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Does the Geographic Information Systems Benefit the Insurance Industry?

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ABSTRACT

This research is intended to determine if the insurance companies are benefiting from Geographic Information System technology in the insurance industry. This is based on the consumers' point of view through the use of research, survey results, and technology at the insurance company's disposal. Today, this technology is used in many different areas including renewable energy, delivery business, and city planning. Insurance companies use this technology in order to determine safe driving habits. Some examples include Progressive's Snapshot and State Farm's In-Drive. These devices are used to collect data on response time, speed, and breaking. This is a possible concern due to methods like Elastic Pathing which allows consumers' locations to be predicted over a period of time. Overall, the average survey responses were negative towards the implementation of the data collection devices in consumer vehicles. Consumers felt the device should not be implemented within their vehicles collecting data on their driving behaviors.

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1. Introduction

This research demonstrates an example of how Geographic Information Systems (GIS) technologies have changed people's lives throughout the years. GIS enables users to see, analyze, and interpret information in order to comprehend relationships, patterns, and trends within businesses. (ESRI, 2015) Businesses choose a direction to improve their company decisions (ESRI, 2015). For example, if a business wants to develop an expansion plan, they take the consumer and population data of their currently profitable stores. This data is then compared across the world for locations with similar patterns of data as the profitable sites. GIS data can be used to identify suitable location that meets the same types of consumers and populations. (Directions Magazine, 2012). Cellular phones have advanced from a Citizens Band radio (CB radio) connections to a wireless mobile filled with features changing consumer driving behavior. RFID tags are established within products to easily track manufacturer products opening a new revenue opportunity for insurance companies. Cities have transformed with cost effective functions using the GIS technologies. Another way to use GIS technology is through the use of sonar which picked up the collection of plastic debris forming an island located within the Pacific Ocean. Global Positioning System (GPS) guides consumers and companies to multiple locations and checks for their current location to continue accuracy of data as the consumer moves through world coordinates. UPS and FedEx uses GIS technologies to improve efficiency and revenue. Insurance companies use this technology to monitor their customers driving habits and utilize this information to determine their insurance rates. Does this affect consumers driving behavior knowing the GIS devices are connected in their vehicles, compromising their privacy, and sending huge amounts of data wirelessly?

1.1 The Beginning Usage and Evolvement of a GIS Device.

Dr. David Warren invented the flight data recorder and cockpit voice recorder designed to explain the cause of airplane crashes. Dr. Warren stated, "I kept thinking to myself . . . If only we could recapture those last few seconds," he told an interviewer in 1985, "it would save all this argument and uncertainty" (Engber, 2014). The design of the flight data recorder logs functions such as direction, altitude, and airspeed to help understand the cause of the plane crash. The cockpit voice recorder located in the tail of the plane logs speech of the pilots and any noises from the plane.(National Geographic, 2014). During Dr. Warren's employment in the 1950s with Aeronautical Research Laboratory in Melbourne, he demonstrated how the black box worked. In 1960 a plane crashed in Queensland, which led Australia to first use the black box required today in all aircraft (National Geographic, 2014). In 1994, GIS devices were used in Cadillac, Buick, Chevrolet, and Pontiac cars so the companies can understand how their cars react in accidents. These devices are similar to an airplane's black box. Since the 2000s, the National Highway Traffic Safety Administration (NHTSA) gathered information within the Event Reader Devices (ERD) for a better understanding of highway accidents. These ERDs give 20 seconds of information around the time a collision occurred (Komando, 2014). An EDR is a small box placed under the front seat or center console connected to a dedicated airbag sensor or vehicle network. In addition, the EDR collects data from other sensors such as anti-lock brakes and every five seconds replaces the data. After a crash occurs, EDR data can be read from a cable to the EDR or the vehicle's onboard diagnostic port (OBD-II) positioned close to the steering wheel (Canis & Peterman, 2014). The NHTSA ruled in August 2006, mandating car manufacturers to inform consumers if their vehicles contain ERDs beginning with 2011 model cars (National Conference of State Legislatures, 2015). In addition, the NHTSA mandated these event recorders must track 15 variables, e.g. vehicle speed, airbag usage, seatbelts worn, and steering angles. Since 2013, 96% of the new cars sold contained the ERD and by September 1, 2014, all new vehicles will have the ERDs installed. Today, consumers are not given a choice whether they want the GIS devices or ERDs installed in the new vehicles (Komando, 2014).

The intent of the installation of the black boxes is for motor safety and to keep people uninjured. "NHTSA says field studies have shown that the devices can increase driver safety by helping modify driver behavior, and the agency cites studies showing commercial fleets have seen crash reductions of as much as 30 percent in vehicles so equipped" (Consumer Reports, 2014). This behavior modification consists of location of the vehicle, length of driving, acceleration speed, braking usage, and cornering the turns. In fact, some insurance providers state not to drive late at night or early morning to achieve a higher driving score (Confused.com, 2015). However when a crash happens, five seconds of data is recorded before the crash and one second after the crash. This information helps auto-safety analysts and investigators to evaluate the vehicle performance. In addition, the data helps first responders predict where to send the injured person for treatment. Consequently, legal matters step in about the accuracy of the data, who owns this information, and how the data is accessed. "But Sean Kane, president of Safety Research & Strategies, a company in Rehoboth, Mass., that studies product hazards, cautions that EDRs can be used against drivers in court cases and that sometimes the information doesn't match the physical evidence in a crash" (Consumer Reports, 2014).

Insurance companies collecting data, along with car manufacturers and state governments, within GIS devices in vehicles bring consumer privacy concerns after installation. While consumers' data of driving habits are tracked, they have privacy worries about how much data, what type of data is recorded, and who can retrieve this data. Fifteen states already have regulations on these GIS devices; however, before the data is retrieved, a car owner must give permission, a court order is established, or a car owner previously opted into an insurance program (Komando, 2014). The car manufacturers are integrating other technology data services within their vehicles, giving the consumers an option of collecting more behavior with hands free telephone calling, GPS directions, and satellite (Telematic) services (Electronic Privacy Information Center, 2015).

Sometimes EDR technology can find a solution or lead to problems with car safety. For instance, Chevrolet Cobalt's ignition switch turned off the engine while the car was in motion; the car crashed due to losing power steering. As a result, the manufacturer recalled 2.6 million vehicles after the ERD data exposed the problem (Canis & Peterman, 2014). An incident occurred after Progressive's Snapshot was installed within a vehicle. As the consumer was using her vehicle, the battery was drained; and as a result, left the car stranded (Horcher, 2014). State Farm uses GIS devices in order to monitor customers' driving habits and use the data to determine the insurance rates. They use Onstar and SYNC systems in order to access data from newer car models. Cars made from 1996 to the present, are provided an In-Drive device from insurance companies to collect consumer's driving data which is similar to Progressive's Snapshot (State Farm, 2015). With consumers being aware of the GIS technology monitoring their driving, this presents an inconsistency of normal driving behavior among consumers. Therefore, insurance companies do not get an accurate reading on how a consumer would typically react in driving situations. The data collected could be misleading if an insurance company is trying to determine the difference between a reckless driver and a driver avoiding an accident. For example, driving with the flow of traffic is important on the highways. This could mean traffic is going faster than the speed limit. Is it fair this data is collected against the driver? This research is measured by the satisfaction of the consumers' acceptance of the GIS devices and value of the data being collected by the insurance companies. The method in this paper includes a survey given to consumers in order to discover their behaviors and thoughts about the insurance process of using GIS in vehicles.

1.2 New Challenges with Hackers and GIS Technology.

The insurance companies have future issues to consider when hackers "take over" a car's system. They expect the driver data wirelessly transferred to them but what happens when the vehicle crashes as a result of the hackers malicious motives. While new technology with the auto industry gives consumers safety and better driving performance, concerns have been raised with the hacking of vehicle operations, privacy, and safety due to the connection of the Internet directing the vehicle's control area network (CAN). Wireless connections allow hackers to invade the electronic connections and data of the vehicle. On September 16, 2015, Senator Edward J. Markey and Richard Blumenthal sent letters to 20 auto manufacturers asking what is being done for auto cyber security. Sixteen of the automobile manufacturers responded with these answers which shows lack of security measures: 100% cars on the market have wireless technologies and are vulnerable to hacking; auto manufacturers are unaware of hacking occurrences; stopping the remote access is inconsistent while many auto manufacturers did not understand the question about security measures; auto manufacturers collect numerous amounts of data on the consumers' vehicles and driving habits; most auto manufacturers use wireless connections without security; how long the data is stored varies with each auto manufacturer; and consumers are not clearly told about the data collection, but if they are aware, they cannot easily opt out of their selected features. "In response to the privacy concerns raised by Senator Markey and others, the two major coalitions of automobile manufacturers recently issued a voluntary set of privacy principles by which their members have agreed to abide. These principles send a meaningful message that automobile manufacturers are committed to protecting consumer privacy by ensuring transparency and choice, responsible use and security of data, and accountability" (Markey, 2015). However, this leads to unclear information for the consumer along with the auto manufacturer's interpretation of consumer privacy.

