Ergonomics and the Future of the Police Vehicle

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Abstract

This study will examine the influences on police vehicle design, considerations for the future, and information regarding the argument for and against the feasibility of a customized task specific police vehicle. A comprehensive review of existing literature is presented to include articles from the motor vehicle industry and law enforcement reviews. Surveys conducted in the year 2000 and of current law enforcement officials show similarities over the years regarding police vehicles. As the law enforcement profession constantly changes with advances in technology recommendations are offered for the efficient interface between officer, vehicle and after market systems. Finally, the study reveals a call for more extensive research to be conducted by human factors engineers and law enforcement officials.

Introduction

The law enforcement profession constantly changes with advances in technology, dramatic changes in the law, and the expectations from local communities and government. The newest generation of law enforcement professionals is more technologically advanced and demographically diverse than previous generations. Uniform patrol officers rely on the resources available to them in the field; more specifically resources within the patrol vehicle. The efficient relationship between the officer and the police vehicle is essential for officer safety, optimum performance, and overall success.

The private sector from manufacturing, to office workers, to service related businesses generally attempt to provide the most efficient means possible for the end product or desired result. There are many examples of other industrial and governmental agencies such as the military, the postal service, EMS and fire service vehicles that are custom designed for their needs and specifications. These sectors of the government and private industry have shown that customized devices, equipment and vehicles produce positive results in the field. Why is there not a law enforcement customized task specific police vehicle? This research will explore the need for such a vehicle and whether it is feasible or is the current system adequate for the needs of law enforcement.

As computers and law enforcement technology blossomed in late 1990's, decisions regarding the interface of officer, computer, vehicle and the numerous other in-car devices required careful consideration. The literature review only produced one article addressing customized vehicles for law enforcement. In an article published in the July 2000 edition of the Law and Order magazine, author

Arthur G. Sharp randomly surveyed law enforcement administrators and asked them; what is your ideal police vehicle? In a random poll conducted among police administrators regarding the ideal police car, 60 percent indicated that such a vehicle is possible. Another 33 percent said it could only exist in theory, the rest of the participants were not sure. The participants who believe that it only exists in theory state that there too many differences among law enforcement agencies and if it they did exist it would probably cost too much. Among the respondents many cited that space for equipment was the biggest challenge with vehicles. Officers have an ever increasing amount of equipment and electronics and a limited amount of space. Law enforcement administrators are concerned over the future availability of a suitable cruiser let alone the ideal cruiser. Chief Robert Warner, Apache Junction, Arizona stated “Sadly, I do not see any resolution to this given the current dollar driven environment within which auto manufactures conduct business and make decisions.”

The research included a literature review and a detailed description of the history of police vehicles and how vehicles were designed and manufactured from the influence of manufactures instead of law enforcement. I presented a detailed overview of computer use within vehicles to illustrate the necessity and importance to consider user interface and strategic planning. A survey was distributed to law enforcement professionals from across the nation similar to the 2000 survey from Arthur Sharp.

Most of the vehicles in law enforcement fleets are utilized in the patrol function. Full size sedans such as the Ford Crown Victoria, Chevrolet Impala and Dodge Intreprid are the most common models. These vehicles are designed and mass produced for the general consumer, some with enhanced features in a police package option or models. In the 1950’s law enforcement vehicles were equipped with 100 horsepower engines and manual, on the column transmission developed in the 1930’s. The vehicles were bare bones, with many not even having heaters. Only a few of the most elite departments were able to afford a police package vehicle offered by Ford in 1952. The decade of the 1960’s saw an introduction of radio communications and other emergency equipment such as emergency lights and sirens. These primitive devices placed significant demands on the battery and electrical systems. Officers required keen awareness of their driving styles as not too tax the engine and electrical system. Many departments recycled and re-installed this equipment from vehicle to vehicle, only replacing it when it was unusable or obsolete. The gasoline shortage of the 1970’s brought about environmental issues and officer safety concerns. Many of the available vehicles were restricted in their horsepower and fuel efficiency. John Christy, an executive editor for Motor Trend Magazine was sworn in as a Technical Reserve Deputy within the Los Angles County Sheriff’s Department in the mid 70’s. Christy’s position and contacts within the automotive industry provided greater influence and it established higher standards for law enforcement vehicles. In 1978, the Michigan State Patrol began their annual testing of police vehicles, this practice continues today. Some creature comforts were finally added to the vehicles such as split bucket seats, air conditioning and power steering. Many law enforcement officials resisted manufactures regarding power steering.

