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An Analysis of the Utilization Rates for Eastern Kentucky University's Fleet of Training Aircraft

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Abstract

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For years, aviation industry experts have warned of a looming pilot shortage in our nation's air transportation system. As outreach efforts have yielded positive results in recruiting pilots, many flight training programs have seen unprecedented increases in enrollment. Eastern Kentucky University is no exception. Partly because of this industry wide growth, the price of acquiring, maintaining, and fueling aircraft goes up each year. As a flight training program grows and resources become scarcer, it is incumbent upon the governing body to maintain control over tangible assets and human assets for the interest of all stakeholders. Through analysis of historical and current data, it is determined the utilization rate of EKU's fleet of training aircraft is 16.68%. An understanding of the reasons behind the fleet's utilization rates will allow for changes in scheduling & efficiency and their effects to be weighed. Further, recommendations of improving scheduling and new programs are made to increase efficiency while maximizing the quality of instruction students receive.

Keywords: collegiate flight training, utilization rate, aircraft utilization, Eastern Kentucky University aviation

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Contents

Introduction

The mission of Eastern Kentucky University's Aviation program is to train and educate students so that they graduate as qualified industry professionals. The professional flight concentration offered by the program specifically seeks to train students to become certificated and qualified pilots. In any flight training program, the aircraft and associated costs are one of the biggest expenses incurred by the goal to train proficient pilots. As such, any fight training program should seek to properly utilize these assets, reducing when possible, the amount of time that aircraft are sitting unused. Using historical data and a comparison to other flight training programs, it is evident that the 16.68% utilization rate of Eastern Kentucky University's fleet of training aircraft could be increased through better management and more effective scheduling. While utilization of the aircraft is only a part of the overall optimization of Eastern Kentucky University's Aviation program, it is an essential aspect that allows for assessment of capacity.

Utilization is this case can be defined as the practical and effective use of EKU Aviation's fleet of aircraft. It is just a part of the optimization of the whole aviation program, which would go on to include instructors, flight simulators, on-campus resources, and everything else that falls under the umbrella of EKU Aviation. This research focuses heavily on utilization of the aircraft understanding that it is a definite variable that can be managed and re-measured to ensure successful application of new practices.

Optimization of the whole system should be the internal goal of EKU Aviation. A goal cannot be attained without a plan and to devise an effective plan, one must first know where they stand. Utilization of EKU's aircraft is just one part, albeit a large one, of the current capacity within the program. Therefore, understanding the current

utilization rate is one step in the direction towards optimization of the entire Aviation program.

There are several reasons why this research is important. The enrollment numbers of EKU Aviation have increased dramatically over the past several years. With the increase in enrollment, the program has acquired additional aircraft to meet the incoming demand for flight training. However, an analysis of aircraft utilization allows for a true understanding of the efficiency of flight operations. Determining the utilization rate allows for the program and its purveyors to understand any excess capacity or need to expand to meet demand.

High aircraft utilization has several benefits. When aircraft are efficiently utilized, students are more effectively trained and prepared for their career. Fixed costs are able to be spread across more people. Efficient scheduling can allow for more student enrollment with the same number of tangible resources. Additionally, in the case of EKU, some of the aircraft in the fleet are leased. There is a contractual obligation to pay for a monthly minimum amount of flight hours, whether or not the aircraft was flown for that amount of time. Though the program is moving away of a leasing model of operation, if these aircraft in particular aren't properly utilized it is money wasted.

Major Barriers to High Aircraft Utilization

Barriers to aircraft utilization can be looked at in two perspectives. One is inefficiencies due to supply, and the other is inefficiencies due to demand.

Inefficiencies Due to Supply

1. **Maintenance.** From a regulatory perspective, every aircraft has to undergo certain maintenance events. This includes an annual inspection, which is

performed every year and is a thorough review of the aircraft and its systems. At EKU, an annual inspection can take up to 3 days. Additionally, a 100-hour inspection is required of any aircraft flown for hire. Performed after every 100 hours of flight, this inspection is similar in scope to the annual inspection and takes at least one full day. All of the aircraft systems (electrical, pitot-static, avionics, navigation systems, etc.) also must be inspected at regular intervals (Inspections, 2021). These scheduled maintenance events are predictable and easily accounted for, but there often are unscheduled events. An unscheduled event is most likely to happen when there is a discrepancy in the aircraft – something in the plane isn't working correctly, which may or may not affect safety of flight.

As per the EKU Standard Operation Procedures handbook, discrepancies in the aircraft are discussed between the party which found it, and maintenance. If maintenance agrees it is something that needs to be addressed immediately, the issue is written into a discrepancy log in the binder containing aircraft documents.

For the purposes of scheduling, EKU assumes that three aircraft will be down for maintenance on any given day. These three aircraft are therefore not scheduled, and left with open availability to accommodate potential maintenance inspections.

2. **Weather.** Weather is the other major impediment to high aircraft utilization. Pilots of certain experience and certificate type are not legally allowed to fly in certain weather. For example, a majority of our nation's airspace requires a

flight visibility of 3 statute miles and a distance from clouds of 500 feet below, 1,000 feet above, and 2,000 feet horizontally (Basic VFR weather minimums, 2021). Aircraft have limited wind capability. Freezing and icing prohibit an aircraft from flying. Restricted visibility can also be illegal to fly in. A prudent pilot and flight training program will recognize that what is legal does not necessary translate to what is safe. For general aviation operations, Federal Aviation Regulation Part 91.175 subpart (f) shows that there are no applicable takeoff weather minimums. It is perfectly legal to take off with 0 visibility and a ceiling on the ground (Takeoff and Landing under IFR). What makes this particularly dangerous is in the event of an engine or equipment failure on takeoff and there is no visual reference to the environment to safely execute a forced landing.

