

Incident Analyses of Helicopter Guimbal Cabri G2

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Abstract- Helicopters play important roles in transporting people and goods and were extensively used for observation and reconnaissance. The Helicopter Guimbal Cabri G2 is usually used for training and recreational purposes. In November 2020, there was an incident involving Cabri G2 in Malaysia. In fact there were several incidents around the world involving this type of helicopter and this paper delineated those incidents and analyses were performed to gain useful insights with regards to those incidents. This paper however did not cover 8 incidents (including the one in Malaysia) as they were still under investigation by respective authorities.

Index Terms- Aviation Incident, Aviation Accident, Crash Investigation, Helicopter

I. INTRODUCTION

The aviation field is vast expanding with various types of helicopter are currently in the market. There exist helicopters that played roles as trainers and were also used for tourism purposes. These helicopters belong to the light aircraft category. According to Airbus Helicopters, light helicopters were usually utilized for surveillance, border patrols and others and light helicopters were usually cost effective and offered users the satisfaction of being “quiet” as compared to other helicopters [1].

The Guimbal Cabri G2 is a type of light helicopter that is mostly used for training and recreational purposes. The Cabri G2 is a helicopter with 3 primary blades and able to host 2 individuals [2]. The Cabri G2 has 2 seats which were certified as crash resistance where the seats are able to withstand a 5 meter free fall [2]. These characteristics had made the Cabri G2 a prominent choice among aviation enthusiasts.

If there were aviation incidents or accidents, relevant authorities would conduct investigations in order to identify causes of these incidents. This is for the purpose of rectifying the situations in order to increase the level of safety in aviation. The investigation usually does not apportion blame to any parties but was carried out to prevent similar incidents as outlined in Annex 13 of the International Civil Aviation Organization [3]. This paper also followed suit and did not apportioned blame to any parties and the analyses in this paper were based upon factual information provided by relevant aviation authorities.

In any incident investigation related to aviation, there are procedures to be followed and steps to be taken in order to have an investigation which is thorough and systematic. The procedural system allow investigators to dissect fully the incident and prevent biases toward certain parties [3]. It's a norm to

cord off the area of the incident to prevent any contamination seeping into the area being investigated.

There were many cases where incidents were caused by maintenance errors. One such case was the Japan Airlines Flight 123 where the incident occurred in 1985. In this incident, the vertical stabilizer of the aircraft was not properly installed onto the aircraft and this caused the stabilizer to disintegrate from the fuselage in mid flight and the uncontrollable aircraft crashed at a mountain in Japan [4]. It is thus important for aviation maintenance crew to be vigilant and attentive and able to follow stipulated procedures during maintenance processes.

Brien stated that aviation personnel that were stressed or fatigued had contributed to aviation incidents [4]. Those who are fatigued or stressed tend to make mistakes and tend to take shortcuts in order to not spend more time on work. This should be addressed as safety is the uttermost important in aviation.

It's imperative for aviation workers to be physically fit in order for them to perform well in their tasks or chores. Performing well would deter mistakes and hence retaining safety. According to Harris, those who are physically fit are able to concentrate much better and thus able to perform better at work [5]. Harris had conducted a study among 116 individuals and these individuals had performed physical activities and their levels of concentration were evaluated after these physical activities were performed [5].

Harridon had studied the crews of Aviation Search & Rescue and the results indicated that crews that were physically fit were able to judge appropriately the situations during flights and this had contributed to the efficiency of the Search & Rescue Missions [6]. According to Harridon, regular physical exercises would enhance the circulation of blood in individuals and this would subsequently enhance the brain capacity in making decision and judgement [6]. Hence those that are physically fit have the ability to make better judgement and this is needed during flight and during any aviation processes that involve safety.

II. LITERATURE REVIEW

With the rise in aviation, various aircraft were manufactured in order to fulfill the needs. Light helicopters offer users affordable ways to train as pilots and to physically transverse from one point to another. However most light helicopters were not equipped with black boxes or Health and Usage Monitoring System (HUMS) which would aid in the improvement of safety and also aid in incident investigation. Peering the data of light helicopters, it's best to have HUMS install onto these helicopters but weight seems to be a hindrance.

Bechhoefer had proposed a new HUMS architecture that employs state of the art components that are suitable to be installed onto light helicopters where this new architecture offer weight reduction and also reduction in technical support [7].

