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The diffusion of GIS in journalism

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THE DIFFUSION OF GIS IN JOURNALISM

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ABSTRACT

The purposes of this study were to determine the likelihood of reporters to adopt Geographical Information Systems and to predict the future of the diffusion of GIS in the journalism industry using the diffusion of innovations theory. The study used two data collection methods: in-depth interviews and a Web survey. The indepth-interviews revealed factors that will influence the diffusion of GIS, including the availability of map data, competition between media agencies, the ease of getting management to buy GIS once its functionality has been demonstrated to them, and the general use of secondary GIS products. The Web survey showed that 63% of the reporters were aware of GIS but only 11% of the reporters surveyed currently use GIS. OLS regression showed that men were more likely to adopt GIS than women, while younger people were more likely to adopt GIS than their older counterparts. The results also showed that reporters who used other technologies in their work were more likely to adopt GIS on a trial basis.

CHAPTER 1: INTRODUCTION

Computer-assisted reporting has gained popularity among journalists in the last two decades with the use of spreadsheet and database software in news reporting. Recently, journalists have added GIS, short for Geographical Information Systems, to the array of computer-assisted-reporting tools they use in their work. GIS simply takes this process to the next level. GIS is "a system of hardware and software used for the storage, retrieval, mapping and analysis of geographical data" (Herzog, 2003, p.3).

Although GIS is not the only mapping system out there, it is unique in that it overcomes the limitations presented by the other systems. Electronic atlases only display images of geographical areas, but provide no tools for spatial analysis. Thematic mapping systems only allow users to create graphical visualizations based on data from spreadsheets and databases. Street mapping systems, though more sophisticated than the other two, only map geographical locations on maps. Some more sophisticated mapping systems allow for analysis of tabular data and the importation of database and spreadsheet information. GIS combines all these functions and more (Breslin, Frunzi, Napoleon, & Ormsby, 1999).

GIS allows users to access information from a map or vice versa. It also allows users to automatically update maps by simply updating the information linked to a particular map. This makes GIS a powerful system that can analyze maps based on layers of data, map out street and location data, analyze geographical locations, update this information easily, and finally create powerful visual presentations of such analysis (Breslin et al., 1999).

For decades, journalists have used maps to communicate information to readers. With GIS, they can now incorporate data onto these maps and look for patterns and interactions that would otherwise go unnoticed. For example, they can perform spatial analysis of these data to

study the geographical proximity of elements. This way, a journalist can easily determine how close a school is to environmental hazards, for example (Herzog, 2003). It allows for the efficient simplification of complex data and the communication of these data visually (Goodchild, 2000).

This means that journalists can now incorporate database and spreadsheet software to produce powerful and unprecedented visualizations of news. Use of GIS in journalism ranges from analysis of national census data, to investigation of housing code violations. The *Miami Herald* used GIS to study damage patterns in the wake of Hurricane Andrew in 1992. The investigation led to discoveries of widespread housing code violations in Dade County. Reporters from the *Philadelphia Inquirer* used GIS to study the relationship between drunken driving and road fatalities. They found that most road accidents occurred within areas with high concentrations of liquor establishments (Herzog, 2003).

Using GIS, investigators from the *Columbus Dispatch* studied inequitable housing tax assessments based on race. The investigation found that minorities living in inner city areas were assessed higher property taxes than residents in suburban areas. Other uses of GIS in journalism include: linking race to spoilt ballots, investigations of environmental hazards, the effectiveness of desegregation in schools, etc.

The power of GIS lies in what it can do and the benefit thereof to reporters. It would have been very difficult for the *Miami Herald* to analyze and visualize the wind patterns against the property damage patterns without GIS. The *Inquirer*'*s* investigation of the relationship between drunken driving and liquor establishments further exemplifies the uniqueness of GIS. Although it would be an over statement to say that such analysis is exclusively possible with GIS, still the visual capacity to display data is what makes GIS unique.

This means that reporters now have a tool to enhance the quality of news reporting in order to give the public a better product. Large amounts of data can now be summarized simply and quickly. The discreet patterns mentioned above can now be displayed visually with maps alongside other infographics. Using GIS maps, reporters can now visually depict crime statistics, census data, tax information, and even ballot information.

Some of these journalistic uses of GIS have gained national prominence, winning prestigious journalistic awards (Herzog, 2003). But more importantly, these are issues that are of extreme importance to the public in everyday life. Some of these investigations resulted in intense public debates leading to new legislation or changes in existing legislation. For example, the *Miami Herald* story on Hurricane Andrew led to tougher regulations on house constructions not only in Dade County, but also in Broward County. Contractors now had to use better quality materials to build houses. In Philadelphia, the *Inquirer* story led to heated public debate. Soon after the story ran in the paper, residents used the *Inquirer's* online bulletin to post their reactions. This soon resulted in the adoption of a new blood alcohol level of .08 (Herzog, 2003). Increased use of GIS in journalism has the power to create a more informed citizenry, contribute to increased public debate, and even lead to important changes in public policy and government leadership that may result in a better society.

GIS has been popular among media marketing agencies to map out the demographics and locations of viewers and subscribers. Similarly, circulation departments have used GIS to map out efficient delivery routes for newspapers. It is in the newsroom that GIS is still trying to gain a foothold, and thus the focus of this paper. The purposes of this paper are 1) to study the likelihood of journalists to adopt GIS for use in the newsroom and 2) to predict the future of GIS in journalism. The study looks at demographics and other factors like technology clusters as

described in the literature, and their effect on the likelihood of journalists to adopt GIS. The study also aims at looking at the factors that will hinder or promote the future of GIS in journalism.

CHAPTER 2: LITERATURE REVIEW

Background

The history of journalism has been marked by important technological advances since Guttenberg's invention of moveable type in 1405. Friedrich Koenig's steam driven press (1814) introduced mass circulation of newspapers. Ottmar Mergenthaler's Linotype machine first used by the *New York Tribune* in 1886 would be an industry standard for the next 90 years. The mid-1930s saw the introduction of cold type and photocomposition technologies that later replaced the expensive and labor-intensive hot-metal typesetting (Moghdam, 1978).

Computers were first used by newspapers in order to replace routine tasks in newspaper production. Two such tasks were line justification and hyphenation, both which took about 40% of the human typesetter's time to perform. The *Los Angeles Times* was the first to use a linecasting machine in 1962 (Moghdam, 1978). With the introduction of time-sharing[1] computers, typewriters slowly disappeared from the newsroom. Reporters now worked on their stories on video display terminals linked to mainframe computers. It was not until the 1980s with the introduction of desktop computers that computer prices went down and the technology diffused quickly. With the desktop computers came a vigorous software industry ready to sell packages for word-processing, spreadsheet analysis, and database management (DeFleur, 1997).

Geographical Information Systems

GIS is "a system of hardware and software used for the storage, retrieval, mapping and analysis of geographical data" (Herzog, 2003, p. 3). It is a computer technology for "managing geographic feature location data and data related to those features" (Cox & Gifford, 1997, p. 449). GIS uses spatial data that can be manipulated, queried, and analyzed. The use of GIS dates

[1] Simultaneous use of a central computer by multiple users.

to the 1960s when need arose to integrate computation and map processing (Goodchild, 2000). It was the Canada Land Inventory that first used a GIS system called the Canada Geographical Information System. They justified the use of GIS on the premise that computational analysis of digital maps was a much faster and cheaper process than if humans did the analysis. The land inventory thought that GIS would do more accurate numeric determinations of land area than humans could.

In order to reduce human error in the analysis of census data, the U.S. Bureau of the Census constructed and used a simple GIS system in 1970. This simple GIS was used to tabulate and spatially analyze the census data. Back then, GIS required extensive training and knowledge of specialized programming languages, making it very difficult to use. However, the 1980s saw the advent of the PC revolution. Not only were desktop computers more affordable and accessible, but so was the GIS software. Currently there are about one million licensed users of different GIS applications that cost $10,000 or more, while users of cheaper GIS applications number almost at 10 million overall. Also, GIS is used in a myriad of fields including but not limited to telecommunications, resource management, urban and regional planning, and delivery services (Goodchild, 2000).

How GIS Works

GIS works with two primary kinds of data: geographic coordinate data and attribute data (Cox & Gifford, 1997). Geographical coordinate data, also called spatial data or shape files refers to map data that show features and locations on earth. These data may be presented in any of the three forms: points, lines, or areas/polygons. Points refer to features like cities or schools, lines may depict streets or highways, and polygons may depict parks, counties, or neighborhoods. Attribute data is the information linked to the features on the map and usually

comes in the form of a database. The attribute may describe the parish, the school, the highway, or the area under study. For example attribute data for a county may contain the population, the area in square miles, names of cities, etc.

In a GIS application, a user may upload a shape file that contains certain features that are under study. Each feature contains an attribute table that contains both string and numerical data describing certain aspects of the feature. Different features and their attributes make up layers. For example, a city map might have layers that represent railroads, highways, schools, parks, buildings etc. Each layer may be linked to an attribute table that gives details about that particular layer. For example, an attribute table for the schools might have the names of the schools, the number of students, location of each school, etc. All these layers make up a GIS database that is used for analysis. In order to map out the best delivery routes for example, a user can compare highway and street layers against locations of customers layers.

Since GIS uses maps and symbols to depict data, it is an important tool for visual analysis. Perhaps the most important feature of GIS is its ability to visually display information. It allows users to simplify complex data efficiently and communicate large amounts of data visually and quickly (Goodchild, 2000). The final analysis display, also called the layout, may include color coded maps, legends, infographics, and even text. This makes GIS an unprecedented tool for research and analysis.

GIS And Journalism

Computer-assisted-reporting has gained popularity among journalists in the last two decades with the use of spreadsheet and database software in news reporting. Recently, some journalists have added GIS to the array of computer-reporting tools that they use in their work. GIS brings news to life with its capability to produce powerful visualizations of patterns and

interactions of spatial data that would otherwise go unnoticed with traditional newsgathering techniques (Herzog, 2003). Several reasons have led to the adoption of this new technology in journalism:

- As mentioned earlier, computer-assisted-reporting enables journalists to analyze data and look for interesting relationships and relate these to news stories.
- With the advent of desktop computers, GIS applications are now widely available for office use. Initially, researchers had to use cumbersome mainframe computers and extensive network systems.
- Government agencies from the federal to the city level are using GIS more and more. Not only does this help the general diffusion of GIS, but most of these agencies provide relevant data either free or at a low cost.
- The Internet also provides a vast store of readily available data at no cost. This data comes from government agencies, GIS consortiums, universities, and commercial ventures (Herzog, 2003).

The Environmental Systems Research Institute (2000), commonly known as ESRI, and who are the developers of one of the most popular suite of GIS software,[2] report an extensive use of GIS by the *Associated Press* and *USA Today*. ESRI reports that the *AP* Graphics Department makes use of MapShop and ArcView to create its news maps. During the presidential elections of 2000, *AP* used GIS to update dynamic maps that showed the results from the presidential and congressional races about 11 times in one night.

[2] ArcGIS, ArcView, ArcIMS, MapShop, ArcSDE, and the Geography Network.

In order to hasten data accessibility to its staff, *AP* has uploaded Census 2000 data into MapShop. The staff can then readily access this data and produce accurate census maps while reporting breaking news. This cuts the time needed to trace relevant map information.

USA Today was the first to use ArcIMS on Census 2000 data, allowing its readers to interactively explore a spatial form of the data online. First, *USA Today* used ArcView and SAS to combine data templates into maps that were later processed through ArcIMS and posted on the web as Macromedia Flash objects. Web users could point on a national level Flash map that would lead them to a county level map and they could view demographic changes since 1990. Drop-down menus of counties and cities in each state led the viewers to ArcIMS. Here, they could view demographic changes at units as small as census tracts (ESRI, 2002).

Florida had long been known to have the most stringent building codes in the nation. Shortly after Hurricane Andrew hit Florida in August 1992, reporters from the *Miami Herald* started covering the extent of the damage. They wanted to investigate whether the damage to homes was entirely due to the hurricane or due to the lack of proper inspections by the authorities. They first obtained data on damaged homes from Dade County, then joined these data to an already existing database that the *Herald* kept on property assessment for the county (Herzog, 2003).

Using Atlas GIS, they combined the data with two maps: a map of the county showing every township and section, and a wind contour map of the hurricane winds. What the output indicated was that damage was not necessarily related to the wind patterns. Homes built after 1980 were more susceptible to wind damage. Further investigations indicated that the same houses were susceptible to the violation of building codes. As a result, and after extensive debate, Dade and Broward Counties tightened their building codes (Herzog, 2003).

With increased concern about road fatalities related to drunken driving, investigators from the *Philadelphia Inquirer* decided to use spatial analysis to study the related patterns. First, they obtained road accident data from the Pennsylvania Department of Transpiration. Next, they obtained data on liquor dispensing establishments from the Pennsylvania Liquor Control Board and geocoded it. Geocoding is a function in GIS where physical address information in the form of a database is plotted on a map. GIS processes each individual address and represents it on a map with a dot. Using maps downloaded from the Internet, investigators then mapped out the accident data to a shape file of the 5-county metro area that the *Inquirer* covered. For this they used Spatial Analyst (an ArcView extension program) that mapped out the densities of the liquor establishments (Herzog, 2003).

They then mapped out the accident crash area, showing streets shaded according to the rates of fatalities. What they came up with was a map that showed that most accidents happened around areas with a concentration of liquor establishments. In order to give the readers more details, the Inquirer developed an interactive online map using ArcIMS. Here, readers could zoom in and look at the statistics in their own neighborhood (Herzog, 2003). Figures1 through 4[3] illustrate this process.