While the federal aviation regulations set minimums for legality of flight, many pilots find that writing and strictly observing their own personal minimums mitigates weather related risks and accidents. The FAA encourages pilots to set their own limitations for every flight "to provide a solid safety buffer between the pilot skills and aircraft capability *required* for the specific flight you want to make, and the pilot skills and aircraft capability *available* to you through training, experience, currency, proficiency and, in the case of the airplane, performance characteristics (Personal Minimums, 2008)." Through this definition, pilots take into account all aspects of their aeronautical experience and training, combined with what it necessary to safely complete their mission. By doing so, the

safety margin is increased and the likelihood of success also increases. Eastern Kentucky University Aviation has created a policy that sets minimums for operations within the program. The Standard Operating Procedures specifically address the weather minima for students and pilots of different experience levels (Figure 3 & Figure 4) (Flight Operations Standard Operating Procedures, 2021*).*

Figure 1.

EKU Aviation weather minima for private pilot students. (Flight Operations Standard Operating Procedures, 2021)

7.3 WEATHER MINIMA (Private Pilot Training)

The following weather minima apply to all EKU-A Private Pilot students:

Type of Operation	Maximum Surface Wind (including gusts)	Maximum Crosswind Component	Minimum Ceiling	Minimum Visibility
Dual Traffic Patter	20 knots	Aircraft Demonstrated Maximum	1500' AGL	4 SM
Dual Local	20 knots	Aircraft Demonstrated Maximum	2000' AGL	5 SM
Dual XC Day	20 knots	Aircraft Demonstrated Maximum	3000' AGL	6 SM
Dual XC Night	20 knots	Aircraft Demonstrated Maximum	4000' AGL	8 SM
Dual Local Night	20 knots	Aircraft Demonstrated Maximum	2,500' AGL	8 SM
Solo Traffic Pattern	12 knots	10 knots	2500' AGL	5 SM
Solo Local	12 knots	10 knots	4000' AGL	8 SM
Solo XC Day	12 knots	10 knots	4000' AGL	8 SM

Note: Minima are increased when the operation is dual – with an instructor. An instructor's experience allows operation in more difficult weather.

Figure 2.

EKU Aviation Weather minima for instrument, commercial, CFI, CFII, and MEI students. (Flight Operations Standard Operating Procedures, 2021)

7.4 WEATHER MINIMA (Instrument, Commercial, CFI, MEL)

The following weather minima apply to all EKU-A advanced flight students:

Type of Operation	Maximum Surface Wind (including gusts)	Maximum Crosswind Component	Minimum Ceiling	Minimum Visibility
Dual Traffic Patter	25 knots	Aircraft Demonstrated Maximum	1500' AGL	3 SM
Dual Local	25 knots	Aircraft Demonstrated Maximum	2000' AGL	5 SM
Dual XC Day	25 knots	Aircraft Demonstrated Maximum	3000' AGL	6 SM
Dual XC Night	25 knots	Aircraft Demonstrated Maximum	5000' AGL	8 SM
Dual Local Night	25 knots	Aircraft Demonstrated Maximum	4000' AGL	8 SM
Solo Traffic Patter	20 knots	15 knots	1500' AGL	5 SM
Solo Local	20 knots	15 knots	2500' AGL	8 SM
Solo XC Day	20 knots	15 knots	3000' AGL	8 SM
Dual IFR	25 knots	Aircraft Demonstrated Maximum	500' AGL	2 SM
Solo Night XC	15 Knots	10 Knots	5000' AGL	10 SM

Inefficiencies due to Demand

3. **Student Schedules.** In the collegiate setting, student course loads and schedules are another large barrier for efficient flight scheduling. While the aviation program has control over its departmental course schedules, the courses for general education degree requirements are scheduled by their respective departments. Some flight training schools unaffiliated with a university put students in an environment where there only focus is flying and studying the appropriate material to learn how to fly. At EKU Aviation, the flight program must contend with the busy schedules of students as they

complete all the required coursework for their degree. Flexibility within the program and by the students must be maintained all schedules can properly function together.

Students are required to fill out availability forms once their schedules for the following semester are determined. With this information, EKU's flight line schedulers are able to assign recurring flight blocks which fit the availability of the student and instructor and the aircraft without conflicts.

4. **Cancellations.** There will always be illness and last-minute family emergencies. Cancellations may happen due to schedule conflicts, lack of aircraft availability, weather, student unpreparedness, etc. This is the area where the program has the most control and oversight ability to mitigate the effects of cancellations on utilization of the aircraft and optimization of the system.

The above listed items all contribute to the difficulty of increasing the efficiency and efficacy of flight line scheduling. Utilization will never be 100% because of these factors. While weather and maintenance are out of the control of the aviation program, steps can be taken to still optimize resources even when flights must be cancelled due to weather.

Aircraft utilization will also never be 100% because aircraft must spend some time on the ground. In addition to the aforementioned barriers to high aircraft utilization, aircraft spend time on the ground to get fueled, go through pre-fight and post-flight inspections, and in transition between students.

Literature Review

Pilot Shortage

On March 1, 2021, Oliver Wyman released a report entitled "After COVID-19, Aviation faces a pilot shortage." Oliver Wyman is a global consulting firm, employing varied industry experts and conducting their own research to assess trends and pattern within various fields. In this report, they reference a poll they conducted in 2019 which found that 62% of flight operations leaders stated that "shortage of qualified pilots" was a key risk to their operations. Reasons for the global shortage vary by region. In the United States, even prior to COVID-19, a pilot shortage was looming because of a few factors: an aging workforce which faces mandatory retirement at age 65, fewer military pilots entering the workforce than in previous decades, and high barriers to entry. Notably in countries such as China which have a burgeoning middle class, the pilot shortage is due from a failure to expand capacity of the air transportation system fast enough to keep up with demand (Murray and Cornwall, 2021).

