Assessing the Diffusion of Drones and Virtual Reality in Local Television News

Douglas A. Ferguson

Professor of Communication

College of Charleston

Charleston, SC

fergusond@cofc.edu

Clark F. Greer

Professor of Strategic & Personal Communication

Liberty University

Lynchburg, VA

cfgreer@liberty.edu

Assessing the diffusion of drones and virtual reality in local television news

Abstract

Emerging technologies are changing how local television stations gather and disseminate news. Two recent technologies are drone journalism and virtual reality. The present study sought to determine the extent to which local TV stations across the US were adopting those technologies as part of their news operations. A survey of news managers (n=94) found that half of the stations were using drones for news, but only to a moderate degree. Only a handful of news directors indicated they were using VR for news but there seemed to be a high level of commitment to using the innovation.

Assessing the diffusion of drones and virtual reality in local television news

In March 2017, television stations in Atlanta dispatched helicopters to facilitate live coverage of a fire and collapse of a bridge on a local interstate (Careless, 2017). Although stations used aircraft for initial news reports, they implemented the use of drones to cover activities the next day and for several weeks after that to track repairs to the bridge. Rather than a rare occurrence, drones are but one recent technology that is changing the face of television news (Kurz, 2016).

Deploying unmanned aerial vehicles (UAV) for reporting illustrates how the diffusion of communication technologies have dramatically changed the way journalists gather news. The adoption of websites in the mid-1990s now seems relatively simplistic when compared to the more recent development of advanced tools that news workers can use to create an "immersive storytelling" experience for their audiences (Preston & Zenni, 2017, para. 1).

According to the results of a 2016 RTDNA/Hofstra survey, more than a third of TV stations in the US owned or anticipated purchasing a drone (Papper, 2017). From an organizational perspective, drones offer a much less expensive alternative to helicopters to gather aerial news footage (Lambert, 2015). Some stations are touting their foray into UAV use, such as San Francisco's ABC affiliate KGO, which was the first station in its area to feature live broadcast from a drone (Miguel, 2015). The Poynter Institute has gotten involved in this trend by offering journalists training about FAA regulations, practical experience operating drones, ethical implications of the devices, and how to incorporate UAVs into news operations (Krueger, 2017).

In addition to drone journalism, Kurz (2016) also noted that virtual news sets and augmented reality would be game changers for the future of TV news. Virtual content enables

audiences to be participants versus simply observers, and can even offer the ability for viewers to choose the path in a story rather than follow linear storytelling (Koski, 2015). An editorial, primarily dealing with print media, in *Journalism and Mass Communication Quarterly* argued that technologies such as VR were contributing to "watershed moments" in news (Marron, 2015, p. 351). For example, in November 2015, the *New York Times* inserted Google Cardboard VR viewers into an edition of the paper that was delivered to more than a million of its subscribers (Wohlsen, 2015). The *Des Moines Register* produced a series of stories that used VR for a series of stories about farming (Hoey, 2015). Those uses of VR provide the ability for news audiences to experience situations and settings (Marron, 2015).

The use of virtual techniques are not solely tools of professional news organizations. The Annenberg School at USC teaches students practical applications of augmented reality and VR, as well as the use of 360 video in journalism (Hur, 2017). Additionally, the Knight Foundation partnered with Google News Lab and the Online News Association to sponsor a competition in the use of virtual reality for news to deliver stories through "immersive storytelling" (Preston & Zenni, 2017, para. 1).

Increased popularity of drone usage in news, along with recent developments in virtual technologies, are setting the stage for different approaches to television news. To date, however, much of the research about drone journalism has focused on topics associated with ethics, privacy, government regulation, and legal matters (see e.g., Culver, 2014; Holton, Lawson & Love, 2015). Particularly scarce are studies about the implications of using virtual reality in TV news. The purpose of the present study is to assess the diffusion of drones and VR in television news from the perspectives of TV news directors, including motivations for device implementation and reasons why stations might not be venturing into these technologies.

Diffusion Theory

Diffusion is how an innovation is communicated over time among members of a social system (Rogers, 1995). In the present study, the innovations are drones and VR. For our purposes, the social system is local television news departments in the United States. Communication may occur in articles in trade publications and interpersonal conversation among news directors.

Rogers (1995) explained five perceived characteristics of an innovation that influence its adoption: (1) relative advantage, (2) compatibility, (3) complexity, (4) observability, and (5) trialability. All characteristics except complexity are positively related to the adoption.

Relative advantage is often associated with a cost/benefit analysis in which individuals or organizations determine whether it is in their best interest to adopt an innovation (Rogers, 1995). An important aspect of this characteristic is audience size, which is usually a crucial issue for broadcasters. For example, Goldberg, Corcoran and Picard (2013) noted the challenges to stations using drones to gathering news but identified competitive opportunities for stations that cannot afford piloted news helicopters. Adoption of drones might, therefore, largely be a matter of cost, since stations need only special permission from the FAA. The low equipment cost (relative to helicopters) also applies to drones.

Compatibility is related to the extent to which the innovation is similar to existing objects or practices, i.e., how well it fits "values, past experiences, and need of potential adopters" (Rogers, 1995). A high degree of compatibility tends to reduce the level of uncertainty toward the innovation. Because stations already have experience with posting to their websites, there is an assumed degree of congruence in delivering content via drones or VR.