Manufactures mandated that power steering would be standard equipment, and no other option would be available. The 1980's brought significant change to production of vehicles and the emergence of the Ford Crown Victoria as the dominant leader in the police market. The Ford Crown Victoria holds 80% of the market share for police vehicles. One reoccurring theme in the 80's and early 90's was that manufactures were designing vehicles for their overall consumer markets. Law enforcement was left with a "make do" philosophy. At the turn of the century, significant events from the terrorist attacks in 2001, to a proliferation of law enforcement technology, to litigation and pressure from law enforcement regarding police vehicle crashes has emphasized the need for specialized vehicles and/or options for officer safety. History has shown that vehicle design and the equipment within the vehicles has fluctuated with some decades being driven by law enforcement and some decades driven by the auto manufactures.

"Ergonomics is the study of the interface between people and machines. A primary concern of ergonomics is that the equipment and the workplace be designed to make jobs as easy as possible" (Rue 170). Each year the Michigan State Police performs comprehensive testing on the latest models offered by Ford, Chevy and Dodge to include sedans and specialty vehicles such as SUV's and other trucks. The testing measures vehicle dynamics, acceleration, top speed, braking, fuel economy and pursuit driving. Historically, the Michigan testing only dedicates a small degree of ergonomics analysis of the interior cockpit section. The results of the 2005 testing of the interior provided an overall cubic feet dimension and a review of the interior focusing on head, leg, should and hip room. The second portion of the test reviewed the ability to install after-market devices such as radios, cameras and computers. The current cockpit design has been developed for the general consumer and not for the law enforcement function. Law enforcement agencies are forced to customize the cockpit around the equipment that they need to install for their daily operations.

Most of the law enforcement agencies in the United States that perform the patrol function install some type of after-market device, the most significant being a computer. The installation of this equipment requires agencies to dismantle the interior so the equipment can be securely mounted and wired appropriately. The following is an overview of the interior cockpit with an example of the most common aftermarket devices. The Ford Crown Victoria Police Interceptor model is the most commonly found vehicle used in patrol operations. Many local departments purchase these vehicles with standard equipment at the lowest price via a state contract. Individual law enforcement agencies may choose to purchase vehicles outside of the state contract by directly working with the vehicle manufacturers or individual dealerships. This method of direct purchase allows for greater individuality and flexibility, but at a much high cost per vehicle. Although it would appear that most patrol officers wearing a gun belt and body armor could enter and exit the vehicle without difficulty or injury, it is not always the case. The driver's seat style is a bucket seat design with an adjustable headrest. The seat fabricate is made of heavy gauge upholstery instead of a vinyl type material. This seat can be equipped with manual or electronic seat adjustments for movement front and rear, slight recline and

lumbar supports. The installation of protective metal and Plexiglas partitions to separate suspects restricts the movement of the front seats to their maximum rear placement. Radio communication and emergency equipment can be critical to officer safety in emergency where the necessity for efficient and accessible equipment is paramount. Many agencies still have individual control boxes for the radio and emergency equipment, although an integrated system that combines the two functions is available. The installation of this equipment varies from attaching the box to the vehicle ceiling, to installing the boxes within the dashboard, to customizing a console between the front seats. Lastly, the computer system within the patrol vehicle is an essential part of the officer's daily routine. Most of these computers are often mounted between the front seats with a customized docking station. Some of these computers are basic consumer notebook style machine, while others are a combination of key board and monitor securing affixed to the interior. Officers utilize the computer network systems for a large portion of their shift. Each day officers dock their computer and log on in preparation for the days activities. The computer provides the officer access to departmental emails, to view and analyze bulletins concerning crime in their zones, and to respond to calls for service. Non-priority calls that are not in progress can be dispatched directly to the officer's vehicle via the patrol computer. The most significant portion of computer use time is completing required police incident reports. Police reports can be very simple with only one or two subjects involved with minimal evidence and a simple narrative. However, most reports consist if multiple subjects with several pieces of evidence or property to be entered along with a comprehensive narrative detailing the investigation and the statements of the participants. The above description outlines the average vehicle consisting of radio and emergency light control boxes and computer; additional devices could be added to include radar and camera systems that are normally attached on top of the dashboard. The size of these devices could significantly obscure the field of vision of the vehicle operator.

