**The Bill Blackwood**
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# Gyrocopters in Law Enforcement

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# ABSTRACT

The topic of this research discusses gyrocopters in law enforcement. The purpose of this study is to determine whether or not a gyrocopter can provide viable airborne services for law enforcement agencies. The primary issue of this research considers whether substituting the gyrocopter for a conventional fixed wing aircraft or helicopter might offer a less costly means of providing airborne services. The methodology used in this research paper includes: the internet encyclopedia, internet gyrocopter manufacturer/dealer sites and the researcher's personal knowledge of gyrocopters and personal flight experience. The findings of this research paper determine that certain models of gyrocopters are capable of delivering most airborne services required by law enforcement agencies. In conclusion, the research discovered that a gyrocopter can provide the majority of airborne services needed by law enforcement agencies at a greatly reduced cost when compared to the rates of conventional fixed wing aircraft or helicopters.

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## INTRODUCTION

In today's law enforcement field, the aircraft often plays a pivotal role in law enforcement duties, activities and the suppression of crime. Often, law enforcement agencies encounter situations in which an aircraft, be it a fixed wing or rotor wing, is needed. Such situations include aiding ground units in vehicle pursuits, surveillance situations or in the search for a missing child or an elderly person that may be on foot. Many smaller agencies do not have the fiscal capability to support the operation of an airplane or helicopter. With today's budget crunches many larger agencies (the Department of Public Safety and the Dallas Police Department) can no longer support the use of the conventional airplane or helicopter except in extreme situations. Therefore, law enforcement agencies must look for operating capital from sources other than the annual budget. Agencies such as the Department of Public Safety and the Dallas Police department must find a less costly alternative to providing air service.

The intent of this research paper will be to examine the use of the gyrocopter in providing necessary law enforcement services such as surveillance and searches at a reduced operating cost. This research paper will examine the history of gyrocopters and their flight characteristics. The paper will also address such questions as: what type of law enforcement equipment could be carried aboard, the initial cost of obtaining and maintaining a gyrocopter, the required pilot training involved, and the total hourly operating cost of the gyrocopter. The research proposes to determine whether or not the gyrocopter can meet the needs of most law enforcement agencies.

The intended methods of inquiry to be utilized in this research paper include: the review of internet articles, the use of manufacture literature, an interview with a

professional pilot and the researcher's personal experience with a gyrocopter. The intended outcome of this research paper proposes to demonstrate that the gyrocopter is a excellent choice in providing a cost effective airborne law enforcement tool. An anticipated finding of this research will expose that currently there is only one manufacturer of gyrocopters at the forefront of providing law enforcement with an airborne platform to meet the needs of law enforcement. Another finding of this research paper will be to illustrate that the gyrocopter is less costly to own and operate than conventional aircraft or helicopters. The research paper will also demonstrate that the gyrocopter will accommodate the law enforcement equipment necessary to perform job related duties. The intended effect of this research paper on law enforcement will be to offer agencies a viable, less costly way to provide essential airborne services.

## REVIEW OF LITERATURE

In 1923, Spanish inventor Juan de la Cierva built the first "autogiro" by combining a conventional fixed-wing aircrafts engine and fuselage with an overhead mast and a three-bladed rotor system. His "autogyro" was named the C-8 Auto Gyro. Cierva chose to have the autogiro retain a short section of wing, about six feet in length, presumably to enhance in-flight stability. The C-8 autogyro and the two that followed were less successful because they lacked the two most important factors, stability and predictable direction control.