Oliver Wyman states that the pandemic changed the pilot shortage to a surplus. As a result of a drastic and immediate decrease in demand, airlines were forced to reduce costs the quickest way possible – through labor. Airlines relied heavily on early retirements to reduce their payroll. This is an effective but also permanent decrease in the supply of pilots. Airline pilots who take early retirement lose their seniority within the organization and after a year of not flying, lose their legal currency which allows them to fly passengers. Thus, it is a permanent decrease in supply as there is no incentive for early retirees to return the workforce in the same capacity. In addition to early retirement, the industry drastically slowed down pilot pipeline programs. These programs take

people through flight training, regional airlines, and on to the major airlines as pilots. The researchers at Oliver Wyman also suggest that as many as 25,000-35,000 new or aspiring pilots will change careers paths as a direct result of COVID because the pandemic has shown the volatile and reactionary truth of the air transportation system (Murray and Cornwall, 2021). This study points to the importance of fast-paced, efficient flight training. There is and will continue to be a deficit of skilled labor in the aviation industry, so flight students can expect to be in demand upon completion of their training.

Federal Aviation Administration First Officer Qualifications

In 2013 after a series of airline accidents that resulted in fatalities, the Federal Aviation Administration enacted the First Officer Qualifications (FOQs). This increased the qualification requirements for first officers and captains who fly for United States passenger and cargo airlines. In addition to the time requirements, the regulation requires pilots earn a type rating for aircraft of a certain weight and number of seats (Pilot Qualification: Certificates and experience requirements, 2021). This is training and testing specific to the aircraft being blown. After investigations of accidents such as Colgan Air Flight 3407, the NTSB found that airline pilots didn't have enough experience to safely complete flights. The direct result was that the FAA created the Airline Transport Pilot Certification, one of the qualifications being 1,500 hours of flight time. This requirement can be reduced to 1,000 hours if the pilot attends and completes flight training and aviation courses at an FAA approved collegiate flight program. This is the biggest benefit of potential pilots completing their education at a collegiate program such as Eastern Kentucky University. Lutte and Lovelace sought to understand how the FAA FOQs affected enrollment in collegiate flight training programs. Before the FOQs,

the pilot certificate needed to fly for airlines was the commercial pilot certificate – which requires aeronautical experience of 250 flight hours. With the new airline transport pilot certificate there was an immediate increase of four times the experience required. This was seen as a large barrier to entry. Lutte and Lovelace determined that this increase in barrier was not matched by an increase in compensation by regional airlines. These factors drastically decreased the amount of people who were willing to pursue professional flying as a career – which in turn is a large contributing factor to the pilot shortage before COVID (Lutte and Lovelace, 2017). Again, the FAA FOQs highlight the need for well qualified pilots and the importance of efficient flight training.

Use of Simulation in Visual Flight Training

Goetz, Harrison, and Robertson studied what effect, if any, the use of flight simulation time has on a student pilot's time to solo (2012). The study sample was a group of 12 students at Southern Illinois University Carbondale. This experimental group were given 3 hours of instruction in an FAA approved flight training device (FTD) prior to training in an aircraft. They received instruction on basic sight pictures, aircraft controls, basic maneuvers, and takeoff & landing. A student pilot's first solo is an important marker from a technical perspective because it requires basic operational ability to take off, land, and operate equipment within the aircraft. From an emotional perspective, the first solo is important because it gives the student pilot a large moment of accomplishment which is often motivating. For these reasons, time to solo was used as the end marker for the experiment (Goetz, Harrison, and Robertson, 2021).

After the 12 students completed their first solo, both the calendar and flight time from beginning training to solo were compared to that of historical data. The conclusion

was that the experimental group had an average of 17.1 flight hours and 77.3 days to solo while the historical control group needed 17.4 hours and 86 days. This was not found to be significant at the .05 level for hours or days (Goetz, Harrison, and Robertson, 2021). Flight simulators serve a special purpose, especially for airlines and large cargo companies. A simulator provides the environment to fly in situations which could otherwise result in loss of life or damage to property; i.e., bad weather, systems failures, etc. This shields the crew and operator from mistakes in the real world which would cost time and money. In 1994, aviation researcher Ortiz studied basic performance of maneuvers between students who only learned in a simulator versus those who learned exclusively in aircraft. He found that the simulator group has significant time savings and that there was a 48% rate of transfer of skills. In 1998, researchers Dennis and Harris also studied the time to mastery of basic flight maneuvers. The control group, which flew in the airplanes took longer to master the maneuvers and had a higher mental workload than the two experimental groups when transferred to the aircraft. Most interestingly in this study, the simulator cockpit was not set up like the aircraft. The simulation time therefore did not teach the mechanics of the maneuvers leading the researchers to conclude that reduced mental workload in the aircraft was due to learning the procedural processes – the concept and what to expect - of flying.

The authors from SIU Carbondale mention that the sample group of 12 students was small and this could largely be a contributing factor for the results that were found. Another issue is that the FAA only allows 2.5 hours in a simulator towards the experience requirements for the private pilot certificate. Extra time in a simulator, while beneficial for training, isn’t eligible to count toward experience for a certificate. The largest gain

from this research is that the students in the simulator were not set back by their sim time. Additionally, time in the simulator costs significantly less than time in the aircraft, with the added benefit of pausing for teachable moments. Even further, these simulator hours have the potential to count towards advanced certificates.

New Zealand based researchers Reweti, Glibey, and Jeffrey developed a study to explore the efficacy of low-cost pc-based aviation training devices (PCATD) for the visual flight rule (VFR) procedure of traffic pattern entry over an airport. Reweti et al. know that an approved flight training device can reduce costs for flights schools as the costs associated with flying (fuel, maintenance, regulatory compliance, etc.) continue to increase. The goal in their study is to see if a simulator setup that is even cheaper than an approved flight training device (FTD) is as effective for proficiency of a certain VFR skill. The ultimate finding of their study was that there was no significant test difference pre/post training between participants in the FTD vs those in the PCATD. Both of these groups showed improvement over the control group who received no training in a simulator.