Figure one shows how the investigators color-coded the streets based on the alcohol related accidents. Figure 2 shows how they geocoded the liquor license locations in the area. They then used Spatial Analyst to calculate and map out the density of liquor establishments (Figure 3). For this investigation they only used densities of areas that had more than two liquor establishments per square mile. Figure 4 shows the output when liquor establishment locations

[3] All figures derived from: Herzog, D. (2003). *Mapping the news. Case studies in journalism*. ESRI Press: Redlands, CA.

were compared with crash locations. The resultant visuals show clear patterns between the presence of liquor establishments and the occurrence of alcohol related car accidents.

However good the results looked, the *Inquirer* was yet to be satisfied. Other factors might have influenced the rate of road fatalities. The investigators wanted to make sure that the relationship between liquor establishments and road crashes was not spurious. They commissioned two external researchers who performed further analysis of the data and verified the results.

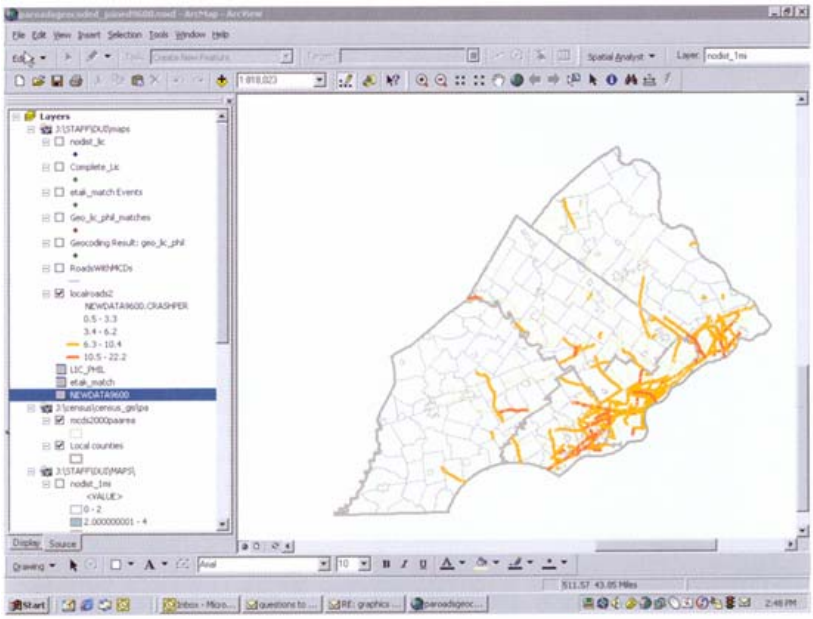

Figure 1: Color Coded Streets Based on Alcohol Related Crashes

Theory: Diffusion of Innovations

The examples described above indicate that GIS is applicable in the field of journalism. Even with this potential usefulness, not many reporters have adopted this software. This study looks at the likelihood of reporters to adopt GIS in their work. The most appropriate theory to guide such a study is the diffusion of innovations theory. Hence, this study uses this theory to determine how likely journalists are to adopt GIS and to predict the diffusion of this technology in journalism.

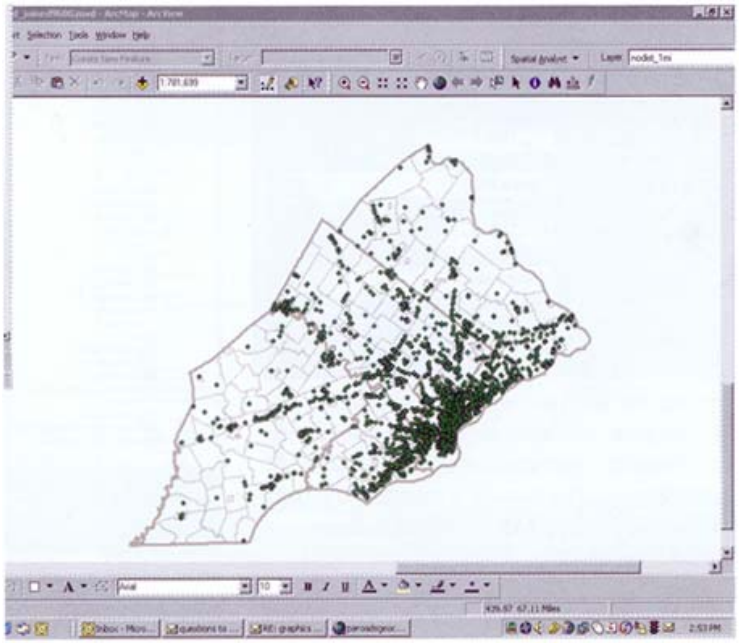

Figure 2: Point Locations of Liquor Establishments

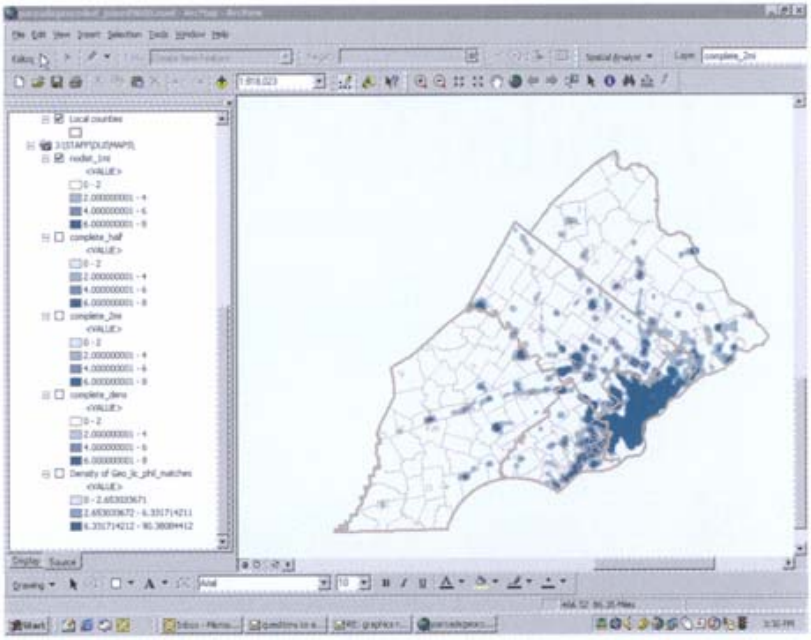

Figure 3: Density of Liquor Establishments

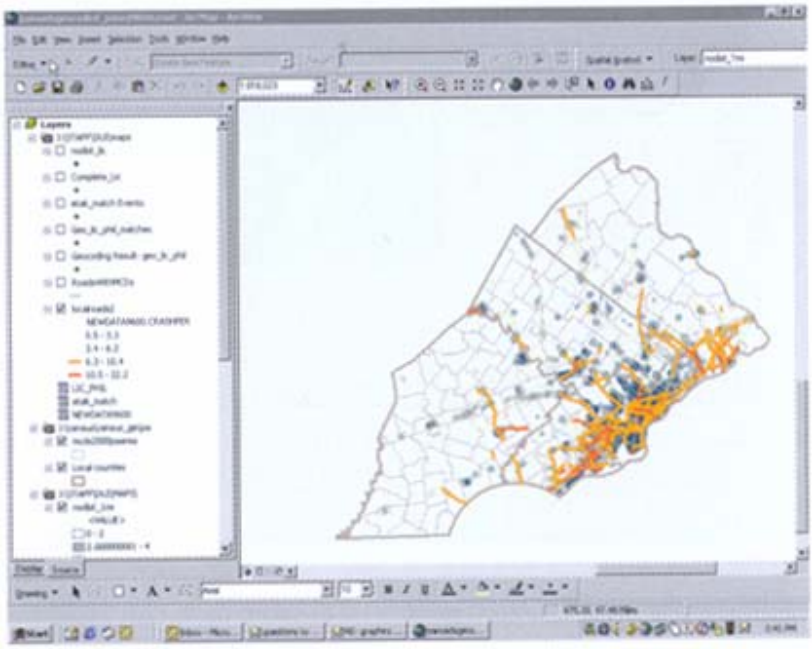

Figure 4: Comparison of Liquor Establishments and Alcohol Related Crashes

Diffusion is the "process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1995, p. 5). An innovation refers to a new idea, object, or practice (Rogers & Shoemaker, 1971). The newness of an innovation is subjective and depends on the interpretation of the individual reacting to it. Although GIS has been around for quite some time in other fields, it is still a very new technology in journalism. The four elements that make up the process of diffusion are: a) the innovation, b) communication channels, c) the social system, and d) time (Rogers, 1995). The process starts out with an innovation that is communicated through a social system over a period of time (Rogers, 2004). This study looks at how much GIS, has diffused within the field of journalism at present, the factors that will affect its future adoption, and how long it will take to diffuse in journalism.

As defined earlier, an innovation is a new idea, object, or practice that is subjectively interpreted by an individual with the possibility of adoption. Even in the case of long time-lags

after discovery or first use, if an idea seems new to an individual, that makes it an innovation to him/her (Rogers & Shoemaker, 1971). Mostly, the word innovation is used interchangeably with technology. Technologies usually have two components: software components that are symbolic and hardware components that represent the material form of an idea. GIS is a software form of an innovation (Rogers, 1995).

Communication refers to the process by which a new idea is transmitted from one individual to another. In the diffusion process, an innovation is passed from the individual who is knowledgeable about it to that individual who is not (Rogers & Shoemaker, 1971). This study will attempt to determine how far GIS has diffused within the journalism industry.

A social system refers to the social confines within which the diffusion process occurs (Robertson, 1971). The social system also can be defined as a group of differentiated individuals engaged in problem-solving activities. Although the individuals are differentiated, they all work in unison to solve a common problem (Rogers & Shoemaker, 1971). In this study, the social system is the newspaper industry. The study was limited to the newspaper industry because GIS has mostly been used by newspaper reporters. David Herzog's *Mapping the News* (2003), the only comprehensive book published to look at GIS and journalism did not contain a single example of the use of GIS and broadcast journalism. Also, a review of literature did not find any examples of GIS use in the broadcast industry.

Time refers to the timeline for the adoption: from the point that an individual hears about an innovation to the time that he/she adopts it. The individual therefore goes through the five steps of the adoption process: "awareness, interest, evaluation, trial, and adoption" (Rogers & Shoemaker, 1971, p. 17). This study will use these steps to determine the present stage of the

diffusion of GIS, and to help predict the future diffusion of GIS in journalism. These steps are discussed in more detail later in this paper.

The Characteristics of Innovations

Innovations have five main characteristics. These are relative advantage, compatibility, complexity, trialability, and communicability (Rogers, 1995).

Relative Advantage

This refers to the extent by which a new innovation has superiority over an older idea, and may be measured in terms of the resultant economic profit. Although GIS does not replace traditional news gathering methods, GIS will help journalists accomplish these tasks much faster, more efficiently, and more accurately. One way that relative advantage manifests is through heavy promotional efforts (Rogers, 1995). The makers of the most popular suite of GIS applications (ESRI) are marketing their products to journalists by holding an annual "Mapping the News" conference in conjunction with the Association of American Geographers, and the National Geographic Society. Apart from inviting specialists and guest speakers, the conference offers seminars and hands-on training on how to use GIS to improve news reporting.

Other organizations affiliated with ESRI also provide GIS workshops that are open to journalists. One such organization is Portland, Oregon-based GIS^3 (GIS Cubed) that offers GIS workshops nationwide.

Compatibility

Compatibility refers to the extent that an innovation is in line with pre-existing values and previous experiences of the adopters. The higher the compatibility, the higher is the likelihood of adoption. This gives the potential adopters some form of security and makes the innovation more meaningful to them. This means that low compatibility rates may in fact hinder the adoption of

innovations (Rogers, 1995). Since GIS is a form of computer-assisted-reporting tool, journalists could easily incorporate it into their already existing tools for computer-assisted reporting. CAR refers to the use of computers and computer-related software in newsgathering and reporting.

Complexity

Complexity refers to the degree of difficulty related to the understanding and use of an innovation. Innovations can be ranked on a complexity-simplicity scale with those easier to understand on the simplicity end. The general suggestion has it that complexity affects the rate of adoption (Rogers, 1995). One factor that might hinder the diffusion of GIS into journalism is the relative complexity of the software as compared with other computer-assisted reporting software. However, ESRI has recently developed a newer version of GIS software (ArcGIS) that has a more user-friendly interface than the older version, ArcView3x.

Trialability

Trialability refers to the extent to which an innovation can be tried on a limited basis. Potential adopters are more comfortable with those innovations that they can try on a limited basis and make judgments based on initial results (Rogers, 1995). While early adopters do not have any past references, laggards can refer to the successes of early adopters before adoption. Herzog (2003) describes eight case studies that successfully used GIS to report news. Two of these are the *Miami Herald* and the *Philadelphia Inquirer* stories described earlier. These can be the reference points for the late adopters.

Observability

Observability refers to the extent that the results of an innovation are observable to others. Results that are obvious and those that are easy to communicate diffuse much quicker than those that are not. The more observable the results are, the more the chances are that

laggards will adopt the innovation (Rogers, 1995). Some communication of this kind has already occurred in the journalism industry. ESRI's marketing of the benefits of adopting GIS to reporters is one such example. The successful use of GIS at different news organizations like the *Miami Herald* and the *Philadelphia Inquirer* are other examples of observability.

