condense the story down to the key points.

3.3.2. Audio clips

Each bulletin contains a number of audio clips which help to break up the newsreader's voice and make the piece more engaging. Relevant audio content is selected, edited to an appropriate length and inserted into the news script. All clips are stored in *dira!* and the MOS plugin is used to find, edit and insert the clips into ENPS (see Figure 2). This uses *dira!* Orion which offers basic cutting, levels and fading functionality. When a clip is finished, it is dragged onto the script at the point in the text where it should be played. The user must give the clip a name, and can optionally add the in and out

words[2]. These and the clip duration appear in the script which helps the journalists and newsreader.

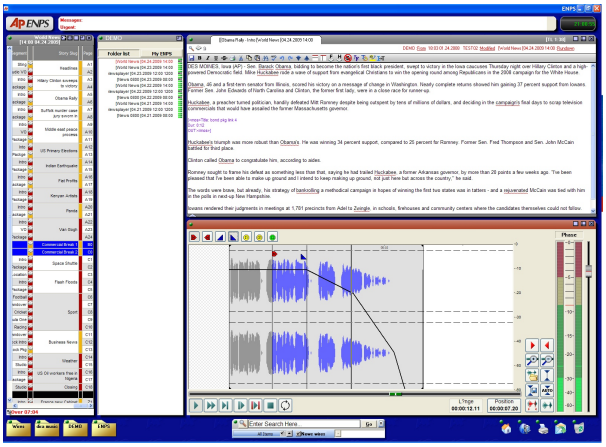


Fig. 2: Editing a clip in ENPS using the MOS plugin for *dira!*.

Audio content comes from a variety of sources including the intake team, newswire team, and individual reporters (see Section 3.1). Off-air content from the BBC News TV channel is also used. For off-air recordings, the journalists must find and clip the audio themselves. Sound from the TV channel is automatically recorded into *dira!* in 40-minute chunks. The recordings are navigated using the MOS plugin, which only displays a waveform and timeline. Without knowing what time the clip starts, the journalists resort to skipping through the 40 minutes listening out for a familiar voice or word, which can be time-consuming and frustrating.

3.3.3. Playout

When a journalist has finished the scripts for their bulletin, these are placed into a 'running order' which is named with the network and time (e.g. 'R4 Thu 10:00'). The assistant editor then reviews the scripts and listens to the clips to ensure they comply with editorial policy and use the correct language and pronunciation. Any required changes are made by the journalist or editor before they are marked as approved. This gives the scripts a green label in ENPS which indicates that they can be read on-air.

The presenter sits in a radio studio and normally has no direct contact with the summaries team. At the time of the news bulletin, the presenter reads the news scripts from ENPS live on-air. The audio clips in each script are automatically loaded into the playout system, and the presenter triggers them at the correct time.

[2]The 2/3 words spoken at the beginning and end of the recording.

3.4. Challenges and opportunities

Finding and cutting clips out of long recordings is a particular challenge. There is very little information to go on so users resort to seeking through the recording, listening out for someone's voice or mention of a certain topic. The pressure of a fast turnaround makes the situation even more frustrating. Application of segmentation or speech-to-text technology could help by indicating where people are speaking, displaying keywords that are mentioned, or allowing the recording to be searched by text.

When it comes to inserting clips into the script, in and out words are manually entered so that the clip can be recognised, but there is not enough time to transcribe the whole clip. Speech-to-text technology would be able to automate this and full transcription could further help the journalists to recall the clip and write the script around it.

4. DRAMA

Radio 4's "15 Minute Drama" is a series of original drama and book dramatisations, broadcast twice-daily. Production of radio drama is radically different from that of news as it is based on a script of a radio play and is created over a number of weeks.

4.1. Roles

The production team is made up of five members, plus a cast of actors. The *director* is the owner of the programme and works with the team to create their interpretation of the radio play. The *broadcast assistant* handles the administrative side and during the recording, they annotate the script with detailed notes. There are three *studio managers* (SMs). The *panel SM* leads the recording process and operates the mixing desk. The *grams SM*[3] makes the recordings and plays pre-recorded sound effects. The *spot SM* works in the studio where they place microphones and create spot effects[4].

[3]'Grams' refers to gramophones, originally the only way to play back sound effects.

[4]Known as 'foley' in the movie industry.