The researchers do point out that a PCATD can fall short of the benefits offered by high-end FTD's, most notably the feel of flight controls and flight dynamics. In the same breath though, they are quick to share that there is a positive transfer of flight training in a PCATD to real aircraft. Ultimately, the study proves that a low-cost pc-based aircraft training device can be just as effective for some maneuvers as the more expensive FTDs. In the literature review, the authors bring attention to recent technologies that further improve the efficacy of PCATDs: "super wide-view high resolution projections, artificially intelligent aircraft traffic, and high-definition terrain

with animated ground vehicles." In further defense of flight training augmented by simulators, attention is drawn to the Multi Crew License (MPL). The MPL is a pilot qualification adopted by the Joint Aviation Authority (JAA) and the European Aviation Safety Authority (EASA) as a way to develop and enhance the skills of pilots in a multi crew aircraft. To obtain this certification, the student receives most of their instruction in multi-crew flight simulation with the ability to pursue self-guided practice in the simulator. Using the simulator overall reduces training time and training cost in pursuit of the MPL. Added to this, the authors cite a study by McDermott with showed that PCATDs and FTDs are equally effective for learning instrument approaches.

The conclusion for the purposes of EKU Aviation is that when weather does not permit, utilizing the simulator on campus is a great way to stay current and make up for the lost time in aircraft. By taking advantage of the available simulators when weather is bad, students can remain fresh with procedural and operational knowledge, making the time in aircraft more efficient. Further, utilizing the simulators increases overall optimization of the program and its resources, even when aircraft utilization is down.

Flight Instructor Training

Researchers Wulle, Whitford, and Keller assert that better knowledge of multiple intelligence theory can benefit flight instructors (2017). The decision to implement this study came from conversation the researchers had with newly certified flight instructors. These new instructors communicated with the researchers about feelings of inadequacy in understanding and transmitting skills learned from *their* instructors. Further, these conversations revealed inadequate training for flight instructors in regards to learning theory. Instructors in training read briefly about different learning methods but were not

given examples or opportunity to apply the information. This lack of initial training results in arguably poor instruction as flight instructors do not understand learning and instruction methods.

Nearly 60% of student pilots never go on to earn a more advanced pilot certificate. Many more drop out even before earning their student pilot certificate, leaving the overall dropout rate of about 70-80% (The Flight Training Experience, 2010). This number is used to support the idea that flight instructors need better instruction methods and understanding of learning theories, personalities, and emotional intelligence. This can arguably greaten the retention of skilled student pilots. Aviation is a rapidly changing industry, largely due to technology and how we understand human factors. However, the ways that pilots are taught has changed *very little* over time. The FAA's *Aviation Instructor's Handbook* only uses four pages of text to cover learning styles. In this handful of pages, the Federal Aviation Administration focuses on what is taught and to what standards, not how it is taught (Federal Aviation Administration, 2008). Gardner in 1983 (revised in 2011) created a new idea termed multiple intelligences theory. His theory outlines that people can have different areas of intelligence which may not be able to be captured by traditional intelligence testing methods. He developed eight categories of intelligence: bodily-kinesthetic, interpersonal, intrapersonal, linguistic, logical-mathematical, musical, naturalistic, and spatial. Gardner argued that each individual may have better inherent intelligence in some areas, but that each can be developed with guidance. Additionally, each prevailing type of intelligence may require a specific instruction method to best understand the material (Gardner 2011). A study in 2009 showed that out of 86 pilots, most typically identified with intrapersonal and spatial

intelligences (Overchuk and Niemcyzk, 2009). This points to the need for flight instructors to tailor their teaching methods to these learning styles in particular. However, not every student will learn this way so understand of each learning style is imperative.

While high dropout rates are likely more related to student motivation than instructor teaching methods, and higher in non-collegiate settings, it is important to note that everyone benefits from recurrent training and evaluation for instructors. In this way, a flight training program can ensure that all students are receiving a good value for the money that is spent. Further, if instructors feel well prepared and equipped, it may lead to high job satisfaction and better more efficient work environment.

Purdue University Aviation Aircraft Utilization

Researchers Mott and Bullock of Purdue University in 2015 sought out to study aircraft utilization in the Purdue University flight training program. A function of scheduling, weather, and maintenance requirements, the two believed that there was excess capacity in the system. Accurately understanding and mitigating excess capacity could lead to benefits for the program. An increase in enrollment could lead to lower costs per student, as the fixed costs of operating aircraft are spread out among more people. Program affordability could be used not only as a recruiting point, but also for retention. Many students end flight training prematurely due to cost. Ultimately, they determined that the fleet of Cirrus aircraft operated by Purdue University had a utilization rate of 24%. Through their study, they determined that the professional flight program could accommodate a 20% increase in enrollment. This would lead to significant incremental revenue which could be allotted for further program growth, reduction of student fees, and in the case of Purdue University, they offered the option of internal

employment options for students who graduate from the Purdue airframes and powerplant mechanic program.

Purdue University is a land grant institution - founded after Indiana's 1865 vote to take advantage of the Morrill Land-Grant Colleges Act of 1862 and John Purdue's donation of land and money to establish a college of science, technology, and engineering. Currently, Purdue Aviation only allows entry to a maximum of 72 students once a year in the fall. Assuming there is 100% student retention and each student takes four years to graduate, this leads to 288 students in the program. Mott and Bullock chose to study the Cirrus SR-20 aircraft as they are used for 95% of the flight training in the program. Because of how much this fleet is used, determining the excess capacity within this fleet of aircraft would allow the greatest benefit. The excess capacity is an asset for the program which could be used to increase enrollment and distribute fixed costs across all students, making for better affordability. Researchers define scheduling inefficiencies in regards to supply, maintenance, and demand (Mott and Bullock, 2015).

Method

Much of this research was inspired by the work of Bullock and Mott. They defined weekly schedulable hours (WSH) and determined it would be the basis for all following calculations, including utilization rates. Calculating WSH gives a quick overview of the capacity of the system. Total weekly schedulable hours are computed as in equation 1.

$$WSH = A * D * L,$$

where

A is the number of aircraft in the fleet,

D is the number of days in the week, and

L is the length of day.

