

Effectiveness of Digital Innovation as the Key to Advance Road Safety and Investigation

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“Success is not final; failure is not fatal; it is the courage to continue the counts”

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The Researchers

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ABSTRACT

This study was undertaken to focus on the effectiveness of digital innovation as the key to advanced road safety and investigation. Specifically, aimed to determine the equipment being used by the PNP Highway Patrol Group, Bus Drivers and UV Express, including the effects of the equipment that are being used and the problems encountered in using the equipment that are being used.

The PNP Highway Patrol Group, Bus Drivers, and UV Express were given a questionnaire by the researchers using the quantitative approach in a descriptive design. Wherein, (N=10) members of the PNP Highway Patrol Group, (N=190) bus drivers, UV Express members who were on duty, and drivers at various bus terminals in Laoag City. Questionnaires were the study's primary tool. The common equipment being use by the PNP Highway Patrol Group are the Dashboard Camera, Body Worn Camera and Global Positioning System. While the Bus Drivers and UV Express is the Dashboard Camera (Dashcam). The level of effectiveness of the equipment that are being used by the PNP Highway Patrol Group implied that the devices are effective in their investigation and operation likewise to the Bus Drivers and UV Express in their transportation and security. In PNP Highway Patrol Group, there is no problem encountered of the equipments. As to the problem encountered of the devices being used by the Bus Drivers and UV Express the main problems are that the equipment sometimes gives poor alternate routes, the equipment invades the privacy of passengers and it does not provide complete and accurate account of event.

Keywords:- Highway Patrol Group, Bus Drivers, UV Express, Road Safety, Equipment being used, Effectiveness of the Equipment.

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CHAPTER ONE

THE PROBLEM AND ITS SETTING

➤ *Introduction*

The global economy has grown and developed as a result of the emergence of new technologies, particularly the internet. Due to this reality, the communication and cultural industries are becoming more and more significant in the global economy (Deng, 2013). When creative integration processes are used to develop, modify, or improve a system, that is what is meant by innovation an action of change that is original. New business models and opportunities have been created in the creative industry as a result of innovation, which has been affected by new technologies and the usage of new devices and digital media (Abelson et al., 2017; Ashurst & Jones, 2017; Pierce et al., 2017). These new business opportunities address requirements that did not exist before. It is intriguing to draw attention to the ongoing expansion of businesses involved in creativity and new media, as well as, most importantly, the part these businesses play in a society that is interdisciplinary and founded on diversity. The originality, distinctiveness, performance, and aesthetic appeal of new items based on technological innovation determines their market worth. (Kao & Liebovitz, 2017).

Advanced technology has been advocated as a means of significantly reducing incidence and severity of road crashes. It is intended as a means of stimulating discussion and interest in the use of new innovation to add some countermeasures that can support the traffic authorities, road users in the resolving and reducing vehicular accidents. (Howie, D.J. 1989) Road users today must maintain constant vigilance due to the constantly changing traffic situation. Some of the causes of traffic accidents include speeding, drunk driving, and not using a seat belt. Accident risk is meant to be reduced by traffic laws. Dealing with issues relating to other road users, the environment of the traffic, and the state of the vehicle are all part of improving road safety. Road accidents are still a leading cause of fatalities, injuries, and property damage. However, the issue goes beyond budget allocation and also involves the DPWH's constrained ability to absorb funds. For instance, in 2007 the DPWH budget increased significantly yet only 66% of that amount was actually spent. Poor progress being made to maintain and/or improve current road assets. Similar to the transition from Morse code to e-mail, state-of-the-art computer technology has undergone an almost unfathomable shift. The basic objectives, ambitions, and scope of the transportation community have not altered much, yet there are more technological obstacles than ever before. Within a generation, computers completely changed how the workforce performed routine activities. Nowadays, computers are used practically everywhere. Resource management has been substantially improved by data management skills. The difficulties of implementing, supporting, and funding these technologies in the transportation industry, however, go along with the benefits. According to this study, sophisticated technology that help lessen traffic bottlenecks and make travelling safer are needed. These technologies, like as video surveillance cameras and remote monitoring, can offer real-time coverage and produce alerts of traffic snarls, vehicle numbers, speeds, and incidents on the road. (SensorTec1990).

The Philippine Road system's coverage and quality could be deemed subpar. Road safety record is poor. Road accidents are currently the Philippines' fourth most common cause of mortality, according to the Department of Health. Estimates place the cost of road accidents at \$1.9 billion, or 2.8% of the GDP, for the entire nation. The Philippines outperformed most of its fellow Association of Southeast Asian Nations (ASEAN) neighbor's in terms of fatalities per million cars (215), recording a rate of fatalities per million vehicles that was lower than average insufficient connectivity to other modes of transportation. Modern planning techniques and instruments for national roads have been built by the Department of Public Works and Highways (DPWH). However, they focus on roads and are not adequately linked to the planning of other modes. As a result, the advantages of using combinations of modes to produce optimum transport schemes have not been taken into consideration.

➤ *Background of the Study*

Ilocos Norte Police Provincial Office (INPPO) reported during the Multi-Council Meeting of Provincial Peace and Order Council at the Provincial Capitol Auditorium on December 4, 2022, that while crime incidents continue to be "generally peaceful" in the province, the rise in traffic accidents is quite alarming. In line with PLtCol. According to INPPO Operations Officer Rafael Lero, there was a 4% decrease in overall crime events from January 1 to November 30 of this year compared to the data from the previous year. Despite the INPPO's unwavering efforts to keep the province peaceful and orderly, the number of vehicular accidents has increased by 27%, or from 888 to 1,093, since the same time period, putting more emphasis on public safety. Drunk driving, human error, a lack of skills, and a lack of road signage were among the listed reasons of vehicle traffic accidents. Governor Matthew Marcos Manotoc advocates for stricter enforcement of traffic laws, especially for motorcyclists, in an effort to reduce the growing incidence of road accidents in the province (Adriano, 2022).

In some situations, technology has the potential to cause car accidents just as much as it has the potential to save lives. For instance, drivers may become distracted by contemporary technologies like smartphones and dashboard entertainment systems. When employing driver-assistive technologies, drivers may also become overly complacent, which can cause sluggish reaction times and subpar driving decisions. The National Highway Traffic Safety Administration reports that 3,142 persons lost their lives in car accidents in 2019 due to distracted drivers. A system combination utilised to deliver information and entertainment is known as an in-vehicle infotainment system. Modern vehicles have big infotainment screens integrated into the dashboard. These technologies can be advantageous for a driver, but they can also be annoying. Even though it is prohibited to use these systems while driving, many motorists nonetheless commit the error and take their eyes off the road, which leads to collisions. Due to their

supposed ability to eliminate driver error, autonomous or self-driving automobiles are promoted as safer alternatives to conventional vehicles. To date, however, human occupants who are meant to be paying attention and taking action to prevent accidents have been the ones to cause collisions in driverless vehicles. Drivers can put too much faith on automated driving technologies and fail to do their bit to prevent collisions.

Law enforcement organizations must keep up with the rapid advancement of technology. In order to better serve and protect their officers and communities, agencies at all levels are investing in the newest technologies. Privacy issues are a challenge presented by technical improvements in law enforcement. The government's unethical use of technology may have a detrimental effect on civil rights and societal stability. Some police officers believe that wearing body cameras violates their privacy. The potential for technology to distract cops while they are performing their duties is a serious matter for concern. Devices like in-car computers, dispatch systems, and cell phones can divert an officer's attention in public safety states and perhaps put them in risk. Although technology can be useful for law enforcement, some officers may find it inconvenient. Law enforcement personnel frequently experience anxiety due to the strain and time required to learn how to use and implement this variety of equipment. It is possible to overcome the drawbacks of technology in the realm of law enforcement. Strict rules can be implemented to guarantee the protection of civil liberties and forbid law enforcement officials from using technology in an immoral way. Additionally, body cameras can only be used when police officers are on the scene or interacting with suspects, as opposed to being mandated for use at all times while on duty. Additionally, all officers should be required to complete sufficient training in order to prevent them from becoming easily sidetracked or deterred from using the technology required to conduct an investigation. The most crucial area to invest in for ensuring public safety is good training, despite all of these technology being marketed in the field.

The researchers shared the experience to the equipment as to the road safety that this equipment prevent accidents by making us aware of road conditions and traffic flow. The researchers who also a passenger of the professional drivers using that equipment it gives an assurance that they will deliver passenger in destination, it provides faster routing and shortens travel distance. Unfortunately, they can't avoid that sometimes that equipment they used causes accidents and destruction.

The present research focused on the effectiveness of digital innovation as the key to advanced road safety and investigation, the researchers want to make a difference, comparing to other research that there is only few who focused on the issues of equipment in road safety. Technology has fundamentally changed how we live only in the last ten years. The innovation revolution has not excluded the road transport industry. Innovation through new technology is one of the major prospects for enhancing operations in the road transport sector.

➤ *Statement of the Problem*

This study focused on the effectiveness of digital innovation as the key to advanced road safety and investigation.

• *Specifically, it Sought to Answers to the following Questions:*

✓ *What are the equipment used by the:*

- *PNP Highway Patrol Group*
- *Bus Drivers and UV Express*

✓ *What is the level of effectiveness of the equipment?*

✓ *What are the problems encountered in using the equipment?*

✓ *What is the proposed action plan to encourage road users to use the digital innovation as the key to advance road safety?*

➤ *Theoretical Framework*

The following are the theories used to attain the objectives of the study.

➤ *Systems Theory*

According to Ludwig Von, Bertalanffy, 1968, System Theory is a complex of interacting elements and that they are open to, and interact with their environments. The systemic theory's response if that mistakes are created because the system is designed incorrectly and does not fit human skills.

Systems theory is used to examine how society adjusts to its environment by changing its structure, which has significant ramifications for our understanding of social order. The complexity of social evolution is revealed by systems theory, which emphasizes the limited ability to influence society. The adoption of new technologies by law enforcement agencies has been accelerating at a very fast rate. Like the Body-worn cameras, improving police enforcement practices generally has been seen as a means to address these issues. When used by cops on patrol or other responsibilities that put them into contact with people of the community, the device, which can be installed on an officer's spectacles or chest area, gives real-time information.

➤ *Adaption-Innovation Theory*

According to Kirton, 1976; Goldsmith & Kerr, 1991, people are different in cognitive style and sit on a normally distributed continuum, ranging from highly adaptive to highly innovative.

The assessment of digital innovation as the key to improved road safety is explained by this theory, which also aided organizations in comprehending problem-solving and cognitive style. Innovative automobile technologies are now being developed by manufacturers in an effort to lower the frequency of incidents involving vehicles and increase road safety similar to a dashboard camera that might record a driver's actions and transfer the data to a computer analysis system to assess driving ability. The camera might capture and keep track of signs of weariness, such as excessive blinking. The system will encourage the driver to take a coffee break if it notices behavior that it links with weariness, assisting in the reduction of distracted driving and related traffic incidents.

➤ *Technology Theory*

John Spacey claims that February 3, 2020. Any hypothesis that has broad consequences for technology and how it affects culture and society is considered a technology theory. These can be utilized to comprehend technology at a high level and are frequently patterns, trends, approaches, and initial principles. This kind of broad knowledge is typically more beneficial than technical expertise, such as knowing how to set up a particular widget.

This technology theory gives a thorough review of how equipment is evaluated in relation to how the transportation system is changing. The probable uses for these technologies and their potential effects on the system are discussed in this technology theory. It also discusses the current situation and necessary future steps to completely integrate these technologies and associated mobility application.

➤ *Conceptual Framework*

The study adopted the Input–Process–Output Outcome, or IPOO, model. The IPOO model represents a system in four stages: input, process, output and outcome. Inputs are the resources used to carry out a task, process is the actions that take place to direct inputs towards intended outputs and outcome, outputs are specific products of our inputs and processes and the outcomes are the things that happen as a result (Canonizado,2021).

The input consists the equipments used by the PNP Highway Patrol Group and Bus Drivers and UV Express, the level of effectiveness of the equipment and the problems encountered in using the equipment. The process includes Quantitative research through descriptive method employing survey questionnaire among PNP Highway Group, Bus Drivers and UV Express of Laoag City. The output will be proposed action plan to encourage road users to use the digital innovation as the key to advance road safety. The researchers made a possible outcome that have PNP Highway Patrol Group encourage to use the most effective and useful equipment during their duty on the road. Bus Drivers and UV Express of Laoag City well-informed and knowledgeable in the use of equipment for their road safety.

