

Collaborative and Experimental Cultures in Virtual Reality Journalism: From the Perspective of Content Creators

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Abstract—Virtual Reality (VR) content creation is a complex and an expensive process, which requires multi-disciplinary teams of content creators. Grant schemes from technology companies help media organisations to explore the VR potential in journalism and factual storytelling. Media organisations try to do as much as they can in-house, but they may outsource due to time constraints and skill availability. Journalists, game developers, sound designers and creative artists work together and bring in new cultures of work. This study explores the collaborative experimental nature of VR content creation, through tracing every actor involved in the process and examining their perceptions of the VR work. The study builds on Actor Network Theory (ANT), which decomposes phenomena into their basic elements and traces the interrelations among them. Therefore, the researcher conducted 22 semi-structured interviews with VR content creators between November 2017 and April 2018. Purposive and snowball sampling techniques allowed the researcher to recruit fact-based VR content creators from production studios and media organisations, as well as freelancers. Interviews lasted up to three hours, and they were a mix of Skype calls and in-person interviews. Participants consented for their interviews to be recorded, and for their names to be revealed in the study. The researcher coded interviews' transcripts in Nvivo software, looking for key themes that correspond with the research questions. The study revealed that VR content creators must be adaptive to change, open to learn and comfortable with mistakes. The VR content creation process is very iterative because VR has no established work flow or visual grammar. Multi-disciplinary VR team members often speak different languages making it hard to communicate. However, adaptive content creators perceive VR work as a fun experience and an opportunity to learn. The traditional sense of competition and the strive for information exclusivity are now replaced by a strong drive for knowledge sharing. VR content creators are open to share their methods of work and their experiences. They target to build a collaborative network that aims to harness VR technology for journalism and factual storytelling. Indeed, VR is instilling collaborative and experimental cultures in journalism.

Keywords—Collaborative culture, content creation, experimental culture, virtual reality.

I. INTRODUCTION

NEWS organisations have been exploring VR technology trying to grasp its potential in journalism. Their VR experimentations were fueled by aspirations for a promising future, which was accelerated by Facebook acquisition of Oculus, the VR headset manufacturer in 2014 [1]. *The New York Times* created *The Displaced* VR piece about people forced to flee their war-torn countries in 2015 [2]. *The*

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Guardian created the 6×9 VR piece about the psychological damage of solitary confinement in 2016 [3]. The BBC created *We Wait* VR about Syrian refugees surrounded by darkness and fear on their way to Europe in 2016 [4].

Curiosity and the desire to be branded as an innovator were the major drivers for news organisations to experiment with VR [5]. News organisations wanted to establish themselves as pioneers who are not afraid of technology. They wanted to contribute to the development process of VR technology, harnessing and shaping it for journalistic purposes. News organisations were afraid of repeating their experience with digitisation, when they were occupied with protecting their positions rather than investing in new media [6]. They saw the strategic opportunity to establish themselves as expert storytellers in the field of VR [7]. However, the VR content creation process is complex and expensive. It requires a specific skill set that is not readily available in news organisations, and that varies depending on the VR project type. A highly interactive VR, for instance, is much more complicated than a 360° video that only permits users to look around. A Computer Generated (CG) VR is completely different from a live-action VR. Still, all types of VR entail new skills, new practices and new roles that disrupt the conventional journalistic practice. Such disruption is evident even when it comes down to live-action 360° video, the simplest form of VR [8].

Media organisations collaborate with external partners to provide sufficient funds, technology or expertise. Journalists, artists and game developers work together in multi-disciplinary teams, becoming VR content creators. New cultures of work emerge, and journalists start to perform new roles.

This study explores how VR disrupts the conventional journalistic practice. It traces every human actor involved in VR content creation and how they interact with each other, drawing on ANT as a theoretical framework to capture the complexities of work.

22 semi-structured interviews with fact-based VR content creators, allowed the researcher to examine the collaborative and experimental cultures in VR work and the new roles that journalists acquire as they become content creators.

II. LITERATURE REVIEW

The rise of experimental and collaborative cultures in journalism can be traced back to the digitisation of work and

internet era. The technology and the fierce competition among news media have forced journalists to adopt new practices and roles to maintain their relevance in the fast-changing media environment. VR journalism has emphasised further these collaborative and experimental cultures.

This section introduces collaborative and experimental cultures in journalism, followed by an overview of VR journalism as an embodiment of these cultures.

A. Collaboration and Experimentation in Journalism

Collaboration either exists among different departments inside the news organisations, or expands to external partners to provide sufficient skills, funds and/or technology [9].

Convergence represents an early stage of collaboration, where a single newsroom creates content for print, broadcast and online platforms [10]. Convergence gives rise to team-based reporting as journalists start to collaborate to create multi-media stories [11]. However, the collaborative teamwork is not an easy task. It defies the journalistic conventions that value individualism and uphold personal resourcefulness and creativity as drivers for better practice [12]. Online journalists are often perceived as inferiors to their print media counterparts in the converged newsrooms, which further challenges effective knowledge-sharing among the team members [13].