4.2. Environment

The observed drama was recorded in studio 60A, which is a purpose-built flexible performance space at BBC New Broadcasting House in London. It contains spaces with different acoustic properties including movable absorbers and a foam-lined spiral corridor, used to simulate distance. There are many fixtures and props for re-creating common environmental sounds including various doors/windows, a staircase with both wood and carpet, a bedroom and a working kitchen.

The studio is connected by a large acoustically-isolated window to the cubicle where the production team sit (see Figure 3). The mixing desk is in front of the window with the broadcast assistant to the right and the director behind. The grams SM sits at the back of the room, while the spot SM spends most of their time in the studio.

Post-production is done in an editing suite which is a compact acoustically-treated room with a PC, speakers, small mixing desk and level meters.

Fig. 3: Cubicle of studio 60A.

4.3. Workflow

Prior to the recording, the cast will have done a read-through where the broadcast assistant notes the time taken to perform each scene.

4.3.1. Recording

The whole team is present during recordings and they normally record at least one episode in a day. The scenes are done in sequence, with multiple takes recorded for each. When the director is satisfied with the takes, the recording moves onto the next scene.

During the recording, the panel SM balances the microphone feeds and sound effects, and makes a backup recording onto a CD. The grams SM records the desk output directly into a digital audio workstation (DAW) and stores each take as a separate clip. The DAW is used to manually label each clip with the episode, scene and take number (e.g. e2s3t1). The grams SM also selects and plays environmental recordings and sound effects, which are recorded onto a separate track in the DAW. The spot SM positions the microphones for the actors and creates live spot effects in the studio. The director listens carefully to the takes and makes their own notes. Between takes, they discuss the performance with the team and give feedback to the actors.

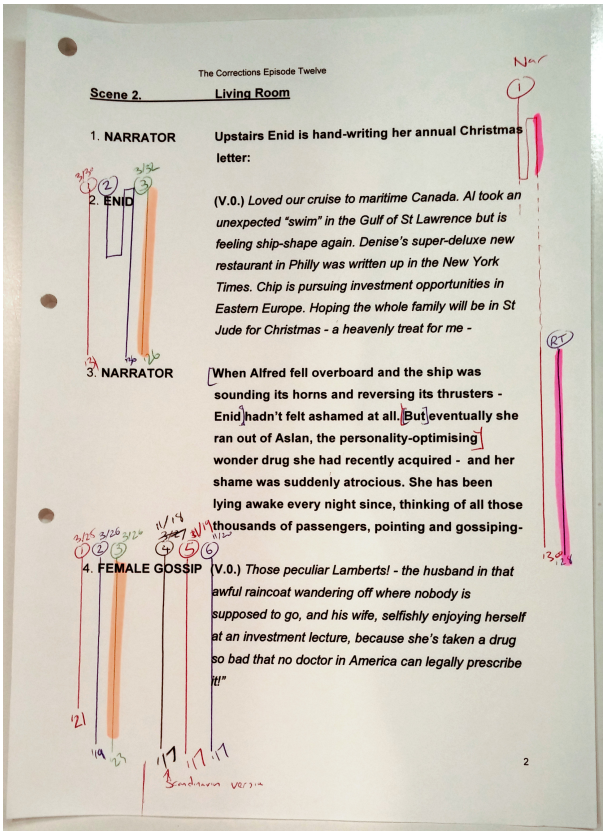
The broadcast assistant takes detailed notes throughout the recording by annotating a paper copy of the script and keeping a spreadsheet of the takes and their length. The paper annotations (see Figure 4) have a well-defined syntax which is explained below. Although this syntax is widely used, it is not formally defined so can vary from person-to-person.

A different coloured pen is used for each take. The start and end of each take is marked with a vertical line on the side of the page, with the take and backup CD numbers written at the top. If the take is repeated within a recording, the line continues back to the top. Repeated words or phrases are marked with square brackets. If multiple brackets overlap, their order is labelled with numbers. Words that are spoken incorrectly are underlined. The best take for each scene is marked by using highlighter pen on the vertical line for that take.

After the recording is complete, the audio files are copied onto a portable hard drive. Although hard drives can fail and be misplaced, they are still used as the computer network is considered too slow and the hard drive can be taken anywhere.