Complexity is associated with the level of simplicity or complexity in using the innovation (Rogers, 1995). Television stations interested in implementing VR will need to understand the technological side of news dissemination and gathering. As noted above, complexity is associated with negatives of adopting an innovation, so that the higher the perceived complexity of the innovation, the lower the tendency to adopt the innovation. For example, a news director who perceives VR as too complex is less likely to implement the technology. News directors might view the entire process as too much trouble. On the other hand, the addition of drones might seem a relatively simple process.

Trialability is the ability for a potential adopter to try an innovation before deciding whether or not to adopt it (Rogers, 1995). Additionally, this provides an opportunity to see how the innovation works in the potential adopter's particular situation. However, as Rogers (1995) noted, some innovations are more difficult to try than others. The use of drones is complicated by FAA regulation that protects commercial flights. Coupled with complexity, local television stations might perceive that implementing drones or VR is too difficult to try because it requires additional technology and permission.

Observability relates to how well potential adopters can see an innovation in use (Rogers, 1995). News directors can observe other stations' use of new technology, but without being able to observe results in relation to television audiences. The issue is the extent to which adoption of drones or VR by other stations in a market influence other news directors to implement new methods for gathering and dissemination. VR is still fairly rare, mostly adopted by metropolitan daily newspapers (see e.g., Marron, 2015), but drones are far more common in local television.

In addition to the perceived characteristics of an innovation, organizations also adopt innovations based on three types (Rogers, 1995). Adoption from the optional perspective means

the organization does not sense a need to adopt or is not mandated to do so. Under collective

adoption, the decision to implement an innovation is based on consensus. The third type of

innovation adoption in an organization is authority-driven. In that instance, a few people who are

in authority positions make the decision to adopt. In the case of drones or VR, stations that are

part of a station group might fall under either collective or authority drive, depending on the

amount of participation the local news director has in the decision process. For example, Cox

Media took advantage of drones for news gathering in 2015 in anticipation of blanket approval

by the FAA in 2016 (Suciu, 2016).

Evolving technologies in TV news

Scholarly research about the implementation of technologies in local television news is

largely delineated by four time periods that reflect overall trends in innovation development and

the emergence of linear and digital communications in the industry: traditional, online, social,

and immersive. Diffusion of journalistic technologies that are commensurate with the traditional

phase have largely corresponded with content and the tools used to gather news, while

dissemination of news to audiences remained linear.

Traditional. One traditional means of obtaining news was through satellite-delivered

sources and station satellite news gathering (SNG) equipment. A survey of news directors in the

late 1980s found that almost three-quarters of stations used satellite sources, but only around

16% had SNG equipment (Lacy, Atwater, & Powers, 1988). Respondents indicated the

technologies made their newscasts better and improved news content.

Another study examined the extent to which television stations used weather reporting

technologies as a promotion tactic (Daniels & Loggins, 2010). Radar, satellite maps, and "short-

term forecasts" were three of the most featured forms of content on 95% of the stations' weather

reports (p. 30). Results also showed that weather branding was most important to the top stations in the markets studied.

Another issue is whether emerging technologies affect news content. One study qualitatively examined four decades of TV news packages produced by a local TV station (Cummings, 2014). The analysis showed there was little difference in the organization of stories across time, although the number of edits increased and the length of edits decreased with the use of digital tools. However, the question remained whether or not technology was the reason for the change versus other factors, such as culture.

Online. A number of studies examined how television stations were implementing the web and related technologies. For example, Kiernan and Levy (1999) analyzed the content of TV station websites and found that stations were more prone to provide local rather than national and international news. There was some differentiation between affiliates, but only for international and local news, civic information and archived content. They found that competition was not a factor in site differences. Other research noted that TV station websites had a relatively high level of interactivity through clickable objects and links, as well as audio visual content, and opportunities for viewers to post comments (Bucy, 2004).

Another consideration in technology adoption by local television is the role of budgets, such as in use of the Internet (Chan-Olmsted & Ha, 2003). Results of the study showed that "customer relations management" was the highest perceived use of the web (p. 606). Respondents viewed the Internet as a way to enhance station offerings and to find out about viewers, rather than to use the technology in advertising.

An additional factor is the impact of technologies on news workers, particularly given the emergence of mobile platforms. According to research by Reinardy and Bacon (2014), online

tools created a sense that news workers were being required to do more, but with less personnel and organizational resources. There also were concerns about quality of stories than with posting the stories online. Respondents who rated their support system as high also had higher "work quality" (p. 141).

Other research revealed that television stations were not fully implementing web features. One study found, at the time, the existence of little interactivity related to stations' newscasts (Gregson, 2008). Sites contained more features that promoted the station than those that promoted the newscast. Only a small percentage of stations highlighted the newscast for a particular day.

A subsequent study analyzed the websites of stations affiliated with ABC, CBS, NBC, and Fox (Cleary & Bloom, 2011). More than two-thirds of the websites provided a way for viewers to share station content. Nearly a half featured user generated content (UGC), but extent of UGC was not related to ownership, market size and network affiliation. Compared with a study from 2009, stations were still relying on text and photos for web content. Although the web has provided opportunities for audience connections (Bucy, 2004), research discussed above found that this platform remained largely linear with little interactivity tied to newscasts (Gregson, 2008).