The Guimbal Cabri G2 is a light helicopter that had gained certifications from several authorities from several countries such as Canada, United States of America, Europe, and others [2]. The Cabri G2 has a maximum gross weight of 700 kg and could fly to an altitude of 5000 feet with that maximum gross weight [2]. The pilot pedals of the Cabri G2 could be adjusted which offers comfort and ease of handling to pilots flying the Cabri G2 [2]. This in fact is an advantage to operators and pilots and perhaps the criteria for Cambri G2 to be chosen as trainers for student pilots.

In aviation safety is prominent and several methods were in placed to eradicate or avoid incidents. But somehow incidents do happen. It's the role of authorities to conduct investigation in relation to incidents. Latipulhayat stated that regulations were in existence in order for crews or aviation personnel to perform works in such a manner that safety would not be in risk and the works are performed correctly and efficiently [8].

Latipulhayat also mentioned that during incident investigation enormous amount of data would be collected and these data originated from various sources such as black box, maintenance records, eye witness accounts, and others [8]. The comprehensiveness of this is due to the fact that all avenues would be explored to pinpoint the exact nature of the incident or accident.

Aircraft maintenance if done properly would ensure that the aircraft is in good form and would fly efficiently without any incidents. This is always the primary purpose of any aviation organization, from airlines to military units. Atak stated that aviation organizations should find a balance between getting aircraft ready swiftly for flights and retaining safety [9]. There were cases where management requires airplanes to always be available for flights and this had created unwanted pressure towards technical crews where they were pushed beyond their capacity in order to get the aircraft ready. Hence Atak advised

airlines or any aviation organization to be prudent and realistic in their objectives and goals as it involves safety and lives of passengers [9].

Samaranayake stipulated that aircraft maintenance is sometimes resource extensive where several resources need to be managed simultaneously and in an optimum manner [10]. There were times when resources needed to be shared and this created constraints. Samaranayake had studied problems that were in existence in aircraft maintenance organizations and had proposed Enterprise Resource Planning (ERP) as a tool to mitigate the current predicaments [10]. Again the purpose of mitigating predicaments is to gain high level of safety which is a requirement in aviation. And subsequently this would deter incidents and save lives.

To retain safety, it's imperative for aviation personnel to be physically fit as individuals that are physically fit have ingrained advantages compared to those that are not fit. Elmagd stated that those that have adequate level of physical fitness are able to be attentive at a much longer time [11]. Attentive is important in aviation where maintenance workers or pilots that are attentive are more vigilant of their ecosystems, situations, and surroundings and thus are able to make decisions which are correct.

Coulson had studied 201 individuals and the results indicated that those who had exercised or performed physical activities were able to perform well in their chores or jobs [12]. Coulson also stated that physical exercises had also shown to be effective in enhancing the moods of individuals and hence propelling them to be more proficient in their jobs [12]. This is clearly a good approach that could be used and perhaps already been used in some departments or sectors in the Aviation Field. Proficiency is the key towards safety and preventing incidents.

III. METHODOLOGY

Figure 1 elucidated our approach in the investigation.

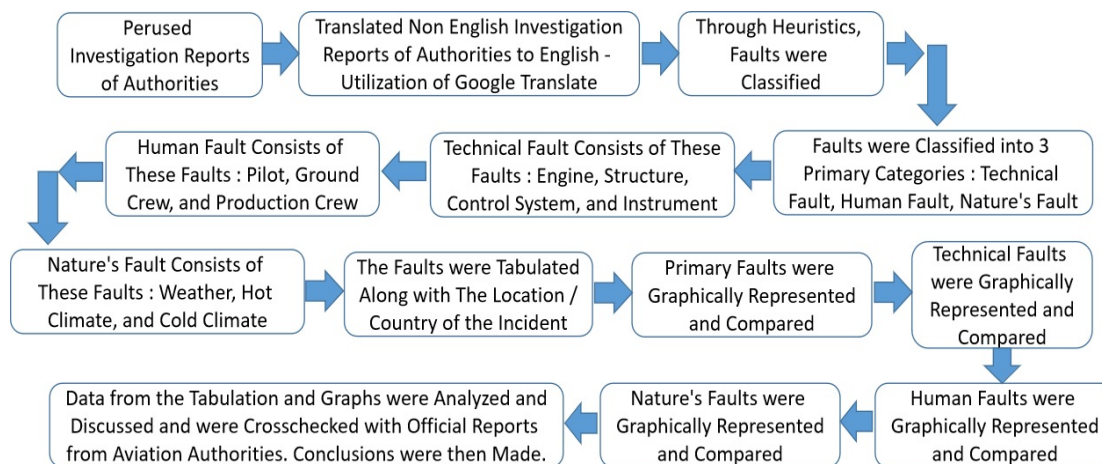


Figure 1. The Methodology of Our Investigation

Incident reports from aviation authorities were perused, read, and looked upon. Several of the reports were in the native languages and these non English reports were translated using