Throughout their long experimentation with convergence, news organisations have identified numerous schemes to improve the quality of work. They provide physical proximity, reward systems, trainings and effective organisation of labour [14]. However, collaboration becomes more problematic as it moves beyond the boundaries of traditional newsroom actors, including print, broadcast and online journalists.

Editorial and commercial side of the news organisations is increasingly collaborating to generate revenues. The commercial side may intervene in the editorial process through budget allocation and topic selection [15]. The commercial side may request certain stories to attract more audience [16]. Journalists may work closely with the business side to identify the market and produce a corresponding news organisation identity [17].

The editorial/commercial collaboration eradicates the Chinese Wall that long existed, endangering the journalistic autonomy and undermining its jurisdiction in society [18]. Trust is undermined. Journalists can no longer perform their watchdog role, a primary role for journalism in liberal democratic societies [19].

Entrepreneurial journalism emphasises the blurring boundaries between the editorial and commercial. Entrepreneurial journalists constantly experiment with non-traditional economic models to overcome the crisis facing established media organisations. They try foundational funding, subscriptions and individual donations as potential funding sources [20]. Journalists, thus, become fundraisers and publishers, overlooking the business side of work in addition to their traditional role as content generators [21]. Journalists may develop pitches trying to convince potential funders [22].

Entrepreneurial journalists may find themselves obliged to deliver their pitched promises and respond to the feedback of funders [23]. Journalists often use transparency as a tool to address autonomy issues. A journalism start-up, for instance, can disclose funders and their roles [24]. It can set a clear policy for dealing with potential conflict of interest issues [25]. Still, entrepreneurial journalism represents a shift from thinking about the audience needs, to thinking about their desires [26]. The provision of facts alone becomes insufficient and journalists may need to think of potential ways to appeal to audience, emphasising the emotional and participatory techniques [27].

Audience participation represents another form of collaboration, which empowers the audience and poses questions about content accuracy and journalistic autonomy.

Internet and digital technology turn the audience into “prosumers” [28]. They interact through direct responses and User Generated Content (UGC), potentially endangering the journalistic autonomy. Journalists tend to publish content that may stimulate debates and drive audience interactivity [29].

UGC also may not follow the standards of accuracy, source reliability and transparency. Journalists embrace UGC but explicitly separate it from the original content [30]. They engage in rigorous research and verification processes and use the verified eye-witness accounts from the interactive audience, turning journalism into a collaborative intelligent work with the help of technology [31].

Interactive and data-driven journalism presents the most recent forms of collaboration where journalists and programmers work together. Programmers collaborate with journalists in multi-media packages, producing interesting interfaces for users to navigate the packages online [32].

Programmers help design inward and outward facing tools [33]. The inward tools help journalists better do their jobs and navigate through the information overabundance in the internet era [34]. The outward tools help the audience better engage with the content. *The New York Times*, for instance, created an interactive interface for a story titled “Is it better to rent or buy?”, where users answer specific questions and get a recommendation based on their answers [35].

Programmer/journalist collaboration faces numerous challenges due to the distinct occupational norms that lead to different views of journalism and its creative processes [36]. Programmers introduce new notions to journalism, including build-it journalism, near/far journalism, see-it-for-yourself journalism, openness and non-linear narrative [37]. These notions revolve around two basic criteria: user agency and journalist new roles. Users are free to navigate the story in a non-linear way, explore the content for themselves and choose to focus on the contextual or personal implications of the story. The programmers as content creators build up tools from scratch, while being open about every step of production. They emphasise knowledge-sharing throughout the production processes, demonstrating openness for feedback and potential suggestions to further improve the tools.

The culture openness about production processes challenges the journalistic conventions that reinforce a sense of

competition among journalists [38]. Journalists tend to feel protective about their knowledge and strive to maintain exclusivity of their sources. Openness culture also presents a major shift towards a culture of experimentation, where journalist may share unfinished products and seek feedback.

B. Collaborative and Experimental Cultures in VR Journalism

VR content creation is complex and expensive. News organisations seek partnerships and funding schemes to fuel VR experimentation and expand its reach. *The New York Times* partnered with Google to deliver over one million cardboard to their readers, encouraging them to experience The Displaced VR accompanying the written piece in the magazine [39]. *The Financial Times* collaborated with Google to distribute 35,000 cardboards among readers to experience a VR piece about Rio de Janeiro [40]. *The Guardian* gave away 97,000 cardboards, with the help of Google, to celebrate the launch of its VR app [41].

Google plays an important role in supporting VR content creation either through formal partnerships, challenge funds or informal knowledge sharing networks.

The Guardian, for instance, partnered with Google to fund the production of 12 VR pieces over an 18-month period, after the success of 6×9 VR piece [42].

Other news organisations applied for funds from Google Digital News Initiative (DNI) to start VR experimentation. Euronews, for instance, received an innovation fund from Google DNI to start 360° video content creation in 2016 [43].