Adopting Innovations

It is important to state that adoption and diffusion are two very similar concepts with different definitional connotations. Rogers (1995) defines adoption as the "decision to make full use of an innovation as the best course of action available" (p. 20). On the other hand, diffusion is the spread of an innovation from its inventors to its adopters/users. This means that while diffusion is more of a group phenomenon, adoption is basically an individual process.

Rogers credits Ryan and Gross (1943)[4] as the first to recognize the stages in the adoption process. These stages are awareness, interest, evaluation, trial, and adoption. This study will use these steps to predict the diffusion of GIS into journalism. The following diagram illustrates the steps as described by Robertson (1971).

The Stages of Adoption

Stage One: Awareness

This is also called the knowledge stage. At this point, although the individual is exposed to the innovation, he/she neither has adequate information about it, nor possesses the motivation to gather more. However, this stage is very important as it initiates the sequence for the other four stages.

[4] Ryan, B. & Gross, N.C. (1943). The diffusion of hybrid seed corn in two Iowa communities. *Rural Sociology*. 8, 15-24.

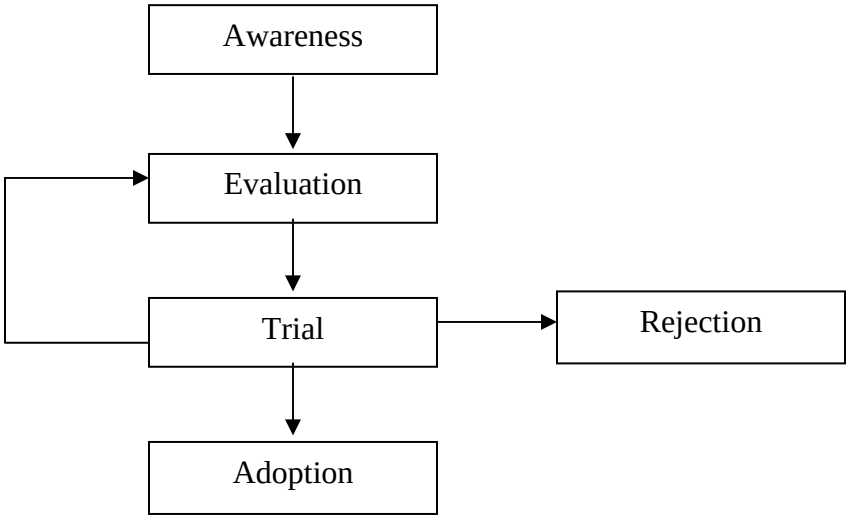

Figure 5: Simple Flow Diagram for the Adoption Process[5]

The assumption is that the individual accidentally becomes aware of the innovation and that the awareness occurs in a random fashion. Although the assumption is that awareness is a passive act, the individual might in fact actively seek information about the innovation. This means that people seek out innovations that help them solve their problems (Robertson, 1971; Rogers, 1962, 1995).

Stage Two: Interest

The interest stage is not included in Figure 5 but is still an important step in the diffusion process. It is also called the information or persuasion stage. Here, the individual seeks more information about the innovation. It is a cognitive stage where the individual looks at the innovation in a general manner but is more involved than at the awareness stage. Therefore, the individual is psychologically more vigorous in seeking information about the innovation. His/her intentions now become more purposive and are guided by the norms of the social system. These

[5] Source: Robertson, Thomas. S. (1971). *Innovative behavior and communication*. Holt, Rinehart, and Winston, Inc.: NY

norms also influence where the individual seeks information, and how he/she interprets this information (Rogers, 1962, 1995).

Stage Three: Evaluation

Here, the individual performs a mental trial by matching the use of the innovation to his/her present and future situation(s). The potential innovator then makes a decision based on the applicability of the innovation and whether the advantages outweigh the disadvantages. The individual may consult with others as a method of reinforcement for the eventual decision (Robertson, 1971; Rogers, 1962).

Stage Four: Trial

Also called the decision stage, here, the individual applies the innovation to his/her unique circumstances. The individual runs a validity test on the innovation before adoption. If the individual needs to seek more information at this stage, it is will be very specific to his/her needs. At this stage the innovation is susceptible to rejection in case the results of the trial stage are misinterpreted (Robertson, 1971; Rogers, 1962, 1995).

Demographic characteristics are among the unique circumstances that have been shown to affect the adoption of technologies. For example, younger religious broadcasters were more likely to adopt digital over analog television than their older counterparts (Shultz, 2002). Technology enthusiasts, also called “techthusiasts” have also been found to be younger people (Crispell, 1994). In a survey of medical doctors in Canada, younger doctors were more likely to have the Internet than older doctors (Martin, 2003).

Gender has often been associated with use of technology, with women being portrayed as passive users. For example, gender is a predictor of an individual’s likelihood to engage in online shopping. Men have been found to be more likely to use the Web to buy goods and/or services

than women (Van Slyke et al., 2002). Age also has a similar effect on the use of the Internet. Gender differences have also been noticed with the adoption of computers (Krendl, Brohier, & Fleetwood, 1989; Reismann, 1990).

Stage Five: Adoption

This is also called the implementation stage. Based on the results experienced at the trial stage, the individual then decides whether to continue using the innovation. Two important factors come into play before and after adoption -- rejection and discontinuance. Rejection refers to the decision to stop using the innovation before adoption. Discontinuance refers to the decision to stop using the innovation after adoption. Early adopters are less likely to discontinue than late adopters (Robertson, 1971; Rogers, 1962, 1995).

Factors that Affect Adoption at the Organizational Level

The success of an innovation depends on various factors. At the organizational level, the four factors that determine the success of an innovation are: benefits, costs, resources, and discounting factors (Agnew, 1980).

Benefits

Most benefits are grouped into three major categories. Programmatic benefits refer to benefits that come as a result of improved effectiveness and efficiencies. Prestige benefits accrue in the form of recognition as a result of early adoption. An example is when the *Miami Herald* won the 1993 Pulitzer Prize for the report on housing code violations and Hurricane Andrew. Structural benefits refer to greater satisfaction received as a result of using a certain innovation (Agnew, 1980). Research also shows that perceived benefits can affect the adoption of new technologies (Davis, Bagozzi, & Warshaw, 1992).

Studies have shown that digital imaging increases a photographer's flexibly, time management, and usability (Fahmy & Smith, 2003). Photojournalists said that the advantages of adopting this technology outweigh its disadvantages. Some of the benefits that resulted from use of digital imaging included increased flexibility, easier transfer of digital images from locations, and more information-sharing in the newsroom. Use of digital imaging also allowed photojournalists to be more aware of their images and this helps to pre-determine usable images before they are sent to the newsroom (Fahmy & Smith, 2003).

Costs

These are the costs that are accrued upon implementation of an innovation (Agnew, 1980). GIS is now sold in the form of licenses. A single-use license for the main GIS software ArcGIS costs $1,500. Another related GIS software 3D Analyst costs $2,500 for a single-license use. The expensive nature of this software might be a limiting factor for its adoption.

Resources

Resources are a central factor influencing the adoption of innovations especially at the organizational level. These resources include: wealth, manpower, equipment, information, and staff. Use of GIS in journalism requires trained staff and proper equipment (hardware and software). These are factors that determine whether an organization will make the extra investment in this new technology (Agnew, 1980). In order to improve the adoption of new technologies, organizations have to invest in the early adopters and make their activity more visible (Berwick, 2003).

Discounting Factors

Discounting factors include the four utility functions that organizational decision-makers put into consideration when faced with decisions on innovations. These decisions are driven by

costs, benefits, and resources. The four utility factors are: risk considerations, the average cost of discontinuance of an innovation at some point before full adoption, uncertainty and doubts about the cost-benefit calculations based on adopting an innovation, and projections of instability as far as future benefit-cost ratios are concerned (Agnew, 1980). Venturesomeness, which refers to the likelihood of decision makers to ignore potential risks and uncertainties when adopting an innovation, is also a factor (Foxall & Bhate, 1991). Since GIS is still a new technology in journalism, these utility factors could as well prove to be obstacles as far as adoption is concerned.

Technology Clusters

"A technology cluster consists of one or more distinguishable elements of technology that are perceived as being closely interrelated" (Rogers, 1995, p. 15). What this means is that people will adopt technologies in bundles. For example, people who buy personal computers also are likely to own technological gadgets like VCRs, camcorders, cell phones, videotext etc. (Lin, 1998, 1994). People who use audiotext are also likely to use videotext and e-mail (Atkin, 1995; LaRose & Atkin, 1992). Since GIS cannot be used in a vacuum, it is assumed that prior knowledge of other technologies/software like CAR-related software might influence one to adopt GIS.

The Diffusion Process

People do not adopt innovations simultaneously (Brown, 1981). That is why diffusion can be viewed as the percentage of people within a social system who adopt certain innovations over time (Robertson, 1971). The diffusion process can be can be depicted either using the cumulative curve or the non-cumulative curve. The cumulative curve plots the cumulative proportion of users against time of adoption and takes an S-shape. The non-cumulative curve is

segmented and is divided into five categories. The non-cumulative curve uses the standard deviations from the mean time of adoption to divide adopters into five categories: the innovators, early adopters, early majority, late majority, and laggards. These two curves are illustrated in figures 6 and 7. It is important to note that both curves assume a 100% adoption rate.

Cumulative Adoption

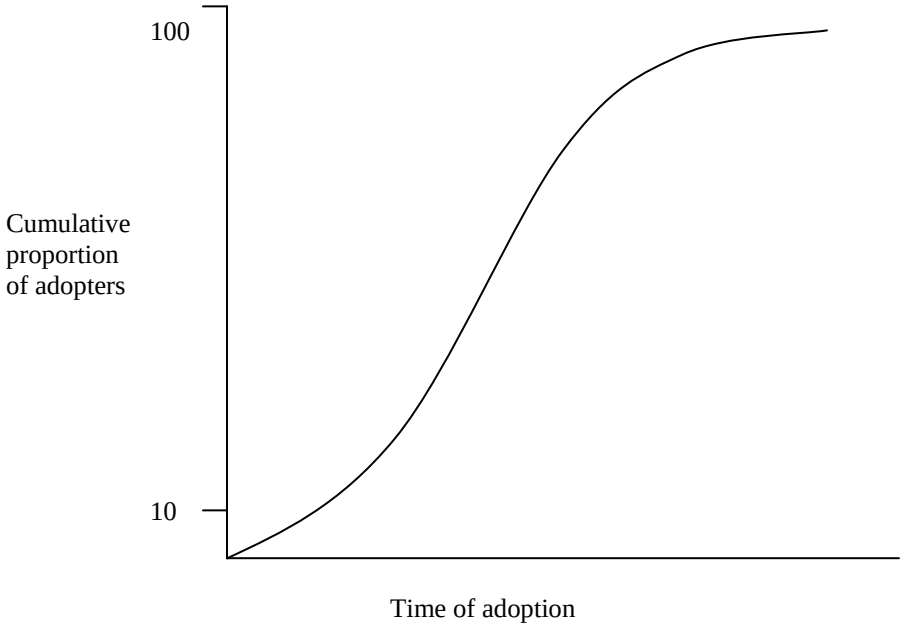

Figure 6: Cumulative Diffusion Using Time of Adoption [6]

The cumulative curve takes an S-shape, most common with the life-cycle of a marketing product and it goes through four stages (Robertson, 1971).

1. At first the innovation is introduced and experiences a slow adoption rate.
2. In the second phase the innovation experiences a rapid adoption rate.
3. In the third phase the adoption rate declines and hits a plateau.
4. Finally the adoption rates begin to drop.

[6] Source: Robertson, Thomas. S. (1971). *Innovative behavior and communication*. Holt, Rinehart, and Winston, Inc.: NY

Non-cumulative Adoption

The non-cumulative process divides adoption into five different categories: innovators, early adopters, early majority, late majority, and laggards. Innovators are the more venturesome people who first adopt an innovation; they do not have to be part of the social system. Early adopters are an integral part of the social system and mostly are opinion leaders in that system. They form a reference point for other potential adopters. Even though they are not opinion leaders, the early majority adopt innovations much faster than the average member of the social system. Late adopters usually are skeptical about innovations. It takes peer pressure for them to finally adopt the innovation. Laggards are the last people in the social system to adopt innovations. They are likely to be societal isolates and have deep suspicion of innovations and change agents (Rogers, 1995). When these categories of people are plotted against time, a normally distributed curve emerges as illustrated in figure 7.

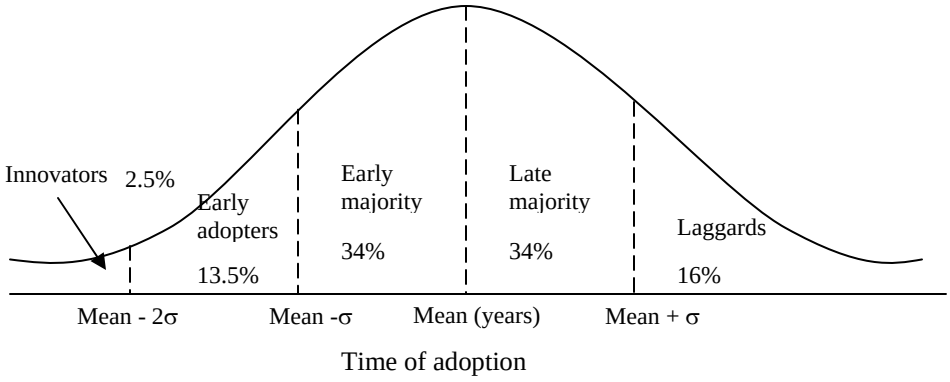

Figure 7: Non-Cumulative Diffusion Using Mean Time of Adoption [7]

[7] Source: Robertson, Thomas. S. (1971). *Innovative behavior and communication*. Holt, Rinehart, and Winston, Inc.: NY

This normal curve depicts the innovators being two standard deviations below the mean years of adoption, early adopters lie within one standard deviation below the mean while the late majority are within one standard deviation above the mean. Laggards fall more than one standard deviation above the mean (Robertson, 1971; Rogers, 1995)

The Diffusion of Other Technologies in Journalism

The use of new technologies is revolutionizing the newsroom. One area where this has occurred is computer-assisted reporting. Three decades ago, researchers like DeFleur and Ball-Rokeach (1975) predicted that computers would forever change the process of communication. The development of computer-assisted reporting dates back almost 30 years, coinciding with the introduction of *precision journalism* (Meyer, 1973). Precision journalism involved the use of social science methods applied to journalism. For example, surveys, data analysis, experiments, and use of computers and databases.