Google Translate. The incident faults that were outlined in the reports were classified using heuristics. The faults were classified into 3 main or primary categories which were Technical Fault,

Human Fault, and Nature’s Fault. The Technical Fault was further classified into 4 categories which were Engine Fault, Structural Fault, Control System Fault, and Instrumentation Fault. The Human Fault was also further categorizes into 3 categories which were Pilot Fault, Ground Crew Fault, and Production Crew Fault. And lastly the Nature’s Fault was classified into 3 classifications which were Weather, Hot Climate, and Cold Climate.

All of the faults were tabulated and the origins (countries) of the incidents were stated in the tabulation. All of the faults were also graphically represented for ease of analyses and all the faults were also compared with each other and with other external data such as data of light helicopters Dynali and HAL Cheetah. The comparisons gave us an overall view of the

standing of Guimbal Cabri G2 in relation with other light helicopters.

The data from the tabulation, graphs, and comparisons were crosschecked with reports from the aviation authorities. This aided the author’s analyses where discreet details were etched to the analyses. Based upon the nature of the faults, recommendations were parlayed and conclusions were made.

IV. RESULTS

Table 1 portrays the tabulation of the incidents and gave descriptions of the incidents. Figures 2, 3, 4, and 5 show the faults or causes of the incidents.

Table 1. Tabulation of Incidents

No	Cty	Technical Fault				Human Fault			Nature’s Fault		
		Eng	Struc	Ctrl	Inst	Pilot	Grnd	Prod	Wthr	Hot	Cold
1	Ger					√					
2	Nth					√					
3	UK					√					
4	Swe	√									
5	Aus					√					
6	Aus					√					
7	Fra					√	√				
8	Swi	√									
9	Nz					√					
10	Ger					√					
11	Ger					√					
12	Ger						√				
13	Pol			√							
14	SA					√					
15	Fra					√					
16	US					√					
17	Nz					√	√				
18	SA					√					
19	Bra					√					
20	Nz					√					√
21	US					√					
22	Nz					√					
23	UK					√					
24	US					√					
25	Nz					√					
26	Cze					√					
27	Slv					√					
28	Swi										
29	UK					√					
30	US					√					
31	US					√					
32	Can					√					
33	Fra					√					
34	US					√					
35	US					√					
36	US					√					
37	Fra					√	√				
38	UK						√				

39	Fra					√					
40	US					√					

Legend used in Table 1 : Cty = Country, Eng = Helicopter Engine, Struc = Helicopter Structure, Ctrl = Control System, Inst = Instrument, Grnd = Ground Crew, Prod = Production Crew, Wthr = Weather

Legend of Countries in Table 1 : Ger = Germany, Nth = Netherlands, UK = United Kingdom, Swe = Sweden, Aus = Australia, Fra = France, Swi = Switzerland, Nz = New Zealand, Pol = Poland, SA = South Africa, US = United States of America, Bra = Brazil, Cze = Czech Republic, Slv = Slovakia, Can = Canada