Cierva solved these problems on his fourth aircraft, dubbed the "C-19 Autogyro" through the addition of a "flapping hinge point" near the hub thus allowing the rotor blades to equalize the lift between the advancing and retreating rotor blades. The C-19 was the first demonstrated in England in 1925 to a group of military officers. In 1928

Cierva gave demonstrations of the C-19 and sold its manufacturing rights to representatives around the world. (Air Command International, 2006). The American rights to Ciervas' C-19 were purchased by Harold Pitcairn who made a few design changes but retained the basic design principals and features found on Cierva's machine. Pitcairns' model was dubbed the "PCA-2 Gyroplane" which incorporated a more modern fuselage with better aerodynamic qualities and offered two engines for use in the aircraft. The engines offered were both radial aircraft engines mounted in the usual tractor configuration. The first engine produced 300 horsepower and the second produced 420 horsepower. Pitcairn also a four bladed rotor system with Cierva's flapping hinge system.

Over the next few years, Pitcairn produced and sold 24 of his PCA-2 Gyroplanes. The PCA-2 Gyroplanes exhibited the versatility and practicality it had been designed for by carrying the mail over a federally contracted route, used to reach the scene of the news and for aerial photography by the "Detroit News" daily newspaper and by setting world records. On April 8, 1931 the PCA-2 was flown by Ameila Earhart to a record altitude of 18,415 feet over Willow Grove, Pennsylvania. (Air Command International, 2006).

Focke-Achgelis, a German aircraft company, became licensed by Cierva to manufacture his patented components. Focke-Achgelis produced the C-19 for a number of years prior to the outbreak of World War ll. In 1937 the German aircraft company, having drawn heavily from the knowledge and experience gained from Cierva's design, rapidly advanced the development of their FA-61 which became the first fully controlled helicopter.

Autogyros were used by the Germans during World War ll as aerial observation posts for the U-boat attack submarines. The autogiro was towed behind the submarine using a long cable thus giving a Focke-Achgelis FA-330 autogyro glider pilot a broad view of shipping in the area. This also gave the glider pilot the ability to detect the widely scattered allied ships and relay the information via intercom to the crew below. Due to difficulties retrieving the aircraft and pilot prior to a battle, the system was discontinued long before the end of the war.

In 1953, Dr. Igor Bensen patented the “gyroplane”. These two bladed rotorcrafts utilized a teetering hub bar and rotor head assembly to equalize the lift from opposing sides of the rotor disc. Bensen developed the gyroplane system to enable a home builder to construct one. By using locally available materials the home builder was able to keep construction cost down. Factory packed material kits were also available; assembly time on either version typically ran in the 150 – 200 hour range. As there were no two place versions available at the time, home builders taught themselves how to fly the aircraft. (Air Command International, 2006).

After the ultra light craze began in the early 1980’s, Bensen gyro pilot Dennis Fetters and ultrahigh aircraft designer, Richard Turner designed a simple ultra light gyroplane. The aircraft was made of round aluminum tubing with a triangulated frame. Dennis Fetters started the Air Command Company at Liberty Landing Airport in Missouri. A born salesman, fetters promoted the Air Command Gyrocopter and sold more of them in a shorter period that anyone ever expected. Today the gyrocopter has made significant developments in performance and safety and are currently produced and sold by numerous companies.

Current gyrocopter manufacturer/dealer literature reviewed by this researcher differs between make and models. There were two manufactures/dealers researched, Groen Brothers Aviation's American Autogyro ion in Salt Lake City, Utah and Air Command International in Caddo Mills, Texas. Groen Brothers Aviation's "Sparrow Hawk APV" (airborne patrol vehicle) and Air Command International's Commander 447 are two models that are offered as law enforcement aircraft. The differences in the two are in price, power, and equipment. ("Sparrow Hawk Specifications", 2001).

## METHODOLGY

The purpose of this research paper is to determine if a gyrocopter will provide law enforcement with a less costly way of providing sufficient airborne services. The methods of inquiry used are limited due to the unique nature of this subject. These modes of inquiry include: the review of gyrocopter manufacturer literature, articles on the history of the Gyrocopter, the researcher's personal experience flying a gyrocopter. The study of current aviation fuel prices and operating costs of fixed wing aircrafts and helicopters as learned from discussions with area flight schools and certified flight instructor Wayne Smith of Telephone, Texas.