Google News Lab, also, launched the Journalism 360 initiative in collaboration with the US-based Online News Association (ONA) and the Knight foundation, a US non-profit interested in journalism, art and technology. The Journalism 360 initiative provides a knowledge sharing community, promoting the use of VR technology [44]. The initiative runs an annual challenge, awarding grants to projects that advance the understanding of ethics, narratives and production of immersive storytelling [45]. Nonetheless, Google is not the sole funder of VR experimentations. Samsung is another key player in the field VR journalism. *The New York Times* partnered with Samsung to launch a year-long daily 360 service in 2017 [46]. The daily service allowed over 200 journalists to learn about VR technology inside the news organisation [47].

Al Jazeera partnered with Samsung to equip and train eight filmmakers from Palestine, Jordan, Lebanon, Tunisia, Morocco, Kenya, Nigeria and South Africa [48]. Al Jazeera aimed at democratising the medium allowing people from the global south to tell their stories in VR and get published through Al Jazeera platform. Still, these partnerships do not provide a sustainable business model for VR journalism. They may endanger the journalistic autonomy. Journalists might feel less inclined to report about the technology partners, specifically during the time of contract renewal [49].

The grant schemes and challenge funds, also, may turn the VR content creators into fundraisers. Content creators apply for grants and pitch their stories to potential funders, providing

a form of entrepreneurial journalism. This may threaten the long-existing separation between the editorial and commercial, calling journalistic autonomy into question [50].

Entrepreneurial culture in VR journalism implies constant experimentation with business models, distribution methods and production techniques.

For business models, VR content creators experiment with sponsorship and branded content to provide revenue streams. CNN, for instance, live streamed the 2017 solar eclipse over the USA in 360 under the sponsorship of Volvo [51]. These business models together with grant schemes and partnerships represent the only viable way to fund VR content creation, yet they are short-term solutions.

For distribution methods, the content creators experiment and collaborate with external partners to reach the potential VR users since the landscape is fragmented [52]. Public understanding of VR is limited, so creators need to educate the potential users and explain how it can add to news [53].

Internet connectivity poses another problem for audience reach. Content creators need to look for creative ways to overcome these challenges. For instance, Now Here Studio, a Berlin-based VR studio, used bus caravans and partnered with universities, Bollywood stars and gyms to expand their reach in India [54].

VR content creation also involves constant experimentation due to the absence of an established work flow or visual grammar. VR content creators become “experimental DIY hacks” [55]. They engage in situation-based decisions about number, sizes and types of cameras to be used.

Content creators engage in a “collective process of discovery” [56], refusing to set an immutable visual grammar and calling for freedom to explore the VR potential in journalism and storytelling. NBC, for instance, created a social VR piece during the 2016 US presidential elections [57]. The users could create their VR avatars and engage in real-time interaction with the TV anchors, whose shows were live streamed in the virtual environment.

VR content creation thus becomes more complex, requiring unique skill sets and expertise that expand beyond the traditional journalistic skills. Game developers, graphic designers, filmmakers and sound engineers may be necessary for a VR project [58]. The new players invite new practices and new notions of work that makes collaborative work challenging. Content creators strive to maintain harmony in their multi-disciplinary teams while adhering to the professional journalistic standards.

III. THEORETICAL FRAMEWORK

ANT originated in science and technology field of studies by Bruno Latour and Michel Callon [59]. The theory deconstructs phenomenon into their basic components and traces the interrelations among them, denouncing any intangible components whose interrelations cannot be empirically studied [60].

ANT is a materialism-based and relational approach that rejects external explanations, and grants components of the studied phenomenon the ability to shape one another through

their interrelations [61]. The components are thus constantly changing depending on their interrelations.

Drawing on narrative theory, ANT perceives every component of the phenomenon as actors exercising agency [62]. Non-humans such as scallops, rocks or ships can be actors, as long as they provide traceable difference [63]. Technology is, thus, an actor exercising a level of agency, though deprived from human intentional behaviour [64]. It can “authorize, allow, afford, encourage, permit, suggest, influence, block, render possible, forbid and so on” [65].

As ANT removes the difference between humans and non-humans [66], it removes the dichotomies of far/near, small/large and inside/outside [67]. ANT focus on associations between entities without posing boundaries to the network; all entities are equals to begin with. Their power emerges only as a result of their associations. ANT is, thus, an empirical version of Foucault discourses of power mechanisms [68].

Applying ANT to journalism studies allows recognising the complex hybrid networks of news production [69]. Socio-technical hybrids are possible due to acknowledging technology as an actor, exercising a level of agency. This approach helps to clarify the relationship between humans, technologies and economic entities, without giving a primacy of humans over technology [70]. Technology is not only an intermediary, but it may become a source of conflict when journalists are introduced to technologies without sufficient training [71].

ANT helps identify the variety of actors involved in the news organisations, including designers, project managers, programmers, sales associates, marketing and big data analysts in the editorial and business sides of the organisation [72]. Thus, the news network concept can be defined as:

“a notion that attempts to embrace the practices and discourses that people (journalists, managers, activists, public relations practitioners, citizens) perform to produce, circulate and use news (collections of ideas, facts and points of reference about matters of common concern in society such as reportages, articles, comments, pictures, etc.), considering professional ideals (autonomy, quality, transparency, democracy, public sphere, etc.), symbolic constructions (newsworthiness, shares, ratings, etc.) and material artefacts (technologies, tweets, newspapers, newsrooms, etc.) as elements that are all important in the process” [73].