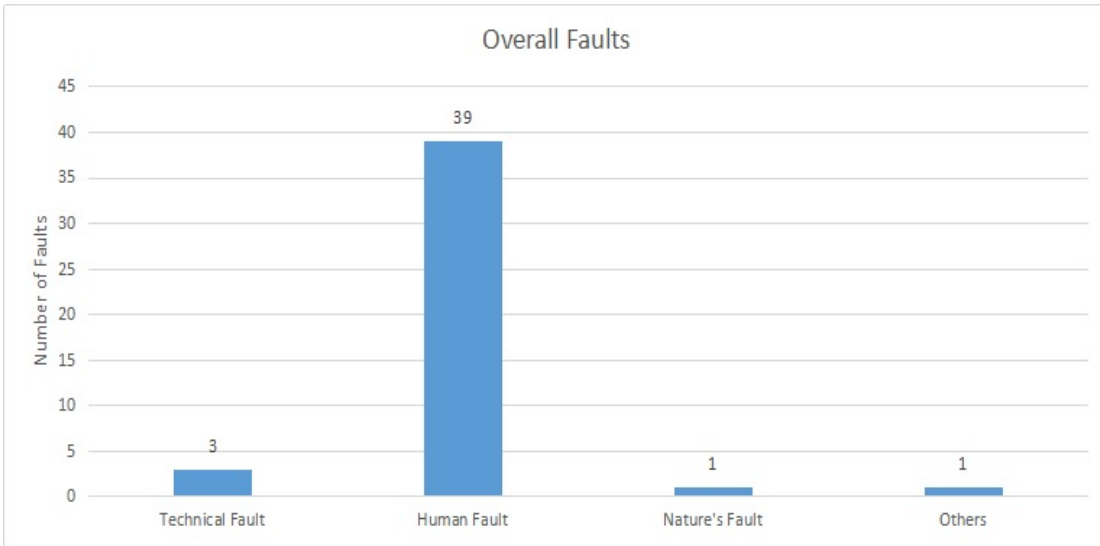


Figure 2. The Holistic View of Faults

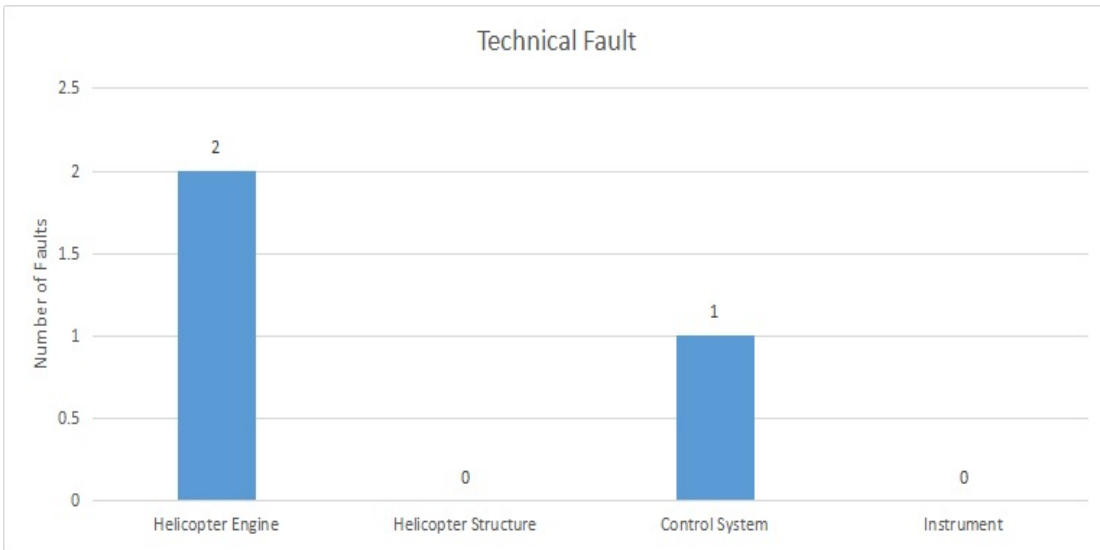


Figure 3. The Technical Fault

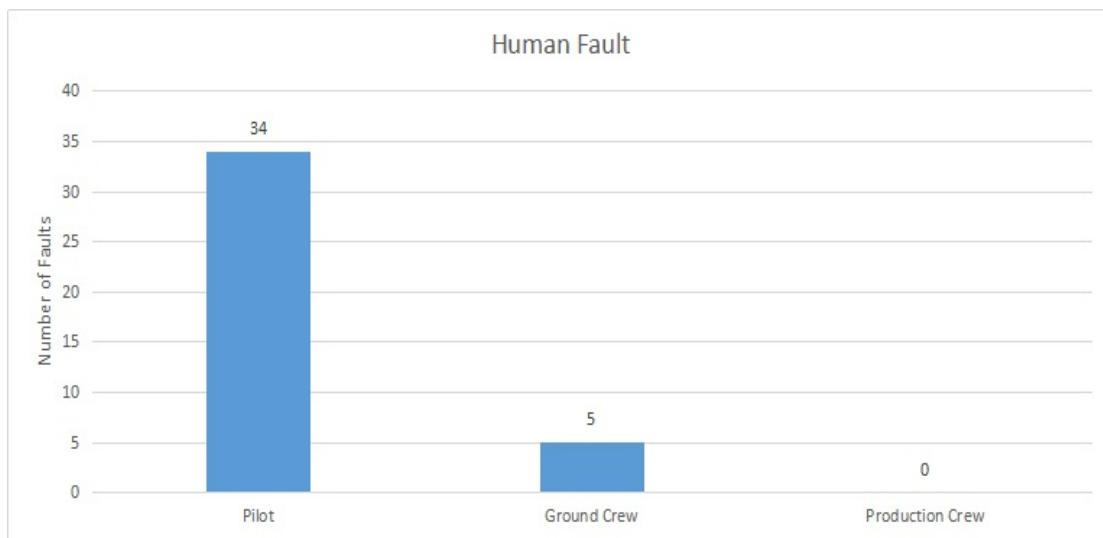


Figure 4. The Human Fault

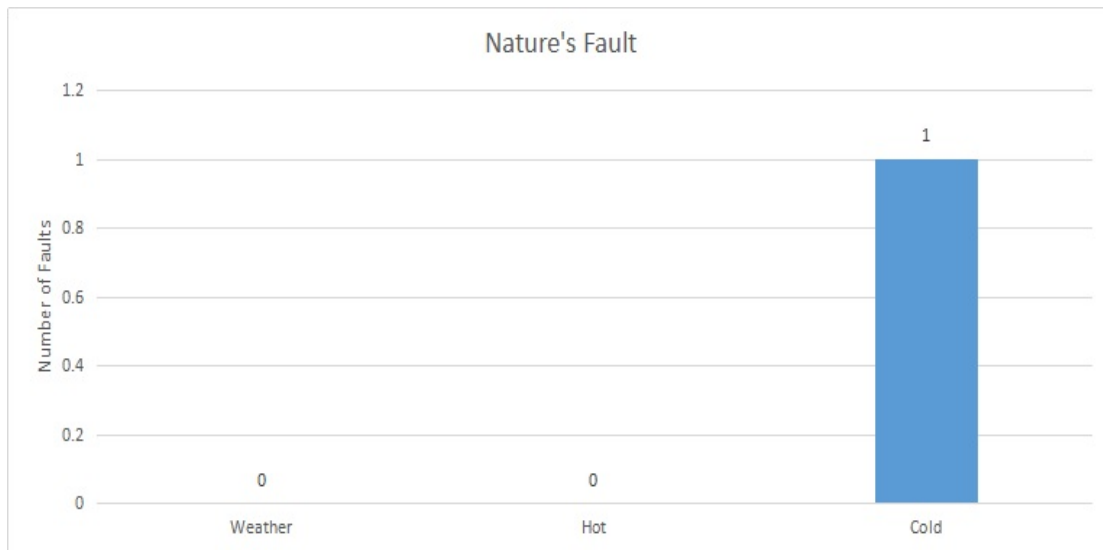


Figure 5. The Nature's Fault

V. DISCUSSION

Peering Table 1, it can be seen that the causes or faults of the incidents were tabulated. Overall there were 40 incidents from the designated period chosen to be analyzed or scrutinized (from the year 2010 till 2020). For a span of 10 years, 40 incidents is considered an eye opener since in aviation safety is critical and is set at the highest standard.

Protocols and procedures clad the aviation industry in order to eradicate incidents or keep incidents at zero. The 10 years of data showed that each year there was an average of 4 incidents. The author had compared these data with another light helicopter of similar nature which is the Dynali and the Dynali had only 7 incidents for the span of 9 years (from the year 2011 till 2020) where the average incident per year was only 0.78 incidents [13]. The author had made another comparison with another light helicopter which is the HAL Cheetah. For a span of 10 years (from the year 2010 till 2020), the HAL Cheetah had only 13 incidents where the average incident per year was only

1.3 incidents [14]. The author was concerned with the average incidents per year of the Cabri G2 as other light helicopters had shown low average incidents annually.

In Figure 2 the holistic representations of the faults were shown. Overall there were 3 Technical Faults, 1 Nature's Fault, and 1 fault which was not quantified by Table 1. Human Fault represented a majority of the fault which is 39 faults (that is 88.64%). The 39 Human Faults contributed to 36 incidents (refer to Table 1). This is worrisome as humans were hugely attributed to reasons of the faults. This reinforced the notion that those that are physically fit were required in aviation as they have the aptitude to remain attentive, concentrate better, have better positional awareness, and others. According to Harridon, training which encompassed technical fields and others such as physical fitness were important in order to ensure flights were safe and mission completed successfully [15]. Harridon had studied crews of Search & Rescue and results had shown that those involved in physical fitness had high chances of delivering output and performing well [15].