The researcher has researched both the Sparrow Hawk APV and the Commander 447. The researcher spoke with Wayne Smith of Telephone, Texas, (a certified flight instructor with numerous hours of flight logged over a 30 year career) and personally flew a gyrocopter at Air Command International in Caddo Mills Texas. Based on the above, the researcher expects to show that either of the two aforementioned models will provide a excellent source of airborne service for law enforcement agencies at an affordable price.

The researcher will discuss the basic flight characteristics of the gyrocopter and compare the differences in cost between the Sparrow Hawk APV and the Commander 447 from the online manufacturer literature of each. The author will also compare the performance of each model and describe his experience of flying the gyrocopter so that the reader will be more able to form their opinion of the gyrocopters ability to provide airborne service to law enforcement. The researcher will also interview a professional pilot with numerous hours in both fixed wing and rotor wing (helicopters) in an attempt to confirm that the gyrocopter is less expensive and capable of providing the same basic service.

## FINDINGS

The gyrocopter has only three controls which include: the control stick, the rudder pedals and a throttle. The control stick is typically a “between the legs” stick. The precession is handled by a mechanical linkage so that the left and right stick motions are more intuitive than Bensen’s simple design. The gyrocopter has a simple set of rudder pedals that operate the hinged back half of the vertical stabilizer allowing the pilot to keep the craft lined up in the desired direction of motion. The stabilizer is mounted aft of the push prop which allows the pilot to steer the craft during taxi operations and during the takeoff run. The throttle and choke are usually installed in a convenient location.

In a gyrocopter, the rotor generates more lift on the leading side and less lift on the lagging side which causes the rotor to tilt backwards with forward air speed. The gyrocopter rotor blade is un-powered. This increases drag and is one of the main reasons that gyrocopters relatively low top speed.

Air Command International in Caddo Mills, Texas, introduces the *Gyroplane Theory of Flight* as the motion of the rotor blade and the resulting thrust, or lift, dependent entirely upon “autorotation”. This “autorotation” results from the air flowing up and through the slightly tilted rotor blades as the machine moves forward.

The windmill was probably the first human invention which used autorotation by harnessing the wind to produce rotary motion. In Air Command’s “Gyroplane Theory of Flight” under “Autorotation” the idea of flying a windmill had a certain fascination among inventors such as Leonardo da Vinci who had thousands of drawings for flight among this line. The real possibility for achieving such a machine was delayed until development of the airfoil and the airplane which embodied this device.

A windmill is basically an airscrew or (propeller) working in reverse. The air flowing over the sails is deflected by them which exert a force on the sails pushing them around. The rotor blades of a gyrocopter are shaped to achieve the same effect, and set at a shallow angle of about two degrees to the horizontal plane in which they rotate. The shape of the rotor blade is that of an airfoil which enables the blade to turn into the airflow rather than be pushed around by it thus creating lift. (“Gyroplane Theory of Flight”, 2005).

Pilots of fixed wing aircraft often regard the Gyrocopter as dangerously unstable. This is certainly true when its pilot is self taught with no professional flight instruction received. Piloted properly, a certified gyrocopter is significantly safer that any other type of aircraft mainly because it cannot stall. The reason a gyrocopter cannot stall is because the rotor is in a state of constant spinning, thus creating constant lift. If translational (forward motion) airspeed becomes zero, the gyrocopter will descend

vertically to the ground, rotor still spinning. Though safe for the pilot and passenger, this type of descent usually results in damage to the gyrocopter.