The Defense Advanced Research Projects Agency (DARPA) funded a study in 2013 allowing two researchers to prove they can connect a cable to computer systems of two different vehicles using a laptop to send commands to the Engine Control Unit (ECU). "In their initial tests with a laptop and two MY2010 vehicles from different manufacturers, they were able to cause cars to suddenly accelerate, turn, kill the brakes, activate the horn, control the headlights, and modify the speedometer and gas gauge readings" (Markey, 2015). The two manufacturers were made aware of the study before it went public; nevertheless, they were not concern because the researchers did not hack into the ECU wirelessly. "What the companies fail to note is that the DARPA study built on prior research that demonstrated that one could remotely and wirelessly access a vehicle's CAN bus through Bluetooth connections, OnStar systems, malware in a synced Android smartphone, or a malicious file on a CD in the stereo" (Markey, 2015). In 2014, the two researchers investigated 21 different vehicles from 10 different manufactures. Through wireless access, the vehicles were able to be compromised (Markey, 2015).

Safety for the consumer continues to be uncertain and action is initiated for consumer protection. Danger occurs when car dealerships and navigation systems providers use remote disabling tactics when payments are not made or vehicles are reported as stolen. These consumers may be in an emergency situation or the driver may be located in an unsafe area while their vehicles are tracked and disabled. Another developing step with feasible wireless technology is the vehicle-to-vehicle (V2V) safety on collision avoidance. The more wireless technology is incorporated, the more ways a hacker can interrupt a consumer's vehicle or compromise their privacy (Markey, 2015). With Markey and Blumenthal's commitment on the consumers' cyber security and privacy on new vehicles, their development of the SPY Car Act is a positive direction for the consumers (EPIC, 2015). With the installation of this technology, hackers now have the ability to hack and locate a car's location. This is a threat to the safety of all citizens using the technology.

2. Literature Review

"The Internet of Things (IoT) refers to the capability of everyday devices to connect to other devices and people through the existing Internet infrastructure. Devices connect and communicate in many ways. Examples of this are smartphones that interact with other smartphones, vehicle-to-vehicle communication, connected video cameras, and connected medical devices. They are able to communicate with consumers, collect and transmit data to companies, and compile large amounts of data for third parties" (EPIC, 2015).

2.1. RFID-Enabled Product-Service System

The "RFID-enabled product-service system for automotive part and accessory manufacturing alliances" research study reports the concern with RFID enabled manufacturing applications in the automotive business. This system has only recently been introduced to the automotive industry for looking up VIN numbers and finding the correct tools associated with the car. Some automotive companies are not adopting the new technology because of the high cost, high risk, and high technical skills required the use the technology. This technology is high cost because it has not be introduced into all companies yet. In the beginning, companies were only looking at the initial investment instead of the accuracy savings. This technology is high risk for companies because it is consistently changing which requires more money to stay current. The technology has high level of specialist skills in information technology to run the software to utilize the RFID tags (Huanga, T, Zhang, & Yang, 2012).

2.2 Elastic Pathing: Your Speed is Enough to Track You

The study of "Elastic Pathing: Your Speed is Enough to Track You" states the concerns people have about their privacy being invaded through the of GPS devices used by insurance companies. They use a method called Elastic Pathing in order to determine the exact location based on a series of routes a consumer takes over a period of time. However, this study referenced that Progressive Insurance claims not to collect information about speed. Overall, companies are more interested in consumer's response times while driving. For example, if a consumer's car was going 20 miles an hour and suddenly hits the break until the car is going 2 miles per hour, the insurance company records this data. The United States federal vehicular safety regulations state a car going 20 miles per hour must be able to completely stop at 20 feet and slow down at a rate of 21 feet per second. This study bases the information on a theory. In reality, there is not a way to know if insurance companies are using this method. This study lacks evidence of insurance companies' internal methods (Gao, et al., 2014).

This study applies to my research because of the growing concern with privacy. When companies such as Progressive promise not to use speeding data against consumers in an unfamiliar location, they are not being 100% truthful. The data can be processed by a method called Elastic Pathing to find the travel locations over a period of time. For example, when the car stops for longer periods of time or overnight, consumers are generally home. This information can be found on file by the insurance agency. Then, they gather the roads and speed limits next to the consumer's house. Once a pattern is found due to slowing down and speeding up between intersections, a map can be made of the locations the consumer visits often (Gao, et al., 2014).

2.3 Example Benefits

GIS technology has been used in multiple difference areas in everyday life. Some examples of this include city planning, resource management, shipping industry, and insurance companies. Cities use this technology in order to monitor requests for service from citizens. Crime and theft can be monitored through the use GPS trackers. Resources can be monitored and new sources located through the use of GIS technologies. The shipping industry uses GPS technology in order to determine the fastest and efficient routes between deliveries. Most recently, insurance companies have been using GPS technology in order to collect information about driving habits to adjust insurance rates.

2.3.1 Real World Applications

City Planning. GIS technology is used by cities to make their systems more efficient. Some examples include road work reporting and law enforcement. San Diego uses GIS technology in order to request street repairs. People have the ability to use the Internet on smart phones to report city problems. For example, they take pictures of graffiti and report it to the proper authorities. ArcGIS technology is used to map the data for dispatchers to respond. When citizens find areas that need attention, they use smartphones and connect to the website, www.sandiego.gov, and click the referring tab, "Request a Street Repair." The citizen actions assist the city in sending a correct number of personnel and avoid sending duplicate dispatch requests (Mueller, 2009). The Police Department in Redlands, California uses GPS technology to stop grave robbers. This was started by Cheryl Martin and a group of people asking the city to find a way to stop the robbers from stealing items from the grave sites. The police department responded by placing GPS trackers on each of the grave sites. These trackers alerted authorities through motion. After this technology was applied to Cheryl's daughter's grave site, the grave robbers attempted a theft 3 hours later which resulted in their arrest and confession. In addition to grave sites, Redland, California uses GPS trackers for assistance in armed robbery, vehicle burglary, bike theft, laptop theft, construction site theft, metal theft, and commercial burglary. Another way to use GPS technology is with truck drivers quickly reporting problems with their truck. They use an application to state the truck's problem. The GPS sends the location data back to headquarters for assistance (Martinez, 2014). When catastrophes occur, GIS works with crowd sourcing to determine who needs immediate help. Crowd sourcing occurs when social media is used to see who needs help within an area. For example, the information was handy for rescue workers to find people trapped in an area of rubble in Haiti. The open source program U-SHA-HI-DI and Open Street Map was used to gather data about Haiti (PENNSTATE Public Broadcasting, 2010).

2.3.2 Cost Reduction

Resource and Asset Tracking. The GIS technologies initial purpose for businesses was to track their products while in delivery. As technology progressed, RFID tags were developed. In order to keep track of their shipments, businesses use Radio Frequency Identification (RFID) tags. Before RFID tags were used in the shipping industry, shipments were logged with paper. This process was time consuming and difficult to track. For example, shipping took longer in a warehouse to sort. Without the aid of RFID tags, people manually located the product and counted how much was in stock. The amount could change daily, so the next day if another employee moved a product, inventory needed checked in two separate locations manually. The RFID technology changed the inventory and package industry by tracking direct assets and actions such as opening packages prematurely in real time, allowed for Just in Time inventory to avoid waste, and increased efficiency as products are shipped.

The beginning steps using this RFID system involves system design, software to manage the devices, and asset tracking hardware. For example, Detroit Diesel avoids losing truck engine manuals at the workstations with this RFID system. Not only does the process reduce paper waste, but places 10 RFID tags on their ProVIEW system which holds the books at each workstation to secure the correct manual while building truck engines. The company had a Return On Investment (ROI) by reducing paper usage and reallocating time employees spent on manual maintenance (Nabrotzky, 2015). This technique is aided by a process called geo-fencing. Geo-fencing is a feature within a computer program that uses RFID tags to define a virtual box where the tag is recognized (Rouse, 2014).

RFID tags helps businesses manage their inventory, increase labor efficiency, reduce waste, and improve Just-In-Time inventory. As they choose their tags, the company considers if their inventory is located indoors or outdoors, the temperature of the room, where the tagged is located, and the volume of the product (OATSystems, 2015). RFID uses radio waves to track inventory with a product status and location. This allows for efficiency because the data shows which products have been sold and how much is currently on the shelves. This system replaces scanning each individual box while being moved in a warehouse. With this procedure, inventory is automatically scanned while moving out of the warehouses (Expertek, 2013). However, businesses are concerned about the privacy of RFID tags. For example, Walmart has RFID tags on all their merchandise which continues to have a tracking device after it is sold and the customer takes the product home (Electronic Privacy Information Center, 2015). This is flagged as a security concern, due to the RFID tags not deactivated. Because of this, rules have been put in place to protect the consumer and business interests. Consumers must be made aware of the tag presence and where the RFID tags are located on the item. While in the store, this protects the consumers from walking too far and setting off an alarm. As RFID tags are in use, they must use a tone, light, or be easily seen as a reader collects information (Electronic Privacy Information Center, 2009). Businesses can choose multiple types of readers for scanning the tags. Some readers stay in one place which have an external antenna and located at the entrances of the business. Handheld readers are versatile allowing for on-demand scanning used by mobile employees. These scanners are ideal for trucks allowing for more accuracy on inventory and tracking. This technology is beneficial to businesses allowing them to see where shipments are located and making an accurate prediction when arriving at their destination (Motorola, 2011).