"In 1970 , Congress enacted the Occupational Safety and Health Act and created the Occupational Safety and Health Administration (OSHA) to assure as far as possible every working man and woman in the nation safe and healthful working conditions" (Velasquez 459). Several hazards and injuries could be associated with the patrol vehicle and computer configuration. Examples of potential injuries such as strain, related to working in a prolonged seated position, eyestrain from using a computer without proper lighting and screen position, and injuries associated with typing in an awkward position such as from behind the wheel of a police vehicle. Injuries associated with being seated for prolong periods can be very serious. "Injuries resulting from sitting for long periods are a serious occupational health and safety problem. This problem will likely become more common in the future because the trend toward work in a sitting position is still increasing" (Canadian). "The most common health problems that employees suffer are disorders in blood circulation and injuries affecting their ability to move" (Canadian). A reduction in body movement that makes muscles more likely to pull, cramp, or strain when stretched suddenly.

Often, officers are required to physically control or chase suspects at a moments notice often following prolonged periods of inactivity. “Prolonged seating causes fatigue in the back and neck muscles by slowing the blood supply and puts high tension on the spine, especially in the lower back or neck, and this can cause a steady compression on the spinal discs that hinders their nutrition and can contribute to their premature degeneration” (Canadian). The position of the officer for normal viewing of the notebook computer and basic keyboarding position often causes injury. Officers are generally seated squarely to the steering wheel. To view the screen, officers must turn their heads to the right forty-five degrees and then tilt forward approximately forty-five degrees. The distance from the officer’s eyes to the screen is approximately twenty-five to thirty inches. To type the report, officers must now reach towards the keyboard. The keyboard is located between the front seats at the seated thigh height and at a forty-five degree angle. For officers to utilize the standard two-hand style of keyboarding their left arm and hand must cross in front of the chest to reach the keys. The officer’s right hand and arm are bent at a ninety-degree angle. Excerpts from the OSHA Ergonomic Report (ah930824) titled “Office Work with Computers” details some potential hazards and possible solutions for employees that use computers in an office environment. “It is recognized that keyboard work, while it entails a minimum of forceful exertion, can have injurious effect on the finger control tendons because of rapid, frequent and sustained activation of the tendons. Sustained periods of frequent finger activity even with low force can be consistent with the development of carpel tunnel syndrome and tendonitis” (United). “Working with the head bent forward is considered a “hidden lifting task,” since the muscles in the back of the neck must lift or hold the weight of the head. The farther the head is bent forward, the greater the strain” (United). An officer’s head in this position for a long period can obstruct blood flow to this area causing the muscles in the neck to fatigue rapidly (United). “The stress of this position is increased when the torso is flexed and/or the arms are extended in front of the body. Tensed, tightened, and fatigued muscles in the shoulder and neck areas are consistent with the development of muscle and eye strain, median nerve compression (often associated with carpel tunnel syndrome), headache, and back problems” (United). Officers are seated in the police vehicle for a good portion of their shift. Officers must tilt their heads down and to the side to view the computer screen. To achieve the keyboarding position officers must reach over by crossing over their torso coupled with the restriction of body armor and gun belts. The computer configuration within the police vehicle and the position that officers must be in to operate the computer can have serious affects on the officer’s health, safety and productivity.