Thus, ANT can help provide a performative understanding of VR journalism, tracing all actors involved and their associations. This study focuses on human actors and the interrelationships that are largely influenced by technology, an essential actor in VR journalism. The study analyses the different human actors and their interrelationships to examine the nature of experimental and collaborative work in VR journalism.

The study attempts to answer the following questions:

RQ1: What is the nature of experimental collaborative work in VR content creation?

- (a) How do journalists collaborate with external funders?
- (b) How do journalists collaborate with story subjects?

(c) How do journalists collaborate in the multi-disciplinary teams?

RQ2: What are the characteristics of VR content creators?

IV. METHODS

This study is an exploratory empirical study that draws on twenty-two semi-structured interviews with fact-based content creators.

The researcher drew the sample from a population of all fact-based VR content creators who are not necessarily affiliated with established media organisations.

ANT as a theoretical framework allowed flexibility in sampling. All content creators engaged in factual storytelling, regardless of their background as journalist or technologists were included. Fact-based content creators from established media organisations and VR studios were included. The researcher also added to them the director of the Journalism 360 initiative.

The researcher used purposive sampling techniques to recruit respondents, reflecting the heterogeneous nature of VR content creators. She, then, used a snowball sampling technique to add more participants to the study. The final sample of interviewees is enlisted in Table I in the appendix.

Semi-structured interviews were conducted using synchronous online communication, to allow for instant feedback, expand the geographical reach and reduce the costs. The majority of interviews were done over Skype and Google Talk, yet some interviews were conducted in-person. The researcher was granted access to workplaces in *The Guardian* and the BBC, which allowed her to conduct face-to-face interviews with VR content creators there. Only a single interview was conducted over the telephone upon request.

All interviews were audio-recorded after taking permission from the interviewees, who also consented to be identified within the research. The interviews took place between November 2017 and April 2018. They lasted up to three hours.

The researcher transcribed all interviews manually and analysed using thematic analysis. She used Nvivo software to code the material, looking for emerging themes that corresponds with the research questions.

V. FINDINGS

VR content creation requires collaboration between diverse actors, including external funders, story subjects, technologists and artists. Each form of collaboration causes significant shift in traditional journalistic practice. It becomes necessary for journalists to acquire new skills and characteristics to work effectively and become content creators. The findings are divided into two basic sections to answer the research questions. The first section addresses the nature of collaborative experimental work in VR content creation. The second examines the characteristics of content creators.

A. The Nature of Collaborative and Experimental Work (RQ1)

1. External Funders

Media organisations, VR studios and freelancers seek funding opportunities to fuel their VR content creations. They may seek sponsorship, grant scheme or formal partnerships, potentially changing the dynamics of journalistic practice.

Sponsors help fund expensive content creation processes, yet they demand branded content that is completely different from journalistic original content. For instance, Volvo, the famous car brand, sponsored the live streaming of the 2017 solar eclipse in the US, covered by the CNN. "It couldn't really be possible without the work of a sponsor because it was just an expensive undertaking," said Bronte Lord, CNN VR producer.

The sponsorship implies collaboration between the editorial and the commercial side of the news organisation. The CNN VR unit closely worked with Courageous, the CNN branded content studio, to cover the solar eclipse, said CNN's Lord. They hosted experts to explain the event, and branded content for Volvo was streamed in between.

Collaboration between the editorial and the commercial starts in an earlier stage to allocate a potential sponsor. Thomas Seymat, Euronews VR editor, explained the process of pitching the content. He said:

"Myself and my colleagues in the marketing department found a new way to go. We now know how to make our products profitable. We can pitch them to clients, because you are doing news you can have a little bit of sponsored or branded content on air".

Although this collaboration clearly threatens the Chinese Wall between the two sides of the organisation, content creators are vigilant to ensure their editorial independence. They choose sponsors who have no interest in the story but its potential audience. "A lot of times there are those sponsors who buy like a series of videos and they may not necessarily care about topics of these videos, they are just really interested in that specific audience," said Taylor Nakagawa, former emerging media fellow at the Associated Press (AP), who worked on the early VR experimentations at the news agency.

VR content creators take great care to delineate the branded content from the original content. "Everywhere you look in the scene, you get to see a disclaimer saying that this is sponsored," CNN's Lord said.

VR content creators often use the revenues of branded content to sustain their work, while applying for grants to do the original journalistic work. "You have branded content that brings in revenue and then you do other projects from grants," said Cassandra Herrman, freelancer and co-director of After Solitary VR, produced by Emblematic studio and Frontline series on the US public broadcaster PBS.

Emblematic VR studio worked with Frontline after receiving \$580,000 grant from the Knight Foundation (Wang, 2015). The grant schemes enable VR experimentation in journalism. The Knight Foundation grant scheme does not pose questions about the integrity of journalistic practice,

since it is a US non-profit dedicated for achieving journalistic excellence in the digital age. However, other grant schemes come from technology companies such as Google. Euronews, for instance, applied for innovation funds from Google Digital News Initiative (DNI) to start their 360° video experimentation. The Euronews Seymat explained their relationships with Google and said:

"They don't really care about what is produced. They just care if we achieved the milestones that we set. There is no control or even discussion about what's being done".