The RFID tag's physical components are expensive to build. This refers to building the network, setting up the network devices, and the server the RFID software operates on. This cost makes it harder for smaller companies to compete. In order to get around the cost, cloud computing is utilized. Cloud computing is a resource that allows on-demand services to be accessed over the network. This allows multiple users to share the same application and it is easily accessible over a web browser. When finding the proper RFID software, smaller companies benefit from cloud computing because they have the option of cancelling the service without a large investment to consider. In this way, the company would only be paying for the initial setup fee and the amount of data transferring to and from the website (Owunwanne & Goel, 2010). Another option for companies are Real Time Locating Systems (RTLS) tags which allows people or items to be tracked in real time movements by wireless transmitters rather than the RFID tags which are activated by radio signals emitted from a scanner. As the object moves with the RTLS tag, a new reference point is transmitted which reveals a new location. Warehouses, shipping yards, and hospital industries have adopted this technology. There are two types of RFID tags, passive and active. The passive tag activates as a reader sends a radio signal to the tag. This type of tag has short range connection and cannot be tracked in real time. An active tag has an internal battery in it that will last multiple years and can be tracked from a larger distance. These types of RFID tags are called RTLS. For example, RTLS tags can use global position system technology to tracking items. The most common example is a smart phone which can find locations.

This method requires the use of three satellites to signal a person or object's position on the Earth's surface. For shipping companies, this is used to track the cargo and the driver (Ekahau, 2015). Data collected with RFID tags can be collected through an oracle database allowing a company to manage the collected information from the tags and analyze the information, especially accessible for future analysis. Companies respond to this data through modifying their business processes (Oracle, 2004).

2.3.3 Resources Monitoring

Renewable Energy and Resources. GIS is used in planning locations for renewable energy. In order to determine the best place for new facilities, they need to look at the land terrain, historical weather patterns, and the data model. While taking this information into account, other variables are taken into account like economics, market potential, costs, reliability, future electricity loads, and local policies (Lopez, Roberts, Heimiller, Blair, & Porro, 2012).

In the case of wind power, terrain will need to be evaluated as the wind mills need to be 80 meters in the air on flat land. The weather climate for wind speed will be evaluated. The conditions are 6.4 meters per second. In this study, the states with perfect conditions are along the coast line that includes Maine to Massachusetts, Texas, Louisiana, Georgia, and the Great Lakes (Lopez, Roberts, Heimiller, Blair, & Porro, 2012).

In the case of solar power, researchers look for flat surfaces. According to the U.S. Renewable Energy Technical Potentials study, flat surfaces are considered in locating new places for solar powered energy. In the study, surfaces can have a 3% variance from being flat in order to be viable for solar power. Concerning flat surfaces, it is important to exclude parking lots, roads, and urbanized areas. Maps make the selection process easier by filtering out areas that are unsuitable. This saves company's time, resources, and money while selecting a site to build solar panels (Lopez, Roberts, Heimiller, Blair, & Porro, 2012).

Plastic Island. In the Pacific Ocean, toxic plastic debris has been gathering and forming and island from trash. The result of the added plastic has caused a lot of dead, sea life. Since plastic is non-biodegradable, it has only broke down into smaller pieces. The island continues to grow and collects trash transported from the ocean currents (Hurrell, 2009). This Atlantic Garbage Patch has been located to cover the distance between 22 and 28 degrees north latitude (Melia, 2010). In this case of the Pacific Garbage Patch, traditional satellite imagery does not show where the trash exists in the ocean. Infra-red imagery does not show the plastic because it is not reflecting light or giving off heat energy. In order to view the plastic locations, it is important to observe the ocean currents (National Geographic, 2015). Sonar technology has the ability to locate plastic is in the water. Sonar uses echolocation to map out structures in the water (Weiner, 2014).

2.3.4 Knowledge of Trends

GIS Maps and Route Planning. The GPS map of networks are collected by people driving around with mapping equipment collecting data. Then, the data is sent to a database and used by the GPS receivers consumers use every day. By the 1980s, remote sensing data was taken from satellites in space. These images of the earth were put together and formed the Topology Integrated Geographic Encoding and Referencing files. Google maps were first based from these initial maps. Later, Google Earth showed the public nearby locations, such as cornfields, houses, and businesses. With the invention of smart phones, a map was created with a user's point in the center. If users are in an unknown area, this device gives you the ability to look for restaurants, shopping centers, and a way to return home (PENNSTATE Public Broadcasting, 2010).

Most recently, shipping companies have used GIS technology in order to plan routes. Some benefits of route planning are better business planning, eliminate inefficiencies, and fleet location management. This system permits the fleet with GPS tracking software to easily plan their route. As they are making their route, the computer calculates fuel efficient routes, alternative routes, real time traffic updates, and saves time a driver would have taken manually planning the route. This improves efficiency because the fleet management software programs the workers' route on a turn-by-turn basis. For businesses, this software reduces fuel consumption, overtime costs, balances schedules, and provides insight to future scheduling (Patel, 2014). There are multiple types of technologies being used by trucking companies. GPS Technologies support multiple types of services for truck fleets like reports of driver usage, which include speed, mileage, address location, and stops. In addition, a history is kept, speed alerts can be set, and geo-fencing is utilized (GPS Technologies, 2015). Geo-fencing is the process of sending information to mobile devices when they are in a specified area and used as advertisements. For example, if a driver is approaching a city where there is a discount on gas, then it appears on his mobile device. When a mobile device reaches a certain point in the geo-fence, a geo-trigger sends the user a message (Case, 2013).

Shipping Industry. In the shipping industry UPS and FedEx are the two largest shipping companies within the United States. Both companies have been using GIS technology to improve their profits.

UPS expanded into air delivery by 1988 when the Federal Aviation Administration gave them approval to operate their own aircraft. In 1993, UPS started to incorporate global computer and communication systems into their delivery system structure. This structure included technology like small handled devices and specially designed delivery packages. At this time, the company made an online presence in other websites included WorldShip quantum view and CampusShip. Tools were also incorporated to process, track, and management shipments and supply chains. By 1999, UPS became a leader in global supply chain management of goods. (United Parcel Service of America, 2015) Before using GPS systems, UPS drivers wrote note cards for their routes and stops (Foust, 2007). This new technology was called Delivery Information Acquisition Device (DIAD). The DIAD V is the first Gobi technology to enable the switching of cellular carriers to maintain a constant connection to the UPS network. This new generation DIAD has image recognition software that evolved from laser bar code scanning technology. This newer model also is lighter and smaller in comparison to its previous releases (Berman, UPS rolls out new edition of its DIAD mobile computer, 2012). Since then UPS has a system that optimizes the route based on 56,000 drivers. This system also gives notes on special instructions given by customers over the years. These instructions confirm the knowledge does not leave when a driver leaves and improves customer service when substitute drivers are necessary (Foust, 2007). UPS logistics started with consumers on February 16, 2012 when they bought out Brussels-based Kiala and increased their business to consumer presence (Berman, UPS expands B2C presence with Kiala acquisition, 2012). "In an interview with LM, Norman Black, UPS spokesman, said that this deal was not necessarily made for UPS to expand its business-to-consumer (B2C) presence, as much as it was that UPS came to the conclusion that it needs to be a leader in developing alternatives for e-tailers in order for them to satisfy their customers" (Berman, UPS expands B2C presence with Kiala acquisition, 2012). Since UPS tracks their drivers' routes, they are able to optimize the routes taken by their drivers. Farmers have used this system in order to determine where the fertilizer needs to be placed on the crops (GPS.GOV, 2014). In lieu of GPS technology, UPS has saved three million gallons of fuel per year by reducing the amount of left turns taken (Rooney, 2007). UPSnet is a communications network that provides an infrastructure for international package processing and delivering (UPS, 2015).

In 1973, FedEx relocated to Memphis, Tennessee and began the modern air/ground express industry. In 1977, FedEx lobbied for Congress to allow airlines to use larger aircraft with no restrictions. In 1980, FedEx implemented Digitally Assisted Dispatch System to coordinate customer pickups (UPS, 2015). In 1979, FedEx launched Customers Operations, and Services Master Online System. This system was used to manage people, packages, vehicles, and weather situations in real time (FedEx, 2015). FedEx developed FedEx PowerShip®, the first PC-based automated shipping system. This software allowed them to monitor the status of packages in transit (FedEx, 2015). SenseAware was first introduced by FedEx into the shipping business in November 2009. Today, it is used for multiple airlines including Delta Air Lines, Southwest Airlines, and United Airlines mainline jets (FedEx, 2012). SenseAware uses location, temperature, humidity, and shock to determine a real time location for packages on route (FedEx, 2015). This process works by packaging up a box, the software invites the business partners to monitor the packages location, and the SenseAware device is attached to the package before it ships. As users are monitoring the package, the device reports back the location, temperature, light exposure, and box integrity. When the package is delivered, it allows for a negotiated time to drop off the package and verifies the package has been opened at the correct time (SenseAware, 2015). On February 29, 1996, FedEx announced the beginning of interNetShip. This web application allows users to input internet shipping capabilities. This software allowed FedEx to become a part of the electronic commerce services (Federal Express Launches Internet Shipping, 2014).