Week Length: Purdue used a six-day week and did not provide reasoning. It is therefore unknown how the determined utilization rate for Purdue Aviation would change should a seven-day week be used. It was determined that a seven-day week would be used to calculate EKU Aviation's utilization, as aircraft are available to be flown all days of the week and there are similarly instructors who are available to work any day of the week.

Length of Day: To accurately assess utilization rates as a function of the number of aircraft hours available, the length of day must be taken into account. A majority of flight training events happen during daylight hours. Much training requires visual reference to the environment. Naturally in summer months there are more daylight hours than in winter months. To bring this factor into the research, 12-hour days were used for the second and third quarters, while 8-hour days were used for the first and fourth quarters.

Number of Aircraft: Eastern Kentucky University aviation has a fairly standardized fleet. However, some aircraft in the fleet serve to fit the training requirements for a small portion of training. At EKU, these include two multi-engine Piper Seminoles, two retractable gear Cessna 172s, and two Cessna 172s which are technically advanced aircraft. The training in these aircraft is a very specific portion of the syllabus and they are not used outside of filling these training requirements. Therefore, these 6 aircraft were not included in the calculation of WSH. As enrollment in EKU aviation has increased, so

has the fleet of aircraft. In the third quarter of 2018, 11 aircraft fit the criteria for use in calculating WSH. By the fourth quarter of 2020, 18 aircraft fit the criteria.

Utilization Rate was calculate using equation 2.

$$UR = Hobbs\ Hours\ Flown / WSH$$

where

Hobbs Hours Flown is indicated by an instrument within the aircraft that measures the amount of time the aircraft engine is turning, and

WSH is weekly schedulable hours as calculated above.

All data comes from the online flight scheduling software used by EKU Aviation – Flight Schedule Pro. The software stores data and allows generation of reports such as "flight detail." The Flight Detail report compiles data related to completed flight events: hobbs time, time and date of flight, aircraft, and instructor. This is the historical data that was used, isolating for the variable required. Figure 3 is an example of this data compiled into an organized data table which would then be used towards the creation and analysis of all data.

Figure 3.

2020 4th Quarter Flight Data.

2020 Quarter 4 Data													
Week	Tach	Hobbs	RG	Seminole	Maintenance	Instructor	Solo	Other	Majority Training	Percent Solo	WSH	WSH Majority	Utilization Rate
Sep 26 - Oct 2	176.7	198	3	4.6	2.1	155.6	42.4		188.3	21.41%	1176	1008	18.68%
Oct 3 - 9	267.3	334.3	7.4	24.2	1	227.7	106.6		301.7	31.89%	1176	1008	29.93%
Oct 10 - 16	211.8	262.3	4.6	11.7	0.9	181.6	80.7		245.1	30.77%	1176	1008	24.32%
Oct 17 - 23	235.6	287.3	4.9	10.2	1.2	199.7	87.6		271	30.49%	1176	1008	26.88%
Oct 24 - 30	78.8	96	0	0	0	59.8	36.2		96	37.71%	1176	1008	9.52%
Oct 31 - Nov 6	203.2	251.6	16.5	26.2	1.2	168.4	83.2		207.7	33.07%	1176	1008	20.61%
Nov 7 - 13	1213.2	255.1	0	10.2	0.7	178	77.1		244.2	30.22%	1176	1008	24.23%
Nov 14 - 20	153.1	182.2	0	6	2.4	146.3	35.9		173.8	19.70%	1176	1008	17.24%
Nov 21 - 27	128.4	162	0	4.1	0	103.2	58.8		157.9	36.30%	1176	1008	15.66%
Nov 28 - Dec 4	162.2	198.8	0	4.7	0.7	136.4	62.4		193.4	31.39%	1176	1008	19.19%
Dec 5 - 11	172	210.9	0	10.6	5	162.4	48.5		195.3	23.00%	1176	1008	19.38%
Dec 12 - 18	131.1	155.6	0	3.8	0.6	108.9	46.7		151.2	30.01%	1176	1008	15.00%
Dec 19 - 25	90.2	104.8	0	11.1	0.2	67.8	37		93.5	35.31%	1176	1008	9.28%
Dec 26 - 31	90.8	109.4	0	1.2	0.2	74.6	34.8		108	31.81%	1176	1008	10.71%
Totals	3314.4	2808.3	36.4	128.6	16.2	1970.4	837.9		2519.1	29.84%			18.62%

Cancellation reports also come from historical data stores by Flight Schedule Pro. Figure 4 shows a compilation of this data for all quarters. Reasons for cancellations include: other, weather, scheduling conflict, instructor unavailable, sick, aircraft not available, student grounded, waiting on stage check, and school break. Beyond these options, there is any area for remarks where the flight instructor can provide further information about the reason for the cancellation. Examples of reasonings for cancellations that fall into the "other" category: "paperwork needs to be completed," "weather. Tstorms withing 20 miles of airport," "paperwork needs to be completed," and "weather. Ceiling 900ft." Clearly some of these cancellations are being recorded incorrectly – cancelling for low ceilings and thunderstorms should fall into the weather category. Additionally, the other reasons point to unpreparedness by the student.

Figure 4.

2018 3rd quarter to 2020 4th quarter cancellation data.