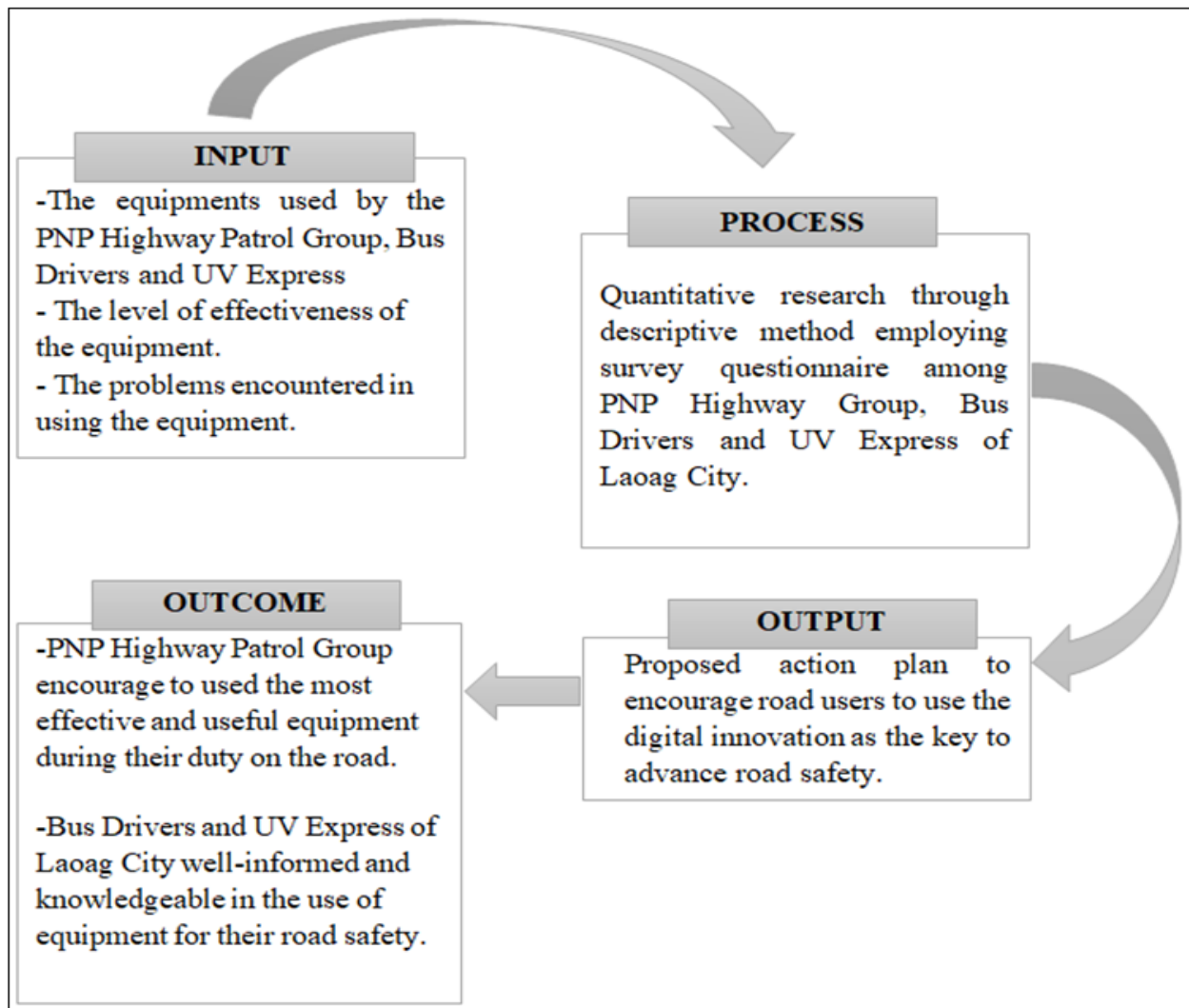


Fig 1 The Research Paradigm

➤ *Significance of the Study*

The result of the study will be beneficial to the following:

- *PNP Highway Patrol Group.*
A unit under Philippine National Police that enforce traffic safety roles, provide traffic control and road safety. The result of the study helps them in determine the most effective and useful equipments during their duty on the road.
- *Bus or shuttle bus driver.*
The bus drivers are responsible for safety procedures for all passengers. This research provides information that determine if these technologies are enough for the Bus drivers to be able to provide road safety.
- *UV Express.*
A modern vehicle that provides a comfortable and safe ride for the passengers. The result of this study can be used as guide for UV express. They became well-informed and knowledgeable in the use of equipment for their road safety.
- *The Local Government Unit (LGUs).*
The LGUs play a major role in enacting and enforcing local traffic ordinances to lower speed limits and promote safe driving practices. The result of the study makes them aware for the implementation of digital innovations on equipment need in road safety by the PNP Highway Patrol Group and Professional Drivers.
- *DPWH.*
The DPWH is responsible in restoring and clearing vital access roads and bridges and reconstruction of road. The result of the study helps them to improve in planning design and securing for all the public works and highways by adaptation of new innovation equipment for road safety.

- *Future Researchers.*

The findings of the study will serve as a reference material and guide for future researchers who shall conduct the same quantitative research related to the effectiveness of digital innovation as the key to advance road safety and investigation.

- *Scope and Delimitations of the Study*

This study focused on the assessment of the effectiveness of digital innovation as the key to advanced road safety and investigation. The participant of this study limited only to the PNP Highway Patrol Group and Bus Drivers and UV Express in Laoag City.

This study was conducted during First Semester, S.Y. 2022-2023.

- *Definition of Terms*

These terms were used in this study and were defined as follows:

- *Bus Drivers.*

A bus driver is a transportation professional who transports people from one's destination to another by driving and operating a bus. They are responsible for safety procedures for all passengers.

- *Dashboard Camera.*

It is defined a video camera mounted usually on the dashboard of a vehicle and used to continuously record activity through the vehicle's windshield. It allows fleet managers to see the road through the truck driver's eyes and capture video evidence. This helps reduce many false claims and potential liabilities.

- *Digital Innovations.*

It is practice of implementing modern digital technology to solve business problems by optimizing processes, improving customer experiences in road safety. Using new technology such as smart traffic light and traffic control systems and automotive technology can contribute to prevent and reduce the number of road related accidents and improve road safety.

- *Google Maps.*

It is a web mapping platform and consumer application offered by Google. This type of warrant uses this technology to determine who is in a specific area at a specific time. This helps aid in investigations and can lead to an arrest.

- *Investigation.*

It is conducted to identify the root cause of an accident in an effort to make recommendations or take corrective actions to prevent the future occurrence of the same or a similar event.

- *Traffic Safety.*

It is the protection of individuals from injuries and accidents on the road. It is the use of all available road safety measures to avoid and protect against traffic accidents. Everybody who travels by car runs the danger of becoming hurt or killed such as passengers, cyclists, pedestrians, and drivers. According to some theories, a person's brain functions in a way that informs them of their current level of safety.

- *Traffic Lights.*

It is a set of automatically operated colored lights, typically red, amber, and green, for controlling traffic at road junctions and crosswalks. It provides a safe and orderly flow of cars on the roads and highways.

- *The global positioning system (GPS).*

It is a network of satellites and receiving devices used to determine the location of something on Earth. Used to monitor vehicle speed, routes, engine start-up and shut down, idling and routes.

- *UV Express.*

It is a license to operate utility vehicles, particularly vans, as an alternative mode of public transportation in the Philippines.

- *Waze.*

It is powered and used by drivers all over the world. Drivers connect to one another and work together to improve each other's driving experience.

CHAPTER TWO

REVIEW RELATED LITERATURE AND STUDIES

This chapter presents an extensive review of related literature and research on the effectiveness of digital innovation as the key to advanced road safety and investigation.

➤ *Body-Worn Cameras*

In circumstances when hard video and audio evidence is required for subsequent examination, BWCs also offer such, as well as documentation of specific events that may have transpired and led to an arrest. According to studies, cases were much less likely to go to trial when authorities could use video from the scene to acquire precise information and accurately document offences. Not only this, but owing to having easy access to film to review for their records, cops were found to spend less time filling out paperwork and were able to patrol more (White, 2014). In that it can enhance the time spent patrolling and decrease the time spent recording crimes, this is highly advantageous for police forces. Additionally, it lessens the burden on the prosecution and defense in court because it might cut down on the number of cases that go to trial and the drawn-out procedure beforehand.

Domestic abuse cases including reluctance on the part of the victim have also yielded fruitful outcomes, as video evidence frequently provides an accurate depiction of what happened right away, including the accused's demeanor and the victim's mental distress. (White, 2014).

Body-worn cameras have been studied in relation to police use of force and citizen complaints against the police, according to Ariel, Farrar, and Sutherland (2015). In the experimental study, police officers worked in two shifts, one of which had body-worn cameras and the other of which did not. The study's findings revealed that cops without cameras reported slightly more than twice as many use-of-force instances as those with cameras. The research period saw a considerable decline in complaints overall, but regardless of camera use, there was no statistically significant change in the number of complaints made against officers. The authors discussed a number of additional theories regarding the decrease in use-of-force incidents by the officers wearing cameras. They noted that, given that the majority of recorded uses of force were made in response to a suspect action, the presence of a camera may have discouraged suspects from acting in ways that would require the police to use force. This observation calls for further investigation into any potential mitigating effects that might exist while cameras are in use. The Phoenix Police Department's two sets of officers, one of whom had been issued body-worn cameras and the other of whom did not, participated in a study on the impact of such devices on interactions between the public and the police.

According to the study's findings, the group of cops who had cameras showed a 62% decrease in complaints against them. It was found that cops did not always activate their cameras as instructed, and the authors noted that an increase in the number of complaints may be reduced by up to 96% if officers activated their cameras more frequently. It has been highlighted that how officers perceive wearing body cameras may affect how often they are used. The presence of a body-worn camera did not significantly reduce incidents of suspects resisting arrest, according to a different conclusion from that of. It was noted that future research might take into account how suspects are made aware of cameras in an effort to better understand suspect behavior when cameras are being used.

Examined a citizen's willingness to comply with police requests during encounters with traffic enforcement officers who were wearing body cameras. According to the study, when a camera was present, people were more willing to follow police directions during traffic stops. Additionally, the presence of a body-worn camera affected how likely drivers were to follow traffic laws and how cooperative they were with law enforcement.

The speed of technological advancement in law enforcement agencies has increased dramatically during the previous ten years. One approach to overcoming these difficulties and enhancing law enforcement practises more broadly has been the use of body-worn cameras. When used by cops on patrol or other responsibilities that put them into contact with people of the community, the device, which can be installed on an officer's spectacles or chest area, gives real-time information. Body-worn cameras also have the advantage of giving law enforcement a surveillance tool to increase officer safety and effectiveness and deter crime. (Chapman 2018)

Body-worn cameras have been found to benefit law enforcement agencies in several ways in previous research. An early UK study showed that wearing a body camera increased public safety and improved interactions between law enforcement and the general public. Both the incidence of crime and the number of citizen complaints were found to be declining. The study discovered that the usage of body-worn cameras increased the number of arrests, prosecutions, and guilty verdicts. As a result of police being able to conclude criminal cases more quickly and with less time spent on paperwork preparation thanks to technology, reports claim that fewer persons choose to go to trial. (Chapman 2018).

The authors claimed that the officers' enhanced actions as a result of wearing cameras led to the improved citizen behavior. To investigate the effect body-worn cameras have on police behavior, researchers in Broward County, Florida studied 51 police officers. One group of cops included sergeants who had to adopt the cameras as well as volunteers who volunteered to use them.

Another group of officers proceeded to perform their duty without cameras. Although the study found a modest decrease in officer use of force, these findings were not statistically significant. The importance of officer compliance with camera activation procedures has been recognized in earlier studies.

The authors discovered that while police initially complied with activating their cameras, doing so at an average rate of 82%, the percentage of camera activation gradually decreased with time, reaching an average rate of 55% at the end of a year. Although there were decreases in suspect non-violent resistance as well, this decrease was actually bigger in the group of cops not employing cameras, the examined how officer responses to resistance were affected by body-worn cameras, as well as how complaints against officers were affected. Data on 89 officers from the Orlando Police Department were gathered, with 46 wearing body cameras and 43 not wearing cameras. According to the study, cops who were employing cameras had lower rates of serious responses to resistance and external complaints than those who weren't. The results of a meta-analysis of 30 earlier studies on the impact of body-worn cameras on police and public behaviour were statistically significant. The use of force was cited by the authors as being the study topic that was explored the most frequently and the main justification for agencies using cameras. Despite the fact that the use of force decreased when body cameras were introduced, no statistically meaningful correlation was found. Numerous other factors were investigated, however it was discovered that the only statistically meaningful result was a decrease in citizen complaints. Body-worn cameras did not consistently alter the behaviors of cops or people, according to the authors' observations across the meta-analysis (Ariel, Farrar, and Sutherland (2020).