2.4 Insurance Companies

Black Box Information Gathering. Since the late 20th century, behavioral pricing has been used on consumers' spending habits by corporations. Consumers have adjusted to corporations having massive knowledge about them and used this information to compete. Insurance companies such as Progressive, State Farm, and Allstate compete with each other for customers through premiums based on calculated risks such as age, gender, make/model of vehicle, and customers' records. These companies continue to look to maximize profits and one way is to convince their customers to install the black box device which records the customers' driving habits (Addessi, 2015).

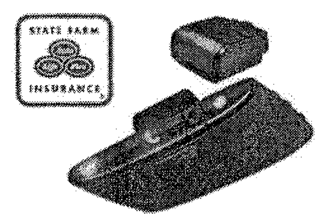

Figure 1a State Farm In-Drive
(In-Drive, 2015)

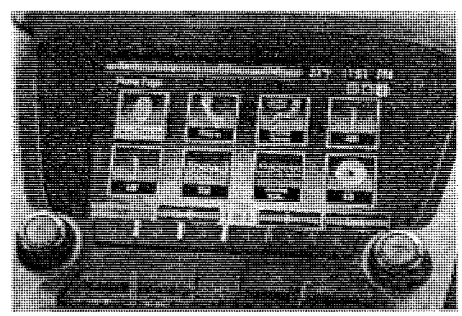

Figure 1b OnStar
(Mvno Dynamics, 2011)

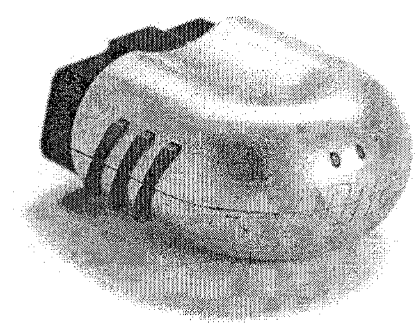

Figure 1c Progressive Snapshot
(Koetsier, 2012)

The black box device connects to the vehicle's system, a port on the steering column, to determine the drivers' premium rates. Progressive embraces their marketed piece as Snapshot which records quantitative data from amount of brakeage, miles drove per day, and time of day the vehicle is driven. Using Progressive's Snapshot may allow up to a 50% discount on a customer's premium rate. State Farm competes with their device as In-Drive which tracks brakeage, acceleration, average speed/speed over 80 mph, turns, GPS usage to record time of day and where the vehicle is driven. Agreeing to install State Farm's In-

Drive, customers are given a 15% discount and possibly more as time progresses (Addessi, 2015).

After the devices are installed in the vehicles, customers' future rates are determined by what has been logged. The original discounts when customers signed up for the devices last between 30 days to six months. Customers can observe their recorded driving habits online and may receive an email alert for any change in their driving behaviors. Insurance companies state the devices will not raise their customers' premium rates for bad driving habits; instead, these customers will not receive any discounts (Addessi, 2015).

3. Research Objective

The objective of this research is to investigate the effectiveness of using GIS technology in assessing consumer habits by insurance agencies. The investigation focuses on how consumers reacted to the new technology being installed in their vehicles.

4. Methodology

Surveys were used to collect information from people at work and at EIU through Qualtrics in order to collect all data in one place. Email messages with approval were sent to the EIU campus to invite participants (see Appendix). The participants included anyone with a driver's license. In addition, I had an interview with State Farm and Progressive to gain further information on how they sell the product to their customers. The 1800 number was used and questions were asked as a potential customer. This data was analyzed by age group and gender. The age group is set by college from 18 to 24, when their insurance lowered from 25 to 29, careers started from 30 to 39, Sr. Careers started with 401k planning from 40 to 55, and people considered retirement for 56 and over. These surveys were selected at random so there could be some uneven distribution of age groups in the data. This data was analyzed through graphs of satisfaction based on their assumptions during the survey. Information included in the survey includes some background information on the survey to allow them to gain some knowledge on what insurance companies are doing with black boxes and data gathering.

5. Survey

The data collection process was closed at 469 surveys. As hypothesized, the data that were received have significantly uneven data collection. There were 32% males and 68% females who responded to the survey. The primary age group in data collection was 18 to 24 years old; primarily due from the survey being sent out to a college campus where most of the students are in that age group. In order to determine an analysis of insurance that used the data collection devices to determine rates, Progressive, Allstate, and State Farm were chosen. The largest amount of participants has State Farm. The majority of consumers taking the survey drive cars. The majority of the consumers taking the survey traveled 20 miles or less per day. Overall, 54% of consumers were aware that insurance companies had the ability to monitor driving habits through a data collection device. The majority of consumers were unaware data collection devices already installed in cars since 2014. Results of the surveys were analyzed using an ANOVA Single Factor comparison with Bonferroni comparison for verification test. This type of analysis was used because it initially assumes an even variance of data and processes the data for correctness. The calculations are made through a series of group means to compare sample groups evenly.

5.1 Survey Questions

A copy of survey questions can be found in Appendix A. The survey started by asking about the gender of the participants as it may have a significant difference between male and female's feelings on the use of data recording devices being used by insurance companies in cars. The age groups were divided considering life events that occur within people's lives. For example, 18 years to 24 years olds are typically working towards their bachelor's degree. At this age, students are starting to learn about future expenses for the first time through the experience of car payments, apartment rent, and school loans. When people reach 25 years old, their insurance rates drop. As their insurance goes down, people might drive more or start interviewing for skilled jobs. When people reach age 30, typically they are beginning their careers. This age group starts considering houses and traveling to work. This increases the amount of travel on a daily basis. At 40 years old, people are developing into senior career goals and contributing more to their retirement plan. At 56 years old, people are considering retirement in a few years and have a different perception on life.

Next, participants were asked if they insured through State Farm, Progressive, Allstate, or other. This question was proven ineffective because the majority of my survey sample size had insurance companies that were not listed on the survey. Question also asked about type of vehicle consumers drove. The choices were simplified to truck, car, van, and SUV. This question was asked because the type of vehicle might influence their judgment with the installation of data collection devices. The participants were also asked how far they travel per day as it believes the less people drive, the more they may be willing to have a device monitor their driving habits. On the other hand, the more someone drives, the less likely they are to accept a data recorder device in their vehicle.

The awareness questions were asked in the survey to determine overall understanding that consumers have on the data collection devices technology being implemented into vehicles and their awareness on insurance companies using the technology to adjust insurance rates. Participants' opinions were rated on a scale of strongly disagree, disagree, neutral, agree, and strongly agree. This group of questions started with "*I agree to install a data recording device in my vehicle to record my driving habits.*" This question was asked to determine if consumers were willing to have the device installed into their vehicles. The next question was "*I agree with the government collecting data through data recorder devices for their research.*" This statement response was asked to determine if consumers were opposed to general government research on these devices. This could potentially be used to mandate future laws on insurance rates. The next question "*I agree with insurance companies collecting my* *driving habits using data recording devices*" was asked to determine if consumers accepted insurance companies collecting information on their habits. This information might influence how the consumer drives if they knowingly are being monitored. Then, the question "*I feel insurance companies use data recording devices to set reasonable premiums for my age group*" was asked to determine consumers' faith in insurance companies' decision making abilities with the new information available to them. The question "*I feel a data recording device will change my driving behavior*" was asked to determine if people's habits would change as a result of this new data recording devices being implemented. Then, the question "*A car crash occurs and the airbags deploy. The data recording device captures 5 seconds before and 2 seconds after the crash. I feel this device will change my driving behavior*" was asked to determine if the knowledge of a black box would change the way people drove if their actions could be recorded after a crash occurred. The last question "*Beginning September 1, 2014, a data recording device is automatically installed in new cars by automobile dealerships. I agree with this data recorder being installed in vehicles 2014 or newer*" was asked to determine if consumers accepted the new devices in their future purchases.

5.2 Results and Discussion

In order to gain better analysis of the survey results, A series of ANOVA tests in SPSS software was used to determine the significance of the data collected between study groups (e.g., gender, age, distance traveled). In SPSS, 95% confidence level was used to determine the significance. In other words, the P-value that is less than 0.05 is significant. After completing the initial analysis, there was no difference between the responses of males and females. All significance levels were below a 95% confidence level.