CAR is the "use of computers to gather information for a news presentation" (Garrison, 1995, p.4), and is made up of online research and database journalism. Online research refers to the search and retrieval of information from the Internet; database journalism is the computerized use of information data banks for news stories (Garrison, 1995). For example, reporters can do online research by performing simple Internet searches. They also can use e-mail lists, news groups, and online encyclopedias to find information on various topics. One example of database journalism is the Pulitzer Prize winning investigation of the pork industry in North Carolina by the *News and Observer*.[8] Using a database of state telephone calls, reporters discovered a peculiar pattern of calls from powerful legislators to a prominent hog farm. The investigation

[8] http://www.pulitzer.org/year/1996/public-service/works/about.html

later revealed that legislators who had connections with the hog industry had supported weak anti-pollution laws that favored the hog industry to the detriment of the environment.

Different CAR technologies have experienced different adoption rates in journalism. One rapidly adopted innovation is online research. Use of online research to supplement news reporting experienced a dramatic jump between 1994 and 1998; in 1994, use of online research in journalism stood at 57% and increased to 97% by 1998 (Garrison, 2001). Table 1 shows the projected demand for CAR-related software from 1995-1998 while table 2 shows the actual adoption rates for the same software by the year 2000 (Garrison, 2001). The projected demand for CAR-related software was based on responses from reporters when asked what they thought the demand for different software would be over the years. The projected demand for online research more than doubled in four years, while the demand for statistical software fluctuated while remaining relatively low. Even though the use of online research remained high, table 2 shows that the actual rates of adoption for other CAR-related software remained low (Maier, 2000).

Table 1: Percentage of the Projected Demand for CAR-Related Software in Journalism from 1995 to 1998

Category	**1995**	**1996**	**1997**	**1998**
Database software	15.8%	11.4%	15.4%	31.1%
Mapping software	9.9%	12.1%	12.5%	14.3%
Statistics software	1.8%	6.1%	2.2%	2.5%
Other new software	4.7%	6.8%	4.4%	4.2%

Source: Garrison, B. (2001). Computer assisted reporting near complete adoption. *Newspaper Research Journal. 22(1),* 65-79.

Table 2: Adoption Rates for CAR-Related Software by the Year 2000.

Category	**Use in the newsroom**
Spreadsheet software	10%
Database software	4%
Mapping software	1%
Statistical software	1%

Source: Maier, S. (2000). Digital diffusion in the newsroom. The uneven advance of computer-assisted-reporting. *Newspaper Research Journal. 21(2),* 95-110.

It has taken 30 years for CAR to enter the mainstream, with the most growth experienced in the last 15 years. One reason for this growth is the emergence of organizations that promote CAR such as the National Institute for Computer-Assisted Reporting. NICAR, based at the Missouri School of Journalism, was formed in 1989 as an endeavor to train journalists in the use of electronic information. Other factors that might have motivated newsrooms to adopt CAR-related technologies include:

- Improved productivity.
- Savings associated with better information gathering techniques such as the use of readily available online data.
- Improved accuracy of information.
- Efficient storage and retrieval systems (Garrison, 1995).

Technological innovations have not been limited to CAR. The field of journalism in general has experienced numerous innovations over the decades. These innovations have all had different adoption rates. One innovation notable for its lack of success is videotex. This is a computerized system that combines and transmits both text and graphics that can be displayed on a television set (Wikipedia, 2005[a]). Videotex was first adopted by the British Broadcasting

Corporation in 1969 (Shedden, 2005), but was not introduced into the U.S. until 1980 by Knight Ridder (Finberg, 2003). However, videotex had a very short shelf life as its use died out with the introduction of PCs in the mid-‘80s (Finberg, 2003).

The earliest use of an electronic database was by the *New York Times* in 1969 with the Infobank, a collection of news story abstracts. This would later develop into a full-fledged commercial database when Nexis bought the Infobank in 1983. This database is presently called LexisNexis and is popular with scholars, lawyers, and journalists. Other early electronic database systems include the Dialog database in 1971 and the ORBIT service started a year later. Dialog not only provides information to media practitioners, but also to people in many other disciplines. While Dialog is still in use, the ORBIT database service was closed in 1999 (Shedden, 2005).

In 1981, The *Columbus Dispatch* was the first newspaper to go online, with the help of CompuServe’s dial-up system. CompuServe was one of the earliest Internet service providers. Soon other newspapers like the *Washington Post*, the *New York Times*, the *San Francisco Chronicle*, and the *Virginia Pilot* followed suit. This process of getting newspapers online was an endeavor between CompuServe and *AP* member newspapers. By 2004 1,500 North American daily newspapers had gone online (Shedden, 2005).

By 1994 reporters were moderate users of the Internet. CompuServe Internet service was used by 35% of the reporters, while America Online was used by 21% of the reporters. Other Internet service providers were used by about 19% of the reporters (Shedden, 2005). Two years later, journalists were well versed in the use of online search engines. Yahoo was the most popular search engine with 29% of the reporters using it. This was followed closely by Netscape

with 25% and Alta Vista with 18%. These numbers changed dramatically in 1997 when 43% of the reporters used Yahoo, with Alta Vista recording a distant second with 19% (Shedden, 2005).

Blogs are one of the latest developments in journalism. Blogs have probably experienced the highest rate of diffusion in journalism. While there were only a dozen blogs in 1999, blogs currently number in the millions (Columbia Journalism Review, 2003). The word blog comes from the term Weblog, coined by John Berger in 1997, an otherwise unknown avid Web surfer (Wikipedia, 2005[b]). Although blogs are not limited to news outlets, many news services have adopted blogs of their own. Examples include Spokane, Washington's *Spokesman Review* blog[9], The *HuffingtonPost.com*[10] run by *Yahoo News*, the *Washington Post*[11] blog etc.

The aforementioned factors might influence the diffusion of GIS in journalism. The purposes of this study are 1) to determine the likelihood of reporters to adopt GIS, and 2) to predict the future of the diffusion of GIS in the journalism industry. In order to meet these purposes, this study will answer the following research questions:

RQ1: What obstacles will the diffusion of GIS in journalism face?

This research question deals with costs and cost-benefit analysis, factors that affect adoption at the organizational level (Agnew, 1980). GIS is now sold in the form of licenses. A single-use license for the main GIS software ArcGIS costs $1,500. Another related GIS software 3D Analyst costs $2,500 for a single-license use. The expensive nature of this software might be a limiting factor for its adoption. This will be answered with results from the in-depth interviews.

RQ2: What is the awareness level of GIS among reporters?

[9] http://www.spokesmanreview.com/blogs/
[10] http://news.yahoo.com/i/2413
[11] http://blogs.washingtonpost.com/campaignforthecourt/

This is derived from the first stage in the adoption process where the individual is exposed to the innovation, but he/she neither has adequate information about it, nor possesses the motivation to gather more.

Table 3: Chronology of Key Technological Innovations in the Newspaper Industry

Year	Technology	Status
1969	Videotex in introduces in the U.K.	Use stops in 1986
1970	Infobank	Sold to Nexis in 1983; Nexis is currently called LexisNexis
1971	Dialog database System	Still in use
1972	ORBIT database system	Closed in 1999
1983	Knight Ridder launches videotex in the U.S.	Knight Ridder ends its videotext project in 1986. Use of videotex dies out around this time.
1981	First newspaper goes online *(The Columbus Dispatch*)	By 2003 1,500 North American newspapers go online
1983	NY Times adopts the Nexis database	Still in use
1997	Yahoo takes 43% of the search engine market among reporters	By 1998, 97% of reporters did online research using a variety of search engines.
2004	Blogs go mainstream	Current estimates list 14.2 million blogs (Technorati.com, 2005).[12]

This stage is important as it initiates the sequence for the other four stages (Robertson, 1971; Rogers, 1962, 1995). This will be answered using the percentage of reporters who said they had heard about GIS.

[12] Technorati.com is a search engine that tracks blogs.

RQ3: How interested are journalists in learning more about GIS?

This measures the second stage of the diffusion process. In the interest stage, the individual seeks more information about the innovation. It is a cognitive stage where the individual looks at the innovation in a general manner but is more involved than at the awareness stage (Robertson, 1971; Rogers, 1962, 1995). This will be answered using the mean level of journalist interest in learning more about GIS.

RQ4a: What best predicts the likelihood of reporters to adopt GIS on a *trial/evaluation* basis using the variables of demographics, the use of other technologies, and organizational size?

RQ4b: What best predicts the likelihood of reporters to adopt GIS on a *permanent* basis using the variables of demographics, use of other technologies, and organizational size?

The difference between these two questions is adoption on a trial basis versus permanent adoption. Demographics have been shown to affect the adoption of technologies. Age has been shown to have such an affect (Shultz, 2002; Crispell, 1994; Martin, 2003), as has gender (Van Slyke et al., 2002; Krendl, Brohier, & Fleetwood, 1989; Reismann, 1990). Use of other technologies has also been shown to affect adoption. Technology clusters are those technologies that have functional similarities (Rogers, 1995). Use of certain technologies has led to the adoption of compatible technologies (Lin, 1988, 1994). At the organizational level, resources have been shown to influence the adoption of innovations (Agnew, 1980).

OLS regression will be used to determine the effect of the independent variables of demographics, use of other technologies and organizational size on the two dependent variables, likelihood to adopt GIS on a trial basis and likelihood to adopt GIS on a permanent basis.

RQ5: How much has GIS diffused in journalism?

This research question is based on the fact that people do not adopt innovations simultaneously (Brown, 1981). The diffusion process can be determined based on the cumulative proportion of adopters over time or the percentage of adopters in the five distinct time segments illustrated in figures 6 and 7. This will be answered using the percentage of reporters who currently use GIS in their work.

CHAPTER 3: METHODOLOGY

This study used two data collection methods: in-depth interviews and a Web survey.

Study 1: In-depth Interviews

There were three purposes for the in-depth interviews: one was to get a general understanding of the dynamics that are involved in the use of GIS in journalism. The second purpose was to have a guide to construct the survey instrument that was used in the Web survey. Thirdly, the results from the in-depth interviews were used to discuss research question 1, which deals with the obstacles that will affect the future of GIS in journalism.

In depth interviews are good when dealing with smaller samples. Unlike surveys, in depth-interviews give researchers a chance to obtain detailed information from respondents. Respondents get a chance to elaborate their opinions at length and recollect past events. Since the interview is done on a person-to-person basis, interviewers can customize the interview to suit each respondent (Wimmer & Dominick, 2000). This study lends itself to this method because it aimed at looking into the dynamics involved in the use of GIS in journalism. This required detailed responses from those reporters who had used this software before. In addition, since only 10 people were identified, this was the most appropriate method to use.

The 10 interviewees were purposively selected from David Herzog's book *Mapping the News* (2003). The snowballing technique was used in order to identify more reporters who have used GIS. An introductory e-mail explaining the nature and purpose of the study was sent to all the people listed in the book. Interviewees were then asked to choose an appropriate time for the interview. The interview was conducted over the phone and the responses were recorded on tape with consent. Both open and close ended questions were used for the in-depth interviews. The

interview started with an introduction and a brief discussion of the reporter's GIS project(s) as discussed in *Mapping the news.*

Some of the sample questions included (See appendix A for full version of questionnaire):

1. What factors motivated you to use GIS?
2. How did you learn about GIS?
3. What are some of the obstacles you faced when using GIS?
4. Do you still use GIS as a tool for newsgathering and reporting?
5. What other computer-assisted reporting tools do you use for news gathering and reporting?
6. What do you think is the future for GIS in the journalism industry?

Results from the in-depth interviews were analyzed and used to construct some of the questions for the Web survey. For example Web survey questions on the use of other technologies were derived from the results of the in-depth interviews. The Web survey asked respondents if they used any database, spreadsheet, or statistical software in their work. Web survey respondents were also asked about their use of online research to augment news reporting, as well as their use of other technological devices in their work.

Study 2: Web Survey

The Internet is changing the face of the survey research industry (Couper, 2000). The proliferation of the Internet and the increase in computerization both have led to the development of self-administered methods of data collection like Web surveys (Torangeau, Steiger, & Wilson, 2002). The Internet provides researchers with a quick and low-cost means by which to reach a vast number of respondents by using Web surveys as opposed to telephone and mail surveys

(Dominelli, 2003). Research also shows that as far as response rates are concerned, Web surveys do not fare worse than other methods of data collection (McCabe, 2004). Unlike mail surveys Web surveys give instant responses and also offer automatic coding of the results. Web surveys are also easy to construct and administer. All one needs is access to the Internet and a Web server, both which are widely available (Dominelli, 2003).