EKU Aviation Cancelled Flight Blocks											
Reason	2018 Qtr 3	2018 Qtr 4	2019 Qtr 1	2019 Qtr2	2019 Qtr3	2019 Qtr4	2020 Qtr 1	2020 Qtr 2	2020 Qtr 3	2020 Qtr 4	**Total**
Other	241.5	337.5	241.5	562	570	481.5	534.5	922	1363.5	1519.5	6773.5
Weather	698.5	1109	698.5	1525	851	1775.5	2482.5	878.5	1526.25	2162	13706.75
Scheduling Conflict	148	231.5	148	223	305.5	287	387.5	296.5	821.5	455.75	3304.25
Instructor not available	47.5	149	47.5	133.5	294.5	236.5	153	43.5	360	281.5	1746.5
Sick	33.5	69.5	33.5	101.5	83.5	108	120.5	233.25	226.25	281.75	1291.25
Aircraft not available	28.5	32	28.5	81.5	279	175.5	111.5	56.75	154.5	132.25	1080
Student Grounded	2	5	2	4	18	11.5	22.5	12	36.5	38.5	152
Waiting on Stage Check	50	141.5	50	214	57	185	178.5	340.5	900.5	559.25	2676.25
School Break	7	103.5	7	14	10	65.5	63	57.5	22	442.75	792.25
Total	1256.5	2178.5	1256.5	2858.5	2468.5	3326	4053.5	2840.5	5411	5873.25	31522.75

Note: Cancellation hours are measure by flight block length, not aircraft Hobbs hours. Therefore, there is not a 1:1 for cancelled hours and potential flight hours.

Certain factors were given special consideration. This study sought to specifically analyze utilization for a majority of flight training. A vast majority of training events take place during daytime conditions. Eastern Kentucky University Aviation's fleet also includes 2 multi-engine aircraft, 2 retractable gear aircraft, and two technically advanced aircraft. These aircraft are used for very small and specific portions of flight training and therefore not taken into account when calculating weekly schedulable hours.

These numbers also do not remove aircraft that were in maintenance and therefore not available. EKU Aviation contracts maintenance to Thoroughbred Aviation, who has consistently kept our fleet well over 90% fully mission capable. The cancellation report also does not account for training events that were cancelled but later replaced with another event. If this were happening often, it would raise the utilization rates.

Findings

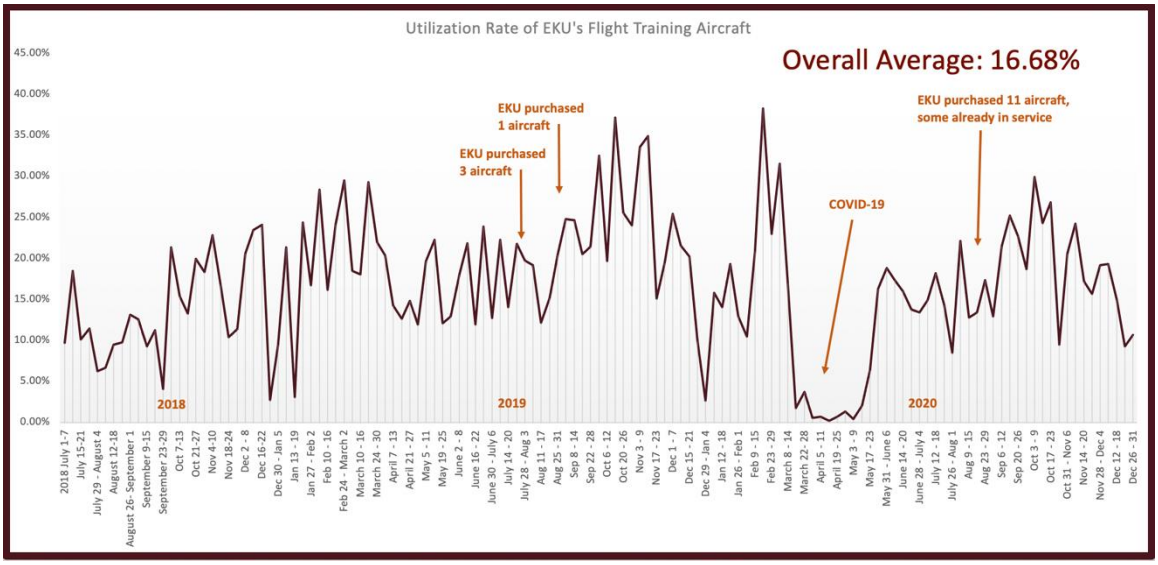
After calculating the weekly utilization rates, the metrics were assembled in a line graph (Figure 1). All weekly utilization rates were then averaged for an overall utilization rate from July 2018 to December 2020 of 16.68%. Given that Purdue Aviation had an

aircraft utilization rate of 24% and it was determined the excess capacity allowed for a 20% increase in enrollment, it stands to reason that EKU Aviation has considerable excess capacity.

The graph depicts much variability within the weekly utilization rates, often indicative of the weather experienced in central Kentucky year-round; a week of good weather will be bookended by weeks of bad weather. The graph also depicts the predictably low rates during the height of the COVID-19 lockdown. Any utilization of the aircraft during this time was not student training, but flights conducted by instructors. These were necessary to retain their currency and be legally allowed to instruct when lockdown concluded. There are also lows during weeks that contain holidays and summer months. This is attributed to the fact that many students return home for school breaks.

Figure 5.

EKU aircraft weekly utilization rates.