Social. Over the last decade, stations have included a variety of social media in their repertoire of communication strategies. Although online and social are both digital and web-based, what differentiates the two technology time segments is the inherent characteristic of social platforms as a means of connecting and building relationships with target audiences (Greer & Ferguson, 2011a). One issue for media scholars is the effect that social networks have on TV stations and their news operations. An early study of social media and local television examined

whether stations were using Twitter as a promotion and branding tool (Greer & Ferguson, 2011b). Findings revealed differences between commercial and public stations. Commercial entities offered more tweets overall, with a predominance of news content, while public stations featured more promotion tweets. However, less than a quarter of stations used the platform for breaking news, and few stations used Twitter to promote their newscasts. Other research similarly showed that few tweets on TV and newspaper Twitter sites contained cross-promotions, interactivity/engagement with followers, or promotional content, although TV stations were more active in "cross-promotion than newspapers" (Meyer & Tang, 2015, p. 249).

Moon and Hadley (2014) examined how much Twitter was used for news sourcing by top TV networks and newspapers. They found that the social network was used as a newsgathering tool, but journalists still relied on traditional sourcing techniques. Television networks were more active in using Twitter for story sources than were newspapers.

Given its visual composition, it is not unexpected that TV stations would utilize social networks that consist primarily of that characteristic. For example, an analysis of TV station Pinterest sites found that stations tended to post more pins on lifestyle boards than they did on promotion boards (Ferguson & Greer, 2015). Lifestyle (which represented the highest percentage of boards) and community boards also had more followers than boards that promoted the station. In contrast, a study of TV station Instagram sites found that around a third of the posts consisted of news, followed by station promotion (Greer & Ferguson, in press). Site visitors interacted more with news posts than they did with content that showed reporters, anchors and other behind-the-scenes visuals of the station.

Immersive. Two of the most recent developments in news-related technologies are drones and virtual reality. Drones offer television news operations a much less expensive alternative to

helicopters to gather news footage, and also give stations the ability to cover news in diverse

locations (Lambert, 2015). One major issue for the use of drones is government regulation that,

by extension, also relates to station staffing. Starting in August 2016, the Federal Aviation

Administration instituted a rule requiring that individuals who fly drones for commercial

purposes obtain an operator license for the vehicles (FAA, 2016). Since news gathering is part of

a commercial operation, an added burden for stations is ensuring that staff who fly drones have a

permit.

Although an increasing number of TV stations are using drones for news, there is a dearth

of research about this topic from a diffusion standpoint. A survey conducted in 2016 by RTDNA

and Hofstra University found that under 20% of TV stations in the US were using drones for

news, although more than 20% indicated they were planning to implement the devices (Papper,

2017). Stations in the largest 50 markets had the highest percentage of drones. A similar study

from the previous year showed that stations with more staff tended more to use the aerial

vehicles (Papper, 2016).

Journalists have historically used a variety of aerial tools, including helicopters, to

capture a bird's-eye perspective of events (Holton, Lawson & Love, 2015). Benefits of using

drones are the ability to obtain visuals when it is not possible to physically travel to a location

due to terrain. However, there also are a number of concerns associated with the use of UAVs for

newsgathering, such as public safety, ethics, privacy, and FAA regulations (see e.g., Culver,

2014; Holton, Lawson & Love, 2015).

As noted earlier in this paper, some stations are experimenting with the use of virtual

reality. This technology is actually divided into three different concepts: Virtual reality (VR),

augmented reality (AR), and mixed reality (MR). Virtual reality places individuals in a created

environment, typically through the use of goggles, such as Oculus Rift (McKalin, 2014). For TV news, VR often consists of giving audiences a 360-degree view of a story versus placing the individual in an "immersive experience" (Watson, 2017, para. 4). The concept of virtual is also being used to denote the use of digital sets in combination with physical objects for newscasts (Kurz, 2015). In contrast, AR combines virtual environments with real objects and settings for user interaction (McKalin, 2014). Mixed reality is using a combination of VR and AR, but with digital content that is superimposed on a viewer's reality, such as virtual objects in a room with which the person may interact (Rivera, 2017).

Based on research about the use of technology in TV news over the four time periods, there are several antecedents that are pertinent to the present study. One is that technology improves the content of news (Lacy, Atwater & Powers, 1988), despite concerns about quality when news personnel work across multiple platforms (Reinardy & Bacon, 2014), and whether technologies affect story organization (Cummings, 2014).

Station characteristics also may serve as antecedents to technology adoption. This includes ownership, market size, and network affiliation, which Cleary and Bloom (2011) found were not associated with the presence of User Generated Content. Kiernan and Levy (1988) also noted that competition was not an issue in TV station websites.

When it came to drone use, one study noted that large market stations were most active in using the vehicles (Papper, 2017). Other factors in drone use include news coverage abilities (Lambert, 2015) and FAA regulations (FAA, 2016), as well as ethics and privacy issues (Holton, Lawson & Love, 2016).

Given prior research about technology and TV news, the following research questions are posed:

RQ1: What are differences between drone and non-drone stations when it comes to station characteristics (market size, ownership, news staff size)?

RQ2a: What is the relationship between motivations to use drones and the importance of drone use for stations?

RQ2b: What is the relationship between motivations to use drones and importance of drones for stories?

RQ3: What is the relationship between station characteristics and VR implementation?

RQ4: What is the relationship between motivation to use VR and the extent of use?

RQ5: What is the relationship between station characteristics and perceived characteristics of VR?

Method

This study was conducted through a survey of news directors of English-language US television station in November 2017. Of 495 invitations, 94 surveys were collected (19%). Respondents were contacted through an email that invited them to click a link that would take them to the questionnaire. Station websites were accessed through StationIndex.com, which provides a listing of stations in ascending order from market 1 (the largest) to market 210. Within each market, stations are listed according to network affiliation. Only affiliates of ABC, NBC, CBS and Fox received the survey invitation, since those stations are most likely to feature a regular newscast. After an initial email invitation, two weekly reminders were sent.