Lately, administering Web surveys has become much easier as online research firms offer cheap and convenient services. For a small fee, one can easily construct and host complicated Web surveys and customized e-mail lists. One example is Surveyconsole.com which was used for this study. For $29 a monthly fee, one can construct surveys with skips patterns and multimedia with absolutely no prior programming knowledge. Surveyconsole also offers a dynamic contact list that automatically updates those respondents who have completed the survey. This way, e-mail reminders are only sent to those who have not yet completed the survey. Surveyconsole also allows for the exportation of data into spreadsheet files that are easily transferable to SPSS.

One important issue with Web survey methodology is coverage error. This occurs when all the units in a population lack a known non-zero chance of being selected in the sample (Dillman & Bowker, 2001). Even with the popularity of Web surveys, it is hard for researchers to come up with representative samples using e-mail. Not everyone has an e-mail, and even those who have e-mail do change the addresses often (Dominelli, 2003). This was not an issue with this study since all reporters in the sampling frame have standard e-mail addresses based on the newspapers they work for. Another issue that hinders the effectiveness of Web surveys is the fact that the respondent has to have computer access. It is unlikely that this could have been a problem with this study because a recent study showed 80% of the reporters access the Web at

least once a week (Weaver, Beam, Brownlee, Voakes, & Wilhoit, 2003). Respondents may also worry about the security issues associated with Web surveys since it is hard to tell online, the legitimacy of a surveyor (Dominelli, 2003).

For the reasons mentioned above, a Web survey was deemed an appropriate method for this study. The survey was constructed using recommendations for effective Web survey design (Couper, Traugott, & Lamias, 2001; Dillman & Bowker, 2001; Dillman, Bowker, & Tortora, 1998; Dillman, 2000) in order to reduce measurement error. Measurement error occurs when respondents give wrong answers due to poor survey design. These guidelines include use of a progress bar, use of plain non-distracting backgrounds, use of single-screen questions, and avoidance of forced-response questions, among others. The Web survey was an adaptation of Garrison's (1995) "Computers and reporting 1994 questionnaire" and "Computer-assisted reporting study 1995 research questionnaire" (See appendix B for questionnaire).

Sampling Techniques

The population comprised of full-time reporters from the top 100 English language U.S. daily newspapers. The study was limited to newspaper reporters. As has been explained earlier, the review of literature revealed that the use of GIS has been limited to the newspaper industry. Also, the only comprehensive publication on GIS and journalism, *Mapping the News* (Herzog, 2003), exclusively reports the use of the software in the newspaper industry. The study was also limited to high circulation newspapers based on the reasoning that high circulation newspapers were more likely to afford an expensive software such as GIS since they had more resources, a limiting factor for lower circulation newspapers.

Sampling frame: The 2004 *Editor and Publisher International Yearbook* was used to generate the sampling frame for the top 100 U.S. daily newspapers. Contact information of all

the reporters from these newspapers was obtained from Burrelles*Luce*, a leading media contact firm. The Burrelles*Luce* Website[13] has an online searchable database. This service usually requires a paid subscription; however, offered a free subscription to students in journalism schools who are engaged in research. The search terms used for this study were: reporters, United States, daily newspapers, and circulation size more than 100, 000.

The initial spreadsheet contained about 6,000 reporters; after deleting duplicates the final number stood at 4,000. The initial spreadsheet also had other fields like the physical address of the newspaper, circulation size, and telephone and fax numbers. These were deleted and only the reporters' names, the newspaper title, circulation size, and e-mail addresses were used for the Web survey. Using SPSS, a 10% random sample was then selected for a sample size of 400.

The spreadsheet was then uploaded to the Web survey's hosting Website (www.surveyconsole.com). Using multiple contacts as described in Schaeffer and Dillman (1998) and Sheehan and McMillan (1999), each reporter in the sample was contacted through e-mail to inform them about the survey. A second e-mail was sent including a hyperlink to the web survey. The second e-mail was more detailed and included a description of the survey and privacy notices. Five e-mail reminders were sent to those who did not fill out the initial survey to help reduce non-response error, which occurs when the respondents who did not answer the survey happen to be demographically different from those who did (Dillman & Bowker, 2001). Survey Console has a function that identifies those who have completed the survey and those who have not, ensuring that reminders are sent only to those people in the sample who have not completed the survey.

[13] http://www.burrellesluce.com/

Dependent Variables

There were two dependent variables: Respondents were asked two questions about their likelihood to adopt GIS on a trial/evaluation and on a permanent basis. The variable was measured on a Likert scale 1-7 (where 1 = not at all likely, 7 = very likely to adopt GIS).

Independent Variables

- Age, measured on a continuous level.
- Gender, men were coded as 1 and women as 0.
- Education: this variable was measured on an ordinal scale where:

  1 = Less than high school
  2 = High school
  3 = Some college
  4 = Undergraduate degree
  5 = Graduate degree

- Organizational size: This variable was measured using the newspaper circulation size, included the database downloaded from the Burrelles*Luce* Website.
- Use of other technologies: this variable was measured as two questions then the two were summed together.
  - Prior use of computer-assisted reporting tools: Respondents were asked if they had ever used CAR tools (variations of spread sheet, database, or statistical software). For each software package used, the respondent received a point. The tally was then used to construct a composite score for CAR tools ranging from 0-10.
  - Use of other technological innovations: Respondents were asked about their use of technological devices in their work. For each device used, the respondent received a point. Apart from use of technological devices, respondents were asked

how often they conduct online research to supplement reporting. Online research was used in a general sense to include use of search engines, online databases, e-mail etc. This was used to construct a composite score for use of other technological innovations ranging from 0-4. The overall range for the use of other technologies was 0-14.

CHAPTER 4: RESULTS

Study 1: In-depth Interviews

RQ1: What obstacles will the diffusion of GIS in journalism of face?

The main obstacles that will affect the diffusion of GIS are the technical nature of the software, the problematic nature of available data, and the effects of these data on map analysis. GIS needs a high level of skill to use effectively, and as one interviewee described, the software was "designed for people who have serious academic training in it, which journalists tend not to have." Even some of the self-taught GIS users have had to attend seminars to advance their skills. One respondent, well versed in GIS said that "my problems with GIS have been educational. Learning some of the more technical aspects of GIS, like statistical modeling and spatial analyst (a GIS extension software)…require a technical and sometimes a mathematical background." Spatial analyst is a GIS extension software that is used for advanced functions, for example to calculate and map out population densities. This extension usually needs extra training even for seasoned GIS users.

The nature of data available to users was also a problem. Although GIS data are becoming more and more available, some of these can be described as "dirty" data, as one respondent said: "journalists tend to be using databases that were gathered through bureaucratic means. Where…concern for spelling of addresses…or abbreviations of streets or avenues or things like that tend to be lost, and that makes GIS more difficult." Such inaccurate databases may pose a problem with the geocoding function of GIS.

Geocoding is a function in GIS where physical address information in the form of a database is plotted on a map. GIS processes each individual address and represents it on a map with a dot. The address information in the database must be exact or as similar as possible to the

physical address in order to match. Only those addresses that match with real-life street information on a particular map are geocoded. This means that a simple spelling error or the omission of address information in the database may lead to geocoding errors. The problem with some of the data that users get from government agencies is that they are not accurate enough to geocode correctly.

Respondents said that it was easy to get help with GIS. Most of the interviewees knew sources that they could turn to in case they needed help with the use of GIS. One such source was the geography departments in various universities. Another source was the aforementioned NICAR Website. NICAR was formed in 1989 as an endeavor to train journalists in the use of electronic information. Based in the Missouri School of Journalism, it provides the aforementioned mailing list (NICAR-L), and a resource center that boasts contact lists and a database library. This library contains database information ranging from a listing of all aircraft registered in the USA to a listing of disaster assistance loans made to businesses and individuals.

NICAR membership is open to all media practitioners. Membership varies from professional, academic, associate, retiree, to student. Professional membership is limited to those actively involved in print, broadcast or online media. Academic membership is limited to those who are involved in research or teaching in the field of journalism. Associate membership is for those who used to work in the field of journalism and now work in a different field. Retiree membership is limited to those who are retired from the field of journalism. Membership is also open to journalism students (both U.S. and international).

The in-depth interview was also conducted to provide a general understanding of GIS and as a guide for the Web survey. Interest in GIS and how the respondents learnt the software was an example. Interviewees were asked how they first had heard about GIS, and how they came to

learn it. The 1990 Census was one of the factors that introduced GIS to some of the reporters, as there was need to spatially analyze census data. Five out of the seven interviewees said that they found that GIS was already in use when they joined their newspapers. Three respondents were self-taught GIS users. Three interviewees attended some form of seminar training for GIS, while only one interviewee took college classes in GIS.

Another area of interest was the types of software that the interviewees used in conjunction with GIS. The interviews revealed that other software used included database, statistical, and spreadsheet software like Access, SAS, SPSS, and Excel. All except one reporter said that they keep in touch with technological developments. One reporter said that most reporters who use computer-assisted reporting tools have to keep in touch with technological developments in general. This interviewee said that "the larger world of investigative reporters to varying degrees keeps up with technology. The sub status of people who do what we call computer-assisted-reporting, many of whom are involved in investigative reporting I would say yes…one of the primary ways they do that…is through the NICAR-L mail list." NICAR-L is a mailing list hosted by the National Institute for Computer-Assisted Reporting, a division of the trade organization of Investigative Reporters and Editors, and serves as a forum through which members can share discussion about computer-assisted reporting and new technologies.

Most interviewees painted a positive future for GIS in journalism. One respondent said "I think GIS has already proven its place and power. The number of stories that have been done that could not have been done any other way are growing every year." Another responded had this to say. "The future of GIS is very bright…mostly because maps are such a good tool to explain data (and) to present data to people. With a map…we can either read or visualize and make data simple."

The availability of map data is one important factor that might influence the future of GIS. “I don’t generally have problems with data availability” said one respondent, who also added that “the Florida public record files are very good and the heavy GIS users in my area are very open and very generous.” The fact that more and more government and private agencies are using GIS means that more data is becoming available to users.

Competition between media agencies was another factor that came up in the interview as one that could bolster the use of GIS in journalism. If one media organization successfully used GIS, other media organizations are likely to follow suit and adopt the use of GIS. This echoes what one respondent had to say. “As newsroom managers look around and see what their peers and competitors are doing with it (GIS) they realize that this is an important thing.”

The interview also revealed that management is more likely to invest in this software once its functionality is demonstrated to them. “The ability (of GIS users) to sell to newsroom management that this is a good idea for doing even basic graphic work is increasing,” explained one respondent. Another affirmed this notion by stating that “at first it is very difficult to get a newspaper to invest in it, precisely because it is expensive. Once an editor sees what can be produced with GIS all of those walls come crashing down, and the editors usually will buy it very quickly.”

One respondent felt that although fewer people are likely to master the software, more people can still find use of its products. This means that even the reporters who do not know how to use the software can still make use of GIS maps to tell stories. The respondent described a project that he had undertaken where he downloaded map and census data onto a server and “different people on our staff were able to virtually just take the base map I had given them and populate variables on the server, so they could look at simple maps of all kinds of variables, and

that led to other people other than me who really didn't understand the GIS being able to come up with some map ideas." Based on the fact that people are familiar with online travel map searches like MapQuest (which are in fact GIS products), the respondent went on to say that "there's a possibility of having more GIS that people would use but not necessarily GIS that people would do. If we served it up to them on a platter I think they would use it more."

Study 2: Web Survey

Of the 400 reporters who were sampled, 106 completed the survey for a 27% response rate. This kind of response rate is not unusual with Web and e-mail surveys (Porter & Whitcomb, 2003; Kaplowitz, Hadlock, & Levine, 2004). A basic tenet in survey research is high response rates because it can help reduce non-response error that occurs when those who do not respond to the survey systematically differ from the respondents (Curtis, Presser, & Singer, 2000). However, low response rates can still result in low non-response errors as long as the respondents and non-respondents do not differ greatly (Keeter, Miller, Kohut, Groves, & Presser, 2000). In fact it is very hard to tell the effect of increased response rates on non-response error. There is little evidence to show that a reduction in error occurs, for example, when response rates are increased from 30% to 50% or even from 50% to 70% (Keeter, et al., 2000).

In order to gauge non -response error, this study used a comparison of the respondents' demographics with known national demographics of reporters from all U.S. newspapers by Weaver and colleagues (2003), as shown in table 4. The table compares the 106 respondents with the sample of 400, the census of 4,000 journalists from the top 100 newspapers, and the Weaver study based on demographics of circulation size, gender, and education. Most of these demographics do not differ greatly. For example the median age in this study was 45 years; the national median age is 41 in the study by Weaver and others (2003). Gender in this study

differed by no more than four percentage points from the initial sample of 400 from the 100 largest newspapers, and no more than seven percentage points from all newspaper reporters. The greatest difference was that this study oversampled in the 300,001 to 500,000 circulation category by roughly 16 to 20 percentage points. The other three circulation categories showed a difference of 10.5 percentage points or fewer between the sample of respondents and the census of reporters at the top 100 newspapers. This means that, with the exception of one circulation category out of four, the chances that non-respondents differed systematically from respondents are reduced.

Table 4: Comparison of the Demographics of the Respondents, the Sample, Population of Reporters in Top 100 Newspapers, and the Nationwide Weaver Study.