➤ *Dashboard Camera*

Digital video recorders known as "Dash Cams" can be installed inside a car and continuously capture what is seen via the windscreen, producing unbiased proof. The pedestrian in this case was struck by an articulated lorry in a traffic collision. In order to reconstruct the manner of death, it was essential to analyze a video clip from a dash cam that was found inside the car during the death scene investigation (DSI). As a matter of fact, the death, which was initially thought to be accidental, was ultimately determined to be a suicide on the basis of the video recording, which showed the deceased rushing to the middle of the road with purpose and abruptness. (Elena Giovannini, Arianna Giorgetti, May 19, 2009).

Despite the fact that dash cam installation wasn't designed with automobiles in mind, it has the added advantage of providing your vehicles with an extra degree of nocturnal security. A lot of dash cams can be set up to record automatically at night, which means they might be able to catch vandals and would-be thieves who may not have expected to be seen on video.

Dashboard cameras give you and your driver's litigation security in the event of an accident or collision by providing tangible, irrefutable video evidence. Legal disputes frequently come down to one party's word versus another. Due of this, it is challenging for judges and insurers to draw valid judgements regarding the real course of events. These claims are especially true in situations involving "induced accidents" or "Crash for Cash" frauds. (Vision Technics, 2020).

Dashboard-mounted cameras, sometimes known as "Dash Cams," are digital video recorders (DVRs) that can be fixed on the dashboard or on the windscreen using a suction cup and continually record the view through the windscreen glass. Such video recordings have improved the safety of law enforcement personnel working in distant areas ever since they were first used in Texas in the 1980s. Dash Cams became more widely available to other drivers as the technology got more affordable, and the number of vehicles with dash cams mounted rose quickly. Some contemporary devices known as "Dual Dash Cams" incorporate a second camera to document the interior and/or back of the vehicle. Additionally, the more advanced Dash Cams permit the collection of additional particular data, such as GPS data files and measurements of the vehicle's speed, steering angle, acceleration and deceleration (g-force), and acceleration and deceleration (g). This could facilitate the reconstruction of the crash events. Dash Cams, however, could provoke unfavorable opinions due to privacy worries, therefore in many nations they are either outlawed or only permitted under specific circumstances.

An eyewitness claimed that a 30-year-old male driver ran off a straight road, exited his seriously damaged vehicle, and then strolled down the side of the road for some time. The man appeared to be lost in thought. After a short while of walking, a Volvo FH 460 articulated truck travelling in the opposite way struck him. The victim's body was discovered at the death scene investigation (DSI) in a field by the side of the road, around 10 meters from the scene of the alleged impact. After the collision, the truck's front right headlamp and front right portion of the bumper sustained damage. Police officers found cannabis goods inside the victim's automobile as well as a dash cam on the articulated lorry's dashboard. Circumstantial evidence indicates that the man did not have depression or any other psychiatric illnesses.

➤ *Global Positioning System*

The Global Positioning System (GPS), which was created and is currently run by TomTom (2015), is a satellite-based radio navigation system. Anyone can utilise the GPS satellites without paying a fee. Any number of land, sea, air, and space users who are properly equipped can receive accurate position, velocity, and time (PVT) information from GPS. The way a GPS satellite works is by sending signals to tools on the ground. GPS receivers do not transmit; instead, they passively receive satellite signals. Since GPS receivers must have a clear view of the sky to function properly, they are only used outside and may not be as accurate

in densely wooded areas or close to towering structures (TomTom, 2015). Atomic clocks in the U.S. offer the highly accurate time reference needed for GPS operations. Navy Observation Post. Atomic clocks are built into every GPS satellite.

The Global Positioning System (GPS) makes use of a network of satellites to enable users of GPS receivers to determine their exact location in any part of the globe. In commerce, science, tracking, and espionage, GPS has become a widely utilized and useful tool. It makes regular tasks like using a cell phone, banking, and even power grid control easier by enabling well-synchronized hand-off switching. Other uses for this technology include measuring the innards of structures, settling land ownership disputes, assisting marine archaeologists with their research, and examining the movements and feeding habits of deer (GPS data showed that Mt. Everest is rising in elevation).

S. S. T. Mahadevaiah K G, Abhishek V, Rakshith P R and Ashish N Koushik a GPS and GSM-based car tracking system that has been proposed. They employed SMS technology to manage the car, which can only be turned off with a straightforward SMS that uses a microcontroller to stop the engine. This system, which is an android-based remote car disengaging system, will offer efficient, real-time vehicle location, mapping, and reporting. It will also add value by raising the standard of service by doing so. The suggested system utilized GSM, SMS, and Global Positioning System (GPS) technologies for wireless data transmission of geographic position and time data. Through the Internet or specialized software, you can view vehicle information on electronic maps. Vehicle tracking systems are also used in consumer vehicles as a theft prevention and retrieval device and employed in a variety of applications, including field service management, food delivery services, and car rental businesses. The Global Positioning System (GPS) is one of several satellites that orbit the entire cosmos. It returns to Earth information about their whereabouts in space. There are several uses for GPS in numerous fields. Any user with a GPS receiver can access it. The military, weather, vehicle location, farming, mapping, and many more fields can all benefit from it.

Clarizza Muriel Elaine T.'s essay "Crime Tracking Using GPS and SMS Technologies Systems" (2013) A beneficial solution, such as a tracking gadget that could help anyone in danger, must be created because to the numerous crimes that occur in the nation and result in injuries and fatalities. The researchers created a device using various technologies that might detect a person in peril by just pressing the SOS button and transmitting their location to the required receiver or receivers. The tracking gadgets that are currently on the market are enormous, pricey, and not recommended for use. Users would prefer a different tracking device with a smaller form.

The "gps based travel time and delay survey" by Regina Jewel Macababbad (2012) Travel time and delay studies are used to assess traffic conditions, determine levels of service, and plan for improvements. However, the Metro Manila Development Authority (MMDA) still uses the manual or stop watch method using a test car to collect travel time and delay data. This method is labor-intensive and prone to human errors as well as being inaccurate.

➤ *Google Map*

When Google Maps doesn't offer the best routes and travel times to their location, Betty Lau the Problem gets irritated. Some people even combine Google Maps with other GPS programmes to gain superior information and time-saving resources. She came up with a solution by redesigning Google Maps and giving it new functionality. Users of the app can rapidly adjust their routes when they are directed onto closed roads, estimate traffic times, plan and save routes in advance, and receive personalized navigation for HOV lanes. These updates benefit consumers, according to Betty Lau, who claims that one of the issues with Google Maps is that sometimes it doesn't give users the optimal routes and timeframes to get where they're going. Some people even combine Google Maps with other GPS programs to gain superior information and time-saving resources. She came up with a solution by redesigning Google Maps and giving it new functionality. Users of the app can anticipate traffic patterns, plan and save routes in advance, adjust their routes immediately when they are pointed in the direction of closed roads, and receive personalized navigation for HOV lanes. Users may spend their time and resources more effectively and travel to their destinations more quickly thanks to these advancements.

The availability of online mapping tools like Google Maps and Street View has increased. Although there are many practical applications for these technologies in daily life, law enforcement organisations have expressed worry that they could be used by criminals to their advantage and potentially change established patterns and habits of criminal behaviour. They may provide new avenues for environmental criminologists to further their studies. (Christophe Vandeviver, 2014) Google Maps (Google 2014c) is a free, web-based mapping tool that integrates traditional cartographic maps with satellite images and high-resolution aerial photography. It was first introduced in 2005. Additional information on the landscape, street and road names, well-known sites and buildings, public transport, and typical and real-time traffic information are integrated in the maps. Surprisingly, criminologists appear to have not fully grasped the benefits of using Google Maps and Street View in their study, but the general public, criminals, and law enforcement agencies have already found their power and use them regularly. Drivers are being warned by Google Maps about police speed traps, accidents, and traffic bottlenecks.

According to the author Rabby Lavilles, social networking or active participation in electronic activities is common among today's youth. Nearly everyone uses social networking sites to keep up with current events or simply to join the crowd. Additionally, several social networking services enable automatic location identification. Aside from social media platforms, there

are other websites that offer the public the most recent information through services like news, current events, and many others. Additionally, people in modern society keep a close eye on any nearby incidents. Some even upload it to social media platforms or video-sharing websites. Despite these tools at our disposal, undetected criminal activity is nonetheless prevalent and on the rise. The creation of a crime reporting system utilising Google Maps is discussed in this paper. Existing System in the Philippines for Reporting Crimes Traditionally, police officers manually recorded all crimes and complaints that were brought to their attention on a police blotter. A police blotter is a ledger that keeps track of all crimes, arrests, and other noteworthy incidents that are reported to the police station each day. The automated blotter system was introduced by the Philippine National Police (PNP) to address the organization's issues with the backlog of crime data and to facilitate and speed up the transfer of police records. Precincts in Metro Manila are the first to test the e-Blotter system, which is intended to speed up the recording of citizen complaints and prevent police officers from tampering with records. However, under the new approach, reports would still be manually logged while also being encoded in a computer connected to a national central server that all police stations could access. The PNP's DIDM, IT Management System, and Management created the software. By appropriating a number of real-time reporting capabilities from the company's other navigation tool, Waze, Google Maps is enabling users to report where police are hidden, car wrecks, and traffic bottlenecks on its app. The ability to report four additional categories of occurrences, including construction, lane closures, disabled vehicles, and debris and other objects on the road, is also being added by Google Maps.

- *Kelly Taylor Hayes 2015.*

Finding Suspects in a Criminal Investigation is Effective when Using Dashboard, BWC, and Google Maps. The investigator for Law Enforcement Agencies (LEAS) must be able to recognise potential offenders and link a specific person to illegal activity. Massive data can be gathered from a variety of sources, including SMS messages, phone records, dashboard information, and more. An ongoing criminal investigation must be maintained. In the fight against crime, relying just on BWC records, tangible proof, or eyewitness testimony is no longer sufficient. Police officers must be able to access and safeguard data from mobile devices, social media, and other data-storing devices. (Rabby Lavilles, 2015).

Elsvier B.V., 2019 Detective Google Maps apprehends criminals Google Maps serves various purposes. Cops use the software to track down criminals while ordinary citizens use it for directions, location information, or, well, stalking people. You might be shocked to find that US law enforcement regularly uses Google's location information in criminal investigations. The strategy has raised concerns about invasions of privacy and bogus arrests, but it has also resulted in a variety of arrests. A 2017 kidnapping and sexual assault case was solved when authorities used a geofence warrant to collect location data from Google, according to a story on January 10, 2022 by Thomas Macaulay. She had observed her attacker open Google Maps on his Samsung phone. According to NBC News, the police utilize this information to ask Google to look for gadgets that had been used in crime-related scenes. As a result, they located a suspect who was ultimately found guilty of all seven charges relating to the assault. The culprit received a prison term of more than 100 years.

- *Road Markings for Road Safety and Modern Traffic Management*

Since the 1950s, reports on the advantages of edge lines in the United States have regularly emphasized their positive effects on safety. According to Miller (1992), roadways with both edge and centre markings saw a 20% reduction in the overall number of incidents. According to Migletz and colleagues (1994), horizontal road marking has a positive effect on safety that is particularly pronounced at night and inclement weather. The influence is made feasible by retro reflectivity, which is done in road marking systems by using glass beads. In specifications, the minimum values for retro reflectivity (RL), wet-night road reflectivity (RW), and luminescence (Qd) are demanded. The benefits and drawbacks of various road marking materials were recently enumerated by Babi and colleagues (2015).

The primary cause of traffic accidents is said to be a lack of focus and a failure to scan the road (Lee, 2008).

It is significant to remember that discriminating cognitive functions in a driving decision-making task rely on visual input. Therefore, creating clearly visible travel routes should result in fewer accidents and more enjoyable driving. High retro reflectivity zones become obvious center of focus at night and help drivers traverse the route.

Horizontal road markings are systems made up of reflective elements and paints or plastic masses, which should be kept in mind. The reflective materials most frequently used in road markers are glass beads. In a "symbiotic" connection, paint gives the necessary color, RL with a reflective surface, and holds the glass beads in place. Glass beads that are properly inserted offer RL while also protecting the paint. The glass beads need to be coated properly for the road marking systems to last. No coating, an excessive or insufficient coating, or the wrong color coating can all be easily removed from painted glass beads.