Technology companies are more interested in publicising VR, creating content for technology to thrive. Louis Jebbs, CEO of Immersiv.ly VR studio and an ambassador for Journalism 360, explained the role of Google in VR journalism, and said:

"They are very good partners they try to control nothing. They simply want the process to be good [...] They want to build a business that works [...] It's all very well to have a lovely piece of tech but if it doesn't have a business, what's the point. It's not supplying journalism".

The Journalism 360 initiative provides an embodiment for Google's attempt to publicise and sustain VR journalism. Journalism 360 aims at creating a knowledge-sharing network where editors understand the technology and journalists understand how to reach people who could help them with their work. The grants from the Journalism 360 challenge added more publicity. "When there is money involved, everyone wants to know why," said Laura Hertzfeld, the program director of Journalism 360. "Making sure that information and the technology are available to journalists is a big part of our mission".

Technology companies may go into formal partnership, instead of grant schemes. Technology companies may approach news organisations, asking to produce a certain type of content for a certain type of technology, said the AP's Nakagawa. The type of content here is not about the story topic but its format. *The Guardian*, for instance, partnered with Google to produce twelve VR piece, six of which had to be interactive VR for Google Daydream headset, said Nicole Jackson, former deputy editor of *The Guardian* VR team. The partnership allowed *The Guardian* to experiment with various formats either live-action, CG, 360° videos or interactive VR. *The New York Times*, similarly, partnered with Samsung to do a year-long daily 360 service in 2017. The partnership allowed to get "reporters, photographers, writers and editors thinking about this technology as something they can use to better tell their stories," said Jenna Pirog, Senior Director of Immersive Experiences at National Geographic, and former Senior Producer of Immersive Journalism at *The New York Times*.

Technology companies are "fantastic partners" because they encourage experimentation but do not interfere with editorial decisions, said *The Guardian*'s Jackson. They are "hands off the story or the money you might generate from selling it to other costumers, like at the AP how we push things down the wire," the AP's Nakagawa added. Still, the financial partnership with technology companies raised ethical

questions to some content creators. "I don't know if it's crossing the line or not. I am not sure," said KC McGinnis, photojournalist and former 360⁰ content creator in *The New York Times* Daily 360 service. Partnership might affect the way news organisation report about the technology partners when they are negotiating their deal, said Zillah Watson, BBC VR Hub Commissioning Editor. Also, partnerships might threaten the trustworthiness of the news organisations due to the negative implications of partnerships in public minds, she added.

News organisations must be extremely cautious about the nature of their partnerships with technology companies. "Samsung did not have a scene in our editorial side," said Zahra Rasool, Editorial Lead of Contrast VR studio at Al Jazeera. Samsung partnered with Al Jazeera to launch the My People Our Stories initiative to empower people from remote places to tell their stories offering them the technology and the sufficient training. "We want to globalise the use of 360 and VR, so that it wouldn't be just something for use in Europe or in the US," said Viktorija Mickute VR Producer at Contrast VR studio in Al Jazeera.

Democratisation of VR technology allows people in remote places to create their own stories and see how they are represented in VR journalism, said Gayatri Parameswaran, Founder of Now Here Media VR studio. It allows for empowering the public and can start from close collaboration with story subjects during content creation processes. Story subjects become the authors of their VR stories as in the My People Our Stories initiative or they can be co-creators.

2. Story Subjects

VR content creators try to give voice and power to their story subjects, said Lakshmi Sarah, journalist and author, educator and an ambassador for Journalism 360. Story subjects engage in a process of co-creation, according to the VR studio founder, Parameswaran. "They must have their final say," Al Jazeera's Mickute said. "You can't just impose something on them".

Empowering the story subjects is particularly important when the VR focus is on human suffering. There is a tricky line about what is acceptable in these types of stories, the Journalism 360 ambassador Sarah said. The VR should make contributors from vulnerable circumstances feel in control; they grew from their experience and they became willing to give back to society, said freelancer Lauren Mucciolo, the co-director of After Solitary VR.

Telling a painful story may trigger an unintended psychological impact; therefore, content creators work closely with story subjects and acknowledge them as co-creators. Freelancer Mucciolo, for instance, noted that they were very thoughtful about Kenny, the former prison inmate and the main story character of After Solitary VR. She and Herrman, the co-directors, decided to pay for Kenny's wife to attend the shooting because she was an important part of his support network. Kenny was also able to oversee the production processes as they went on. "We didn't want him to tap in anything that is difficult," freelancer Mucciolo said.

The role of story subjects as co-creators may expand to become active participants of content creation, not just overseeing or having the final say. The Al Jazeera VR team gave an opportunity to a boy from the local community in Bangladesh to become an audio assistant in I'm Rohingya VR. "We try to include those people. We try not just to shoot them from far away," Al Jazeera's Mickute said.

As content creators collaborate with the story subjects to remain truthful to their stories, they work in multi-disciplinary teams of journalists, technologists and creative artists to create compelling VR experiences.