		Respondents N= 106	**Sample N = 400**	**Population N = 4,000**	**Weaver* Study**
Gender	Male	60%	56%	+	67%
	Female	40%	44%	+	33%
Circulation	100,000-300,000	41.5%	49.9%	52%	+
	300, 001-500,000	42.5%	25.6%	22.7%	+
	500,001-700,000	9.4%	4.6%	11.2%	+
	700,001- above	6.6%	19.9%	14.1%	
Education (college graduates)		92%	+	+	89%

*From Weaver et al., (2003)
+Statistics not yet available

As far as the use of CAR-related software is concerned, table 5 shows that Excel was the most popular while SPSS and SAS were the least used. Eighty-three percent of the respondents conducted online research at least once a day. Respondents were also asked about the

technological devices they use in their daily work. By far the most popular device was the cell phone, followed by text messaging, instant messaging, and blogs.

Table 5: Frequencies and Percentages of CAR-Related Software in Use

Software	**Frequency**	**Percentage**
Online Research	102	96%
Spreadsheet Software	80	76 %
Database Software	59	56%
GIS	12	11%
Statistical Software	4	4 %

N = 106

Variable Transformations

Some variables were transformed due to skewness. Education had a moderate negative skew and was transformed using the square-root transformation SQRT (K-X). Use of other technologies and organizational size both had a substantial positive skews and were transformed using the log 10 transformation LG10 (K-X). Interest to learn more about GIS, likelihood to adopt GIS on a trial basis, and likelihood to adopt GIS at the permanent level all had moderate positive skews. These were also transformed using the square-root transformation SQRT (K-X). Non-transformed statistics were used in the interpretation for ease of understanding.

RQ2: What is the awareness level of GIS among reporters?

In order to measure the awareness level of GIS in journalism, respondents were asked if they had heard about GIS. Sixty-three percent stated that they had heard about GIS.

RQ3: How interested are journalists in learning more about GIS?

After a brief description of what GIS is, respondents were asked how interested they would be to learn more about the software. This was a Likert scale question that ranged from 1-7 (1 = not at all likely and 7 = very likely). The mean interest level was 2.64 (s.d. = 1.65).

RQ4a: What effect do demographics, the use of other technologies, and organizational size have on the likelihood of reporters to adopt GIS on a trial/evaluation basis?

Results of OLS regression analysis showed that three variables were significant predictors of likelihood of adopting GIS on a trial basis: being male, younger, and high use of other technologies. The model was significant at $p < .01$ and explained nearly 13% of the variance (See Table 6). Males were significantly more likely to adopt GIS on a trial basis than females (Male M = 2.59, s.d. = 1.67; Female M = 2.07 s.d. = 1.43). Age was significantly and negatively related to likelihood of adopting GIS; for every one year increase in age, there was a .074 decrease in likelihood of adopting GIS. Use of other technologies was significantly and positively related to the likelihood to adopt GIS on a trial basis; for every piece of technology that reporters said they used, likelihood of adopting GIS on a trial basis went up by .16 of a point. Education and organization size were not significant predictors of the likelihood to adopt GIS on a trial basis.

RQ4b: What effect do demographics, use of other technologies, and organizational size have on the likelihood of reporters to adopt GIS on a permanent basis?

The results showed that males were more likely to adopt GIS on a permanent basis. Men were more likely to adopt GIS than women (Male M = 2.57, s.d. = 1.61; Women M = 2.07, s.d. = 1.43). Age was significantly and negatively related to the likelihood to adopt GIS on a permanent basis. For every one year increase in age there was a .61-point decrease in the likelihood to adopt

GIS on a permanent basis. Education, organization size, and the use of other technologies were not significantly related to the likelihood to adopt GIS on a permanent basis (See Table 7).

Table 6 : Standardized and Unstandardized Regression Coefficients for Demographics, Circulation, and Use of Technology on Likelihood to Adopt GIS on a Trial Basis.

Variable	**B**	**S.E.**	**Beta**
Constant	.416	.348	
Age	-.035*	.031	-.226
Gender	.76*	.052	-.243
Education	.304	.048	.120
Circulation	-2.23	.000	-.014
Use of other technologies	.22*	.074	.206
Df	5		
F	3.889**		
R^2	.128		

*p<.05 **p<.01 ***p<.001 N = 106

RQ5: How much has GIS diffused in journalism?

The level of the diffusion of GIS in journalism was measured by the question: "do you currently use GIS?" Eight respondents indicated that they currently use GIS. These respondents were asked if they knew other people that use GIS at their respective newspapers. Four other people were listed for a total of 12 users.

This research question was also used to gauge the current level of the diffusion of GIS in journalism. This is illustrated in Figure 8 using the S-shaped cumulative adoption curve adopted from Robertson (1971). The curve shows that the diffusion of GIS is at the initial stage of diffusion and the diffusion is still at a very slow rate.

Table 7: Standardized and Unstandardized Regression Coefficients for Demographics, Circulation, and Use of Technology on Likelihood to Adopt GIS on a Permanent Basis.

Variable	**B**	**S.E.**	**Beta**
Constant	.393	.350	
Age	-.03*	.032	-.197
Gender	.76*	.052	-.241
Education	.30	.049	.117
Circulation	-3.84	.000	.026
Use of other technologies	.19	.074	.190
Df	5		
F	3.321**		
R^2	.106		

*p<.05 **p<.01 ***p<.001 N = 106

This should explain the small number of reporters who currently use the software. This initial stage precludes the other stages where an innovation experiences rapid adoption, which later tapers off and starts to drop. The 12 GIS users make up about 11% of the sample. This qualifies them as early adopters according to the non-cumulative curve. Since the non-cumulative curve divides the time of adoption in segments representing the adopters, a determination of the current state of GIS diffusion in journalism can be made. Figure 9 shows that although GIS is past the innovators stage, it is still at the early adopters stage at best.

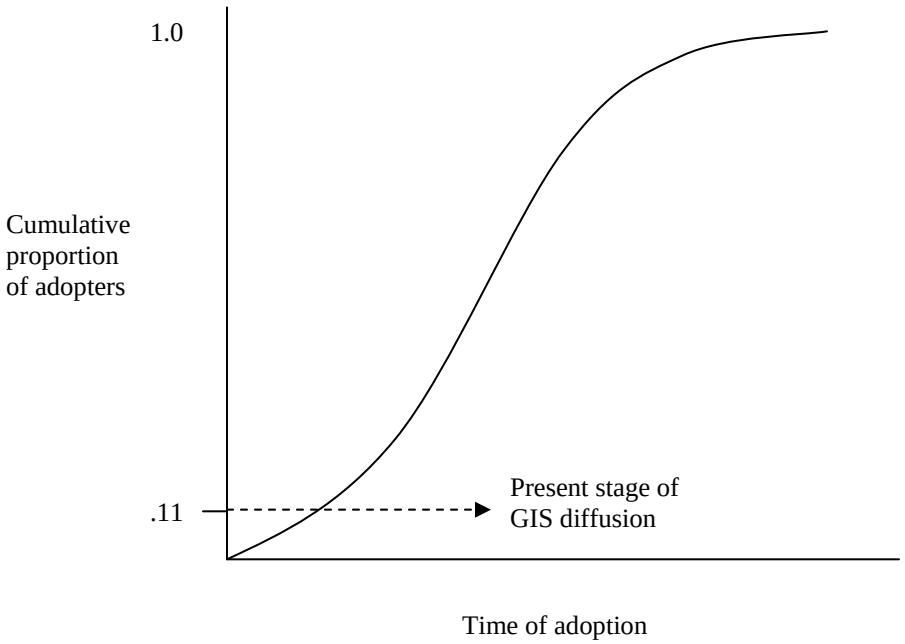

Figure 8: Estimate of the Cumulative Diffusion of GIS Using Time of Adoption

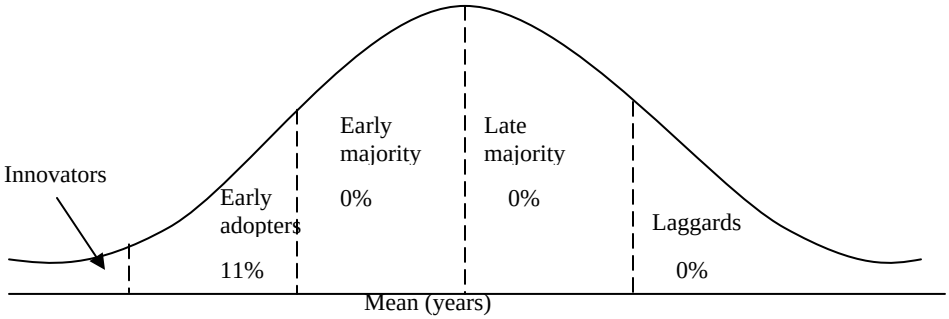

Figure 9: Estimate of the Non-Cumulative Diffusion of GIS Using Mean Time of Adoption

CHAPTER 5: DISCUSSION

The purposes of this study were to determine the likelihood of journalists to adopt GIS and to predict the future of the diffusion of GIS in journalism. The results show that a majority of journalists are aware of GIS but very few have adopted the software so far. Use of this software in journalism is still in its early stages. The awareness stage is an important step in the diffusion of innovations process as it is the trigger for the rest of the adoption process. Although awareness does not necessarily translate to action as far as the use of an innovation is concerned, the fact that 63% of the respondents know about GIS cannot be ignored. Since GIS is a relatively new development in journalism and is mainly confined to investigative reporting, such a high awareness level is bound to draw attention. More so, it is important to stress that this study looked at the general population of reporters and not just investigative reporters, who are more likely to use GIS.

Despite this high level of awareness, the results indicate that currently GIS has diffused very minimally in the field of journalism. This should not come as a surprise. By nature journalists are very slow in adopting new technologies. Garrison (1995) attributes this to the fact that journalists tend to be satisfied with the status quo as far as the use of technology is concerned. Another factor could be the technical nature of GIS. The complexity of an innovation or the relative difficulty to learn or use the innovation affects its diffusion. Complex innovations take longer to adopt (Rogers, 1995). This complexity has to do with the technical nature of GIS and the type of training needed to comfortably use the software.

Although it is also possible that some of the reporters did not see the applicability of GIS in their area since GIS has been restricted to investigative reporting, the software can be used more widely. Business reporters could use a combination of GIS and investigative reporting

techniques to map out the relationship between the locations of high-interest predatory lenders and low-income areas. This way, they can visually demonstrate if high interest lenders are more likely to target low income people by situating in certain areas. Features reporters can map out the different types of community recreational facilities to see if there is inequitable distribution based on socio-economic factors. Similarly, they also could do similar analysis and map out the quality of the same facilities.

The two factors mentioned above also may explain why reporters were not very willing to learn more about the software. The mean for the interest to learn more about GIS (measured on a 1-7 scale) was 2.64. This is despite a 63% awareness level. Journalists are aware of the software but are not really interested in learning more about it.

This low interest rate among reporters may also be due to the aforementioned fact that GIS is a relatively new development in the field of journalism. The earliest report of GIS use by a reporter was in the early ‘90s (Herzog, 2003). This means that GIS has had a very slow adoption process than other software. For example, adoption of online research went from 57% in 1994 to 97% in 1998 – nearly doubling in four years (Garrison, 2001). However, GIS adoption has performed better than statistical software which has been in existence longer. Both software had an adoption rate of 1% in the year 2000 (Maier, 2000); but this study five years later has GIS with an adoption rate of 11% while statistical software remains at 1%.

However, the perceived demand for some CAR-related software followed a non-linear pattern from 1995- to 1998, as shown in table 1. While mapping software had a steady but modest increase over the four-year period, the perceived demand for database software dropped by more than four percentage points from 1995 to 1996, regained these points in 1997, and then rose sharply to 31% by 1998. Statistical software had a jump of four percentage points in 1996,

but by 1998 its perceived demand had dropped to 2.5%. More research is necessary to understand why demand may increase, decrease, and even increase again.

Also, the nature of journalism might be a limiting factor for those reporters who might want to learn new software. Daily deadlines do not leave reporters with much time to attend seminars that require three eight-hour days such as those offered by ESRI training partner GIS^3 (Cubed). A reporter would have to take at least three days off from work specifically to learn GIS. This does not include the extra long hours needed to refine one's GIS skills. Coupled with the complex nature of the software, this makes it hard for reporters to learn GIS.

The results show that age and gender were predictors of the likelihood to adopt GIS both on a trial and long-term basis. This means that GIS might be a more attractive option to younger reporters than to older reporters, and that men are more likely to adopt GIS than women. These findings are in line with standard diffusions of innovations research (Shultz, 2002; Martin, 2003; Van Slyke et al., 2002).

The results indicated that the use of other technologies and CAR-related software increased the likelihood of adopting GIS on a trial basis. Use of GIS goes hand-in-hand with the use of CAR-related software like database, spreadsheet, and statistical packages. In fact, proper use of GIS requires a good understanding of these software packages. These findings are also in line with existing diffusions of innovations research. Rogers (1995) talks about the adoption cluster, a process by which people adopt different technologies that may have some form of functional similarity. GIS belongs in a cluster with use of innovations such as Access databases, Excel spreadsheets, and even statistical analysis using either SPSS or SAS. Rogers also talks about the compatibility of new innovations to pre-existing innovations. The in-depth interviews revealed that GIS users also have to master these CAR-related programs. This might increase the

reluctance of reporters to learn GIS. Apart from learning GIS, they would now have to master database, spreadsheet, and statistical software too.