Keep in mind that horizontal road markings are systems composed of observable components and paints or plastic masses. Glass beads are the most typical reflective material used in road markers. The glass beads are "symbiotically" held in place by the paint, which also serves as the necessary color and RL's reflecting surface. Glass beads that are strategically positioned within the paint both supply and safeguard RL. To ensure the longevity of the road marking systems, glass beads must have the proper coating. Glass beads that have been stained might easily have no coating, an excessive or insufficient coating, or the erroneous color coating removed.

In order for autonomous vehicles to recognize it and communicate with it, it should be mentioned that better road marking must also be developed. Such "smart" markings must communicate consistently and in all weather conditions if they are to interact with self-driving cars. Recent patent applications for a technique that would make road markings detectable to radar were made by a significant resin producer for road markings. Vehicles built for autonomous driving usually employ radar to scan their surroundings.

➤ *Traffic Signal Control Strategies*

According to the TRB 2000 edition of the U.S. Highway Capacity Manual, "A traffic signal essentially distributes time among conflicting traffic movements that seek to use the same space." The Swedish definition of traffic signal control (Bang et al. 1978) as "time separation between conflicting traffic movements with the use of signals" is consistent with this concept. As a result, traffic lights are utilized at at-grade junctions to time-share the right of way and minimize confrontations. Although it potentially reduces the intersection's capacity, this considerably improves safety. Furthermore, it is widely recognized that using traffic signals frequently runs the risk of being mistaken for a solution to all traffic issues. As a result, many nations have created standards and justifications for signal construction based on the volume of traffic, visibility, and reported incidents (Webster and Cobbe, 1966; Bang, 1978).

Beginning in the early 1930s, Americans tried to improve traffic signals by installing microphones along the side of the road and asking vehicles to honk their horns in order to make the signals more "intelligent" or vehicle responsive. The first electrical and pneumatic traffic detectors were developed as a result of this plainly not being very popular.

The three light signals of green, red, and amber are now utilized in traffic signals around the world. Additionally, according to tradition, they are often positioned vertically, with the red light at the top and the green light at the bottom. The position in question is one where a driver might not be able to stop in front of the stop line with a fair rate of deceleration or to cross the intersection after seeing an amber light. It is feasible to decrease the number of vehicles in the dilemma zone and, consequently, the risk of rear-end incidents and attempting to run red lights by recognizing the vehicles at the beginning of the zone and postponing a definitive shift to amber utilizing prior.

Since the 1970s, there are more intersections in Sweden that are managed by traffic lights. The majority of Sweden's 3,200 traffic signal installations—or signalized junctions—are signalized intersections, according to the Swedish Road Administration (SRA). The bulk of signalized crossings use the so-called LHOVRA technique and function as isolated junctions with gap extension signal group based control. Less than 50% of Sweden's signalized crossings have fixed time coordination for intersections in metropolitan areas. (Davidsson 1990).

➤ *Waze Navigation Application*

Waze updates maps and traffic conditions while drivers are on the road using their mobile devices. Drivers can also independently report and inform other users about what's going on the road, including accident alerts, police mobility, weather damage, fuel discounts, and more. Waze is offered to drivers at no cost because the map and its content are user-generated.

G. Alan Marlatt and others. One of the most well-liked program, particularly among GPS-based program, is Waze, which makes it easy to share information on traffic conditions in real time. Users' reports of the traffic on Waze are continually reviewed by other users. Based on the position of the user's mobile phone, the GPS-based program generates real-time information about users and their travels. Waze, in contrast to conventional GPS-based gadgets, includes distinctive features that turn its users into a social network, including a circle of friends and a messaging platform. Waze continuously studies the driving patterns of its users in order to recommend driving routes and deliver real-time traffic updates. Users of the app can report traffic congestion, dangers, roadworks, and other events. Users can hit the "like" button to affirm a warning or the "deny" button if they believe it is inaccurate. All alerts posted by users are subject to examination by other users.

Brian McClendon, vice president of Google Geo, once wrote in his blog post that we would be able to get real-time traffic updates from our friends and fellow drivers who are travelling ahead of us, notifying us that they are trapped in a certain lane and showing us the fastest routes in order to escape congestion. And indeed, on June 11, 2013, when Google revealed that it had purchased Israeli mapping firm Waze, this vision began to materialize (Google Buys Israel's Waze to Keep Mobile Maps Lead | Reuters, 2013). By working together, we could solve the issue of traffic congestion. As more people adopted smartphones and other mobile devices, the need for maps and navigation services increased for technology businesses. Waze creates maps and traffic data using satellite signals from its users' smartphones, which it then shares with other users to provide real-time traffic information.

➤ *Related Studies*

At practically every stage, including resource allocation, patrolling, crime prevention, crime tracking, hot pursuits, and criminal solving, police use information technology tools. Information technology, according to Colvin and Goh (2005), has a significant impact on police practice. Additionally, any increasing adoption of information technology by police officers enhances

the effectiveness of law enforcement organizations and the quality of policing (Gottschalk & Holgersson, 2006). It is crucial to understand how effectively an information technology system serves a police department.

For as long as anybody can remember, technology has been seen as a key influence on the techniques and tactics used by police enforcement. In the 20th century, the development of the telephone, the automobile, and two-way radios caused fundamental changes in the work of the police, driving departments towards a policy of quick response to civilian requests for police help (Harris, 2007). These technology advancements allowed for improved communication and information exchange between the police and the people they serve. Powerful technological innovations have now surfaced in the twenty-first century, including closed-circuit television, automatic license plate readers (LPRs), in-car cameras, body-worn cameras (BWCs), predictive policing software, and social media communication and surveillance tools.

Law enforcement officials now have access to a wide range of technologies that were completely unknown to their forebears due to the spread of computer technology, communication technology, and other significant technological advancements during the past few decades. Particularly in times of constrained resources, increased public scrutiny of law enforcement practices, and increased public attention to results, many agencies are employing these and other technology to boost efficiency and improve outcomes. The selection of technological tools by police agencies or the manner in which agency features impact their technological portfolios are not well known, despite the theoretical linkages between technology and policing strategies and outcomes. In addition, each police department has a unique philosophy, culture, management style, and agency goals (Weiss, 1997). As a result, different police departments may have different technological priorities and usage patterns. Theoretical approaches to understanding how technology is adopted in organizations currently seem out of touch with the reality of technology acquisition in law enforcement agencies (LEAs) and do not take into account the unique variations among LEAs in terms of decision-making processes or perceptions of impact. (e.g., see Rogers, 1962). The lack of information regarding the technology implementation process, particularly the particular difficulties faced by LEAs, translates into less resources that can be used to inform LEA decisions on which technologies to acquire and how to use them. Police executives and civilian policymakers must have reliable empirical evidence about the presence, role, and impact of technology in modern policing given that it can have a significant impact on how policing is carried out, on community relations, and the degree to which public safety is protected.

The nature of policing has altered so drastically as a result of technological advancements in recent years that many techniques and instruments used just ten years ago are now outmoded and unusable (Goodison, Davis, & Jackson, 2015). These developments include interoperable Web-based and other communication tools that make it easier for police to connect with the communities they serve as well as location-monitoring devices for the tracking of high-rate offenders, predictive analytics, and crime mapping software for the deployment of officers into areas where crimes are occurring or are likely to occur, crime scene technology, which improves the collection and processing of evidence, and crime scene technology. According to Koper et al. (2015), research indicates that technological advancements have increased police capabilities, but it is not certain that they have made it possible for law enforcement to perform their duties more effectively (see Danziger & Kraemer, 1985; Ioimo & Aronson, 2004; Roman et al., 2008; Roth, Koper, White, & Langston, 2000; Lum, 2010). For instance, despite significant advancements in DNA technology and computer databases for handling forensic data. Additionally, increased efficacy is not always a direct result of better efficiency. Radios, 9-1-1 systems, computer-assisted dispatch, and geographic information systems (GIS) have historically allowed police to dispatch officers to crime scenes more quickly and have been hypothesized to help clear more cases at the scene by arrest. However, actual evidence has refuted the claim that 9-1-1 systems lead to increased arrests. For instance, a research by Sherman and Eck (2002) found that there are frequently delays in the reporting of crimes, so reducing reaction times had no effect on the number of arrests. Furthermore, the burden of responding to 9-1-1 calls, approximately half or more of which do not require immediate attention but call for quick action (Mazerolle, Rogan, Frank, Famega, & Eck, 2002, p. 98), strains scarce resources and frequently deprives police of time for proactive or community-oriented policing.

When it comes to bus scheduling, many bus transportation service providers have challenges in the modern world; many services adhere to a defined schedule with specific departure and arrival times at stations along the route. These may be challenging to maintain in the event of traffic jams, malfunctions, on/off bus incidents, or severe weather (Walter, 2016), therefore service quality becomes a tool that can aid in efficient service delivery.

When using the technology, time gaps also widened, which is an improvement in traffic safety. The authors issue a long-term caution on behavioral adaptability. The term "behavioral adaptation" describes how drivers adjust their driving style to account for changes in their risk perception as a result of the new system's support and engage in riskier behavior. (e.g., drive closer to the vehicle in-front) (Rudin-Brown and Jamson, 2010). Particularly on urban roadways, the system had a high level of motorist acceptance. The advancement of technology significantly affects the driving task. Many systems are now available to help drivers in their daily tasks. Additionally, there are so-called cooperative systems that share traffic-related information. These systems comprise information-sharing vehicle-to-vehicle (V2V), infrastructure-to-vehicle (I2V), and vehicle-to-infrastructure (V2I) communication systems. These systems seek to increase emissions, traffic safety, and overall traffic performance. The amount of time it takes to exchange information and its accuracy are key factors for I2V systems. Information accuracy refers to the precise start and conclusion of traffic occurrences, which is how incidents and accidents on the highway are detected by road sensors. These systems can gather and communicate data on various traffic incidents, such as accident and

incident warnings. (e.g. drivers are warned about an accident or incident ahead); weather condition warnings (e.g. drivers are made aware of environmental-related problems such as black ice, fog, heavy rain, or storms); roadwork and lane utilization information (e.g. drivers are made aware of the lane control policy applied and the lane utilization information); in-vehicle variable speed limit information; traffic congestion warnings and intelligent speed adaptation, Böhm et al., (2009). Systems for distributing information use warning messages about impending traffic occurrences to affect the choice of speed. To increase road safety, these systems are also being researched. These devices can enhance traffic flow and safety generally, but especially on highways. Due to traffic conditions like congestion, accidents, severe weather, etc., dangerous situations could arise when high-speed vehicles abruptly collide with low-speed vehicles. For instance, Vaa et al. (2007) reviewed the literature to determine how ITS systems affect traffic accidents. According to their findings, accident warning systems might cut the number of collisions by 44%. A fog warning system might also potentially cut the amount of accidents by 84%. According to reports, a queue warning system resulted in a 16% decrease in accidents. A warning system has been shown in another study by Farah and Koutsopoulos (2014) to improve traffic performance overall by reducing acceleration rates and hence coordinating drivers' speed behaviour for equipped vehicles. In a similar vein, Grumert et al. (2015) observed that the warning system allowed for reduced acceleration rates, smoothing vehicle flow and decreasing exhaust emissions. Therefore, these systems have great potential to harmonize speed preferences, smooth speed levels while approaching critical traffic events and comply with speed limits providing for a safer traffic system.

The most popular pieces of equipment, such as the dashboard, BWC, GPS, and Google Map, significantly contribute to safer roads. Technology advancements not only make cars safer but also improve measurement and evaluation capabilities. In order to have a contemporary safety feature for vehicles to safeguard drivers and retain recordings of incidents that occurred during transit, this equipment is required by bus drivers or other road users. To document a road journey, examine routes, or record real-time footage of incidents, see Dukic Willstrand et al. 2017.

A particular subgroup of video surveillance systems that record events on the road through the windscreen of the vehicle include dashboard, Google Maps, and BWC security systems. They are used primarily to ensure vehicle safety. Vehicle safety, in particular, entails objectively documenting traffic accidents or other occurrences relating to road safety, hence decreasing the ambiguity in witness testimony and false testimony from specialists. Another benefit of this equipment is that it helps insurance firms resolve damage compensation issues more effectively. (Kolla et al., 2019).