News director names and email addresses were located by searching the websites of the stations. For stations that did not indicate the news director's name, a search was conducted through Google in an attempt to locate that information. Some stations did not provide an email address of the news director. However, locating the email address of other station personnel on

the website provided a pattern for the email address of the director. Despite these efforts, the researchers were still not able to locate an email address for some individuals. In those instances, the invitation was sent to a general email address, such as newstip@stationdomain.

The questionnaire first sought information related to the respondent. Since not all emails were directed to an individual, the first item on the questionnaire asked for the respondent's job title. News directors (or higher-level news title, e.g., News Manager or Vice-President of News) accounted for 93 of the 94 responses ("Director of Content" was the lone exception). Next were questions related to the station, including market number (responses ranged from DMA 9 to 202), ownership status (group or independent/single owner), network affiliation, and number of full time news staff, ranging from 3 to 185 people (M=46.39, SD=32.29). Group ownership of affiliates comprised 86.2% of stations. Large market size (1-50) accounted for 19 stations (20%), medium markets (51-100) were 26 stations (27.4%) and small markets had 52.6 affiliates (52.6%). Excluding the numerous duopolies (29 of the 94 affiliates that began the survey), there were 17 stations affiliated solely with ABC (25.4%), 22 with CBS (32.8%), 14 with NBC (20.9%), and 14 with Fox (20.9%).

The bulk of items on the questionnaire were divided into segments first relating to drone use, then adoption of VR. Respondents were presented with a filter question asking whether or not the station uses drones for newsgathering. If answered in the affirmative (n=47, 50%), each respondent was asked to indicate on a scale (0=not at all; 5=daily) the frequency with which the station features drone-shot videos in newscasts (M=2.28, SD=1.23).

The next two sets of questions were adapted from previous research related to the adoption of technologies by local TV stations (Ferguson & Greer, 2013). First, respondents were asked to indicate the extent on a scale of 1 (not at all involved) to 5 (highly involved) that each

person or entity on the given list contributed to adopting drones for news: news manager (self) (*M*=4.43, *SD*=1.04), other news staff (*M*=3.73, *SD*=1.36), station/group owner (*M*=3.79, *SD*=1.59), viewers (*M*=1.34, *SD*=0.80), advice from friends (*M*=1.45, *SD*=1.11), and news managers at other stations in the market (*M*=1.42, *SD*=1.13). Next, respondents were presented a series of potential benefits of using drones and indicated on a scale the importance of each (1=not at all important; 5=very important) in determining whether the station implemented or might implement the use of drones for newsgathering. See table below.

	N	Mean	*SD*
To improve the station's image with its community	39	3.54	1.25
To be one of the first television stations in my market	38	3.63	1.44
To provide better viewpoints when covering stories	40	4.88	0.33
To be on the cutting edge of television news technology in general	39	4.36	0.90
To provide enhanced news programming	40	4.65	0.53
To help my station achieve higher ratings in our market	38	4.05	1.04
To distinguish my station from other stations in this market	38	4.18	1.09
Because other stations in my market are using drones	38	2.50	1.50

A subsequent group of three items, adapted from prior research (Adornato, 2016) asked respondents, using the previous 1-5 scale, to indicate the importance of a story that features drone shots: place the story high in the newscast (*M*=2.68, *SD*=1.21), give more time to the story (*M*=2.55, *SD*=1.20), show drone-shot video of the story to tease a newscast or the story itself (*M*=3.53, *SD*=1.18).

Respondents who earlier indicated in the filter question they did not use drones were shown a set of questions that listed possible reasons why the station has not implemented the

technology for news gathering. Individuals were asked to indicate their level of agreement on a scale of 1 (strongly disagree) to 5 (strongly agree) for each item in a list that included potential issues that media face when using drones (see e.g., Culver, 2014; Holton, Lawson, & Love, 2015; Tompkins, 2017): concerns about privacy (M=2.38, SD=1.11), cost of equipment and maintenance (M=3.24, SD=1.35), FAA regulations (M=3.61, SD=1.42), need for specialized staff (M=3.26, SD=1.34), need for additional news personnel (M=2.29, SD=1.35), and station management does not see value in drone use (M=1.87, SD=1.10). Regarding the latter reason, a news director contacted the researchers to add that his station's ownership (Nexstar) forbade the staff of its 171 stations from using drone video of their own making, in order to avoid lawsuits.

The second major section of the questionnaire dealt with virtual reality. A filter question asked the respondent to indicate if the station used VR as a way to produce and delivery stories. A "yes" response (n=29) was followed by asking the respondent to indicate on a scale of 1 (not at all) to 5 (daily) the extent to which the station used VR for news stories (M=4.30, SD=1.57).

As with the drone section, news managers were asked to indicate on a scale of 1 (not at all involved) to 5 (highly involved) the extent to which individuals and entities influenced the decision to adopt VR for news (which were nearly the same proportions as indicated for drone adoption). Next, respondents were given a series of items adapted from prior research (Ferguson & Greer, 2013) that asked for level of agreement regarding the station's use of VR for stories. See table below.