From the survey question "I agree to install a data recording device in my vehicle to record my driving habits", the overall average rating is 2.2 out of 5 (Figure 2a), which means most people disagree to install a data recording device in their vehicle. ANOVA test shows there is a significant difference between age groups (Figure 2b). The post-hoc test reveals the significance between age 18-24 and age 25 to 29 (p-value of 0.039), as well as between age 18-24 and age 40-55 (p-value of 0.001) (Figure 2c). This means participants of age 18-24 are likely to accept the device more than groups of age 25-29 and 40-55. However, from survey data the majority of age 18-24 group were unaware of data collection device used by insurance companies. At this point in their lives, they are moving away from home or deciding what to do after high

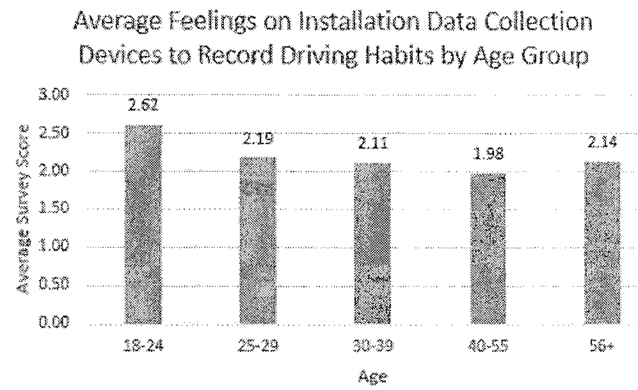

Figure 2a Age Group, Data Collection Device Acceptance Bar Graph

Q1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	31.758	4	7.940	6.478	.000
Within Groups	568.681	464	1.226		
Total	600.439	468			

Figure 2b Age Group, Data Collection Device Acceptance ANOVA Chart

Dependent Variable: Q1
Bonferroni

(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	2	.431*	.148	.039	.01	.85
	3	.503	.180	.054	.00	1.01
	4	.632*	.156	.001	.19	1.07
	5	.480	.245	.511	-.21	1.17
2	1	-.431*	.148	.039	-.85	-.01
	3	.072	.213	1.000	-.53	.67
	4	.202	.193	1.000	-.34	.75
	5	.049	.271	1.000	-.71	.81
3	1	-.503	.180	.054	-1.01	.00
	2	-.072	.213	1.000	-.67	.53
	4	.130	.218	1.000	-.49	.75
	5	-.023	.289	1.000	-.84	.79
4	1	-.632*	.156	.001	-1.07	-.19
	2	-.202	.193	1.000	-.75	.34
	3	-.130	.218	1.000	-.75	.49
	5	-.152	.275	1.000	-.93	.62
5	1	-.480	.245	.511	-1.17	.21
	2	-.049	.271	1.000	-.81	.71
	3	.023	.289	1.000	-.79	.84
	4	.152	.275	1.000	-.62	.93

*. The mean difference is significant at the 0.05 level.

Figure 2c Age Group, Data Collection Device Acceptance Bonferroni Analysis school graduation. Most of these people are still on their parents' insurance and less concern on prices and discounts offered by the insurance companies. From the question "I agree to install a data recording device in my vehicle to record my driving habits." all of the groups of vehicles have an average score of 2.62. This means the average person surveyed disagreed with the installation of the data collection devices being installed in newer vehicles. The order of least to greatest is van, cars, SUV, truck. The order occurred might be because trucks are larger and required more concentration to drive in heavy traffic. A van has more blind spots so they need to drive more carefully due to their vehicle type. Cars may have a little less resistance to this device because they can easily maneuver in between traffic. While they can maneuver easier, they have the ability to gain speed quicker. SUVs are similar to trucks, they are larger vehicles and require more concentration and timing to maneuver through traffic.

From the survey question "Beginning September 1, 2014, a data recording device is automatically installed in new cars by automobile dealerships. I agree with this data recorder being installed in vehicles 2014 or newer", the overall average rating is 2.31 out of 5 (Figure 3a). This means consumers slightly disagree with the black boxes being installed in vehicles since the average score is in between disagree and neither agree or disagree. The ANOVA test reveals that there is significance

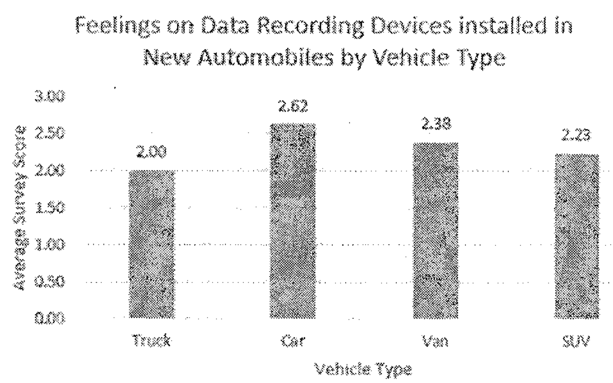

Figure 3a Vehicle Type, 2014 Vehicles with Data Collection Devices Bar Graph

Q6

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	18.764	3	6.255	5.208	.002
Within Groups	558.481	465	1.201		
Total	577.245	468			

Figure 3b Vehicle Type, 2014 Vehicles with Data Collection Devices ANOVA Chart

difference between vehicle types (Figure 3b). The post-hoc test shows participants who drive trucks and cars (p-value of 0.19), as well as participants driving SUVs and cars (p-value of 0.022 are significant (Figure 3c).

Dependent Variable: Q6
Bonferroni

(I) VehicleType	(J) VehicleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.621*	.209	.019	-1.17	-.07
	3	-.385	.294	1.000	-1.16	.39
	4	-.233	.232	1.000	-.85	.38
2	1	.621*	.209	.019	.07	1.17
	3	.236	.223	1.000	-.36	.83
	4	.388*	.133	.022	.04	.74
3	1	.385	.294	1.000	-.39	1.16
	2	-.236	.223	1.000	-.83	.36
	4	.152	.245	1.000	-.50	.80
4	1	.233	.232	1.000	-.38	.85
	2	-.388*	.133	.022	-.74	-.04
	3	-.152	.245	1.000	-.80	.50

*. The mean difference is significant at the 0.05 level.

Figure 3c Vehicle Type, 2014 Vehicles with Data Collection Devices Bonferroni Analysis

This means consumers who drive cars more likely to accept the data collection devices being installed in vehicles 2014 and newer. Overall, it could be a combination of age group influence on the data and consumers feeling on operating the vehicle. A truck, van, or SUV is larger and more difficult to weave through traffic. While weaving through traffic, a truck might have to speed up and slow down faster than the speed limit to reach the correct destination. I did an analysis of my responses and found that 18 to 24 year olds made up 212 of my 327 responses. This group already appears to be more accepting in the age comparison and has an influence over this analysis.

From the survey question "I feel insurance companies use data recording devices to set reasonable premiums for my age group", the overall average rating is 2.79 out of 5 (Figure 4a). This means consumers only slightly disagree since the average response was

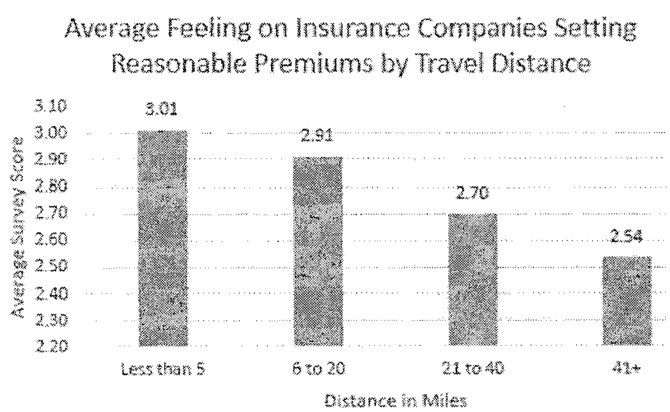

Figure 4a Distance Traveled,
Insurance Reasonable Rates Bar Graph

in-between Disagree and Neither Agree or Disagree. The ANOVA test shows there is a significance difference when this data is compared by distance traveled (Figure 4b). In Figure 4c, the post-hoc test shows significance between the consumers who drive less than 5 miles and 41 miles or more miles a day (p-value of 0.04). This means the more consumers travel, the less the consumer trusts insurance companies to make reasonable rates for their age group. This is because the consumers have more chances to make mistakes which increase their rates over larger distances. The less the consumer travels, the more willing they are for insurance companies to adjust their rates. This could be true because they may receive a lower rate for being a smaller risk as they do not drive as much.

Q3

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.048	3	4.016	3.105	.026
Within Groups	601.529	465	1.294		
Total	613.578	468			

Figure 4b Distance Traveled, Insurance Reasonable Rates ANOVA Chart

Dependent Variable: Q3
Bonferroni

(I) TravelPerDay	(J) TravelPerDay	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
1	2	.099	.122	1.000	-.22	.42
	3	.314	.164	.337	-.12	.75
	4	.476*	.175	.040	.01	.94
2	1	-.099	.122	1.000	-.42	.22
	3	.215	.165	1.000	-.22	.65
	4	.377	.175	.192	-.09	.84
3	1	-.314	.164	.337	-.75	.12
	2	-.215	.165	1.000	-.65	.22
	4	.161	.207	1.000	-.39	.71
4	1	-.476*	.175	.040	-.94	-.01
	2	-.377	.175	.192	-.84	.09
	3	-.161	.207	1.000	-.71	.39

*. The mean difference is significant at the 0.05 level.

Figure 4c Distance Traveled, Insurance Reasonable Rates Bonferroni Analysis

From the survey question "I agree with insurance companies collecting my driving habits using data recording devices", the overall average rating is 2.28 out of 5, which means most people disagree to allow insurance companies to collect driving habits through the use of data collection devices (Figure 5a).

As shown in Figure 5b, ANOVA test shows a significance by vehicle types. The post-hoc test reveals the significance between consumers who drive trucks and cars (p-value of 0.12) (Figure 5c). This means consumers who drive cars are more likely to allow insurance companies to collect data on their driving habits through the use of data collection devices. Trucks are more likely to resist and disagree on the use of the data collection devices. This is due to vehicle size difference. Cars have the ability to weave in and out of traffic easier with a smaller vehicle. Trucks are larger and have trouble going in and out of traffic and sometimes require the driver to break the speed limit in order to change lanes. This would force their rates to go up since the insurance company will not be aware of specific circumstances.