New equipment is being used to improve passenger safety, reduce expenses, and protect the environment, according to the European Commission (2001). The only things that are behind other fields are the pace and scope. The most crucial issue is enhancing safety. In all contemporary vehicles, you can find technological helpers like the dashboard camera, GPS, BWC, and GPS. Assistance that can keep you on the road, at a safe distance from the automobile in front of you, or even autonomous braking to protect oncoming traffic or the occupants of the car. A good example of how to increase efficiency is to share information with other drivers about traffic jams and road closures that has been provided by other vehicles. The ecosystem of the majority of automotive navigation systems is well-integrated with technology. Imagine the possibilities, though, if data about traffic jams and road closures could be gathered from every vehicle on the road and sent as needed. Similar rules apply to lessening environmental impact. It is possible to reduce the speed limits on highways and actively reduce the pollution with the use of intelligent sensors that measure pollution and subsequent automation. Citizens can also be warned to avoid areas with high pollution levels via a mobile app at the same time. Safety improvement is a long-term, ongoing activity. Years must pass before new technology and policies are put into place and before accurate data about their effects is obtained. We examined the European Union's road safety policies and the measures that were implemented in order to show how this process works and to prove the beneficial benefits of new technology in transportation. We then compared these findings to statistical data to assess their effectiveness.

A risk that can put passengers in danger was found to be improper system installation. Due to durability problems and frequency restrictions, audio transmitters were repeatedly mentioned as being unreliable. The majority of state agencies said the procurement procedure took a long time. Accepting the lowest bid, according to a number of agencies, frequently led to issues with quality control and prolonged system downtime.

Other problems mentioned included: the absence of an organized infrastructure for the management, storage and handling of audiovisual recordings; officers' concern over cameras being used as a tool to monitor the passenger; lack of training of drivers, funding, and written policies and procedures prior to the use of in-car camera systems Daniel N. Rosenblatt, 2020.

In order to solve the changing problems faced in the transportation industry and further increase the efficiency and effectiveness of operations and transportation, Secretary Joseph Emilio Aguinaldo Abaya believes that regional transportation innovation should be implemented. In order to advance inclusive mobility, it is necessary to fulfil everyone's transport needs, especially those of individuals who live in disadvantaged areas of our society. Enhancing mobility leads to higher productivity, which quickens the pace of economic development. In order to achieve inclusive mobility, all economies in the region's economies must take into account everyone's requirements in their transportation plans, programs, activities, and initiatives.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter presents the research method and design, population, instrumentation and data collection procedures and tools for data analysis.

➤ *Research Method*

The study utilized the quantitative method through descriptive approach. It is focused to the effectiveness of digital innovation as the key to advanced road safety and investigation.

Quantitative research is a structured way of collecting and analyzing data obtained from different sources. This involves the use of computational, statistical, and mathematical tools to derive results, SIS International Research (2015). The descriptive approach use to conduct a survey questionnaire which is a checklist on the selected participants to provide information by generating equipment being used, the effectiveness of that equipment and problem encountered of the equipment.

➤ *Population and Locale of the Study*

The respondent of the study were composed of 10 PNP Highway Patrol Group and 190 Bus Drivers and UV Express at Laoag City. The participants selected through random sampling. A sample chosen randomly is meant to be an unbiased representation of some larger population to which population to which findings can be generated.

This research study undergone in Laoag City, where the researchers conduct on the PNP Highway Patrol Group and Bus terminals and UV express located at Laoag City.

➤ *Data Gathering Instrument*

The instrument used in the study was survey questionnaire and semi-structured. The instrument was validated by the Chief of Police under PNP Highway Patrol Group before it laid hand on the study and the requirements in the designing of good collection instrument were considered. Which consist of three parts; Part I the equipment used by the PNP Highway Patrol Group, Bus Drivers and UV Express. Part II is the Level of effectiveness of the equipment being used by the PNP Highway Patrol Group and Professional Drivers. Part III is the Problem encountered in using the equipment.

➤ *Data Gathering Procedures*

A letter requesting to conduct the study was prepared. The questionnaire checked, validated by the Chief of Police under PNP Highway Patrol Group and approved by the research adviser. The researcher sought permission through a letter to the Chief of Police under Highway Patrol Group and Terminal manager of Bus to allow the conduct floating of questionnaire to the officers of PNP Highway Patrol Group, Bus Drivers, and UV express within Laoag City, Ilocos Norte. After its approval, the questionnaire was given to the target respondents.

➤ *Treatment of Data*

The data gathered, collected, and tabulated was subjected to analysis and interpretation through the use of appropriate tools. Descriptive statistics was used in the study. In Part I the researchers use Frequency and Rank to determine what is the most used equipment by the respondents. In Part II and Part III the researchers use mean. To determine the level of effectiveness and the problem encountered of the respondents.

Table 1 The Arithmetic mean (Average) and Interpretation on the Level of Effectiveness of the Equipment.

Point Value	Range Values	Descriptive Interpretation
5	5.00-4.21	Strongly Agree
4	4.20-3.41	Agree
3	3.40-2.61	Neither
2	2.60-1.81	Disagree
1	1.80-1.00	Strongly Disagree

Table 2 The Arithmetic mean (Average) and Interpretation on the Problems Encountered in using the Equipment.

Point Value	Range Values	Descriptive Interpretation	Verbal Description
5	5.00-4.21	Strongly Agree	The problem occurred everytime.
4	4.20-3.41	Agree	The problem occurred frequently.
3	3.40-2.61	Neither	The problem occurred sometimes.
2	2.60-1.81	Disagree	The problem occurred rarely.
1	1.80-1.00	Strongly Disagree	The problem occurred never.

➤ *Ethical Consideration*

Significant ethical issues have clear ramifications for this quantitative study. These problems and worries can mostly result from the approach used in this study. The difficulties of adequate study operation, secrecy, and anonymity were the applicable ethical challenges in this research area.

Regarding the informed consent procedure, potential research participants were fully informed of the objectives, methodology, and advantages of the study in the most detailed way possible given the limitations of the study. It is clear that the respondents' participation was willingly asked because their consent was gained. This was done in writing, outlining all the crucial information that had to be communicated to the survey participants as well as the methodology used to conduct the survey. The respondents had to sign the informed consent form to confirm that they willingly decided to participate in the study. The respondents were willing adults, thus parental approval was not required. The survey form did not include the identities of the participants, and the results were kept confidential.

Participants have the right to privacy, which cannot be violated without their informed agreement in accordance with the Data Privacy Act of 2012, a law that defends this fundamental human right. Giving respondents the opportunity to omit their names from the survey questionnaire is one technique to maintain privacy and confidentiality in this quantitative study. Therefore, for reasons of safety, their identity was kept a secret. Even their answers to the survey questionnaire's questions were kept private and taken into consideration.

The researchers also used of anonymization by not including their personal names to the transcripts of the study. Respecting these ethical consideration fosters a safe and trusting research environment, encouraging participants to share their thoughts and be part to the researchers study entitled Effectiveness of Digital Innovation as the key to advance road safety and investigation.

CHAPTER FOUR

PRESENTATION, INTERPRETATION AND ANALYSIS OF THE DATA

The presentation, interpretation, and analysis of the data that the researchers collected are covered in this chapter. According to the exact queries posed on the problem description, the aforementioned data were presented in tabular form.

Table 3 Equipment used by the PNP Highway Patrol Group

PNP Highway Patrol Group	Frequency	Rank
Dashboard Camera	10	1
Global Positioning System	0	0
Body Worn Camera	10	1
Google Map	10	1

From the table 1 data reported, the equipment that has the highest frequency of 10 with a rank of 1 is the Dashboard Camera, Body Worn Camera and Goggle Map used by the PNP Highway Patrol Group.

It is revealed that the most used equipment by the PNP Highway Patrol Group is the Dashboard Camera, Body Worn Camera and Google Map which is as a tool for the accidents or traffic crashes Dashcams recordings from the device can be analyze for the evaluation of the case for proper reconstruction of the facts. While the Google Map can be used as a tool for tracking that can be used by both military and civilians.

Goodison, Davis, and Jackson's (2015) research. The nature of police has altered so drastically in recent years due to technological advancements that many practises and instruments used just ten years ago are now outmoded and incompatible with modern technology. These innovations include crime scene technology that improves the collection and processing of evidence, location-monitoring devices for the tracking of high-rate offenders, predictive analytics and crime mapping software for the deployment of officers into areas that cause or are likely to cause crime, and interoperable.

The Philippine National Police Highway Patrol Group is designated and expected to supervise and inspect dedicated control points along roads to ensure the safety of the motorist. By those equipments that they being used they can provide a crime prevention in the road.

Table 4 Equipment used by the Bus Drivers and UV Express

Bus Drivers and UV Express	Frequency	Rank
Dashboard Camera	179	1
Global Positioning System	145	2
Google Map	86	3
Traffic Lights and Signal Lights	82	4
Body Worn Camera	13	6
Waze	52	5

From the table 4 data reported, the equipment that has the highest frequency of 179 with the rank of 1 is the Dashboard Camera. The second highest frequency of 145 with the rank of 2 is the Global Positioning System. The third highest frequency of 86 with the rank of 3 is the Google Map. The fourth highest frequency of 82 with the rank of 4 is the Traffic Lights and Signal Lights. The fifth highest frequency of 52 with the rank of 5 is the Waze and the least frequency of 13 with the rank of 6 is the Body Worn Camera used by the Bus Drivers and UV Express.

This shows that the Bus Drivers and UV express that the most equipment being used is the Dashboard Camera that this can provide the recording of the events or activity in the road. The second method is GPS, and the third is Google Map, both of which may be used with today's portable, inexpensive electronic gadgets to follow the movements of moving objects. The creation of a fresh and extensive source of traffic data on the road network as a result of this implication has had a significant impact on the transport industry. The fourth is the employment of traffic lights and signal lights, which provide an orderly flow of traffic, give pedestrians and vehicles a chance to cross an intersection, and assist in lowering the number of collisions involving cars coming from various directions into crossings. The Body Worn Camera and Waze have the least amount of equipment.

According to Dukic Willstrand et al. 2017 Equipment like Dashboard, BWC, GPS and Google Map are the most used equipment and making a significant contribution to safer roads. Not only are developments in technology maker vehicles safer, but also increases the ability to measure and evaluate. This equipment needed by the bus drivers or road users in order to have a modern safety feature for vehicles to protect drivers and keep records of events that happened during travel. While capture real-time footage of accidents, survey routes, or simply memorialize a road trip.

Table 5 Level of Effectiveness of the Equipment that are used by the PNP Highway Patrol Group Officer n=10

Investigation	Mean	Descriptive Interpretation
Dashboard Camera		
The equipment provide security and proof in case of a road accident.	4.20	Agree
It can provide protection against false accusations.	3.60	Agree
The equipment is useful in investigating road accident.	4.50	Strongly Agree
Body Worn Camera		
Used by police officers to record their daily routine, and evidence from law enforcement scenes.	4.20	Agree
It can provide protection against false accusations.	4.30	Strongly Agree
The video and audio captured by the bodycam can be used as evidence in arrests or prosecutions.	4.20	Agree
Google map		
It can present visualize image of road for investigation.	4.20	Agree
It can provide records or identifying information of road familiarization.	4.40	Strongly Agree
This equipment applied in clarifying issues in road accidents.	4.10	Agree
<i>Over all weighted mean</i>	4.19	Agree
Operation		
Dashboard Camera		
This equipment help greatly increase police efforts to ensure transparency and accountability in road operation.	4.30	Strongly Agree
It can captured real time footage in operation of road accidents.	4.40	Strongly Agree
It can provide additional evidence to what they already collected during operation.	3.90	Agree
Body Worn Camera		
It can improve security levels in public areas and protect officers in operation.	4.20	Agree
The equipment can record video and audio during the operation of road accidents.	4.50	Strongly Agree
It can provide independent confirmation of the road accidents.	4.10	Agree
Google map		
It can present visualize image of road for investigation.	3.90	Agree
It can provide records or identifying information of road familiarization.	4.10	Agree
This equipment applied in clarifying issues in road accidents.	4.40	Strongly Agree
<i>Over all weighted mean</i>	4.20	Agree

Table 5 shows the result of the level of effectiveness of the equipment that used by the PNP Highway Patrol Group under Investigation. The result of the study revealed that respondents under investigation in which the dashboard camera answered “strongly agree”. Wherein, the “strongly agree” of the effectiveness of the devices is *The equipment is useful in investigating road accident. (4.50)*. There is a statement which was answered “agree” by the respondent this statement are; *The equipment provide security and proof in case of a road accident (4.20)*; and *It can provide protection against false accusations (3.60)*. Secondly, the study revealed that respondents under investigation in which the body worn camera answered “strongly agree”. Wherein, the “strongly agree” of the effectiveness of the devices are: *It can provide protection against false accusations (4.30)*. There is a statement which was answered “agree” by the respondents this statement is: *Used by police officers to record their daily routine, and evidence from law enforcement scenes (4.20)* and *The video and audio captured by the bodycam can be used as evidence in arrests or prosecutions (4.20)*. Lastly, the study revealed that respondents under investigation in which the google map answered “strongly agree”. Wherein, the “strongly agree” of the effectiveness of the devices is: *It can provide records or identifying information of road familiarization (4.40)*. There is a statement which was answered “agree” by the respondents this statement are: *It can present visualize image of road for investigation (4.20)* and *This equipment applied in clarifying issues in road accidents (4.10)*.