3. Multi-Disciplinary Teams: Journalists, Technologists and Creative Artists

Interactive VR often requires collaboration between content creators from journalism and game developing background. The work becomes more challenging because team members speak different languages and come from different backgrounds, freelancer Mucciolo said. "Probably I have been in an environment where people know very little about how a game is made and what is behind it," said Federico Fasce, former media technologist at The Guardian VR.

It takes perseverance for content creators to get through their differences and bridge their gap to communicate effectively. "You have to keep trying, keep listening and keep trying to get what you are saying across," freelancer Mucciolo said.

Interactive VR may require working with Unity, a game engine used in game and VR designs. Content creators without a gaming background did not understand the program at first; they had to pass through a learning experience. "The more we work with it, the more we know what it can do and what it cannot do. And then, we learn the words to use to explain what we want to creative technologists," said Lisa Golden, former VR Producer at *The Guardian* VR team. Content creation, thus, becomes methodical and technical. "You can't see everything in real time," freelancer Herrman said. Everything is in code, and content creators need to imagine the final outcome rather than seeing it unravelling as in documentary filmmaking.

Technologists pass through a similar experience, as well. "I just have to explain and train my language in a way to make everything understandable for everyone," *The Guardian's* Fasce said.

Content creation is thus a challenging and a rewarding experience. All content creators are united in a goal. They want to tell meaningful stories. "I have always been more interested in how games can be used to tell stories, rather than the usual commercial kind of power, fantasy and stuff. I have always been interested in experimental games that have [a] sort of meaning," *The Guardian's* Fasce said.

Content creation is also a fun experience, in which VR creators experiment and learn how to clearly communicate what they want to accomplish, freelancer Herrman said. Journalists do not feel they will be replaced by technologists. Instead, they collaborate to reach a common goal and tell a meaningful story. "I don't think that anybody thinks that VR is

gonna replace their jobs at all,” the AP’s Nakagawa said.

Technologists are not only responsible for content creation of interactive VR but also they help develop VR apps and work on its maintenance, the former *New York Times*’ Pirog said. As the hierarchy between technical and non-technical people disappeared in news organisation, the next frontier would be placing the technologists at the centre of newsrooms, CNN’s Lord suggested.

Technologists in the ideal scenario should take part from the ideation phase of VR content creation, according to the VR studio founder Parameswaran. “It’s much better to have experts put their input before you make up your mind, specially in such a technical field where you don’t have all the technical knowledge,” she said. *The Guardian*’s VR team included the technologists at the earliest discussions about of story not just as a tech person. “Everyone just put on certain ideas, and then we try to connect them together and see if something good can stem from them,” *The Guardian*’s technologist Fasse said.

VR content creation may also require creative artists, coming from sound design, drama and theatre backgrounds. Creative artists understand how to control space, sound and lightening, *The Guardian*’s Golden said. “It was all those artists painting the world in 360 for us. We can just learn from everyone else,” she said.

Working with creative artists can be a fun experience where journalists and creative artists learn from one another. *The New York Times*, for instance, collaborated with production studios to create their earliest VR pieces. The production studios “taught us everything we know about VR content creation,” said the former *New York Times* VR editor Pirog. Journalists had to bring “their sensibility and ethics of journalism” to prevent the VR experience from becoming a Hollywood film, she added.

The VR content creation, as a collaborative process with technologists, creative artists and journalist, has a zero precedent. The work flow is iterative, changing from one project to another. “Everything is crazy and messy. We make it [the work flow] up as we go along,” said Anetta Jones, former VR producer and director at *The Guardian* VR.

Experimentation is thus the essence of VR content creation. “Creating as much content as possible is the key to train your eyes to catch mistake, to improve your work and to open up your mind to more innovative ideas,” said Maria Fernanda, VR Producer in Contrast VR at Al Jazeera. The trial-and-error approach allows content creators to be ready for and confident with VR technology, the AP’s Nakagawa said.

Experimentation allows news organisations to be well placed should the VR become mainstream, said Dinah Lammiman, VR Producer at the BBC VR Hub. On the one hand, news organisations understand their audience tastes, according to the BBC’s Lammiman. On the other hand, news organisations use experimentation as a strategy to locate talented VR content creators to rely on for future assignments, according to the Euronews’ Seymat.

With this experimental approach, error is not an issue anymore. “It’s OK to mess things up,” the Euronews’ Seymat

said. News organisations are experimenting with the technology to establish themselves as innovators. For instance, Al Jazeera’s first experiment with 360 live streaming was not the best, yet they are proud of it. “It shows us that we, as a company, we want to move forward. We are forward thinkers, in a sense, we want to test new things and we aren’t afraid to do that,” Al Jazeera’s Mickute said.

The collaborative and experimental nature of VR work requires fundamental characteristics in VR content creators. These characteristics do not necessarily exist in journalists, yet they are fundamental for them to become VR content creators.

B. Characteristics of VR Content Creators (RQ2)

The experimental nature of VR work requires an openness on the part of content creators to discuss, try and learn new things. “The work might become very frustrating because content creators don’t know everything,” said Alistair Leithead, BBC journalist, radio anchor and VR content creator. “I became more obsessed with that, and therefore I gave myself more time and brought in a whole team to work on it and by doing so, I took the pressure a little bit off,” he said.