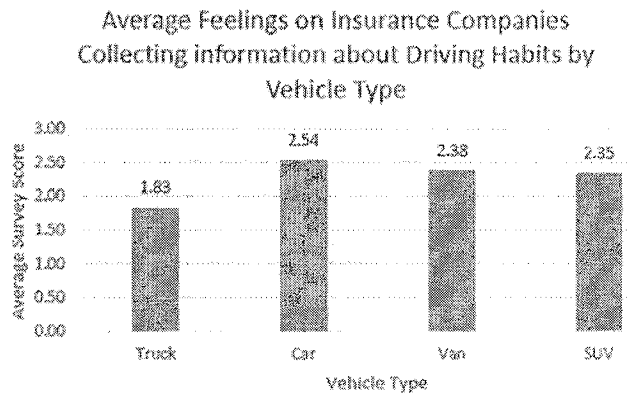

Figure 5a Vehicle Type, Insurance Company Data Collection Bar Graph

Q2

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14.769	3	4.923	3.515	.015
Within Groups	651.201	465	1.400		
Total	665.970	468			

Figure 5b Vehicle Type, Insurance Company Data Collection ANOVA Chart

Dependent Variable: Q2
Bonferroni

(I) VehicleType	(J) VehicleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
1	2	-.702*	.226	.012	-1.30	-.10
	3	-.551	.317	.497	-1.39	.29
	4	-.516	.251	.243	-1.18	.15
2	1	.702*	.226	.012	.10	1.30
	3	.151	.241	1.000	-.49	.79
	4	.186	.143	1.000	-.19	.57
3	1	.551	.317	.497	-.29	1.39
	2	-.151	.241	1.000	-.79	.49
	4	.036	.265	1.000	-.67	.74
4	1	.516	.251	.243	-.15	1.18
	2	-.186	.143	1.000	-.57	.19
	3	-.036	.265	1.000	-.74	.67

*. The mean difference is significant at the 0.05 level.

Figure 5c Vehicle Type, Insurance Company Data Collection Bonferroni Analysis

From the survey question "I feel a data recording device will change my driving behavior", the overall average rating is 2.5 of 5, which means most people disagree that it would change their driving behavior (Figure 5a). ANOVA test shows there is a significant difference between age groups (Figure 5b). The post-hoc test reveals there is a difference between 18 to 24 years and 40 to 55 years (p-value less than .001), as well as, 18 to 24 years and 56 plus years (p-value of 0.006) (Figure 5c). In addition, groups 25 to 29 years and 40 to 55 (p-value of .018) years are significant. This means 18 to 24 year olds are more likely to change their driving behavior when compared to 25 to 29 year olds and 56 plus age groups. The analysis also shows 25 to 29 year olds are more likely to change their driving behavior when compared to 40 to 55 year olds.

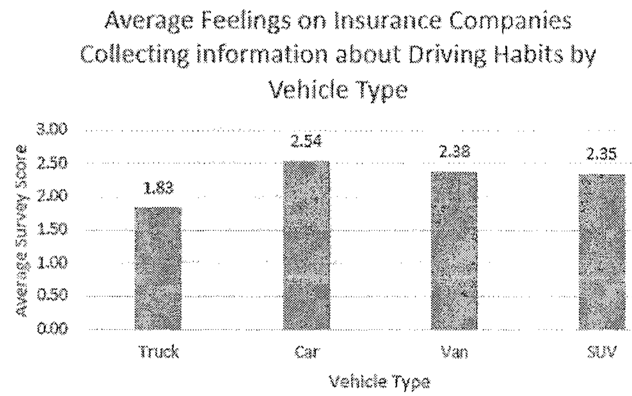

Figure 5a Vehicle Type, Insurance Company Data Collection Bar Graph

Q2

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14.769	3	4.923	3.515	.015
Within Groups	651.201	465	1.400		
Total	665.970	468			

Figure 5b Vehicle Type, Insurance Company Data Collection ANOVA Chart

Dependent Variable: Q2
Bonferroni

(I) VehicleType	(J) VehicleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.702*	.226	.012	-1.30	-.10
	3	-.551	.317	.497	-1.39	.29
	4	-.516	.251	.243	-1.18	.15
2	1	.702*	.226	.012	.10	1.30
	3	.151	.241	1.000	-.49	.79
	4	.186	.143	1.000	-.19	.57
3	1	.551	.317	.497	-.29	1.39
	2	-.151	.241	1.000	-.79	.49
	4	.036	.265	1.000	-.67	.74
4	1	.516	.251	.243	-.15	1.18
	2	-.186	.143	1.000	-.57	.19
	3	-.036	.265	1.000	-.74	.67

*. The mean difference is significant at the 0.05 level.

Figure 5c Vehicle Type, Insurance Company Data Collection Bonferroni Analysis

Overall, the average response shows the younger age consumers are more likely to change their driving behavior.

From the survey question "A car crash occurs and the airbags deploy. The data recording device captures 5 seconds before and 2 seconds after the crash. I feel this device will change my driving behavior", the overall average rating is 2.44, which means most people disagree with black boxes being installed in cars to record information on crashes (Figure 7a). ANOVA test shows a significant difference between vehicle types. The post-hoc test reveals consumers who drive trucks and cars (p-value of 0.48) are significant (Figure 7b, 7c). This means consumers who drive cars are more likely to accept the installation of black boxes in their vehicles when compared to trucks. This could be due to drivers feeling safer in trucks as there is more space inside the vehicle. Cars are more compact and may be subject to further

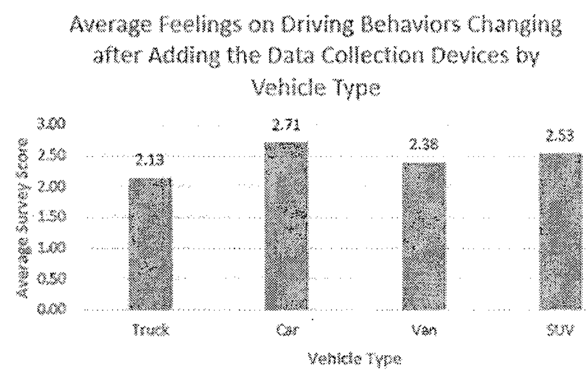

Figure 7a Vehicle Type, Black Box Driving Behavior Change Average Bar Graph

Q5

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.784	3	3.928	3.062	.028
Within Groups	596.416	465	1.283		
Total	608.200	468			

Figure 7b Vehicle Type, Black Box Driving Behavior Change ANOVA Chart

Dependent Variable: Q5
Bonferroni

(I) VehicleType	(J) VehicleType	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.576*	.216	.048	-1.15	.00
	3	-.251	.303	1.000	-1.06	.55
	4	-.402	.240	.571	-1.04	.23
2	1	.576*	.216	.048	.00	1.15
	3	.325	.231	.959	-.29	.94
	4	.175	.137	1.000	-.19	.54
3	1	.251	.303	1.000	-.55	1.06
	2	-.325	.231	.959	-.94	.29
	4	-.150	.253	1.000	-.82	.52
4	1	.402	.240	.571	-.23	1.04
	2	-.175	.137	1.000	-.54	.19
	3	.150	.253	1.000	-.52	.82

*. The mean difference is significant at the 0.05 level.

Figure 7c Vehicle Type, Black Box Driving Behavior Change Bonferroni Analysis damages which means they might have to pay more money to fix their vehicle or replace their vehicle in the event of an accident.

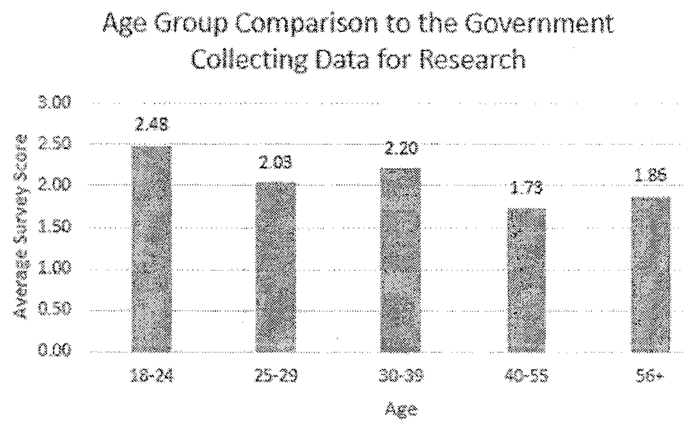

Figure 8a Age Group, Government Comparison

For the last survey question "I agree with the government collecting data through data recorder devices for their research", the overall average rating is 2.06, which means most people disagree with the government collecting data on driving behaviors and using it for research purposes (Figure 8a). The ANOVA test shows there is a significant difference between age groups (Figure 8b). The post-hoc test indicates a difference in 18 to 24 years and 25 to 29 years (p-value of 0.26) (Figure 8c). This means 18 to 24 year olds are more likely to accept the government using the data for research purposes. At this point of 25 years, insurance rates go down for the 25 to 29