4.3.2. Rough edit

The rough edit is created with a DAW by one of the studio managers, usually the panel SM. As the files are stored on a portable hard drive, this process can be done either in an edit suite or on a laptop at home. The first step is to create a sequence of the best takes from the recordings. The annotated script is used to identify these, and they are dragged


The Corrections Episode Twelve

Scene 2. Living Room

1. NARRATOR Upstairs Enid is hand-writing her annual Christmas letter:

2. ENID (V.O.) *Loved our cruise to maritime Canada. Al took an unexpected "swim" in the Gulf of St Lawrence but is feeling ship-shape again. Denise's super-deluxe new restaurant in Philly was written up in the New York Times. Chip is pursuing investment opportunities in Eastern Europe. Hoping the whole family will be in St Jude for Christmas - a heavenly treat for me -*

3. NARRATOR When Alfred fell overboard and the ship was sounding its horns and reversing its thrusters - Enid hadn't felt ashamed at all. But eventually she ran out of Aslan, the personality-optimising wonder drug she had recently acquired - and her shame was suddenly atrocious. She has been lying awake every night since, thinking of all those thousands of passengers, pointing and gossiping-

4. FEMALE GOSSIP (V.O.) *Those peculiar Lamberts! - the husband in that awful raincoat wandering off where nobody is supposed to go, and his wife, selfishly enjoying herself at an investment lecture, because she's taken a drug so bad that no doctor in America can legally prescribe it!"*

2

Fig. 4: An annotated drama script page.

from the DAW's 'clip list' onto a timeline. There can be many clips, so sometimes they are searched with text to narrow-down the list. Mislabelled clips or misread labels can occasionally cause issues at this stage.

The script is used to identify and remove errors in the takes, particularly re-takes or repeated words. Sometimes these are missed and must be removed later. The sound level is adjusted to be consistent throughout, either by using the mouse for in/out fades or by recording automation with a mixing desk slider.

Sound effects that are listed in the script but were not played at the time of recording are added at this stage. Roughly 600GB of effects are stored on the local computer and their metadata can be searched using text. It takes skill and experience to know which words to use for the search or to know which CDs or collections to use for certain effects.

The recordings are listened to so that any unmarked errors are identified, such as noise caused by actors handling the script during recording. Long sequences are played at double-speed to save time.

4.3.3. Fine edit

Once the rough edit is complete, the director joins the SM in an edit suite to cut the programme to the correct length, select the best performances, tweak the sound effects and add background music.

The finished programme must have an exact duration to fill its assigned broadcast slot. Almost always, the programme will be too long and some lines must be removed. This can only be done by the director as these decisions have a strong editorial impact.

While listening through the programme, the director may want to compare the chosen take with other takes that were recorded. To do this, the SM must find the correct recording using their labels, drag it onto the timeline and find the right position in the recording. This process introduces an overhead which can put directors off comparing performances too often.

Music is not specified in the script, so the director has the creative freedom to choose what they want. Popular consumer music services are used to find commercial tracks, but often directors will choose 'production music', which is designed for TV/radio and is easier to license. These are found using one of a number of online music libraries which, similarly to the sound effects, are searchable using descriptive keywords. The director provides the music to the SM on a USB storage device for them to insert and mix.

Once finished, the final edit is mixed down to stereo by playing the programme through a digital loopback. Although this can be done automatically, it forces the director and SM to listen to the programme from beginning to end in one go.

4.4. Challenges and opportunities

The clear syntax used to annotate the drama script shows that the production workflow is well-organised and makes good use of existing tools. However in the rough edit stage, the SM is performing simple non-creative editing tasks based purely on the annotations. If these could be captured in a digital

format, the rough edit stage could conceivably be fully or partly automated.

In addition to being script-based, a defining characteristic of drama production is that multiple takes are recorded in order to capture the best possible performance. However, there is no simple way to directly compare performances so the director relies heavily on the script annotations and written notes. Providing an easy method of comparing different takes by ear could potentially lead to selection of better performances.

When actors fluff a line, they often say the line again immediately which is usually noted in the script with square brackets. However, these can be missed and are not easy to spot in a DAW. Simple audio analysis could be used to detect and highlight where this happens.

5. DOCUMENTARY

"The Report" is a weekly investigative documentary that covers topical news stories. It is produced over a three week period by the BBC Current Affairs team and is broadcast at 8pm every Thursday on Radio 4. The team was observed for four days at various points during the three weeks.

5.1. Roles

The documentary is created by a core team of three people. The *producer* owns the programme. They decide what the story-line will be, who to interview and how it is edited. The *researcher* assists the producer with research and investigation, setting up interviews and transcribing recordings. Both work full-time on the documentary throughout the three weeks. The *presenter* is the narrator for the documentary. The Report has a regular presenter who typically works on two or three documentaries at once.