Certain types of gyrocopters suffer from a weakness referred to as “pitch instability” (pitch is the tilting up or down of the craft as viewed from the front or back). Pitch instability occurs when a gyrocopter loses rotor control authority in negative-G forces which “unload the rotor” causing control authority to be lost. Positive-G forces push people into their seats; negative-G forces make people float out of their seats. An airborne gyrocopter hangs from its rotor much like an object hung from a string. As long as the craft is hanging from the rotor, stability is maintained. The instant zero or negative-G’s are introduced, rotor speed begins to decay and the forces stabilizing the plane are lost. One cause of encountering negative-G is Pilot-Induced Oscillation, or PIO. This occurs when a pilot adjusts his pitch too much too quickly, then makes a countering control input to bring the pitch back. This countering input often overcompensates, and the gyrocopter begins to buck like a learner of a stick shift car bucks. This most likely occurs at a higher engine throttle setting. If the pilot continues to fly the plane, the rotor can slow down due to lack of positive-G force, flop down striking the spinning push prop. This will result in the destruction of both the rotor blade and the push prop sending the craft into an uncontrollable fall. The way to avoid this during an incipient PIO is to apply gentle back pressure on the stick and cut engine power. This procedure is exactly opposite of the procedure that fixed wing pilots are taught to do when in trouble. This procedure being opposite that taught in fixed wing training has led to some unfortunate accidents and explains the gyrocopter’s reputation for being dangerous. (“Autogyro”, 2006).

Bunting over, or a Power Push-Over (PPO) is another danger you want to avoid when piloting a gyrocopter. A gyrocopters vertical air speed (climb or sink rate) is directly coupled to airspeed. The faster one moves forward, the more lift is created. In order to maintain level flight at high engine throttle settings, the pilot must tilt the rotor forward to prevent climbing and maintain level flight. The rotor becomes more nearly horizontal and the control stick becomes more sensitive. Too much forward stick and the rotor can aim downward. When this happens, negative-G occurs, rotor speed drops too low to provide lift. At this point a “high thrust line” gyrocopter is then pitched forward by the push prop thrust and the craft tumbles end-over-end in a somersault. It is virtually impossible to regain control after a full PPO. In spite of these dangers, most gyrocopters are designed to reduce these dangers and the majority of a gyrocopter pilots training involves avoidance of PIO and PPO.

In comparing the Sparrow Hawk APV with the Commander 447 the researcher finds that while they do much the same job, there are some major differences. The Sparrow Hawk is priced at $31.950.00 and the Commander 447 is priced at $12,600.00. The Sparrow Hawk APV is a 2 seat gyrocopter with a molded fiberglass cabin. Its empty weight is 850 lbs. with a useful load of 500 lbs. and a gross weight of 1350 lbs. It is equipped with a 160 hp engine and has a fuel consumption rate of 6 gallons per hour @80%. Its cruise speed is 70 knots with a cruise range of 245 NM. It has an operating cost of $20.00/hr. This includes fuel, maintenance and overhaul costs. The hourly operating cost of most single engine fixed wing aircraft average about $90.00/hr and helicopters operating costs range from around $120.00/hr and up. Helicopters require and average of 8 hrs maintenance for every hour of flight time.

The Commander 447 is a single seat gyrocopter with a molded fiberglass cockpit that is open. Its empty weight is 252 pounds, useful load of 300 pounds, and a gross weight of 552 pounds. It is equipped with a 40 horse power engine and a fuel consumption rate of 2.5 gallons per hour @80%. Its cruise speed is 50 miles per hour with a cruise range of 180 NM. It has an operating cost of approximately $15.00/hour including fuel, maintenance and overhaul costs. Both models can be equipped with law enforcement communications systems and what is called a Forward Looking Infra Red unit.

Prior to writing this paper the researcher contacted Air Command International in Caddo Mills, Texas. The purpose of this visit was to procure a test flight in a gyrocopter and to evaluate it performance with law enforcement needs in mind and to get first hand knowledge of its handling characteristics. After meeting with the personnel of Air Command International, who were very helpful and professional, they arranged for the researcher to take a flight in a gyrocopter with an instructor. The day was hot and humid so there was a concern about being able to get the craft off the ground with the weight of two people aboard. Holding a private pilot's certificate and having logged a miniscule amount of time in helicopters, the researcher was anxious to get a chance to take the controls. The gyrocopter flown was a Subaru powered Air Command Tandem. With the researcher having previous flight experience the instructor placed the researcher in the front seat. After buckling in and getting the radio/intercom in the helmet connected, the instructor walked the researcher through the engine start up procedure. Once started, the craft taxied in the same manner a fixed wing aircraft. Prior to the take off the instructor engaged the pre-rotor clutch which brought the rotor to