Even though organizational size was not a significant predictor for the likelihood to adopt GIS, this variable should not be dismissed. It should remain as an important factor related to the diffusion of GIS since the software is costly and requires extensive training and hardware. The results showed that there was not much variance in the circulation figures of the newspapers under study and this might explain why the variable did not turn out to be a predictor of adopting GIS. Literature also shows that resources are an important factor in the adoption of innovations at the organizational level (Agnew 1980). Management has to make decisions on whether to invest money in this software and the relevant training costs. This might be a tough decision given the minimal diffusion of GIS presently. It would still be reasonable to argue that larger newspapers with higher revenues would be more likely to invest in GIS than smaller operations. Although the results from the in-depth interviews indicate that it is easy to get management to invest in new software like GIS, one should note that these interviews were done with reporters who work at relatively large newspapers.

As far as other related software are concerned, fewer reporters use statistical packages than GIS or any other CAR-related tool. Even then, it is not good news for GIS. Only 11% of the respondents used GIS. This stands in stark contrast to the 96% that perform online research, the 76% that use spreadsheet software, or the 56% that use database software. To put these figures in context, the adoption rate for online research in 1994 was 57%. The adoption of spreadsheet software among spreadsheet software has been reported to be as low as 10% in 2000 and that of database software as low as 4% in the same year. Apart from online research, which seems to

have reached its full capacity for adoption, database and spreadsheet software adoption are doing quite well, unlike GIS and statistical software.

Statistical software has been around much longer than GIS. However, statistical software has consistently scored low on adoption. In 2000 only 1% of investigative reporters had adopted statistical software (see Table 2). Demand for statistical software has not been very impressive since then either. In 1995 the demand was 1.8% and only 2.5% in 1998. This study showed that in 2005 only 4% of the reporters used statistical software. Like GIS, SAS and SPSS are very technical software. In fact to use SAS or SPSS one needs a good understanding of statistical methodology. One would have to take several statistics classes at the university level to grasp the wider concepts of research methodology. Just like is the case with GIS, journalists do not have the time to attend extra classes to learn statistics.

The indepth-interviews were conducted to get a better understanding of the dynamics involved in the use of GIS in journalism. The results revealed that while GIS is a "technical heavy" software that requires expertise to use, it should not necessarily be out of reach for reporters. Three out of the seven respondents who were interviewed were self-taught GIS users. In fact, only one out of the seven took college classes in GIS. Although this should be taken with guarded optimism, some respondents also painted a very bright future for GIS in journalism. Although GIS is costly, management is willing to invest in it once they get to see its functionality. This gets easier in the case of competing media agencies. If one agency successfully uses GIS, other competing agencies are likely to follow suit and buy the software.

The interviews also revealed that not everybody has to know GIS in order to use it. Some people can just use its products. Reporters can still use GIS maps and map analysis in their work, for example if they were to work in teams involving GIS experts. Some of the case studies

described in this paper on GIS and journalism were done on team basis. Not all reporters knew how to use GIS. The easy availability of GIS (map and database) data also could bolster the diffusion of GIS in journalism. As more private and government agencies use GIS, it becomes easier to access relevant data. These are the key factors that will affect the diffusion of GIS in journalism.

Recommendations to Improve Adoption

These results bring about many important questions about how GIS stacks up in comparison to other innovations in journalism (see table 3). Will GIS be another promising technology to fizzle out like videotex? Will GIS ever enjoy such high adoption rates like online research and blogging? As more and more newspapers become more tech-savvy by going online, can any of this rub off on the adoption of GIS? Although GIS might not enjoy the kind of adoption rate that blogging currently enjoys, it will not die out as videotext did. Unlike videotex, GIS has had very humble beginnings. It has been confined to investigative journalism, where it has been used very successfully. Unlike videotex, GIS is not a commercial venture. It is a tool to tell news stories. While it does not revolutionize the newsroom, it enhances the news product. Also, GIS has already been in existence much longer than videotex did. Videotex lasted only three years in the U.S., giving credence to the fact that GIS is already time tested.

It is up to the manufacturers of the software, journalists who already use the software, media managers, and journalism schools to push for the use of GIS. One way manufacturers can help is by using well established marketing principles. One such principle is the use of product samples (O'Guinn, Allen, & Semenik, 1998; Bovee, Thill, & Wood, 1995). This can be done by providing free/sample software. ESRI, the makers of the most popular suite of GIS products, currently offers free evaluation software on its Website. The problem is that they only offer the

software for a 30-day evaluation period. Granted that this is a kind gesture, it would be very hard for a novice to master GIS skills in 30 days. ESRI could extend the evaluation period for its sample software to six or eight months. These evaluation licenses should not be limited to potential GIS users; newer versions of GIS can also be extended to seasoned GIS users. This way, users can sample the improved functionality of newer GIS software and this might increase the likelihood to adopt.

Another marketing principle is the use of promotional price packages (O'Guinn, Allen, & Semenik, 1998). As mentioned earlier, GIS is expensive, with single use licenses running up to $1,500. Furthermore, some extension software cost upwards of $2,500. What a price-pack does is offer the software at a reduced price for a limited time. The price-pack also could be extended to certain segments of the industry. ESRI could offer special prices to smaller circulation newspapers. They also could offer reduced academic prices to encourage the use of GIS in journalism schools.

Training seminars oriented towards journalists could be another method to bolster the diffusion of GIS in journalism. The Mapping the News Conference aimed at journalists a positive step towards this goal. This seminar, sponsored jointly by the Association of American Geographers, The National Geographic Society, and ESRI, aims at bringing journalists, geographers, editors, and GIS experts together. It is hoped that the conference will help media organizations use maps in order to improve news reporting for the public. Prior conferences have dealt with a variety of topics on how to use maps when reporting election results, crime, and health stories, among other topics. Editors also get to discuss with geographers and government

officials the role of maps in news reporting and how this shapes the meaning and context of news.[14]

Another way to improve the diffusion of GIS in journalism is to expand the curriculum at journalism schools to include GIS in CAR courses. This initiative has emerged in some schools already. NICAR is an endeavor between the University of Missouri School of Journalism and Investigative Reporters and Editors. David Herzog, whose book *Mapping the News (2003)* has been cited extensively in this study, teaches students how to incorporate GIS in news reporting[15] at the Missouri School of Journalism. Even in schools where GIS is not directly taught to journalism students, journalism departments can organize ways for students to take classes in geography. In fact, the in-depth interviews revealed that some reporters actually get GIS help from the geography departments at different universities.

Advertising in specific publications is another marketing principle that the makers of GIS could use to push GIS into journalism schools (O'Guinn, Allen, & Semenik, 1998; Bovee, Thill, Dovel, & Wood, 1995). ESRI could advertise its GIS products in trade and research journals in order to attract journalism schools and professionals too. ESRI could also send pamphlets to the same schools touting the benefits of using GIS in news reporting. These pamphlets also could detail ways in which cheaper CAR-related tools like database and spreadsheet software could be incorporated with GIS to improve new reporting.

Those journalists who already use GIS can also encourage their colleagues to take an interest in GIS. One of the respondents in the in-depth interviews said that he once downloaded

[14] More information on the conference can found at:
http://www.esri.com/news/arcnews/summer04articles/mapping-the-news.html
http://www.aag.org/mapnews/

[15] http://journalism.missouri.edu/news/releases/2003/2003-09-10-herzog.html

map and census data to his newsroom's server; other reporters who had no previous GIS knowledge where then able to perform simple spatial analysis with these data and produce simple maps. Most of the case studies discussed earlier in this paper indicate the successful use of GIS. It is important to note that most of these projects were done in teams and not everyone on the team knew how to use GIS. Those reporters who know GIS can easily team up with others to perform GIS related tasks.

The applicability of GIS also increases as the number of online newspapers increases. The key lies in the target audience of the online newspaper versus that of the print version. A local or regional newspaper will only reach a limited target audience in its circulation area while its online version will reach a limitless number of readers. This means that reporters could use GIS to do stories and analysis that surpass their local/regional bounds and focus on a national audience. Such analysis need not appear in the print version of the paper, but could appear online to interest a bigger and more varied audience. For example, a reporter could do a story on environmental justice by mapping out the proximity of chemical plants to poor neighbors. If such a relation existed locally, he could also expand this analysis to see if the trend is common in other parts of the country. This kind of story would interest not only the local audiences but also attract a national readership for the online version of the newspaper. This could even have an impact on readership numbers and eventually on revenue.

The fact that GIS would work better for some online stories does not mean that these stories are not suitable for the print version of the newspapers. It just means that online, the story could be more interactive and readers can access multimedia materials that supplement the story. They also get an opportunity to give instant feedback and even engage in public debate with readers from other parts of the country. The online story will also have more space in which to

display different maps and map analysis. One map could concentrate just on the problem in one area of the locality, while another could display the problem on a regional and national basis.

GIS Benefits Journalism, Society

It is important to re-emphasize the importance of GIS in journalism. The power of GIS lies in what it can do, and how this can benefit a reporter in his/her work. The capability of GIS to analyze map data is unprecedented; its magic lies in the way it can produce these analyses visually in a way few other software can. The *Miami Herald* demonstrated this functionality when it used GIS to analyze the damage patterns from Hurricane Andrew. Without spatial analysis, it would have been very difficult to analyze and visualize the wind patterns against the property damage patterns. Similarly, the *Philadelphia Inquirer* investigated the relationship between drunken driving and liquor establishments. This is just another example showcasing the uniqueness of GIS in news reporting. These types of patterns and phenomena would be less discreet with other analysis tools.

This study also gives an insight into the potential effect of GIS on public debate and public policy. As described earlier, the two most successful uses of GIS in journalism at the *Miami Herald* and the *Philadelphia Inquirer* demonstrate that even with limited use, GIS can greatly affect public life. The *Inquirer* story led to heated public debate on the change of alcohol testing levels. People use the *Inquirer's* online forum to post their reaction to the story. This debate was not lost to the lawmakers as they finally adopted a new blood alcohol level of .08. In Dade County, authorities tightened housing codes for contractors after the *Herald* ran the story on Hurricane Andrew. One should picture the impact that these kind of stories even with a moderate use of GIS in journalism.

Summary

This study set out to predict the future of the diffusion of GIS in journalism. Figure 10 gives a good description of this future trend. GIS might not enjoy the adoption rates like those of online research, database software, or spreadsheet software. It will however diffuse much quicker than statistical software. In 1998 the demand for mapping software stood at 14% (see table 1). This study found that only 11% of the reporters sampled used GIS. In a period of seven (1998-2005) years, the 14% demand rate has resulted in an 11% adoption rate. In 2000 the adoption rate for GIS stood at 1% (see table 2). This means that in a five-year period adoption of GIS jumped tenfold. Assuming that all other factors remain constant, 20% of the reporters in the journalism industry will have adopted GIS by the year 2010. This will put the diffusion of GIS at least in the initial stages of the early majority stage (see figure 7).

The only way that this diffusion rate can be speeded up is if there are heavy promotional efforts by the manufactures and the introduction of GIS in the curriculum at the journalism schools. As mentioned earlier, the reporters who already use GIS could also become change agents at their respective newspapers. If these factors come into play then maybe the adoption of GIS will move from the early adopters' stage that it is in right now to the latter part of the early majority stage within the next decade. The early majority stage requires an adoption rate of at least 34%.

As stated earlier, this study may also inform those who are interested in the applied aspect of GIS and journalism. The in-depth interviews depict the use of GIS from the viewpoint of the journalists. These interviews reveal what it takes to be a GIS expert and what one has to learn and do to achieve this. The interviewees attended seminars, taught themselves to use the software, combined the use of CAR-related tools with GIS among other things. The interviews

also tell us what it takes to improve the diffusion of GIS at the organizational level. Editors, who are the key decision-makers at the newspapers, have to be shown the functionality of this software in order for them to invest in it.

CHAPTER 6: CONCLUSIONS

The results send a mixed message about the diffusion of GIS in journalism. While a majority of reporters are aware of GIS, very few have taken up the use of this software. As stated earlier, the nature of GIS makes it a “hard” tool to learn and use. This alone is enough to discourage reporters from learning the software. They will have to attend lengthy seminars to learn the software and probably most reporters are not disposed to do this, given the nature of their work and the deadlines that they have to meet daily. GIS also comes with extensions. These are add-on programs that enhance its functionality. Even seasoned GIS users have to attend more seminars to learn these extensions.

The diffusion of GIS is still in its early stages. The adoption curves in figure 10 show that at best, GIS is still at the early adopters’ stage, or at the very initial stage of the diffusion process. This stage is marked by a limited use of an innovation. Currently the awareness level of the software in journalism is high. This is positive indication but it should be viewed with guarded optimism. Probably most reporters are familiar with its unprecedented functionality in spatial analysis. Perhaps they just don’t have the time to attend GIS seminars. Even with the cost factors, the in-depth interviews revealed that reluctant managers can be swayed into purchasing the software once its functionality is demonstrated to them. Competition among media agencies is another factor that will bolster the diffusion of GIS in journalism. Once one media agency successfully uses it, others will likely follow suit. Even for those reporters who don’t know how to use the software, there is a high probability that they can still use GIS products. They can use GIS maps for news and analysis, or even perform simple spatial analysis under the guidance of veteran GIS users.

This study takes a pioneering look into the diffusion of GIS in journalism. Some of the findings in this study are fairly standard to the diffusions research. Demographics have been shown to dictate the adoption of innovations. However, the study also showed that the field of journalism might be unique in some ways. The study revealed that level of education might not be a determining factor in the field of journalism, since there is little variation as far as education is concerned. Most journalists have an undergraduate degree or better.