The team is supported by the *editor* who runs the current affairs team. They provide feedback on the documentary and must give approval for the documentary to be broadcast. On the final day of production, a *studio manager* (SM) joins the team to create the final edit.

5.2. Environment

The team is based in BBC New Broadcasting House in London. Their desks are grouped together in an open-plan office, beside four studios. The studios are organised into pairs so that one can be used for recordings and the other as a control room. Each studio is acoustically treated and contains a PC, mixing desk, microphones and a telephone.

5.3. Workflow

The three weeks it takes to create the programme can be very roughly divided into research, interviews and editing. However in reality these activities are dependent on external factors and can overlap significantly.

5.3.1. Research

The purpose of the research stage is to take the idea behind the programme and form an interesting and relevant storyline around it. Often the topic will be in the news that week, so the producer will be looking for an interesting angle which can be explored in greater depth.

The research stage does not require any special tools other than a web browser and a telephone. The team will read around the topic so that they are knowledgeable enough to tell the story well and can identify a number of people they want to interview. Popular sources of information are previous reports or documentaries, newspaper articles, encyclopedias and contacts who already know the subject. The producer will make rough notes for themselves in Microsoft Word and prepare a draft outline of the programme.

5.3.2. Interviews

Once the team have identified who they would like to interview, they will approach them to see if they are interested. If the interviewee has the time available, the producer or researcher will do a 'pre-interview' over the phone to see what the person will say and whether it fits the documentary.

Most interviews are done face-to-face, either on-location or in a studio, depending on the situation. A portable audio recorder and shotgun mic is used for recordings outside of the studio. The presenter holds the microphone and asks the questions while the producer controls the recorder and the microphone level. Recordings in the studio are made straight into the *dira!* system using Orion.

If it's not possible to meet face-to-face, interviews can either be done using a local studio and ISDN[5]

[5]Integrated Services Digital Network. A communication

link, over the phone but with a portable recorder at each end[6], using an IP-based link such as Skype, or just over the phone. The phone is always a last resort as the quality is very poor.

5.3.3. Rough edit

When a producer is working on their own, they will usually edit the interviews directly using a DAW. However, when a team is collaborating with interview material, all of the recordings are first transcribed. Some of this is done using a third-party transcription service, but the programme's budget can only cover transcription of three or four interviews. The rest must be transcribed by the team themselves using Microsoft Word. Whereas the professional transcription service includes every word, the team's own transcriptions will skip out many words, leaving only enough to get a good idea of what they said.

The transcriptions are printed out on paper and the team works with these printouts until the last few days of production. Lines from the interviews that they want to use in the programme are marked with highlighter pen. Other informal notes are made on the paper.

The producer takes the annotated transcriptions and pieces together a rough edit using *dira!* StarTrack. As the position of each question in the transcription is marked with a timestamp, the producer can narrow-down the location of the highlighted text in the recording, but only to within a few minutes. For each interview, the producer cuts out and saves any lines that they have highlighted. These are then sequenced into a rough edit of the programme.

While the producer creates the rough edit, the presenter writes the programme's 'links' – the narrative elements that join the interview clips. When the first rough edit is complete, the whole team sits down with the editor for a 'run-through'. The programme is performed out loud, straight-through from beginning to end, with the presenter reading the links and the producer playing the clips. This allows the editor to hear the programme and give feedback early on, and for the length of the current edit to be determined. This run-through process typically happens two or three times for each programme.

standard that can be used to send low-latency digital audio over telephone networks.

[6]Known in the business as a 'simulrec' or 'mic hold'.

5.3.4. Fine edit

The fine edit happens on the day that the programme is to be broadcast. A studio manager (SM) joins the team to create the final mix. The fine editing requires that the rough edit is transferred into a DAW that has more features than *dira!* StarTrack.

The SM starts by cleaning up the interview clips. This is done by removing redundant noises (e.g. 'umm') and phrases (e.g. 'you know'). Some are left in as they are too difficult to remove or are editorially relevant. Long pauses are removed to ensure there is a good pace, but are sometimes left in for effect. The SM also balances the levels by recording automation using a fader or by dragging in/out fades.

The links are recorded by the presenter who sits in the studio opposite the SM. This is done straight into the DAW and the intro/outro to each clip is played to the presenter. The producer sits in and gives feedback to the presenter over an intercom. After the links are recorded, the SM goes back to correctly align the interview and link clips in the timeline.

The Report has theme music which is added at this stage, along with any additional music chosen by the producer. Similarly to drama (see Section 4.3.3), production music is often used and is chosen using an online library.