Department’s have a responsibility to the tax-paying citizens to perform to the highest standards with reasonable costs, without causing unnecessary injuries to officers. The use of computer technology is an important element of the patrol officers daily activity and efficiency. For management to ethically evaluate the decision to implement this system one should consider the utilitarian approach to efficiency. “Such efficiency is precisely what utilitarianism advocates because it holds that one should always adopt the course of action that will

produce the greatest benefits at the lower cost (Velasquez 78). Many defects still exist within the patrol vehicle for computer users. Many of the daily activities performed by officers over a period of time could lead to serious health issues such as hand and wrist injury and back and neck strain. An ergonomically correct office environment as outlined by OSHA standards can not be achieved with the existing computer configuration. It is the responsibility of management to monitor and evaluate employee comments and complaints about the system and to evaluate whether they are supported by good reasons (Velasquez 11). Velasquez asserts that it is a basic moral obligation of the employer to provide fairness to employee working conditions (457). Managers and designers will be challenged to find the correct ergonomics for patrol vehicle computer use in an era of advancing technology.

This single example of using a computer illustrates the need for intensive research to be conducted on seating, lighting, computer and key board position so the likelihood of injury and lost productivity could be reduced.

Now five years later, a customized vehicle still does not exist with no concrete prospects of one being designed or manufactured. Over the last five years law enforcement has increasingly become the most important component to productive and successful communities. An explosion of businesses as spurred fierce competition among public safety companies providing technology and equipment to law enforcement. The days of doing things as they have always been done are over. Doing more with less, faster, cheaper and ever changing is the future of law enforcement. Law enforcement managers must be the initiators of systems that will improve performance and safety. Are the futuristic purpose built police cars the wave of the future or does the current system in place provide adequate service at the best possible price?

Methods

The law enforcement vehicle with its array of equipment has become the most important tool for field officers today. Still, there are many who debate the need or feasibility of a customized vehicle specifically designed for daily patrol operations. Since a customized vehicle does not exist, my research will be based on the theories and opinions of industry experts, reviews and research of existing literature and a random survey of a variety of state highway patrol agencies.

The review of the archival data provided significant credibility of the sources from law enforcement, government and educational institutions. Unfortunately, no data truly existed regarding a task specific law enforcement vehicle. I was only able to locate a single company that proposed a customized law enforcement vehicle. The strength of the survey was the respondents were from large agencies from all regions of the county. Regrettably, I was limited to only nine of these agencies which are only a small sample overall.

Results

The essential mission of job method design is to find the best way to do a job (Rue 170). “Job method is defined as the manner in which the human body is used, the arrangement of the workplace, and the design of the tools and equipment used” (Rue 170). The University of New Hampshire and the New Hampshire State Police have teamed up and introduced their “Car 54” project. “The Car 54” introduces technology that integrates all of these systems and lets police officers talk to their cars. A simple command will turn on lights, start the siren, or call the dispatcher on the radio—all without having to remove either hand from the wheel” (University). This project has incorporated years of study and research regarding officer performance and task within the vehicle while driving and performing their routine tasks. The system integrates the radio, computer, radar and emergency equipment to one central on-board computer that can be operated manually or by voice commands. This one solution to integration, officer safety, comfort, and efficiency is relatively cheap and easy to install. The major drawback to the system is the training time involved for the system to learn the officer’s voice and for the officer’s consistent pronunciation and clarity while speaking using terms recognizable to the system. This system is currently installed and working in over 200 patrol vehicles in New Hampshire and the system is being implemented in the city of Boston.

Information gathered from an article in Law Enforcement Technology described the release of the 2006 DaimlerChrysler Dodge Magnum Police Vehicle. The author interviewed Gerry Appie, manager of Fleet Engineering who gave a detailed overview of the standard equipment developed from suggestions from numerous law enforcement officers. Much of the equipment centers around the vehicle cockpit to include roomier interior and seating, adjustments to the seat belt system to fit better around a gun belt, a short on the column shifter that avoids tangling with radio cords, one connection box for all after market electronic devices, and a center console computer mounting bracket that withstood crash tests. I was able to meet Gerry Appie in person and he confirmed the articles description of the vehicle’s features. There were other numerous upgrades to the performance and handling of the vehicle specifically related to law enforcement driving and performance. This vehicle certainly will hold the attention of fleet managers.

The North Company of California was the only company I located that is proposing a vehicle design specific for law enforcement/public safety use. It is their feeling that the big three manufacture’s business model of high volume sales does not permit them to accomplish the specific needs of a low volume consumer niche market in law enforcement. The North Company will strive to develop a low-volume purpose built vehicle with anything the consumer wants including available after market devices. The overall vehicle will be a sturdy, high performing machine with officer safety, comfort and efficiency at the forefront. According to North considerable cost savings could be enjoyed in the long term due to less maintenance and better fuel efficiency over the life of the vehicle. Direct end to end service will enable the end user to effectively manage repairs

and maintenance. The drawback to this vehicle is the initial startup cost for the company who will have to build a manufacturing plant that will meet the needs of consumer demand.