the correct rpm (approximately 150 rpm) to enable the craft to lift off after gaining sufficient ground speed. Prior to the take off roll the instructor disengaged the pre-rotor clutch. The researcher expected the sensation to be like that of flying in a helicopter. To the researchers surprise it was much like flying in a fixed wing aircraft. After some instruction, the instructor let the researcher have the controls. He was amazed with the stability of the craft and how responsive the controls were. As the craft climbed through 2000 feet the air became very cool, dry and stable as opposed to the hot humid air below 2000 feet. The instructor demonstrated the near hover ability of the aircraft. The researcher decided to see if he could follow and keep up with vehicles traveling below on I-30. He picked out a white Suburban and began to follow it and before he knew it, the craft was overtaking the Suburban. The researcher with the aid of the instructor then returned to the airport and performed several touch and go landing procedures. At the end of the flight the instructor demonstrated the short landing distance of the craft. He landed the craft on the taxi way next to the hanger in a distance of approximately 30 – 40 yards.

Learning to fly a gyrocopter from a certified instructor is extremely important. Teaching ones self to fly a gyrocopter can be fatal. Gyrocopter manufacturers, Groen Brothers and Air Command International, strongly recommend anyone wishing to learn a gyrocopter to take lessons from a professional. Groen Brothers will not sell a gyrocopter to anyone who has not first become proficient flying a gyrocopter by taking lessons. Flying experimental aircraft requires no license. However, the gyrocopter is considered a “legal ultra-light” and therefore requires a “Recreational Pilot Certificate” (FAR AIM, 2003, p.79).

## CONCLUSIONS

Law enforcement agencies are held to strict operating budgets and must continually seek less costly means to perform their duties. Often times a law enforcement agency will require the use of an airplane or helicopter to aid in searching for a lost child or elderly person that may be on foot in a rural area or to assist ground units in vehicle or suspect pursuits. Many smaller agencies do not have the fiscal means to operate and maintain its own aircraft. With the rising cost of fuel, larger agencies that have aircraft must closely monitor the cost of aircraft operation. The purpose of this study was to determine if a gyrocopter can meet the airborne needs of most law enforcement agencies and meet those needs a reduced cost. The hypothesis of this paper is that the airborne needs of most law enforcement agencies could be met with the gyrocopter.

The findings of this research paper conclude that there are a number of gyrocopter manufacturers/dealers that provide types of gyrocopters that can meet the airborne needs of most law enforcement agencies. The findings also indicate that the gyrocopter, while not as prestigious, elegant or comfortable as a fixed wing aircraft or helicopter, can be purchased and operated at a significantly lower cost than fixed wing aircraft or helicopters.

The findings of the research and subsequent conclusions do support the hypothesis that the airborne needs of most law enforcement agencies could be met with the gyrocopter. Limitations that affected research on this subject are as follows. The researcher could find no comparison data from any agency that have switched to gyrocopters, nor could the researcher locate any similar research having been

completed on this subject. The researcher was limited to gyrocopter manufacturer literature, articles on the history of the gyrocopter, the researchers own flight experience (having held a private pilot's certificate since 1974) and knowledge of current aviation fuel prices and operating costs of fixed wing aircraft and helicopters as learned from discussions with area flight schools.

This study is relevant to law enforcement agencies requiring airborne services. The findings of the study conclude that most law enforcement airborne services can be provided by the use of a gyrocopter at a reduced operating cost as compared with the operating costs of fixed wing aircraft and helicopter. It will also allow agencies that cannot afford conventional aircraft a means of supplying airborne services (that would fall within their budget restraints) to enhance the public safety.

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