	N	Mean	SD
My station has established specific goals for implementing VR in news	9	2.89	1.62
My station conducts research to better understand how to use VR in news	9	1.67	1.00
My station conducts research to better understand audience attitudes about the use of VR for news in our market	9	2.00	1.23

| VR is part of my station's long-term strategic planning | 9 | 2.67 | 1.50 |
| My station is willing to allocate resources to VR for news | 9 | 2.78 | 1.30 |

The next set of questions, adapted from previous research (Ferguson & Greer, 2013),

focused on the five perceived characteristics of innovations (Rogers, 1995) and contained eleven

items.[1] After scale analysis, none of the alphas seem to warrant using multi-item factors. For

relative advantage, "worth the cost of the technology" (*M*= 3.22, *SD*=1.09) was selected. For

compatibility, "fits the technology philosophy" (*M*= 3.11, *SD*=1.05) was used. For complexity,

"VR is a complex technology" (*M*= 2.78, *SD*=1.20) was chosen. For trialability, "it would be

easy to try VR without making a commitment" (*M*= 3.22, *SD*=1.30) was selected. For

observability, "I can observe other stations using VR" (*M*= 2.67, *SD*=1.41) was used.

Finally, respondents who indicated earlier that they had not adopted VR for news were

asked to indicate their level of agreement (1=strongly disagree; 5=strongly agree) with four items

related to why they had not implemented the technology: cost of hardware and software

(*M*=3.55, *SD*=1.40); requires special training of staff (*M*=3.07, *SD*=1.36); requires hiring

additional news personnel (*M*=2.79, *SD*=1.40); and station management does not see the value in

VR for news (*M*=3.21, *SD*=1.32).

Results

RQ1 was answered by comparing drone and non-drone stations on market size and size

of news staff. DMA rank for drone stations (*M*=89.98, *SD*=53.09) differed from non-drone

stations market rank (*M*=124.76, *SD*=53.00) significantly, *t*(90)=3.15, *p*=.002. For staff size,

drone stations (*M*=57.09, *SD*=32.61) differed from non-drone stations (*M*=36.06, *SD*=29.04)

significantly, *t*(91)=-3.29, *p*=.001. Using a crosstab comparison of drone use to group ownership,

no association was found, $\chi^2(1, 91)=0.59$, $p=.44$. A similar comparison to network affiliation also showed no association, $\chi^2(3, 64)=1.24$, p=.74.

RQ2a looked at the relationship between station motivations to use drones and drone use. Of the nine motivations, four had significant correlations with drone use (listed in descending order): increase number of viewers, $r(36)=.43$ ($p=.01$), being first in the DMA, $r(36)=.38$ ($p=.02$), distinguishing newscast from competition, r(36)=.36 (p=.03), and enhancing the news program $r(38)=.32$ ($p=.048$). A stepwise regression also showed the significance of increasing audience size, $\beta=.43$, $F(1, 37)=7.95$, $p=.008$, adjusted $R^2=.16$.

RQ2b also looked at drone use, but with the respect to importance to news stories. Two of the three motivations showed correlations in the 20s but the statistical power was too low for any significant finding (listed in descending order): Showing drone-shot video of the story to tease a newscast or the story itself, ($r(40)=.24$, $p=.15$), giving more time to the story ($r(40)=.22$, $p=.17$) and placing the story high in the newscast ($r(40)=.12$, $p=.46$).

RQ3 was answered by comparing VR and non-VR stations on market size and size of news staff. With DMA rank, VR stations ($M=92.44$, $SD=60.62$) did not differ significantly from non-VR stations ($M=111.58$, $SD=53.27$), $t(84)=1.01$, $p=.32$. For staff size, VR stations ($M=66.44$, $SD=54.11$) did not differ significantly from non-VR stations ($M=43.05$, $SD=27.59$), $t(8.49)=-1.28$, $p=.24$ (with Levene correction for unequal variance). Only seven stations using VR were affiliated with a single network, so crosstabs were not prudent for this research question. Group ownership was not associated with VR use ($\chi^2(1, 85)=.08$, $p=.78$).

RQ4 looked at the relationship between station motivations to use VR and VR use. Of the five strategic motivations, three had significant correlations with VR use (listed in descending order): Willing to allocate human and financial resources to VR for news, $r(7)=.90$ ($p=.001$),

having specific goals for implementing VR in news, $r(7)=.72$ ($p=.03$), and being part of the station's long-term strategic planning, $r(7)=.69$ ($p=.04$). A stepwise regression also showed the significance of willingness to allocate resources, $\beta=.90$, $F(1, 8)=31.11$, $p=.001$, adjusted $R^2=.79$.

RQ5 was addressed by using five adoption characteristics with station characteristics. DMA market was significantly correlated solely with trialability, $r(7)=.85$, $p=.004$. Likewise, the number of news staff was only correlated with trialability, $r(7)=-.73$, $p=.02$. With regard to DMA market grouping (small/medium/large), an ANOVA test showed significant differences but the sample was too small for post-hoc tests, $F(2, 8)=11.80$, $p=.008$. Group owned stations ($n=8$) showed no t-test differences from the sole independent station ($n=1$).

Discussion

The diffusion of emerging technologies continue to change how local television stations gather and disseminate news. Over the past two decades, research has examined how stations have evolved from relatively simple online distribution points through websites (e.g., Kiernan & Levy, 1999; Gregson, 2008; Cleary & Bloom, 2011) to enhanced connectivity of social media (e.g., Ferguson & Greer, 2015; Greer & Ferguson, 2011; Moon & Hadley, 2014). More recently, academic scholars and market researchers have turned their attention to issues associated with immersive technologies, such as drones (Holton, Lawson, & Love, 2015) and virtual reality (Koski, 2015). Despite the increased adoption of the latter two innovations in recent years, few studies have considered the current status of drone (see e.g., Papper, 2017) and VR implementation in TV newsrooms, and rationale for their use. The present study polled TV station news managers across the US to provide an early benchmark for the use of both technologies.