Rabby Lavilles' 2015 research. Finding Suspects in a Criminal Investigation is Effective when Using Dashboard, BWC, and Google Maps. The investigator for Law Enforcement Agencies (LEAS) must be able to recognise potential offenders and link a specific person to illegal activity. Massive data can be gathered from a variety of sources, including SMS messages, phone records, dashboard information, and more. An ongoing criminal investigation must be maintained. In the fight against crime, relying just on BWC records, tangible proof, or eyewitness testimony is no longer sufficient. Police officers must be able to access and safeguard data from mobile devices, social media, and other data-storing devices.

The result of the level of effectiveness of the equipment that used by the PNP Highway Patrol Group under operation. The result of the study revealed that respondents under operation in which the dashboard camera answered “strongly agree” of the effectiveness of the devices are: *It can captured real time footage in operation of road accidents (4.40)*; and *This equipment help*

greatly increase police efforts to ensure transparency and accountability in road operation (4.30). There is a statement which was answered “agree” this statement is: *It can provide additional evidence to what they already collected during operation (3.90)*. Secondly, the study revealed that respondents under operation in which the body worn camera answered “strongly agree” of the effectiveness of the devices is: *The equipment can record video and audio during the operation of road accidents (4.50)*. There is a statement which was answered “agree” by the respondents this statement are: *It can improve security levels in public areas and protect officers in operation (4.20) and It can provide independent confirmation of the road accidents (4.10)*. Lastly, the study revealed that respondents under operation in which the body worn camera answered “strongly agree” of the effectiveness of the devices is: *This equipment applied in clarifying issues in road accidents (4.40)*. There is a statement which was answered “agree” by the respondents this statement are: *It can provide records or identifying information of road familiarization (4.10) and It can present visualize image of road for investigation (3.90)*.

The study of Weisburd & Neyroud, 2011. The use of equipment in the Highway Patrol group during their operation just like dashboard cameras, car cameras provide video evidence for calls for service and are typically attached to the interior windshield or to the top of the dashboard in a police vehicle. This technology was prioritized by the expert panel because knowledge gained may be informative for understanding nuances related to up-and-coming surveillance and event-capture technology such as BWCs. The use of technology by law enforcement, particularly HPG, can lead to lively discussions about the function and authority of the police in modern society. For instance, technology like dashboards has sparked a lot of discussion regarding privacy, yet BWCs have been hailed as a means of fostering more respectful interactions between police and the community.

Table 6 Level of Effectiveness of the Equipment that are being used by the Bus Drivers and UV Express n=190

Transportation	Mean	Descriptive Interpretation
The equipment increased visibility to the final delivery destination.	4.15	Agree
It provides faster routing options.	3.92	Agree
It optimizes delivery routes and shortens travel distance.	3.40	Neither
The equipment helps in searching elimination and optimization of transport route thus saving time.	4.03	Agree
Introduction of advance technology in transportation has become environmental friendly.	4.06	Agree
<i>Over all weighted mean</i>	3.91	Agree
Security		
It secures to determine the best route, which is then displayed on head-up display that physically directs the diver along route.	4.24	Strongly Agree
Faster delivery times and mitigates risks.	3.99	Agree
The equipment can alert the authorities in case a passenger becomes unruly or inflict harm.	4.00	Agree
Increased speed and give higher security service.	3.94	Agree
Effectively monitor the activities of the passengers.	3.94	Agree
<i>Over all weighted mean</i>	4.02	Agree

Table 6 shows the result of the level of effectiveness of the Equipment used by the Bus Drivers and UV Express under Transportation. The result of the study revealed that the respondents answered “agree” in the effectiveness of the devices are: *The equipment increased visibility to the final delivery destination (4.15); Introduction of advance technology in transportation has become environmentally friendly (4.06); The equipment helps in searching elimination and optimization of transport route thus saving time (4.03); It provides faster routing options (3.92)*. On the other hand, there is a statement which was answered “neutral” by the respondents. This statement is: *It optimizes delivery routes and shortens travel distance (3.40)*.

New equipment is being used, according to European Commission (2001), to improve passenger safety, reduce expenses, and protect the environment. Simply put, the pace and scope lag behind other sectors. The main focus should be on increasing safety. In all contemporary vehicles, you can find electronic helpers like the dashboard camera, BWC, and GM are electronic assistants you can find in all modern vehicles.

These devices are capable of gathering and disseminating traffic data for a variety of traffic-related events, such as: accident-incident warnings (e.g., drivers are informed of an accident or incident that is imminent); weather condition warnings (e.g., drivers are informed of problems caused by the environment, such as black ice, fog, heavy rain, or storms); roadworks and lane utilization information.

The result of the level of effectiveness of the Equipment used by the Bus Drivers and UV Express under Transportation. The result of the study revealed that the respondents answered “strongly agree” of the effectiveness of the devices are: *It secures to determine the best route, which is then displayed on head-up display that physically directs the diver along route (4.24)*. On the other hand, there is a statement which was answered “agree” by the respondents. This statement are: *The equipment can alert the*

authorities in case a passenger becomes unruly or inflict harm (4.0); Faster delivery times and mitigates risks (3.99); Increased speed and give higher security service; and Effectively monitor the activities of the passengers (3.94).

A specific subset of video surveillance systems, such as dashboard, Google Map, and BWC, record events on the road through the windscreen of the car, according to Kolla et al.'s study from 2019. Their use is mostly done to guarantee car safety. Vehicle safety, in particular, entails objectively documenting traffic accidents or other occurrences relating to road safety, hence decreasing the ambiguity in witness testimony and false testimony from specialists. This device also helps insurance firms resolve issues relating to damage compensation more effectively, which is another benefited.

Table 7 Problem Encountered in using the Equipment by the PNP Highway Patrol Group n=10

Dashboard Camera	Mean	Descriptive Interpretation
This equipment may not provide a complete and accurate event of road accident.	1.50	Strongly Disagree
This equipment is incompatible of performing its main purpose.	2.00	Disagree
This equipment invades the privacy of citizens.	2.40	Disagree
Body Worn Camera		
This equipment invades the privacy of citizens.	1.20	Strongly Disagree
This equipment may not provide a complete and accurate event of road accident.	1.90	Disagree
This equipment is incompatible of performing its main purpose.	2.20	Disagree
Google map		
It can present visualize image of road for investigation.	2.20	Disagree
It can provide records or identifying information of road familiarization.	2.30	Disagree
This equipment applied in clarifying issues in road accidents.	2.10	Disagree
<i>Over all weighted mean</i>	1.98	Disagree

Legend:

5.00 - 4.21 = The problem occurred everytime.

2.60-1.81= The problem occurred rarely.

4.20 – 3.41 = The problem occurred frequently.

1.80-1.00= The problem occurred never.

3.40 – 2.61= The problem occurred sometimes.

Table 7 shows the result of the problems encountered of the devices that used by the PNP Highway Patrol Group. The result of the study revealed that respondents under dashboard camera answered “strongly disagree” on the problem encountered is *This equipment may not provide a complete and accurate event of road accident. (1.50)*. While there are statements which was answered “disagree” by the respondents. This statement are: *This equipment invades the privacy of citizens (2.40) and This equipment is incompatible of performing its main purpose (2.00)*. Secondly, the result of the study revealed that respondents under body worn camera answered “strongly disagree” on the problem encountered is: *This equipment invades the privacy of citizens (1.20)*. While there are statements which was answered “disagree” by the respondents. This statement are: *This equipment may not provide a complete and accurate event of road accident (1.90) and This equipment is incompatible of performing its main purpose (2.20)*. Lastly, the result of the study revealed that respondents under google map answered “disagree” on the problem encountered are: *This equipment applied in clarifying issues in road accidents (2.10); It can present visualize image of road for investigation (2.20) and It can provide records or identifying information of road familiarization. (2.30)*. Thus, the overall weighted mean of 1.98.

According to Howie, D.J. 1989, Advance technology has been advocated as a means of significantly reducing incidence and severity of road crashers. It is intended as a means of stimulating discussion and interest in the use of new innovation to add some countermeasures that can support the traffic authorities, road users in the resolving and reducing vehicular accidents. In order to better serve and protect their officers and communities, Agencies at all levels are investing in the newest technologies. Privacy issues are a challenge presented by technical improvements in law enforcement. The government's unethical use of technology may have a detrimental effect on civil rights and societal stability. Some police officers believe that wearing body cameras violates their privacy. The potential for technology to distract cops while they are performing their duties is a serious matter for concern. Devices like in-car computers, dispatch systems, and cell phones can divert an officer's attention in public safety states and perhaps put them in risk. For some cops, technology might be inconvenient even though it can be useful for law enforcement. Agents in law enforcement frequently feel uneasy because of the strain and time it takes to learn how to use and implement this variety of technology. There are ways to overcome the drawbacks of technology in law enforcement. Strict rules can be implemented to guarantee the protection of civil liberties and forbid the immoral use of technology by law enforcement personnel. Additionally, body cameras are only permitted to be utilized when police officers are on the scene or engaging with suspects, as opposed to being mandated for usage at all times while on duty. All officers should also be required to complete sufficient training in order to prevent quickly becoming sidetracked or losing interest in using the technology required to conduct an investigation. The most crucial area to invest in for ensuring public safety among all of these technologies being promoted in the field is good training.

Table 8 Problem Encountered in using the Equipment by the Bus Drivers and UV Express n=190

Bus Drivers and UV Express		
The equipment causes destruction while driving.	2.16	Disagree
The offline function of the equipment is very limited.	2.50	Disagree
The equipment causes diversion of traffic to gives poor alternate routes.	2.75	Neither
This equipment invades the privacy of passengers.	2.67	Neither
This equipment may not provide a complete and accurate account of the event.	2.69	Neither
<i>Overall weighted mean</i>	2.55	Disagree

Legend:

5.00 - 4.21 = The problem occurred everytime.

2.60-1.81= The problem occurred rarely.

4.20 – 3.41 = The problem occurred frequently.

1.80-1.00= The problem occurred never.

3.40 – 2.61= The problem occurred sometimes.

Table 8 shows the result of the problem encountered of the devices that used by the Bus Drivers and UV Express. The statement which was answered “Neither” by the respondents. These statements are: *The equipment causes diversion of traffic to gives poor alternate route (2.75); This equipment may not provide a complete and accurate account of the event (2.69) and This equipment invades the privacy of passengers (2.67)*. The problem that they did not encountered by the Bus Drivers and UV Express: *The offline function of the equipment is very limited (2.50) and The equipment causes destruction while driving (2.16)*.

Improper system installation was recognized as an issue that may threaten passengers, according to Daniel N. Rosenblatt 2020. Due to durability problems and frequency restrictions, audio transmitters were repeatedly mentioned as being unreliable. The majority of state agencies said the procurement procedure took a long time. Accepting the low bid, in the opinion of several organizations, frequently led to issues with quality control and prolonged system downtime. Other issues raised were the lack of a structured infrastructure for the management, storage, and handling of audiovisual recordings, the officers' concern that cameras might be used to watch the passenger, and the lack of funding, written policies and procedures, and driver training prior to the use of in-car camera systems.

➤ *Action Plan*• *Rationale*

Road accidents and dangers are increased by driving. In some places, public transit may be provided by buses that are crammed full, overweight, and top-heavy. In this situation, heed the counsel of any legal or public employees, program providers, or other responsible parties in charge of overseeing travel safety. Assessment of cutting-edge automotive technology reduces risk when using either public or private transportation.. Strengthening a road safety culture requires addressing human error, which is the primary cause of accidents. Every motorist has a crucial duty to perform on the road. With this information, the researchers developed a plan of action to reduce the frequency of traffic accidents and adapt new technologies to the road.

• *Objectives*

The overall goal of this action plan is to provide all road users with information about the equipment and other alternatives when they run into problems on the road.