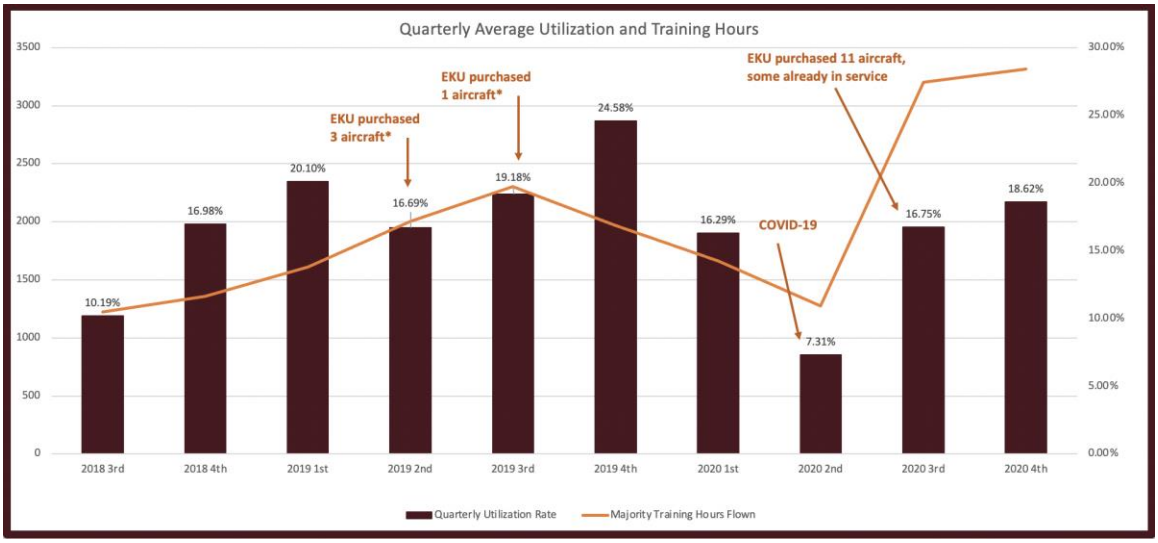


*Note:*This graphical display points to aircraft purchases by the progam, though this doesn't necessarily correlate with an increase in fleet. Sometimes these aircraft were being leased by EKU and already in the fleet at the time of purchase.

A graph was produced that showed the quarterly utilization rates and training hours flown (Figure 4). This graph shows that with an increase in fleet size, more hours are able to be flown overall, but there isn't necessarily an increase in the efficiency in how the aircraft are scheduled. It is a visual representation of both the growth and stagnation of the scheduling process for EKU Aviation's fleet of training aircraft.

Figure 6.

Quarterly Utilization Rates and training hours flown.

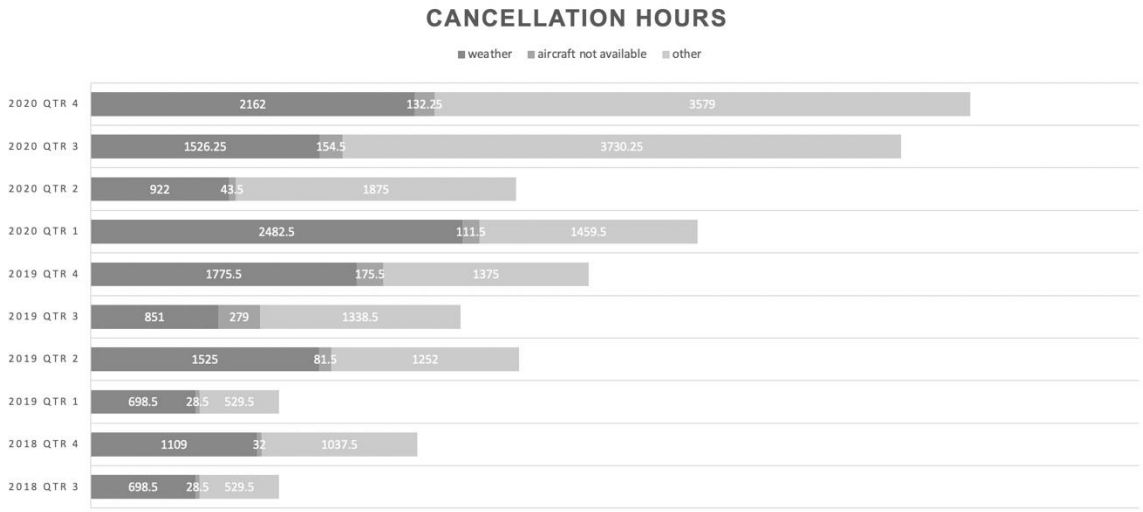


Cancellation reports were assessed quarterly. Nearly half of all cancellations were due to weather (Figure 5). A small portion of cancellations happened because aircraft were not available. This would most likely be because the aircraft was in maintenance. It

could also be because an aircraft was taken for the day for a check ride so that student could take the practical test for a new certificate or rating. In the fourth quarter of 2020, there were 3579 flight bock hours that were cancelled for “other” reasons. This is where the program has the greatest opportunity to improve utilization rates.

Figure 7.

Quarterly Cancellation Hours.

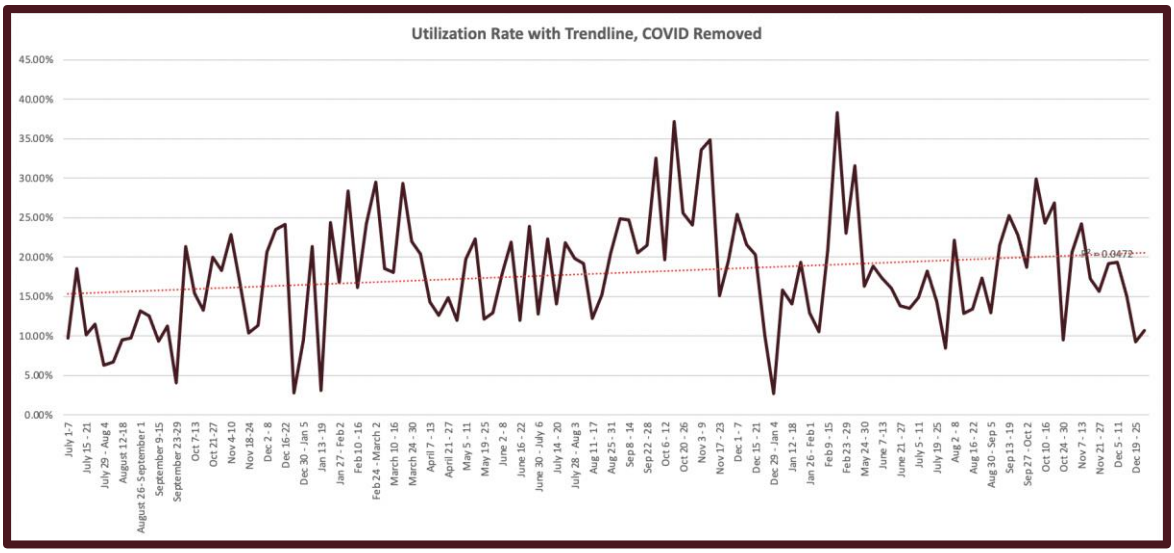


Note: Cancellations due to weather account for 46.05% of all cancellations.