Survey Results

The survey was distributed to some of the law enforcement members of the Law Enforcement Safety & Stops (LESS) subcommittee from the International Association of Chief's of Police. Nine state agencies responded; this group was representative of all regions of the country.

Question 1 established number of years of service of the respondent, the least amount of service was 19 years, the most 35 years, and the average being 25 years.

Question 2 determined if their agencies purchased vehicles ready to go or did they dismantle the interior to install after market equipment. All 9 agencies responded that they dismantle their vehicles.

Question 3 asked to describe if the police vehicles manufactured by Ford, Chevy and Dodge met the specific needs and demands of patrol officers. 4 agencies responded above expectations, 5 responded average and 0 below expectations.

Question 4 and 5 asked what the best and worst things were about the vehicles their agencies utilize. The choices were the same for both questions: cost, safety, comfort and efficiency, after market adaptability and other. Overwhelming, the best was safety with 6 responses. The worst question revealed a variety of answers; 3 for after market adaptability, 2 costs, 2 unknown and 1 safety.

Question 6 asked "Do you believe that a vehicle specifically designed and manufactured for law enforcement use is possible?" 5 said Yes, 3 Not sure, and 1 No.

Question 7 inquired about devices in the patrol vehicle: 8 states use removable notebook style computers, only 1 answered with a permanently affixed computer. Several states use a variety of computers throughout their agency.

Question 8 asked if their agency experienced officer injury related to computer use in vehicles. 7 agencies said No, 1 said Yes and 1 did not respond.

Discussion

A primary concern for management is to identify how their strategic plans will impact operations and the various stakeholders in and around the organization (Vernon 86). "Strategic planning is analogous to top-level, long-range planning. It is the planning process applied at the highest levels of the organization, covering a relatively long period and affecting many parts of the organization" (Rue 142). The patrol officer and patrol operations are at the core of the department. "Operational planning is concerned with designing the

systems of the organization that produces the goods and services and with the planning of the day-to-day operations with those systems" (Rue 162). Law enforcement managers should be cognizant and prepared to change and improve systems in an era of rapid changes. The police department has substantial resources invested in their strategic plan and they have to monitor the progress of the system and analyze how officers are affected by workload and technology.

The survey results as compared to the 2000 survey revealed interesting information. Overwhelmingly, all nine agencies dismantled their vehicles to install after market devices. One half of them state that the worst element about their vehicles is after market adaptability. The majority felt that the current vehicles were safe and performed above expectations or average. Only one agency reported experiencing officer injury related to computer use in vehicles.

This research has clearly identified the need for more comprehensive analysis and coordination among law enforcement agencies and private industry to seek out the feasibility of purpose built vehicles. At this point we do not know if vehicles built for day to day rigorous law enforcement operations may last longer with fewer maintenance repairs then the continuing revolving door of our current system. We know the system is driven by money. Profit margin is the focus of manufactures whereas the lowest bidder is the focus for government spending. The Ford has done a tremendous job in response to the rear end collision incidents. The future is promising in 2006 with the Dodge Magnum emerging as the closest thing to a specific law enforcement vehicle. Without more research we will never know if a vehicle built with stronger frames could keep officers safer in vehicle crashes, or if the dashboard and interior functionality was designed for law enforcement equipment to enable officers to view important data without taking their eyes off the road. Would it be more cost effective to have a vehicle roll into service instead of dismantling the interior? I truly believe that officers deserve and need a vehicle designed for the law enforcement function but the reality of achieving that goal only exists in theory.

Lieutenant George Koder has been with the Clearwater Police Department since 1991. He is currently a Patrol District Commander for his agency. George has been involved with Mental Health Issues and Community Policing Initiatives. He is also a certified instructor for Driving, Firearms, FATS and OC Spray. George has a Bachelor's degree in Public Safety Management from Eckerd College.