Curiosity and risk taking are the fundamental characteristics of VR content creators. “They mustn’t be confined to their comfort zones but rather be risk takers,” Euronews’ Seymat said. “You need to be curious, willing to experiment and learn from your mistakes,” said Al Jazeera’s Fernanda. Content creators must adaptive to change without freaking out. Al Jazeera’s Mickute put it:

“You can’t just be like: Oh! That’s how I used to be doing. No, it doesn’t matter. I mean, tomorrow you might have to get used to other things. So, it’s just that you can’t get stuck”.

VR content creation is not the natural fit for TV journalists who may resist change, suggested Joi Lee, VR Producer at Contrast VR in Al Jazeera. “Most TV news journalists wouldn’t experiment with it because the audience they can get is so much less,” the BBC’s Watson said. “It’s naturally counter intuitive to do a 360° video, while you spent a long time doing TV pieces and you are able to shoot a TV report with your eyes closed,” the Euronews’ Seymat added.

The 360° camera is very different from the traditional 2D flat camera. Deciding on its placement is an acquired skill learnt through trial and error. Things may be also be learned the hardest way when the content creator is forced to leave out footage due to its low quality, said Marc Ellison, photojournalist and freelance VR and novel journalism content creator. The BBC’s Leithead described how the cameraman felt uncomfortable with the 360° camera. “He likes what he does, which is shooting for TV news. At some point I felt as if he is going to knock over Marvin [the camera] with an elbow,” he said.

VR is one the most exciting media to work with because it has no established grammar, the VR studio founder Parameswaran said. Content creators have complete freedom to explore and push the boundaries. They must be ambitious to fully explore while paying attention to lessons learnt from

games and theatre, said the BBC Lammiman. Content creators realise that no one is an expert of everything in VR, therefore they must be open to collaborate with everyone and tap into their creative juices, Al Jazeera's Lee said.

Content creators embrace the collaborative culture and tap into knowledge-sharing communities, where they can share lessons learnt and best practices. "Everybody is connected somehow, which in a sense is nice because you can collaborate more, and then you can build more friendships and sort of trustworthy collaborations," Al Jazeera's Mickute said. The knowledge sharing practice surpasses the boundaries of a single news organisation or a single project, as VR creators throughout the world collaborate. This culture is often instilled by the ethos of technology companies, who are the main funders of VR journalism collaboration. Euronews, for instance, disclosed everything once they received the Google DNI fund. "They naturally publish what they have done to show how they have done it," Journalism 360 Ambassador Jebbs said. Knowledge sharing might seem counter intuitive to the deep sense of competition between news organisations, yet VR creators are now unified in their goal to harness technology for journalism. Competition "might happen in the future, but right now we are just working and thinking," Al Jazeera's Rasool said.

VR content creators challenge themselves to learn new things, freelancer Herrman said. They are self-starters, who teach themselves everything, said freelancer Ellison. Freelancers McGinnis, for instance, explained how he made some investment to buy 360 camera and familiarise himself with the technology. Similarly, Euronews' Seymat explained how he took the initiative and applied for Google DNI funds because VR was part of his personal interests.

In this experimental phase, VR content creators constitute innovators and early adopters in the diffusion of the innovation curve. They are risk takers, self-starters and adaptive to change.

VI. CONCLUSION

The findings show the collaborative and experimental cultures existing in VR content creation. These cultures are not new to journalism. They existed long ago since the start of digitisation. The internet era and fierce competition among news organisations introduced collaboration and experimentation, yet VR pushed them further.

Collaboration is not confined to the boundaries of the news organisation anymore. Instead, VR content creators and enthusiasts from across the industry, share knowledge about best practices and lessons learnt to improve the VR potential in journalism. VR content creators embrace the open source culture that long existed among technologists but in a different way. There shared knowledge is not about sharing beta-versions of their codes and software on GitHub, a web-based platform for coders to share their work and ask for feedback and contribution. Rather, content creators are using blogs and conferences to get together, form real friendships, extend their knowledge and collaborate.

VR content creation openness surpasses the traditional

tendency to cooperate with people who share similar backgrounds and expertise. Journalists, artists, and technologists are open to one another. They are willing to speak their minds and listen for advice and thus communicate effectively. Journalists want to learn how Hollywood and theatre work, while creative artists want to understand the essence of journalism. Technologist want to use their skills to create meaningful journalistic stories, while journalists want to understand coding and game engines to best produce interactive VR. All actors are collaborating to reach a common goal, making the collaboration process rewarding.

However, the collaboration is challenging. Technologists and journalists speak different languages, and creative artists tend to emphasise aesthetics over ethical persuasiveness. All actors pass through a tiring and timely learning process. Technologists train their language to make their work understandable. Journalists teach themselves and familiarise themselves with technology. They try to communicate effectively with artists and ensure that the creativity is guided by journalistic professional standards of facticity and accuracy.