Once all of the elements have come together, the producer and SM must cut the programme down to a specific duration (in this case 27:45). This is done by removing sections of speech that can be cut without impacting on the story. These are usually found at the beginning and end of interview clips.

The finished programme is played for the editor who gives their final feedback and approval. Once signed-off, the documentary is mixed down to a stereo .wav file and imported into *dira!*. The producer must then listen to the entire programme in *dira!* to ensure the bit-stream that will be broadcast contains no errors.

5.4. Challenges and opportunities

The documentary production relies heavily on paper-based transcripts. This allows the team to easily collaborate and to make notes, but means that there is a disconnect between the words and audio content. This results in wasted time when the producer has to go back and cut out the selected parts

of the interviews. There is also no easy way to listen back to a line in the transcript. Creating a link between the transcripts and the audio recordings would allow the producers to work with transcripts as normal, but to simultaneously navigate and edit the audio content.

The fine edit revealed opportunities for assisting the studio manager with the clean-up process. If an acoustic model of redundant noises and phrases was developed, these could either be highlighted, cut for easy removal or removed automatically.

6. FINDINGS

Generally speaking, the study identified a number of opportunities to improve the handling, generation and presentation of metadata, as discussed below.

6.1. Text-based working

The study found that the production teams relied strongly on scripts and transcripts of the audio content. The rough edits for both the drama and documentary were directly created from annotated scripts of the recordings. Additionally, the news summaries team manually annotate their audio clips with in/out words to help them identify the recordings. These workflows indicates that producers would much rather work with text representations than with audio on a timeline.

Creating a link between the words in the transcript and their position in the audio could allow the producers to navigate and edit with text as they prefer, but for the audio to be edited automatically. Hyperaudio [7] is an example of a web-based video editor that already uses this approach. In the case of dramas and documentaries, the full text of the recordings is already available so speech alignment technology such as SailAlign [11] could be used instead of full speech-to-text.

6.2. Use of paper

Both the drama and documentary teams preferred to work with paper copies of the scripts. Many producers are not technology-savvy and are therefore much more comfortable with the idea of paper. It also affords them the freedom to make unstructured notes and easily collaborate face-to-face. However, the use of paper also creates a barrier between the work done on the page and the work done on the screen. Digital pens and interactive paper are tools that have the potential to break that barrier while retaining the advantages of both ways of working. Further investigation is needed to see how such a system could integrate the two approaches and whether the technology is viable.

6.3. Redundant speech

Observation of the fine edit in the documentary found that a significant proportion of the studio manager's time was spent on cleaning-up interview material. Much of this was caused by redundant noises such as 'umm's and 'err's, or redundant phrases like 'you know'. These could be identified using a system designed or trained for the purpose. Depending on the producer's confidence in the algorithm, it could either remove the redundant material automatically or assist the studio manager in identifying and removing the material.

6.4. Speaker diarization

All of the observed productions could benefit from being able to see where different people are speaking in a recording, known as 'speaker diarization'. In drama it would help the producers identify different lines in the script, in documentaries it would highlight the position of the questions in interview recordings, and in news it would help producers find what they're looking for more quickly in long off-air recordings. The research around diarization is fairly mature [4] and although it is starting to be used in some experimental BBC services such as the World Service Archive [5], it has yet to become available any mainstream production tools.

6.5. Comparing takes

Drama production is unique in the way it records multiple takes of the same content. This technique allows the producers to get the most from the actors, but means that it can be difficult to select which performances to use. Comparing takes during post-production is possible but the process is clumsy. Providing an easy way to directly compare performances would allow the director to make a better informed decision on which to use. If the rough edit for the drama was assembled automatically, comparison could be made easier by aligning the takes on different tracks.

7. CONCLUSION

An ethnographic study of radio production was conducted by exploring three case studies. It found that producers of speech radio prefer to work with text-based representations of audio rather than with the recordings directly. Their workflows are primarily paper-based which creates extra work when moving between paper and audio. Creating a link between the words on the paper and their location in the audio recordings could significantly improve the production workflow.

The study also identified opportunities to apply semantic audio technology and interaction design to radio production tasks. Lots of time is spent cleaning up recordings by removing redundant speech, which could be fully or semi-automated. Segmenting speech content by speaker would make a positive impact on most speech-based tasks. Finally, drama productions could benefit from an easy way to compare multiple takes of the same scenes.

8. ACKNOWLEDGEMENTS

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