One key element in this study was the extent to which drone journalism is diffusing among TV stations. Slightly more than half of the respondents indicated their station had implemented this technology for news. However, the amount of use was moderate, with an average degree of use, on a scale of one to five, of 2.28. This study also found that larger markets tended more to use UAVs, which was not unexpected given the amount of financial and personnel resources that are typically available to larger stations. The finding coincides with a RTDNA/Hofstra study, which showed that large market stations represented the highest percentage of drones used for news (Papper, 2017). The present study also found that drone stations had more news staff, which was similar to stations polled in an earlier RTDNA/Hofstra study (Papper, 2016).

In contrast with the results noted above, this study found that ownership was not a factor in the adoption of drones for news. Stations that were either group owned or under independent ownership were equally likely to implement the devices. Also, this study showed there was no relationship between network affiliation and drone news adoption.

Another concern in the present study was whether there was a relationship between the use of drones for news and the use of drones from a station perspective. A pertinent issue is the impetus for adopting the technology. The news manager was perceived to be the most influential person, followed by the station or group owner, and then the news staff, all of which averaged at least 3.73 on a five-point scale. From an organizational diffusion perspective, adoption of the technology is somewhere between consensus and authority-driven (Rogers, 1995). In contrast, low influence were viewers, advice from friends, and news managers at other stations. This suggests that the most important factors in adopting these vehicles are internal rather than external. These findings about drone implementation contrast with earlier research that focused

on TV general managers and the adoption of Mobile DTV (Ferguson & Greer, 2013). In that study, the station or group owner was rated as having the most influence, followed by the station manager. Station staff was only moderately a part of the adoption decision. The differences in influence between the two studies might be an artifact of cost and complexity, since Mobile DTV requires specialized equipment and associated expenses. Additionally, that technology also affects station operations rather than just one aspect of the station (i.e., news). At the same time, the fact that the decision to use drones was in the control of the news manager indicates autonomy of news departments when it comes to reporting.

Several of the goal-oriented reasons to adopt drones for news coverage were significant. This included increased viewership, being first in the DMA to use a drone, distinguishing the station's newscast from competition, and enhancing the news program. These represent differences in content for the station versus simply using drones compared with the competition. When all motivations were regressed, increasing audience size explained the highest variance, which suggests that news managers perceive drone news use is a way to attract additional viewers. It was interesting to note that improving relationships with the community, providing better viewpoints for stories, being on the cutting edge of technology, higher ratings, and the use of drones by other stations in the DMA were not significant motivations when related to the extent of drone use.

Although more than half of the stations used drones for news, around 49% of the stations were not using the technology. The highest mean score for not using drones were FAA regulations, cost of equipment, and the need for specialized staff. Those findings were similar to several concerns noted by communication scholars (e.g., Culver, 2014; Holton, Lawson, & Love, 2016). Among possible concerns that were rated low was if station management was not seeing

value in drone use. As noted earlier in this paper, one news director indicated the group owner did not allow drone use at the stations due to concerns about lawsuits.

An examination of the relationship between motivations to use drones and the importance of drones for news stories produced no significant results. This coincides with the extent of drone use for news in that, while half of stations were using the technology, they were only moderately active in doing so. These results might be similar to what Moon and Hadley (2014) observed about journalists using Twitter, while still relying on traditional news gathering techniques. In the case of drones, perhaps TV stations are still focusing on standard story sourcing versus placing drone newsgathering high in importance. As noted earlier, providing better viewpoints for stories was not a significant concern in relation to drone usage motivations. The highest score for importance of drone shots in stories was teasing the newscast or story, which contrasts with media studies showing that promoting the station was not the most important content in social media (Ferguson & Greer, 2015).

The second major section of this study involved the adoption of virtual reality in TV news. The questionnaire for this study did not differentiate between VR, AR and MR. Only 29 respondents indicated the TV station used VR to produce and deliver stories, but only a few managers answered all the questions about this technology. However, those respondents had an average score (on a five-point scale) of 4.30, suggesting that stations that adopted VR were active in using the innovation. Respondents were asked about the level of influence individuals and entities had on their decision to use VR in news, but results were essentially the same as in the adoption of drones for news. There was no relationship between VR- and non-VR users and station characteristics.

Three motivations to use VR were significant in relation to the extent of VR use: allocating resources, having specific goals to use VR in news, and VR as a part of the station's strategic planning. Additionally, a regression that showed a willingness to allocate resources explained nearly 80% of the variance. These findings suggest that stations using VR are intentional in their adoption of the technology, to the extent that they have planned for its use and the types of resources needed to make it happen. One caveat, however, is that each of the motivations had low mean scores.

Finally, this study examined the relationship between station characteristics and the perceived characteristics of VR as considerations when determining whether to adopt the technology. As noted by Rogers (1995), relative advantage, compatibility, trialability and observability are positively associated innovation adoption, while complexity is a negative factor in the process. Analysis here showed significant relationships between trialability for both DMA rank and the number of news staff at the station. Given the newness of VR technology for news, this makes sense. News managers likely want to try out the technology before making an adoption decision, which may be difficult given the fact that VR has not yet been widely used in TV news contexts. In particular, analysis showed a strong positive correlation between the technology being easy to try and DMA rank. News managers in smaller market stations were more concerned about the ability to try the technology before making a commitment to adopt. As noted above, the small number of responses should be taken into account when interpreting this data.