Though these forms of collaboration might resemble the interactive data-driven journalism, the intensity of the work and the infancy of VR journalism make it different. No actor can claim the full expertise of knowledge, whether journalists, artists or technologists. VR technology is ever changing, and all actors are trying to keep up with the pace of change, experimenting, exploring to produce the best they can do. VR has no established grammar; it has no explicit rules for right and wrong. All actors are free to explore and push the boundaries as much as they can within the framework of their understanding of journalistic professional standards. This nature of work is what leads respondents to describe VR content creation as a crazy, messy and fun experience.

Outside the multi-disciplinary teams of content creation, collaboration takes new forms and provide interesting implications.

The close collaboration with story subjects helps to add truthfulness to the story. It empowers them and gives them voices. However, it may also pose questions to journalistic autonomy and the degree of detachment in a story. Allowing the story subjects to become co-creators who may have the final say on the content could make the story slightly biased. This close collaboration is not new, narrative journalism and human-interest stories may use similar techniques. Yet, their implication is intensified in VR due to the technological capacities.

External funders, also, are another type of collaboration that poses several questions to the degree of autonomy and editorial independence. VR journalism requires sponsors, challenge funds, grant schemes and formal partnerships to cover its expensive production costs. The wall between the editorial and commercial is arguably eradicated. VR journalism is thus a form of entrepreneurial journalism, where content creators become fundraisers. However, content creators are aware of these potential implications and they openly insist that they maintain the complete editorial

independence.

The study findings pose new questions and issues for future research to examine and probe. The close collaboration with story subjects, for instance, is not new as explained. However, narrative journalists tended to be reluctant to acknowledge the fact that story subjects may get to see the story before being published. Narrative journalists were clear about how such an act endangers their autonomy and credibility in the public minds. Future research may examine such a significant shift,

and whether it reflects a shift in the normative understanding of journalism. Also, future studies need to further examine the mechanisms through which content creators maintain their editorial independence while embracing an entrepreneurial culture. Nonetheless, this study represents an attempt to map the different actors working in VR journalism and how they collaborate with one another using ANT as a theoretical framework.

TABLE I
LIST OF INTERVIEWEES

Date	Interviewee	Affiliation	Length	Method of Communication
1	6/11/2017 Taylor Nakagawa	Former emerging media fellow at The Associated Press	0:57:03	Google Talk
2	16/11/2017 KC McGinnis	A photojournalist and a former 360° content creator in the Daily 360° service at <i>The New York Times</i>	0:52:10	Skype
3	26/11/2017 Marc Ellison	Photojournalist and VR content creator	1:05:46	Skype
4	26/11/2017 Zahra Rasool	Editorial Lead at Contrast VR, which creates VR for Al Jazeera	0:27:37	Skype
6	1/12/2017 Louis Jebbs	Founder and CEO of immersiv.ly VR studio, and a former journalist	1:03:23	Skype
7	4/12/2017 Kevin Tsukii	Immersive journalist and VR producer at Emblematic studio	1:02:22	Skype
8	6/12/2017 Laura Hertzfeld	Program director of Journalism 360 initiative	1:12:05	Skype
9	7/12/2017 Joi Lee	VR Producer at Contrast VR in Al Jazeera	0:27:26	Skype
10	7/12/2017 Jenna Pirog	The Senior Director of Immersive Experiences at National Geographic, and former senior producer of immersive journalism at <i>The New York Times</i>	00:53:49	Skype
11	8/12/2017 Gayatri Parameswaran	VR creator, documentary filmmaker and journalist. The founder of Now Here Media studio.	1:53:09	Skype
12	19/12/2017 Viktorija Mickute	VR Producer at Al Jazeera Contrast VR studio	0:59:53	Skype
13	22/12/2017 Maria Fernanda	VR Producer at Al Jazeera Contrast VR	0:55:45	Skype
14	15/1/2018 Thomas Seymat	VR Editor at Euronews	1:00:00	Google Talk
15	18/1/2018 Bronte Lord	CNN VR producer	1:18:26	Skype
16	18/1/2018 Cassandra Herrman	Documentary producer and director and VR creator at Emblematic studio. Co-director of After Solitary	00:30:00	Skype
17	19/1/2018 Lauren Mucciolo	Co-Director of After Solitary and a freelancer for Frontline	3:07:02	Skype
18	24/1/2018 Nicole Jackson	Former deputy editor of <i>The Guardian</i> VR	1:41:38	Skype
19	24/1/2018 Anetta Jones	Former VR producer and director at <i>The Guardian</i>	0:45:00	Face to face
20	24/1/2018 Lisa Golden	Former VR producer at <i>The Guardian</i> VR		
19	24/1/2018 Federico Fasce	Former technologist at <i>The Guardian</i> VR	0:30:00	Face to face
20	5/2/2018 Lakshmi Sarah	Journalist and author, educator, VR content creator, freelancer and an ambassador for the Journalism 360 initiative	00:30:00	Face to face
21	2/3/2018 Dinah Lammiman	VR Producer at BBC VR Hub	1:15:30	Skype
22	6/4/2018 Alastair Leithead	BBC journalist, radio anchor and VR content creator	0:45:00	Telephone
23	23/4/2018 Zillah Watson	BBC VR Hub Commissioning Editor	2:00:00	Skype

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