Q7

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	36.030	4	9.008	7.308	.000
Within Groups	570.643	463	1.232		
Total	606.673	467			

Figure 8b Age Group, Government ANOVA Chart

Dependent Variable: Q7
Bonferroni

					95% Confidence Interval	
(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
1	2	.451*	.149	.026	.03	.87
	3	.275	.180	1.000	-.23	.78
	4	.726*	.157	.000	.28	1.17
	5	.616	.246	.127	-.08	1.31
2	1	-.451*	.149	.026	-.87	-.03
	3	-.176	.214	1.000	-.78	.43
	4	.274	.194	1.000	-.27	.82
	5	.165	.271	1.000	-.60	.93
3	1	-.275	.180	1.000	-.78	.23
	2	.176	.214	1.000	-.43	.78
	4	.450	.220	.408	-.17	1.07
	5	.341	.290	1.000	-.48	1.16
4	1	-.726*	.157	.000	-1.17	-.28
	2	-.274	.194	1.000	-.82	.27
	3	-.450	.220	.408	-1.07	.17
	5	-.110	.276	1.000	-.89	.67
5	1	-.616	.246	.127	-1.31	.08
	2	-.165	.271	1.000	-.93	.60
	3	-.341	.290	1.000	-1.16	.48
	4	.110	.276	1.000	-.67	.89

*. The mean difference is significant at the 0.05 level.

Figure 8c Age Group, Government Bonferroni Analysis year old age group. The government using the statistics from the data may cause the government to keep insurance rates the same for this age group if they find the driving behavior is unsafe for this age group. The 18 to 24 year old group is already paying higher premiums as they are considered a high risk. Therefore, they could be more willing to allow their data to be monitored on average.

6. Conclusion

Overall, the study shows there is a negative consumer correlation associated with the data collection devices being installed in vehicles to adjust insurance rates for consumers. It can be concluded that insurance companies are not benefiting from implementing this technology into vehicles due to lack of advertisements. After enough time passes, most vehicles will be 2014 or newer. This means most cars will have the data collection devices already installed. This installation is currently marketed in the form of a different service such as OnStar. Therefore, insurance companies might require this device to be installed in the future if a law passes mandating collection of data for insurance purposes. However, this study was strongly impacted by the age group of 18 to 24 year olds which changes the outcome due to their limited life experiences.

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Appendix A (Survey)

What is your gender?

Male / Female

What is your age?

a. 18 to 24 (College)

b. 25 to 29 (insurance lowers)

c. 30 to 39 (career starts)

d. 40 to 55 (Sr. Careers and growing 401k)

e. 56+ (retirement considerations)

What insurance do you have?

a. Progressive

b. State Farm

c. AllState

d. Other: ________

How far do you travel per day?

a. Less than 5 miles

b. 6 to 20 miles

c. 21 to 40 miles

d. More than 41 miles

Are you aware insurance companies can now monitor your driving habits through the use of a GIS data collector (black box)? (State Farm, 2015)

Yes / No

Are you aware auto manufacturers are adding the "GIS Data Collector Device" (black box) feature to vehicles which gathers data of your location, speed, response time, vehicle's maintenance, etc. (State Farm, 2015)

Yes/ No

Circle the closest answer of your opinion.

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Are you comfortable with the GIS device installed in your vehicle which records your driving habits? (State Farm, 2015)

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Are you comfortable with companies collecting location data from your vehicle? (Martinez, 2014)

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Do you feel insurance companies are using this GIS device to set reasonable premiums when compared to your driving age group? (Confused.com, 2015)

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

If a recording device is monitoring your driving habits, will your driving behavior change? (Confused.com, 2015)

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

If an accident occurs and the airbags are deployed, the GIS Data Collector Device (black box) records 5 seconds before and 2 seconds afterwards. Does this information change your driving behavior? (Electronic Privacy Information Center, 2015)

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Beginning September 1, 2014, a GIS Data Collector Device (black box) is automatically installed in new cars by automobile dealerships. How do you feel about this added feature? (EPIC, 2015)

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Are you comfortable with the government collecting data from these GIS devices for research? (Electronic Privacy Information Center, 2015)

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Appendix B (IRB Form)

For IRB use only
IRB File No.: __________
Date received: __________

Form A

Eastern Illinois University

Institutional Review Board

NEW APPLICATION FOR REVIEW OF RESEARCH INVOLVING HUMAN SUBJECTS

Federal regulations and Eastern Illinois University's IRB policy require that all research involving humans as subjects be reviewed and approved by the University's Institutional Review Board (IRB) prior to the commencement of the data collection. Approval of this project by the IRB only signifies that the procedures adequately protect the rights and welfare of the subjects.

1. Title of Project: __Does Geographic Information Systems (GIS) benefit the Insurance Agency______

2. Principal Investigator*: Andrew Brachear____

Status: ☐ Faculty ✔ Student* ☐ EAP Staff ☐ Other—specify: ________________

*Note: Students engaging in research are required to have a faculty sponsor or executive, administrative, or professional (EAP) staff sponsor. List sponsor below.

Mailing address: 17070 W. 93rd Place Apt 14204, Lenexa, KS 66219______________________

Phone: __(816) 226-6711_______ E-mail: abrachear@gmail.com_________________

Department or Unit ___School of Technology_____________________________________

Has PI completed CITI training? ✓ Yes ☐ No

Prior to IRB approval, all PI's, Co-PI's, and sponsors must complete the <u>CITI Program training</u>

Co-Investigator or Sponsor: ______Dr. Wutthigrai Boonsuk_________________

Status: ✓ Faculty ☐ Student ☐ EAP Staff ☐ Other—specify:

Mailing address: ____600 Lincoln Ave, Charleston, IL 66219_____________

Phone: __(217) 581-5772_________ E-mail: wboonsuk@eiu.edu

Department or Unit _____School of Technology_______________________

Has Co-PI or sponsor completed CITI training? ✓ Yes ☐ No

List additional co-investigators, including above information, on a separate sheet.

3. Level of Review Sought: ✓ Exempt (submit Form B) ☐ Expedited (submit form C) ☐ Full Committee

4. Is this research being conducted to meet requirements of a course or to complete an academic degree?

   ✓ Yes (do NOT submit your dissertation or thesis proposal) ☐ No

5. Estimated Project Starting Date: __11-16-15__ Estimated Project Completion Date: __12-15-15_

6. Extramural Funding:

   Principal Investigator of Contract or Grant: ___________________________

Funding Source: ____

Contract or Grant Title: ____

Contract or Grant Number: ____

7. Indicate the categories of subjects and controls to be included in the study: Check ALL that apply:

_____ Abortuses/Fetuses

_____ Decisionally Impaired

_____ Decisionally Impaired (Institutionalized)

_____ Minors (17 yrs or less)—Give age range: _____

_____ Students

_____ Normal Volunteers

_____ Patients

_____ Prisoners

_____ Pregnant Women

8. Approximate number of human subjects: ___200____________________

9. Indicate which of the categories listed below accurately describes this protocol:

__✔__Not greater than minimal risk

_____ Greater than minimal risk, but presenting the prospect of direct benefit to individual subjects

_____ Greater than minimal risk, no prospect of direct benefit to individual subjects, but likely to yield generalizable knowledge about the subject's disorder or condition

_____ Research not otherwise approvable, but presents an opportunity to understand, prevent, or alleviate a serious problem affecting the health and welfare of subjects

10. Does this research involve any of the following? (Check all that may apply)

_____ Past, present, or future physical health of the participants

_____ Mental health (as defined in DSM-IV TR)

_____ Provision of health care to the participants

_____ Past, present, or future payments for the provision of health care to the participants

If any of the above categories are checked, please refer to Appendix 4, HIPAA Information, in the EIU Policy and Procedures for the Review of Research Involving Human Subjects

11. Will a public use data file be created? ☐ Yes ✓ No

12. Complete all items in the following Research Description section.

Investigator Assurance

I certify that the information provided for this project is correct and that no other procedures will be used in this protocol. I agree to conduct this research as described in the attached supporting documents. I will request approval from the IRB for changes to the study's protocol and/or consent forms and will not implement the changes until I receive IRB approval for these changes. I will comply with the IRB policy for the conduct of ethical research. I will promptly report significant or adverse effects to the IRB in writing within 5 days of occurrence. I will be responsible for ensuring that the work of others involved with this project complies with this protocol. I will complete, on request by the IRB, the Continuation Request or Completion of Research Activities Forms.

Andrew Brachear — 10-25-15

Principal Investigator's Signature — Date

Faculty or EAP Staff Sponsor Assurance (required when a student is the PI)

This is to certify that I have reviewed this research protocol and that I attest to the scientific merit of this study and the competency of the investigator(s) to conduct the project. I assure that the investigator(s) is knowledgeable about the regulations and policies governing research with human subjects. I agree to meet with the investigator on a regular basis to monitor study progress and compliance with IRB policy for the conduct of ethical research.

Faculty or EAP Staff Sponsor's Signature — Date

RESEARCH DESCRIPTION

Provide responses to the following items. If an item does not apply to your research project, simply indicate "Not applicable."