The extent to which VR is being adopted by local TV station news departments is still up in the air at least for this study, particularly given the small number of respondents to that part of this study's questionnaire. Examples of VR use in journalism seem primarily to exist in print

settings (e.g., Hoey, 2015; Wohlsen, 2015). Indeed, research by Pavlik and Bridges (2013) about the diffusion of AR in news contexts indicated that major newspapers were primary adopters of the technology at the time of their study. In the present study, a respondent called one of the researchers with a question about the survey and volunteered his view that he believes newspapers are more interested in VR. His opinion was that newspapers have a greater need to establish a video presence than television stations.

The present study provides a current perspective about the user of drones and VR in television station newsrooms. Due to its exploratory nature, however, there are a number of limitations that should be noted. One is the number of respondents to the VR section of the questionnaire. More than 90 news managers completed the section associated with drone journalism, but few respondents continued through the end of the questionnaire. This could be attributable to questionnaire fatigue. As discussed above, stations that have committed to using VR in news contexts appear to be all-in when it comes to implementing the technology. Future research should focus on adoption of that specific innovation.

Another limitation also relates to the notion of virtual reality. This study used the concept of VR in a general sense rather than asking questions about VR, AR and MR that distinguished the various terms. It is possible that some stations are using virtual sets, while others are experimenting with more advanced technologies (Kurz, 2016). Case studies would offer more in-depth understanding about how stations are using these tools, especially over time, as these innovations diffuse through local TV stations.

There is a growing body of scholarly literature dealing with drones and journalism. Future research should track the diffusion of these devices for TV news over time, especially as the vehicles become more commonplace. Also, this study considered only news managers'

perception of drones. Additional research should examine perceptions and attitudes of TV news audiences regarding whether immersive reporting techniques are enhancing viewers' experiences with stories. Longitudinal studies also will ascertain whether the public's concerns about issues associated with drones (e.g., privacy and safety) decrease over time.

Endnotes

[1]Relative advantage: VR will increase news quality; it is worth the cost of the technology; it is a better way to tell stories. Compatibility: VR fits the technology philosophy of the station; implementing VR in news production would take too much time from normal activities. Complexity: VR is a complex technology to use at my station; Adding VR to news operations would involve too much effort. Trialability: I would like to use VR on a trial basis; it is easy to try VR without making a commitment. Observability: I can observe other stations using VR; the results of VR for new are apparent to me.

References

Adornato, A. C. (2016). Forces at the gate: Social media's influence on editorial and production

decisions in local television newsrooms. *Electronic News, 10*(2), 87-104.

doi.org/10.1177/1931243116647768

Bucy, E. P. (2004). Second generation net news: Interactivity and information accessibility in the

online environment. *Internal Journal on Media Management, 6*(1-2), 102-113.

doi.org/10.1080/14241277.2004.9669386

Careless, J. (2017, October 18). Drones make their mark in hurricane coverage. TVTechnology.

Retrieved from http://www.tvtechnology.com/resources/0006/drones-make-their-mark-in-

hurricane-coverage-by-james-careless/282016

Chan-Olmsted, S. M., & Ha, L. S. (2003). Internet business models for broadcasters: How

television stations perceive and integrate the Internet. *Journal of Broadcasting &

Electronic Media, 47*(4), 597-617. doi: 10.1207/s15506878jobem4704_7

Cleary, J., & Bloom, T. (2011). Gatekeeping at the portal: An analysis of local television

websites' user-generated content. *Electronic News, 5*(2). 93-111. doi:

10.1177/1931243111408389

Culver, K. B. (2014). From battlefield to newsroom: Ethical implications of drone technology in

journalism. *Journal of Mass Media Ethics, 29*(1), 52-64. doi:

10.1080/08900523.2013.829679

Cummings, D. (2014). The DNA of a television news story: Technological influences on TV

news production. *Electronic News, 8*(3), 198-215. doi: 10.1177/1931243114557596

Daniels, G. L., & Loggins, G. M. (2010). Data, Doppler, or depth of knowledge: How do

   television stations differentiate local weather? *Atlantic Journal of Communication. 18*, 22-

   35. doi: 10.1080/15456870903340472

Federal Aviation Administration (2016, June 21). Press release: DOT and FAA finalize rules for

   small unmanned aircraft systems. Retrieved from

   https://www.faa.gov/news/press_releases/news_story.cfm?newsId=20515

Ferguson, D. A., & Greer, C. F. (2013). Predicting the adoption of Mobile DTV by local

   television stations in the United States. *International Journal on Media Management, 15*,

   139-160. doi: 10.1080/14241277.2013.767259

Ferguson, D. A., & Greer, C. F. (2015). Pinning and promotion: How local television stations are

   using Pinterest for branding and audience connectivity. *Journal of Promotion Management,

   21*, 64-81. doi: 10.1080/10496491.2014.971210

Goldberg, D., Corcoran, M, & Picard, R. G. (2013, June). Remotely piloted aircraft systems &

   journalism: Opportunities and challenges of drones in news gathering. Reuters Institute for

   the Study of Journalism. Retrieved from https://ora.ox.ac.uk/objects/uuid:a868f952-814d-

   4bf3-8cfa-9d58da904ee3

Greer, C. F., & Ferguson, D. A. (2011a). Following local television news personalities on

   Twitter: A uses and gratifications approach to social networking. *Electronic News, 5*(3),

   145-157. doi: 10.1177/1931243111420405

Greer, C. F., & Ferguson, D. A. (2011b). Using Twitter for promotion and branding: A content

   analysis of local television Twitter sites. *Journal of Broadcasting & Electronic Media,