More importantly, this study advances the diffusion of innovations theory by comparing the diffusion of different innovations in the field of journalism. It starts by focusing on GIS and then expands to the diffusion of other innovations like CAR-related software, videotex, online research, etc. This simultaneous examination of myriad innovations in journalism offers new insights that result in theoretical additions to the model. Diffusions theory states that the adoption process of most innovations takes the form of a cumulative S-shaped curve. This study uses this cumulative curve to describe and predict the diffusion patterns of different innovations in the field of journalism. However, the findings regarding the diffusion of GIS and similar software, such as statistical packages, show a slower rate of adoption. Some innovations, such as online research and word processing take a much steeper curve with its rapid rate of adoption. This suggests that a multi-curve process offers a better explication of the theory than the single curve that currently exists. The multi-curve graph as illustrated in figure 10 gives a new depiction of the adoption of innovations in journalism.

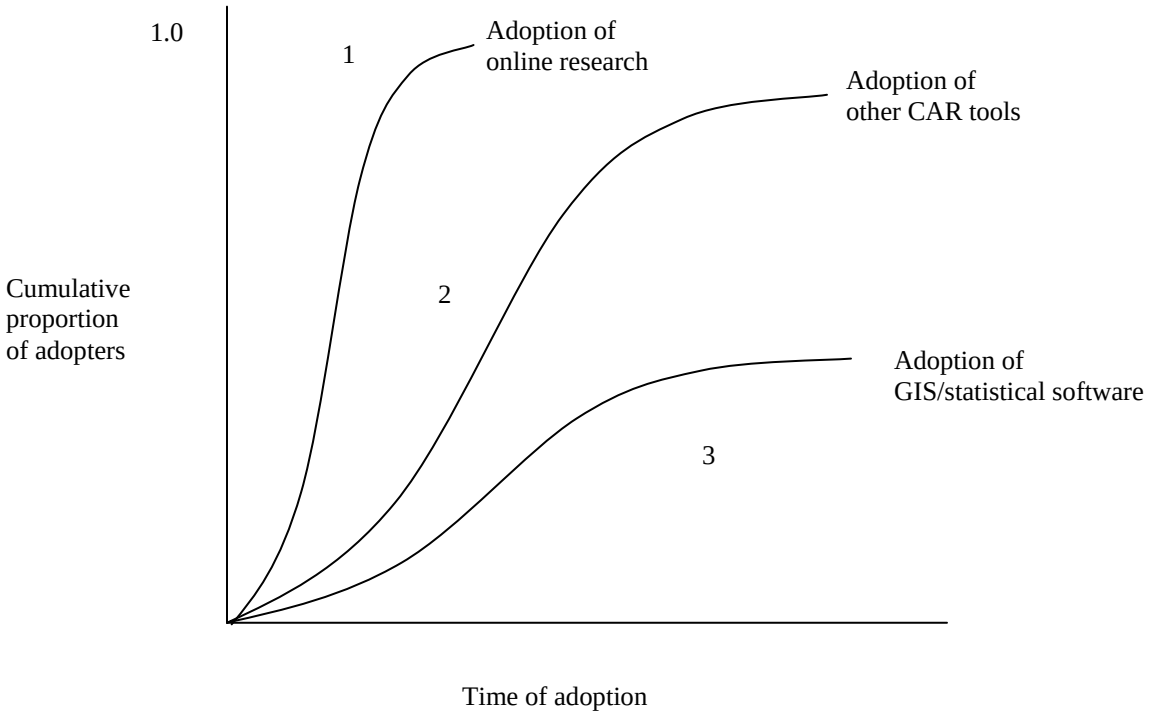

Figure 10: Prediction of the Adoption of GIS, other CAR-related tools, Statistical Software, and Online Research in Journalism.

The figure shows that while the adoption of most innovations still may take an S-shape, the slopes for different innovations vary. This may be due to the complexity of different innovations. Diffusion of innovations theory postulates that complexity affects adoption (Rogers, 1995), but this contingent condition is not reflected in the normal S-curve. For example, the adoption of online research takes a steep curve while that of statistical software and GIS takes a much flatter curve. While it is easy for a reporter to conduct online research, it is much harder for him/her to do statistical analysis without having taken research methodology classes probably at the university level.

Another new construct this study adds to the diffusions theory is the idea of applicability of an innovation. Applicability refers to the extent and the ease with which different reporters can put a software to use in order to enhance their work. For example, online research has much more applicability than does GIS or statistical analysis. Almost every type of reporter, from

business to sports to features, can make use of online searches. Online research requires little training – a colleague can show the novice how to do this a time or two and then the novice needs only a little bit of practice. It requires no time away from the office to master. Furthermore, online research can take as little as five minutes to complete; reporters can determine how much time they spend searching online, which fits well with a deadline-oriented job. With a 96% adoption rate, online research has almost reached its full adoption capacity. GIS and statistical software, on the other hand, have much less applicability. These two pieces of software are only likely to be used by an investigative reporter, thus limiting their utility to other kinds of reporters. GIS and statistical software require considerable training that cannot be accomplished in the newsroom; multi-day training seminars and possibly even semester-long college courses are needed to fully understand the applications and their use. Furthermore, a reporter must block out large chunks of time in order to conduct a statistical or GIS analysis – hours and hours over several days is common. This stands in stark contrast to the flexibility of online searches, which can take five minutes, or five hours, depending upon the reporter's needs and available time. What this means is that those innovations with wider applicability will have steeper S-curves. Also, the study shows that some software like GIS might not attain 100% adoption rates, but might never die out like videotex.

This theoretical process is posited to apply to the adoption of other kinds of innovations, not just GIS. The addition of steeper and slower curves to the normal S-curve, along with the explication of contingent conditions that will determine which curve an innovation takes, and the addition of the concept of applicability help enlarge the theoretical framework of diffusion theory. This gives us a better specified theory with greater ability to predict and explain the adoption of different kinds of innovations.

Recommendations for Future Research

Presently there is a paucity of literature that can guide researchers who examine the use and diffusion of GIS in journalism. In fact this study is a pioneer in that sense. The lessons learned while conducting this study will help related research in the future. Researchers should look at how the new cumulative S-curve described in this study can be applied to other technologies in journalism. Replication of these findings with other innovations will be necessary to test and expand this theoretical addition to diffusion of innovations models.

In addition, future studies can alleviate some of the difficulties encountered here. The nature of this study made it difficult to attain high response rates. The fact that respondents in the Web survey were asked in detail about the kinds of software they currently use and if they are likely to adopt GIS gave them the impression that it was a marketing ploy disguised as an academic study. The proliferation of junk and spam e-mail may be another contributing factor. This fact did not become apparent until the data collection process was well underway. This was deduced from the e-mail responses to reminders sent to those respondents who had not completed the surveys. Some of these responses are listed below:

Quotation 1:

> "I did not think it was an attempt to sell me anything. I was questioning the purpose of information you are gathering. It looks more like a marketing survey than an academic survey of journalistic methods."

Quotation 2:

> "Ben, this research seems more like a disguised sales pitch."

Quotation 3:

> "I was more concerned that the survey appears to be geared toward information for marketing purposes than for the study of journalism. I have been advised not to participate in the survey."

Quotation 4:

> "I took at face value your statement that this was not a marketing survey. You'll pardon me if I say it certainly read like one. What possible academic interest would anyone have

> in whether I'd be willing to try a certain kind of tool of very limited utility to a reporter on a trial basis? That sounds fairly close to a cold sales call to this reporter."

In the future, researchers should take extra steps in allaying these fears among the respondents. Another way of reducing this problem is to use a mixed-mode of data collection as described by Czaja and Blair (1996). This means that researchers could use mail surveys for those respondents who are not comfortable with online surveys. Telephone surveys can also be used to supplement online and mail surveys. Due to time and financial constraints, the mixed-mode method was not used in this study.

The study only looked at reporters in general. Future studies could focus mainly on the decision-makers like the management in different media houses. After all, it is their final decision when it comes to buying new software. Such a study would reveal if there is a disjunction between management and reporters as far as the adoption of GIS is concerned. Even though the diffusion of GIS is still at a very young stage it still has the potential of enhancing news reporting. As described earlier in the case studies, it would be very difficult to map out certain trends and interactions without map data. This, added to the power to visualize data, makes GIS an unprecedented tool to analyze trends and report news.

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APPENDIX A: IN-DEPTH INTERVIEW QUESTIONNAIRE

Hi. My name is Ben Wasike from Louisiana State University. I sent you an e-mail earlier about a project I'm doing on the use of GIS in journalism. Is this a good time to talk?

It seems that not too many journalists are using GIS in their news gathering tasks, despite the fact that some (including you) have successfully used GIS in their work. As you are aware, GIS provides journalists with a powerful method by which to map out and visualize data in an unprecedented manner.

1. How did you first learn about GIS?

2. How did you learn GIS:

3. What encouraged you to use GIS in your work?

4. Do you still use GIS in your work?

5. Did your newspaper already use GIS when you started working there?

6. How many other people at your newspaper use GIS?

7. What GIS software do you use?

8. What version of GIS software is that?
    a. If using older version: when do you/your newspaper plan to upgrade

9. What GIS extensions do you use?

10. What other computer software do you use in conjunction with GIS?
    a. Do you use any statistical analysis software?
        i. Which one(s)
    b. Do you use any Spreadsheet software?
        i. Which one(s)?

11. In general do you keep up with technological development?

12. Do you use any of the following electronic gadgets?

a. Cell phones

b. Text messaging

c. Instant messaging

d. Blogs

e. GPS equipment

f. Pagers

g. Any others?

13. In general, what are the problems you have encountered in the use of GIS:

a. Data availability

i. Is it easy to get relevant maps?

b. Is it easy to get outside help when using extensions that you re not familiar with?

14. What is your view on the future of GIS in journalism?

a. How receptive are other journalists that you know to learning GIS?

b. Overall do you management at different newspapers are willing to invest in GIS?

c. In your opinion what would tale for more journalists to use GIS?

d. Do you think GIS will be a major instrument for investigative journalism in the future?

APPENDIX B: WEB SURVEY QUESTIONNAIRE

Hello:

Thank you for accessing this survey. This survey is in no way an attempt to sell anything. It is an academic survey about the diffusion and use of new technologies in journalism. The purpose of the research is to determine the types of tools/technologies that reporters use in the field of journalism.

The questions are very general in nature and query you on the types on technologies/devices you use in your reporting work. As stated earlier, this is purely academic research, and your responses are confidential. The survey should take an average of three minutes to complete.

In accordance to the Louisiana State University's IRB (Institutional Review Board) requirements, I have included a consent form (below). This form explains the names of the researchers, privacy and confidentiality issues, etc.

Investigators: The following investigators are available for questions about this study (M-F, 9:00 a.m. - 4:30 p.m.)

Ben S. Wasike* 225-334-5019/ wasikesurvey@yahoo.com

Renita Coleman, Ph.D. 225-578-2045/ rcoleman@lsu.edu

*Denotes Principal Investigator

Risks: No apparent risks are expected to occur.

Right to Refuse: Subjects may elect not to participate in the study or to withdraw from the study at any time without penalty or loss of any benefit to which they might otherwise be entitled.

Privacy: Results of the study may be published, but no names or identifying information will be included in the publication. Subject identity will remain confidential unless disclosure is required by law.

Signatures: The study has been described to me. I understand that additional questions regarding the study should be directed to investigators listed above. I understand that if I have questions about subjects' rights, or other concerns, I can contact Dr. Robert Mathews, Institutional Review Board, (225) 578-8692.

I agree to participate in the study described above and acknowledge the investigator's obligation to provide me with a signed copy of this consent form.

Does your newspaper use any of the following mapping software?

ArcGIS

ArcView

MapInfo

Atlas GIS

Map Publisher

None

Don't Know

Other _____

Do you use any of the following database software?

Access

Lotus Pro

None

Other _____

Do you use any of the following statistical packages?

SPSS

SAS

None

Other

Do you use any of the following spreadsheet software?

Excel

Lotus 1-2-3

Quattro Pro

None

Other

How often do you use online research to supplement reporting?

Daily

Weekly

Monthly

Less than monthly

Never

Do you use any of the following? (Check all that apply).

Cell phones

Text messaging

Instant messaging

Blogs

GPS equipment

Pagers

PDAs

Other

Have you ever heard of Geographical Information Systems (GIS)?

Yes

No

Have you used GIS in your work?

Yes

No

What is the main reason that you have not used GIS in your work?

Do you currently use GIS in your work

Yes

No

What is the main reason that you stopped using GIS in your work?

What specific tasks do you use GIS for

Do you know someone who can help you in the use of GIS?

Yes

No

Does anyone else at your newspaper use GIS?

Yes

No

If you answered yes above, please provide the names of the other people that use GIS at your newspaper:

Reporters use GIS software to digitally analyze maps and to produce graphical visualizations of news and other phenomena. Using a scale of 1 -7 where 1 means not at all likely and 7 mean very likely:

How likely would you be interested in learning more about GIS?

1 2 3 4 5 6 7

If you had the opportunity to learn this software how likely would you be willing to use this software on a trial/evaluation basis?

1 2 3 4 5 6 7

If you had the opportunity to learn this software how likely would you be willing to use this software on a permanent basis?

1 2 3 4 5 6 7

What newspaper do you work for?

In what year were you born?

What is your gender?

Male

Female

What is the highest level of education you have completed so far?

Less than high school

High school

Some college

Undergraduate degree

Graduate degree

What most closely describes your job position?

Reporter

Editor

Graphic designer

Other _____

VITA

Ben Wasike graduated from Moi University, Eldoret, Kenya, in 1996 with a bachelor's degree in government and public administration. In 2000 he received his Master of Public Administration degree from Southern University, Baton Rouge. He will take a faculty position at the University of Texas at Brownsville in the fall of 2005. His research interests are visual communication, new media, online journalism, and survey methodology.