✓ *The Specific Objective Include:*

- To promote awareness, encourage them (Professional Drivers and PNP Highway Patrol Group) to set beyond their knowledge in adapting to the use of advance technology in the road for safety. It also aims to address possible queries or problems that the road users in general may encounter. For them to learn and acquire skills and knowledge needed in keeping safe or secured in the road.
- Introduces relevant concept and their application to the real-world helping them to emerge better equipped to tackle strategic initiatives and drive change and innovation. This program is designed to help all road users to expand their strategic mindset.
- To recommend to the LTO/LGU that they may implement law that requires road users to adapt to the advancement of technology for the purpose of handling the equipments for safeness on the road.

• *Strategies*

Strategies The following are the strategies which help to attain the objectives of the action plan.

- ✓ A face-to-face promotion which main task is to reduce the number of fatalities on roads through conference. There will be a speaker who will discuss about the aid of having advance equipments while traversing.

- ✓ A flyers will be distributed to all road users informing them what are the advance technological equipments and its importance in affecting road safety. Encourage them to understand the importance of having advance equipment as tool for additional awareness, security and Safeness on the road.
- ✓ To encourage Land Transportation Office (LTO) and Local Government Unit (LGU) to have an inspection to the installed traffic devices to make sure that the devices are still functioning or it needs to be upgraded.

• *Expected Outcomes*

The following are the expected outcome resulting from the action plan.

- ✓ PNP Highway Patrol Group used the most effective and useful equipment for their function during the duty on the road.
- ✓ Bus Drivers and UV Express of Laoag City well-informed and knowledgeable in the use of equipment for their road safety.
- ✓ Improved road user behavior through advocacy efforts and by increasing awareness of risk factors and reduced the number of accidents through the use of advanced technology equipment.

Table 9 Action Plan: The used of Digital Innovation as the Key to Advance Road Safety

Persons or Agencies Concerns	Objectives	Strategy	Expected Outcome
PNP Highway Patrol Group and Professional Drivers	To promote awareness, encourage them (Professional Drivers and PNP Highway Patrol Group) to set beyond their knowledge in adapting to the use of advance technology in the road for safety. It also aims to address possible queries or problems that the road users in general may encounter. For them to learn and acquire skills and knowledge needed in keeping safe or secured in the road.	A face-to-face promotion which main task is to reduce the number of fatalities on roads through conference. There will be a speaker who will discuss about the aid of having advance equipments while traversing.	PNP Highway Patrol Group used the most effective and useful equipment for their function during the duty on the road.
Road Users	Introduces relevant concept and their application to the real-world helping them to emerge better equipped to tackle strategic initiatives and drive change and innovation. This programme is designed to help all road users to expand their strategic mindset.	A flyers will be distributed to all road users informing them what are the advance technological equipments and its importance in affecting road safety. Encourage them to understand the importance of having advance equipment as tool for additional awareness, security and Safeness on the road.	Bus Drivers and UV Express of Laoag City well-informed and knowledgeable in the use of equipment for their road safety.
Land Transportation Office (LTO) and Local Government Unit (LGU)	To recommend to the LTO/LGU that they may implement law that requires road users to adapt to the advancement of technology for the purpose of handling the equipments for safeness on the road.	To encourage Land Transportation Office (LTO) and Local Government Unit (LGU) to have an inspection to the installed traffic devices to make sure that the devices are still functioning or it needs to be upgraded.	Enhance road user behaviour by raising awareness of risk factors and promoting advocacy, and decrease the number of accidents by using high-tech tools.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter contains the summary of findings, conclusions and recommendations of the whole study. The summary of findings without so much detailed information is written on the summary.

➤ *Summary of the Findings*

Findings of the study shows that the Equipment being use by the PNP Highway Patrol Group are the Dashboard Camera, Body Worn Camera and Google Map. While the Bus Drivers and UV Express is the Dashboard Camera (Dashcam). The level of effectiveness of the equipment being used by the PNP Highway Patrol Group implied that the equipments are effective in their investigation and operation likewise to the Bus Drivers and UV Express in their transportation and security. As to the problem encountered of the equipments used by the Bus Drivers and UV Express the main problems are that the equipment sometimes gives poor alternate routes, the equipment invades the privacy of passengers and it does not provide complete and accurate account of event.

➤ *Conclusions*

Based from the result of the equipment used by the PNP Highway Patrol Group are the Dashboard Camera, Body Worn Camera and Global Positioning System. On the other hand, the most used equipment by the Bus Drivers and UV Express is the Dashboard Camera (Dashcam). The equipment used is effective on their line of works and for the road safety as to the PNP Highway Patrol Group under Investigation and Operation likewise to the Bus Drivers and UV Express as to their Transportation and Security. As regard to problem encountered of the equipment used by the Bus Drivers and UV Express are the equipment causes diversion of traffic to gives poor alternate routes, this equipment invades the privacy of passengers and this equipment may not provide a complete and accurate account of the event.

Furthermore, the findings of this study concluded that researchers must develop an action plan to encourage road users to use the digital innovation as the key to advance road safety.

➤ *Recommendations*

Based on the finding and conclusion of the study, the researchers highly recommend that:

- The PNP Highway Patrol Group and Bus Drivers and UV Express, may find an alternative way of accessing location even there is no internet connection.
- The road users, may adapt to the advancement of technology for the purpose of they can properly handle the equipments to provide an enough alternative routes so that it can provide complete and accurate account of event.
- To the passengers, remind them the importance of this equipment for their security and safety during their travel.
- To the Local Government Unit (LGU), it is about time to adapt technology into the transportation in the City of Laoag.

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APPENDIX “A”
Letter to Conduct Study in PNP Highway Patrol Group

DATA CENTER COLLEGE OF THE PHILIPPINES
COLLEGE OF CRIMINAL JUSTICE EDUCATION
Brgy. 1 San Lorenzo, Rizal Street
Laoag City, Ilocos Norte

October 19, 2022

JOHNWEN L. BALUETA
Chief of Police
Highway Patrol Group
Laoag City

P/Major Balueta:

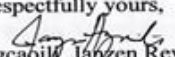
Greetings of peace and prosperity!


The undersigned fourth year students of Data Center College of the Philippines, Laoag City Inc. taking up Bachelor of Science in Criminology and currently enrolled to Criminological Research 2 and presently proposing a study entitled **EMERGING DIGITAL INNOVATIONS: KEY TO ADVANCE ROAD SAFETY**. The purpose of this research is to find out the technology devices or equipments installed by the Highway Patrol Group and to address the current situation on the Emerging Digital Innovations as to advance road safety.

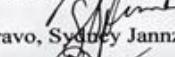
With your related knowledge and experience, researchers would like to request you to be one of our respondents in our study. The researchers hope that you will take time answering the questions honestly. And rest assured that all information's obtain is strictly confidential, the researchers and the adviser will have the direct access of the data as it is only used for statistical purposes.

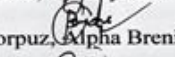
The researchers hope this request merits your kind consideration and approval. Thank you very much and God Bless.

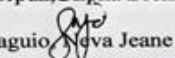
Respectfully yours,



Agcaoili, Janzen Rey R.

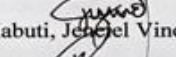

Asuncion, Christiane Danelle

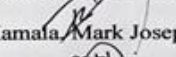

Bravo, Sydney Jannzen F.

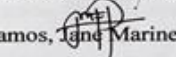

Corpuz, Alpha Brenie


Daguio, Neva Jeane B.

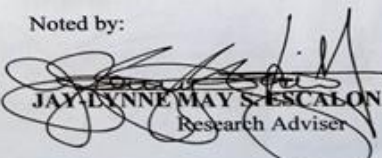

Dela Cruz, Marc Leiane


Mabuti, Jechel Vince Abeil V.


Mamala, Mark Joseph R.


Ramos, Jan Marinel F.

Noted by:


JAYLYNNNE MAY S. ESCALONA, MSCRIM
Research Adviser

APPENDIX “B”
Letter to Conduct Study in Partas Transportation Inc.

DATA CENTER COLLEGE OF THE PHILIPPINES
COLLEGE OF CRIMINAL JUSTICE EDUCATION
Brgy. 1 San Lorenzo, Rizal Street
Laoag City, Ilocos Norte

October 19, 2022

GEORGE YOLOPE R. RIVAD
Partas Transportation, Inc.
Laoag City

Respected Head Manager:

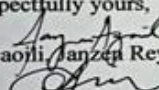
Greetings of peace and prosperity!

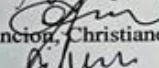
The undersigned fourth year students of Data Center College of the Philippines, Laoag City Inc. taking up Bachelor of Science in Criminology and currently enrolled to Criminological Research 2 and presently proposing a study entitled **EMERGING DIGITAL INNOVATIONS: KEY TO ADVANCE ROAD SAFETY**. The purpose of this research is to find out the technology devices or equipments installed by the public transportations and to address the current situation on the Emerging Digital Innovations as to advance road safety.

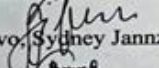
With your related knowledge and experience, researchers would like to request you to be one of our respondents in our study. The researchers hope that you will take time answering the questions honestly. And rest assured that all information's obtain is strictly confidential, the researchers and the adviser will have the direct access of the data as it is only used for statistical purposes.

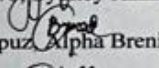
The researchers hope this request merits your kind consideration and approval. Thank you very much and God Bless.

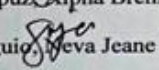
Respectfully yours,


Agcaonli, Jannzen Rey R.

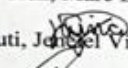

Asuncion, Christiane Danelle


Bravo, Sydney Jannzen F.


Corpuz, Alpha Brenie


Daguio, Neva Jeane B.

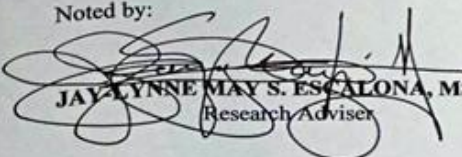

Dela Cruz, Marc Leiane


Mabuti, Jeneel Vince Abeil V.


Mamala, Mark Joseph R.


Ramos, Jane Marinel F.

Noted by:


JAYLYNNE MAY S. ESCALONA, MSCRIM
Research Adviser

APPENDIX “C”
Letter to Conduct Study in Maria De Leon Trans

DATA CENTER COLLEGE OF THE PHILIPPINES
COLLEGE OF CRIMINAL JUSTICE EDUCATION
Brgy. 1 San Lorenzo, Rizal Street
Laoag City, Ilocos Norte

October 19, 2022

ROGER PASTOR
HeadManager
Maria De Leon Trans
Laoag City

Respected Head Manager:

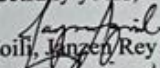

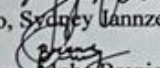
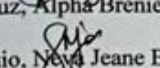
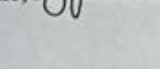
Greetings of peace and prosperity!

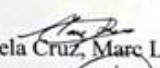
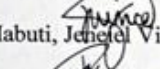
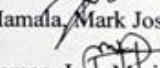
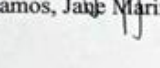
The undersigned fourth year students of Data Center College of the Philippines, Laoag City Inc. taking up Bachelor of Science in Criminology and currently enrolled to Criminological Research 2 and presently proposing a study entitled **EMERGING DIGITAL INNOVATIONS: KEY TO ADVANCE ROAD SAFETY**. The purpose of this research is to find out the technology devices or equipments installed by the public transportations and to address the current situation on the Emerging Digital Innovations as to advance road safety.

With your related knowledge and experience, researchers would like to request you to be one of our respondents in our study. The researchers hope that you will take time answering the questions honestly. And rest assured that all information's obtain is strictly confidential, the researchers and the adviser will have the direct access of the data as it is only used for statistical purposes.

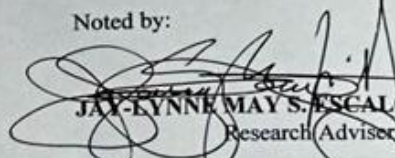
The researchers hope this request merits your kind consideration and approval. Thank you very much and God Bless.

Respectfully yours,


Agcaoili, Jansen/Rey R.

Asuncion, Christiane Danelle

Bravo, Sydney Lannzen F.

Corpuz, Alpha Brenie

Daguio, Neva Jeane B.


Dela Cruz, Marc Leiane

Mabuti, Jhenel Vince Abeil V.

Mamala, Mark Joseph R.

Ramos, Jane Marinel F.