The author had dissected further the Technical Fault and the discreet details were shown in Figure 3. The Technical Fault was divided into 4 sections. There were 2 Helicopter Engine Faults, 0 Helicopter Structure Fault, 1 Control System Fault, and 0 Instrument Fault. The majority of the Technical Fault was the Helicopter Engine Fault. Both of the incidents of the Helicopter Engine Faults showcased severe vibrations in the engine. It's recommended for the manufacturer to look upon these failures and implement improvements upon the design or actuate appropriate modifications upon the engine.

Figure 4 showed the components of Human Fault. There were 34 Pilot Faults, 5 Ground Crew Faults, and 0 Production Crew Fault. The majority of the Human Fault was Pilot Fault and the Pilot Fault contributed to 34 incidents. 34 out of the total 40 incidents were due to Pilot Fault which represented 85% of the incidents. This is really a concern. According to the Australian Transport Safety Bureau (ATSB) which investigated incident number 5 (refer to Table 1), pilots should be familiar with the handling characteristics of Cabri G2 and different types of helicopter require different handling maneuvers and touches [16]. The author had perused incident reports from different authorities of other countries with regards to the incidents stated in Table 1 and most of the reports indicated that pilots should have first hand knowledge of how to specifically control the Cabri G2. The Cabri G2 is different from other helicopters in terms of the application of intensity of physical inputs from the pilot towards the helicopter [17].

Figure 5 showed the dissection of Nature's Fault. There were 0 Weather Fault, 0 Hot Fault, and 1 Cold Fault. Peering Table 1, the Cold Fault had caused incident number 20. According to the Civil Aviation Authority of New Zealand, there was a mist built-up in the cockpit which had covered the windshield and subsequently obstructed the view of the pilot [18]. The helicopter struck a pole and crashed to the ground [18]. The author opinionated that in cold weather it's imperative for an anti fogging device be activated to prevent moisture or mist built-up in the cockpit. It would be in everyone's interest if the anti fogging device be installed in the cockpit.

Observing the overall data and analyses, it's clear that Pilot Faults had caused most of the incidents and this is a point that should be looked into in depth in terms of mitigating these faults and finding solutions to decrease Pilot Faults. Apart from rigid and continuous technical training, another aspect that should be taken into account is the physical fitness of pilots. Pilots that are physically fit are able to make better judgement, are much more attentive, and are able to concentrate more. According to a study done by Reigal, those that are physically fit are more attentive and able to make decisions better [19]. Reigal had studied 210 individuals and had indicated that concentration levels of those who were fit were much better than those who were not fit [19].

According to several reports by authorities, pilots involved in the incidents were not able to input adequate forces (legs and hands) to yaw and move the helicopter sufficiently [17]. Harridon had studied the physical fitness of personnel involved in Aviation and Harridon had came out with physical methods to aid personnel or pilots in controlling their physical inputs especially the utilization of their legs [20]. Harridon had proposed Partial Squats, Step-Ups, and Calf Raises where these physical exercises would collectively decrease the strains in the

legs of the aviation personnel and subsequently the reduction of strains would allow these individuals to control the movement of their legs in an efficient manner as minor pain or strain would not be an obstacle anymore [20]. Even if the pilots were not clad with strains within their legs, these physical exercises are beneficial as these exercises offer avenues to pilots to practice their controlling skills especially controlling the movement of their legs (from slow to moderate to fast and also from low intensity to high intensity). Another research by Harridon indicated that individuals which are unhealthy in terms of weight are prone to gain strains in their legs and this could hamper their abilities to efficiently control the yaw of the helicopter [21].

VI. CONCLUSIONS

Analyses had been actuated with regards to the incidents of Helicopter Guimbal Cabri G2 where the analyses were based upon reports from relevant authorities that had investigated the causes behind the incidents. Analyses from this paper had shown that Pilot Fault had contributed to a majority of the incidents. This paper was not intended to apportion blame but to pinpoint causes of the incidents for the intention of alleviating safety and finding solutions to improve safety. The author had defined several ways and methods to increase safety in terms of improving the skills of pilots and maneuvering the helicopter in an efficient manner.

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