   55*(2), 198-214. doi: 10.1080/08838151.2011.570824

Greer, C. F., & Ferguson, D. A. (in press). The local TV station as an organizational self: Promoting corporate image via Instagram. *International Journal on Media Management.*

Gregson, K. S. (2008). Missed opportunities: Use of the Web to promote the local television newscast. *Journal of Website Promotion, 3*9(1/2), 102-117. doi: 10.1080/15533610802052837

Hoey, A. (2015, May/June). Journalism's emerging platforms. Columbia Journalism Review. Retrieved from https://www.cjr.org/the_experiment/journalisms_emerging_platforms.php

Holton, A. E., Lawson, S., & Love, C. (2015). Unmanned aerial vehicles: Opportunities, barriers, and the future of "drone journalism." *Journalism Practice, 9*(5), 634-650. Doi: 10.1080/17512786.2014.980596

Hur, E. (2017, September 1). Digital journalism class focuses on virtual reality. Retrieved from dailytrojan.com

Kiernan, V., & Levy, M. R. (1999). Competition among broadcast-related websites. *Journal of Broadcasting & Electronic Media, 43*(2), 271-279. doi: 10.1080/08838159909364489

Koski, O. (2015, Winter). Virtual reality lets audiences step into the story. Nieman Storyboard. Retrieved from http://niemanstoryboard.org/stories/virtual-reality-lets-the-audience-step-into-the-story/

Krueger, V. (2017, January 30). Announcing Poynter's 2017 drone journalism school. Retrieved from https://www.poynter.org/news/announcing-poynters-2017-drone-journalism-school

Kurz, P. (2015, June 18). Gray TV takes aim at hybrid news sets. TVNewsCheck. Retrieved from http://www.tvnewscheck.com/article/86270/gray-tv-takes-aim-at-hybrid-news-sets

Kurz, P. (2016, May 19). Five technologies reshaping TV news. TVNewsCheck. Retrieved from http://www.tvnewscheck.com/article/94879/five-technologies-reshaping-tv-news

Lacy, S., Atwater, T., & Powers, A. (1988). Use of satellite technology in local television news. *Journalism & Mass Communication Quarterly, 64*(4), 925-929.

Lambert, B. (2015, April 8). For local TV news, there's revolution in the air. *Minnpost*. Retrieved from https://www.minnpost.com/media/2015/04/local-tv-news-theres-revolution-air

Marron, M. B. (2015). Watershed moments in journalism. *Journalism & Mass Communication Quarterly, 70*(4), 351-353. doi: 10.1177/1077695815625497

McKalin, V. (2014, April 6). Augmented reality vs. virtual reality: What are the differences and similarities? *Tech Times*. Retrieved from http://www.techtimes.com/articles/5078/20140406/augmented-reality-vs-virtual-reality-what-are-the-differences-and-similarities.htm

Meyer, K. M., & Tang, T. (2015). #social journalism: Local news media on Twitter. *International Journal on Media Management, 17*, 241-257. doi: 10.1080/14241277.2015.1107569

Miguel, K. (2015, July 13). DroneView7: Bay area's first live drone broadcast. ABC7News. Retrieved from http://abc7news.com/technology/droneview7-bay-areas-first-live-drone-broadcast/838447/

Moon, S. J., & Hadley, P. (2014). Routinizing a new technology in the newsroom: Twitter as a news source in mainstream media. *Journal of Broadcasting & Electronic Media, 58*(2), 289-305. doi: 10.1080/08838151.2014.906435

Papper, B. (2016, May 16). RTDNA research: The business of news. Retrieved from https://rtdna.org/article/rtdna_research_the_business_of_tv_news

Papper, B. (2017, May 8). RTDNA research: The business of news. Retrieved from

   https://rtdna.org/article/rtdna_research_the_business_of_tv_news_2017

Pavlik, J. V., & Bridges, F. (2013). The emergence of augmented reality (AR) as a storytelling

   medium in journalism. *Journalism & Communication Monographs, 15*(1), 4-59.

Preston, J., & Zenni, N. (2017, July 11). 11 ideas win journalism 360 challenge on immersive

   storytelling. Knight Foundation. Retrieved from https://knightfoundation.org/articles/11-

   ideas-win-journalism-360-challenge-on-immersive-storytelling

Reinardy, S., & Bacon, S. (2014). Feast and famine? Local television news workers expand the

   offerings, but say they are hungry for quality journalism. *Journal of Media Practice, 15*(2),

   133-145.

Rivera, A. (2017, October 9). Reality check. VR vs. AR vs. MR. Business.com. Retrieved from

   https://www.business.com/articles/virtual-vs-augmented-vs-mixed-reality/

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). NY: Free Press.

Suciu, P. (2016, July 19). FAA clears way for news drones. *TVTechnology*. Retrieved from

   http://www.tvtechnology.com/resources/0006/faa-clears-way-for-news-drones/278998

Tompkins, A. (2017, September 22). Poynter workshops produce new drone journalism ethics

   policy. Poynter. Retrieved from https://www.poynter.org/news/poynter-workshops-

   produce-new-drone-journalism-ethics-policy

Watson, Z. (2017, April 24). VR for news: The new reality. Reuters Institute for the Study of

   Journalism. Retrieved from https://reutersinstitute.politics.ox.ac.uk/our-research/vr-news-

   new-reality

Wohlsen, J. (2015, November 9). Google Cardboard's *New York Times* experiment just hooked a

generation on VR. *Wired*. Retrieved from https://www.wired.com/2015/11/google-

cardboards-new-york-times-experiment-just-hooked-a-generation-on-vr/