PROJECT DESCRIPTION

1. DESCRIPTION—Provide a brief description in layperson's terms of the proposed research. Include the purpose and research questions/hypotheses.

   My research is on Geographic Information Systems and the Insurance Industry. Insurance industries today are providing discounts for the use of a Geographic Information Systems data collector. This is similar to a black box that is placed in airplanes. The initial purpose of these devices is to record a few seconds before and after a crash. My research is going to see if the trend is accepted by the public and how different age groups respond to this information. Once this information is collected, this will help me determine if insurance companies are going to be successful in implementing these devices.

   I believe people will feel like their privacy is being invaded by data collector devices. They will feel like "big brother" is always watching their movements and collecting data from their habits.

2. DISSEMINATION—Describe how the results of the research will be disseminated. Dissemination includes, but is not limited to: honor's, master's or doctoral theses; presentation at a scientific/professional meeting or conference; submission to or publication in a scientific/professional journal (paper or electronic); and internet postings.

   Masters Thesis

METHODOLOGY

3. PARTICIPANTS—Describe the characteristics (e.g., age, gender, ethnicity, health status) of the subject population whom you are targeting and the approximate number of participants. Provide exclusion and inclusion criteria. Will there be any special populations (see 45 CFR 46, subparts B, C, and D), such as children, mentally incapacitated individuals, prisoners, or others whose ability to give voluntary informed consent may be in question included?—If yes, explain the rationale for their inclusion.

   People 18 years or older, male or female, and United States Citizens.

4. RECRUITMENT—Describe how you will identify and recruit prospective subjects. Attach a draft or final copy of any planned advertisements, flyers, letters, and emails to potential subjects.

This will be done through language in an email and online survey. An email will be sent to the EIU Campus.

An email will be sent to the faculty, staff, and students on EIUs campus. This survey will be administered through email that includes a link to Qualtrics. The ideal candidates will have a driver's license in order to determine the response of insured current drivers. This study will be limited to United States citizens.

Hello,

My name is Andy Brachear. I am a graduate student pursuing my degree in Computer Technology. You have been selected to take part in a research study about the effectiveness of data recording devices in the Insurance Industry.

I would appreciate it if you would complete my survey so I can determine the public's reaction to this new process. The survey takes 5 minutes to complete, is multiple choice, anonymous, and no personal information is collected.

This survey is voluntary and there is no obligation to take this survey.

http://eiu.co1.qualtrics.com/SE/?SID=SV_0PKRbqlf0VvpHWB

If you have any questions, please contact Dr. Boonsuk or me.

Dr. Boonsuk
(217) 581-5772
wboonsuk@eiu.edu
600 Lincoln Ave
Charleston, IL 61920

Andy Brachear
arbrachear@eiu.edu

Thank you in advance for your participation in my survey.

Andy Brachear

5. LOCATION OF STUDY—Identify specific sites or agencies to be used. For research conducted at a facility other than one owned and operated by Eastern Illinois University, additional information is required.

   a. Non-federally funded research—If the research project will not receive federal funds, a letter from the appropriate administrator of each facility should be submitted on the facility's letterhead stationary and should contain the following: agreement for the study to be conducted; identification of someone at the site who will provide information about appropriateness for its population; assurance of adequate capabilities to perform the research as approved by the IRB; and if applicable, assurance that facility personnel involved in data collection have appropriate expertise and will follow IRB approved procedures. If the approval letters are not available at the time of IRB review, IRB approval will be contingent upon receipt of the letters.

b. Federally funded research—If the research project receives federal funds from an agency such as the National Institutes of Health (NIH), each study site must have a Federal Wide Assurance (FWA) with the Office for Human Research Protections (OHRP). FWAs are a requirement of OHRP or NIH and not EIU's IRB or EIU's Office of Research and Sponsored Programs. EIU has negotiated a FWA. Contact ORSP for the information to enter on the funding agency's application form regarding FWA documentation. If the study is a collaborative project and another organization in addition to EIU is engaged in human subjects research (as defined by DHHS), then the PI must obtain information on the other organization's FWA and provide it in this section of the EIU application. A search for another organization's FWA may be found at OHRP's web site, http://ohrp.cit.nih.gov/search/asearch.asp#ASUR.

6. INSTRUMENTS, RESEARCH MATERIALS, RECORDS, & PROCEDURES—Describe the study design and research procedures that will be followed. Identify all procedures that will be carried out with each group of subjects. Describe the setting and mode of administration (e.g., group, telephone, individual); describe the duration of administration, intervals of administration (if multiple administrations), and overall length of participation. Identify the sources of research material (e.g., specimens, records, data) to be obtained from subjects. Indicate whether the material or data will be obtained specifically for research purposes or whether use will be made of existing specimens, records, or data. If applicable, differentiate between procedures that involve standard or routine procedures for care or treatment from those which will be performed specifically for the conduct of this research project.

   NOTE: Attach a copy of all questionnaires, tests, surveys, or other materials to be administered to the subjects, if applicable.

7. DATA COLLECTION, STORAGE, AND CONFIDENTIALITY—Describe how data will be collected and recorded. State whether data will be recorded with or without names or identifiers. If subjects are identifiable by name or other means, explain special steps that will be taken to ensure confidentiality. Describe how data will be stored during the study and how it will be secured. Delineate who will have access to the data or to subject identifiers. Describe what will happen with data from subjects who formally withdraw from the study. Describe what will happen to the

data when the research has been completed. [Note: Records (e.g., signed informed consent forms, data) relating to the research project must be retained for at least three years after completion of the research. See 45 CFR 46.115(b)]

The data will be gathered anonymously.

If all or some of the subject(s) of the proposed research will be audio or videotaped, justify why the use of audio or videotaping is necessary to the study. Who will have access to the tapes and for what purposes? Where will the tapes be stored and what security measures will be taken to prevent unauthorized persons from accessing the tapes? What are your plans for the ultimate use and disposal of the tapes?

Not Applicable

8. INFORMED CONSENT—Describe the informed consent procedures to be followed, including circumstances under which consent will be sought and obtained, who will seek it, and the method for documenting consent. **Include applicable informed consent forms for review purposes. If the informed consent process is to be waived, or if written consent or a signed informed consent is not to be obtained, specifically point this out and complete and submit Form I, Request for Waivers of Informed Consent** [see 45 CFR 46.116(d) and 45 CFR 46.117(c)].

   Email contains the informed consent.

   Special Considerations

   Minors: If the study involves minor participants (17 years of age or under), describe the process for obtaining parent permission, and include the parent informed consent form. Also describe the child assent process (written assent may not be required in every case).

   On-line Research: If the research is to be conducted completely on-line (such as surveys or questionnaires administered via the internet or email), it may be possible to waive the written documentation of informed consent. Complete Form I, Section B, to request a waiver.

RISKS/BENEFITS

9. RISKS—Describe the short-term and long-term potential risks (physical, psychological, social, legal, or other) to subjects and assess their likelihood and seriousness. Where appropriate, describe alternative treatments or procedures that might be advantageous to the subjects.

   There are no foreseeable risks.

10. SAFETY PRECAUTIONS—Describe the procedures for protecting against or minimizing any potential risks, including risks to confidentiality. Where appropriate, discuss provisions for ensuring necessary medical or professional intervention in the event of adverse effects to the subject(s) and attach a referral list. Also, where appropriate, describe the provisions for monitoring the data collected to ensure the safety of subjects.

    Online survey and it will be anonymously.

11. BENEFITS—Describe the potential direct benefits subjects may receive as a result of participating in this research. Describe the potential benefits to society that may be expected from this research.

    Knowledge of public behavior in response to the black box being installed in vehicles.

12. BENEFITS VS. RISKS—Discuss why the risks to subjects are reasonable in relation to the anticipated benefits to subjects and in relation to the importance of the knowledge that may reasonably be expected to result.

    I believe there are no risks associated with this survey. The information does not single anyone out for medical history or trauma related experiences. The person taking the survey will be in their own environment at their computer and will not feel compelled to take the survey if they feel uncomfortable.

13. INCENTIVES AND RESEARCH RELATED COSTS—Describe the incentives, if any, being offered to subjects for their participation in the research study. If monetary compensation is offered, indicate how much subjects will be paid and describe terms of payment. Describe what will be done if subjects withdraw before completion of the research (e.g., will monetary payments be prorated or payment in full?). Also, if applicable, describe any costs which will be accrued by the subjects as a consequence of participating in the research.

    No incentive.

QUALIFICATIONS OF INVESTIGATORS

14. Briefly describe the qualifications of the investigators(s) conducting this research project.

Andy Brachear; I am a technology student with studies in Geographic Information Systems. I believe I am qualified because I understand the concept of GIS and enjoy learning about new technology.

Dr. Boonsuk has a background in teaching technology and Geographic Information System technology.

OTHER (Provide information regarding the following if applicable)

15. DATA SAFETY AND MONITORING FOR NIH SPONSORED RESEARCH—The National Institutes of Health policy requires that grantees have in place procedures for data safety monitoring of clinical trials. The IRB is required to review and approve the data safety monitoring plans. For NIH funded clinical trials, include a description of the Data Safety Monitoring Plan.

    Not applicable.

16. Describe any requirements imposed by funding agencies that are not already covered in this application.

    Not applicable.