Noted by:


JAY-LYNNE MAY S. ESCALONA, MSCRIM
Research Adviser

Scanned by TapScanner

APPENDIX “D”
Letter to Conduct Study in Fariñas Transit Company

DATA CENTER COLLEGE OF THE PHILIPPINES
COLLEGE OF CRIMINAL JUSTICE EDUCATION
Brgy. 1 San Lorenzo, Rizal Street
Laoag City, Ilocos Norte

October 19, 2022

VICE MAYOR REY CARLOS FARIÑAS
Fariñas Transit Company
Laoag City

Respected Head Manager:

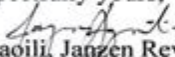
Greetings of peace and prosperity!


The undersigned fourth year students of Data Center College of the Philippines, Laoag City Inc. taking up Bachelor of Science in Criminology and currently enrolled to Criminological Research 2 and presently proposing a study entitled **EMERGING DIGITAL INNOVATIONS: KEY TO ADVANCE ROAD SAFETY**. The purpose of this research is to find out the technology devices or equipments installed by the public transportations and to address the current situation on the Emerging Digital Innovations as to advance road safety.

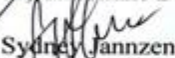
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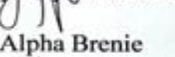
The researchers hope this request merits your kind consideration and approval. Thank you very much and God Bless.

Respectfully yours,



Agcaoili, Janzen Rey R.

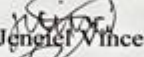

Asuncion, Christiane Danelle


Bravo, Sydney Jannzen F.

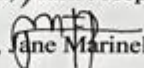

Corpuz, Alpha Brenie


Daguio, Jeane B.


Dela Cruz, Mare Leiane


Mabuti, Jenciel Vince Abeil V.


Mamala, Mark Joseph R.


Ramos, Jane Marinel F.

Noted by:


JAY-LYNNE MAY S. ESCALONA, MSCRIM
Research Adviser

APPENDIX “E”
Letter to Conduct Study in GV Florida Bus Station

DATA CENTER COLLEGE OF THE PHILIPPINES
COLLEGE OF CRIMINAL JUSTICE EDUCATION
Brgy. 1 San Lorenzo, Rizal Street
Laoag City, Ilocos Norte

October 19, 2022

VIRGILIO FLORIDA JR.
GV Florida Bus Station
Laoag City

Respected Head Manager:

Greetings of peace and prosperity!

The undersigned fourth year students of Data Center College of the Philippines, Laoag City Inc. taking up Bachelor of Science in Criminology and currently enrolled to Criminological Research 2 and presently proposing a study entitled **EMERGING DIGITAL INNOVATIONS: KEY TO ADVANCE ROAD SAFETY**. The purpose of this research is to find out the technology devices or equipments installed by the public transportations and to address the current situation on the Emerging Digital Innovations as to advance road safety.

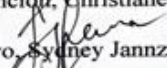
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The researchers hope this request merits your kind consideration and approval. Thank you very much and God Bless.

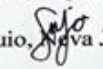
Respectfully yours,

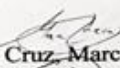

Agcaonili, Janzen Rey R.

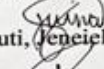

Asuncion, Christiane Danelle


Bravo, Sydney Jannzen F.


Corpuz, Alpha Brenie


Daguio, Neva Jeane B.

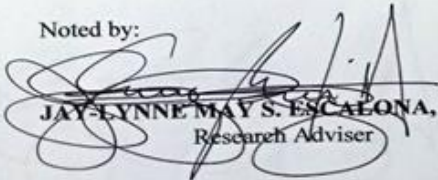

Dela Cruz, Marc Leiane


Mabuti, Jeneiel Vince Abeil V.


Mamala, Mark Joseph R.


Ramos, Jane Marinel F.

Noted by:


JAY-LYNNE MAY S. ESCALONA, MSCRIM
Research Adviser

APPENDIX “F”
Letter to Conduct Study in Claveria-UV Express Van Terminal

DATA CENTER COLLEGE OF THE PHILIPPINES
COLLEGE OF CRIMINAL JUSTICE EDUCATION
Brgy. 1 San Lorenzo, Rizal Street
Laoag City, Ilocos Norte

October 19, 2022

ELLIAS ILACUNA
Claveria-UV Express Van Terminal
Laoag City

Respected Head Manager:

Greetings of peace and prosperity!

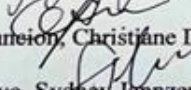
The undersigned fourth year students of Data Center College of the Philippines, Laoag City Inc. taking up Bachelor of Science in Criminology and currently enrolled to Criminological Research 2 and presently proposing a study entitled **EMERGING DIGITAL INNOVATIONS: KEY TO ADVANCE ROAD SAFETY**. The purpose of this research is to find out the technology devices or equipments installed by the public transportations and to address the current situation on the Emerging Digital Innovations as to advance road safety.

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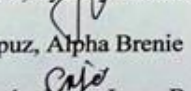
The researchers hope this request merits your kind consideration and approval. Thank you very much and God Bless.

Respectfully yours,


Agcaolli, Ianzen Rey R.


Asuncion, Christiane Danelle


Bravo, Sydney Jannzen F.

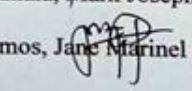

Corpuz, Alpha Brenie


Dagui, Jeane B.

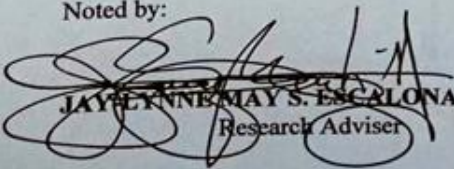

Dela Cruz, Marc Leiane


Mabuti, Vince Abeil V.


Mamala, Mark Joseph R.


Ramos, Jane Marinel F.

Noted by:


JAYLENE MAY S. ESCALONA, MSCRIM
Research Adviser

**“APPENDIX “G”
Research Questionnaire PNP Highway Patrol Group**

**DATA CENTER COLLEGE OF THE PHILIPPINES
COLLEGE OF CRIMINAL JUSTICE EDUCATION
Brgy. 1 San Lorenzo, Rizal Street
Laoag City, Ilocos Norte**

EFFECTIVENESS OF DIGITAL INNOVATION AS THE KEY TO ADVANCED ROAD SAFETY AND INVESTIGATION

The purpose of this research is focused to determine the effectiveness of the equipment being used by the Highway Patrol Group.

Name (Optional): _____

Direction: Read carefully each given statement. Put a check mark (/) on the given items below by checking the corresponding numbers.

Part 1: Equipment that I used as a PNP Highway Patrol Group Officer

- | | |
|--|---------------------------------------|
| <input type="checkbox"/> Dashboard Camera | <input type="checkbox"/> Google Map |
| <input type="checkbox"/> Global positioning system | <input type="checkbox"/> others:_____ |
| <input type="checkbox"/> Body Worn Camera | |

Please state and specify: _____

Part 2: Level of effectiveness of equipment that I used as a PNP Highway Patrol Group Officer in Investigation and Operation.

- 5 - Strongly Agree
- 4 - Agree
- 3 - Neither
- 2 - Disagree
- 1 - Strongly Disagree

Investigation					
Dashboard Camera					
	5	4	3	2	1
The equipment provide security and proof in case of a road accident.					
It can provide protection against false accusations.					
The equipment is useful in investigating road accident.					
Global Positioning System					
This equipment is an assurance in enforcing security and safety of the personnel.					
Use to find suspects and witnesses near the crime scene.					
This equipment help efficiently pinpoint location and direct emergency response for road accident.					
Body Worn Camera					
Used by police officers to record their daily routine, and evidence from law enforcement scenes.					
It can provide protection against false accusations.					
The video and audio captured by the bodycam can be used as evidence in arrests or prosecutions.					
Google Map					
It can present visualize image of road for investigation.					
It can provide digital records or identifying information of road familiarization.					
This equipment applied in clarifying issues in road accidents.					
Operation					
Dashboard Camera					
This equipment help greatly increase police efforts to ensure transparency and accountability in road operation.					
It can captured real time footage in operation of road accidents.					
It can provide additional evidence to what they already collected during operation.					

Global Positioning System					
It provides immediate updates during pursuits in road incidents operation.					
The data provides accurate, objective records that show where a vehicle was located at any given time.					
It can supplement trust-building by helping police accurately track criminals in the operation.					
Body Worn Camera					
It can improve security levels in public areas and protect officers in operation.					
The equipment can record video and audio during the operation of road accidents.					
It can provide independent confirmation of the road accidents.					
Google Map					
The equipment can help to accomplish task easily such as recording a report or mapping an incident.					
It requires additional updating the system of the equipment.					
The equipment can only use when there is an available internet.					

Part 3: Problem encountered of the devices that I used as a PNP Highway Patrol Group Officer.

- 5 - Strongly Agree
- 4 - Agree
- 3 - Neither
- 2 - Disagree
- 1 - Strongly Disagree

Dashboard Camera	5	4	3	2	1
This equipment may not provide a complete and accurate event of road accident.					
This equipment is incompatible of performing its main purpose.					
This equipment invades the privacy of citizens.					
Global Positioning System					
The equipment provide incorrect routes for investigation.					
It requires additional updating the system of the equipment.					
The equipment can only use when there is an available internet.					
Body Worn Camera					
This equipment invades the privacy of citizens.					
This equipment may not provide a complete and accurate event of road accident.					
This equipment is incompatible of performing its main purpose.					
Google Map					
The equipment provide incorrect routes for investigation.					
It requires additional updating the system of the equipment.					
The equipment can only use when there is an available internet.					

Thank you very much for your cooperation!

**“APPENDIX “H”
Research Questionnaire PNP Highway Patrol Group**

**DATA CENTER COLLEGE OF THE PHILIPPINES
COLLEGE OF CRIMINAL JUSTICE EDUCATION
Brgy. 1 San Lorenzo, Rizal Street
Laoag City, Ilocos Norte**

The purpose of this research is focused in the assessment of the equipments installed by the Highway Patrol Group.

Name (Optional): _____

Direction: Read carefully each given statement. Put a check mark (/) on the given items below by checking the corresponding numbers.

Part 1: Devices that I used as a Professional Drivers

- | | |
|---|--|
| <input type="checkbox"/> Dashboard Camera | <input type="checkbox"/> Waze |
| <input type="checkbox"/> Global positioning system | <input type="checkbox"/> Google Map |
| <input type="checkbox"/> Traffic Lights and Signal Lights | <input type="checkbox"/> others: _____ |
| <input type="checkbox"/> Body Worn Camera | |

Please state and specify: _____

Part 2: Level of effectiveness of the devices that I used as a Professional Drivers Scale Descriptive Interpretation

- 5 - Strongly Agree
- 4 - Agree
- 3 - Neutral
- 2 - Disagree
- 1 - Strongly Disagree

Transportation	5	4	3	2	1
The equipment increased visibility to the final delivery destination.					
It provides faster routing options.					
It optimizes delivery routes and shortens travel distance.					
The equipment helps in searching elimination and optimization of transport route thus saving time.					
Introduction of advance technology in transportation has become environmental friendly.					
Security					
It secures to determine the best route, which is then displayed on head-up display that physically directs the diver along route.					
Faster delivery times and mitigates risks.					
The equipment can alert the authorities in case a passenger becomes unruly or inflict harm.					
Increased speed and give higher security service.					
Effectively monitor the activities of the passengers.					

Part 3: Problem encountered of the devices that I used as a Professional Drivers

	5	4	3	2	1
The equipment causes destruction while driving.					
The offline function of the equipment is very limited.					
The equipment causes diversion of traffic to inadequate alternate routes.					
This equipment invades the privacy of passengers.					
This equipment may not provide a complete and accurate account of the event.					

Thank you very much for your cooperation!

“APPENDIX “I”
Documentation on Conducting Survey Questionnaire

DATA CENTER COLLEGE OF THE PHILIPPINES
COLLEGE OF CRIMINAL JUSTICE EDUCATION
Brgy. 1 San Lorenzo, Rizal Street
Laoag City, Ilocos Norte



➤ *Description:*

The researchers presented and conducting the research survey questionnaire which has a title of “effectiveness of digital innovation as the key to advance road safety and investigation” to the PNP Highway Patrol Group of Laoag City.

- *Documentation on Conducting Survey Questionnaire*

**DATA CENTER COLLEGE OF THE PHILIPPINES
COLLEGE OF CRIMINAL JUSTICE EDUCATION
Brgy. 1 San Lorenzo, Rizal Street
Laoag City, Ilocos Norte**



➤ *Description:*

The researchers presented and conducting the research survey questionnaire which has a title of “effectiveness of digital innovation as the key to advance road safety and investigation” to the Bus drivers and UV Express of Laoag City.