An important note is the utilization rates were not immune to COVID and the effects of lockdown. Taking this in mind, a chart was made which removed the months where utilization was most highly effected by COVID. After this data was removed, a trendline was formed which showed a steady increase over time. Moving in a positive direction, this could likely be contributed to an increase in enrollment over the last two and a half years and more strict scheduling practices than in 2018.

Figure 8.

Utilization with trendline, COVID effected months removed.



Recommendations

In the Purdue study, researchers determined that the excess capacity should be used to increased enrollment. Purdue Aviation limits the number of new students each year, so the argument was that increasing enrollment would similarly increase utilization of the aircraft. An alternative perspective, with immediate results, is that the excess capacity in EKU's fleet allows for currently enrolled students to fly more often. Currently, each student is given two flight blocks a week at an average of 1.5 hours per block. This period is meant to provide enough time for students to complete pre-flight actions, fly an hour lesson, and debrief with the instructor.

If the aviation program were to instead allow each student to fly 3 flight blocks a week, utilization would increase 50%, for an overall average rate of just over 25%. Additionally, this would decrease the calendar time it takes students to complete their flying by 33%. Not only does this expedite the training and certification process for student pilots, it increases efficiency. When a person learns a new skill, consistency is incredibly important to build and solidify new neural networks. The longer between

flights (especially if many are cancelled for any reason), the more flight lessons overall a pilot must take because the information isn't retained or recalled as readily.

A more creative, long-term, and marketable solution is a private pilot summer camp. Incoming freshman could have the opportunity to attend a summer semester in which they complete the necessary private pilot ground course and associated flight labs. Ideally this would give students the opportunity to complete their private pilot's license before beginning coursework, allowing them to fully dedicate time and energy on learning this new skill. Historically, utilization rates in the summer have been especially low, as many students return home to live for the summer. From the university's perspective, this summer semester would increase summer aircraft utilization and offering a marketing tool for the aviation program.

Additionally, increased staffing would help with the workload of an increase in flying. A further recommendation then, is to add a dispatcher to the flight operations at EKU Aviation. The dispatcher, aided by student workers, would oversee the preparedness of students and instructors. They would hold students and their instructors accountable for cancellations and the reason for cancelling. Further, the dispatcher would then apply the flight lab policy of unexcused cancellations and no shows. The role would also call for approval of flight plans, management of airspace and practice areas, ordering fuel between flights, administer pre-flight checklists, and then physically dispatch the aircraft keys to the student.

The key element which makes the dispatcher desirable is the program's ability to maintain positive control over cancellations. In the fourth quarter of 2020, 3579 flight hours were cancelled due to reasons listed as "other." With accountability, it is likely that

this number would decrease drastically. If the number does not decrease, then those students or instructors who regularly cancel flights for invalid reasons can be removed from the schedule to make room for more motivated students.

The final recommendation is to better optimize the entire program and system through improved simulator utilization. Eastern Kentucky University Aviation has two FAA approved flight simulators. When a flight must be cancelled due to weather or maintenance, there is still opportunity to learn and stay proficient with the procedural aspects of flying. Without a doubt, simulators are effective in all stages of flight training and should therefore be utilized in the case that a flight is cancelled.

Areas of Further Interest

In this analysis, topics which have the potential contribute to underutilization were discovered. While outside of the scope of this topic, they are ancillary to the topic of optimization and show possible opportunities for improvement.

Capacity of Flight Instructors.

For most flight instructors, reaching students how to fly is simply a time building opportunity; very few instructors continue to do so after they have achieved the number of hours necessary to be employable by an airline or another operation, such as charter or corporate flight departments. There are a number of compounding reasons for this, number one being money. Flight instructors typically make between $20-30 an hour and this only account for hours while the aircraft is in operation. Many hours are spent on the ground working – providing ground instruction, briefing and debriefing, pre/post-flighting the aircraft – that are not accounted for in pay. Given that a flight instructor has

invested tens of thousands of dollars to be able to instruct, it is unreasonable to expect longevity with this pay. Opportunities and programs to attract and retain qualified and effective should be considered and developed.

The problem lies in that when air transportation reaches the level of demand seen in 2019, airlines will need to hire more pilots quickly. Flight instructors have had the opportunity during COVID to build the necessary aeronautical experience to be a candidate for hire and as such will be eligible to move on quickly. The federal aviation regulations also limit flight instructors to 8 hours of instruction per 24 hours period. The excess capacity of Eastern Kentucky University's Aviation program will only exist as long as there are enough instructors to teach out of the aircraft. It would therefore be in the best interest of the aviation program to determine how best to procure and retain qualified instructors. In addition to the capacity of the flight instructors, there is room for improvement for the way some of them teach. It is to the benefit of both a flight training program and the students attending that instructors are taught the different methods of instruction, evaluated on their skills, and participate in continuing education to remain effective instructors.

Cancellation Reports

In analysis of the data, it was discovered that many cancellations may be for unexcused reasons. Moving forward, regular internal audits of cancellations and their reasons would assert positive control of the cancellation system. It was found that some cancellations were noted for the reason "Other," but then indicated weather in the comment section. Some notable explanations include: "Student didn't give reason, just

said he needed to cancel," "Student has to finish written," and "Renter's insurance expired." These reasons are able to be mitigated, and with enough advanced notice, the flight block could be rescheduled for a student who is present, prepared, and motivated to fly. Again, the position of dispatcher could hold the role of keeping students and instructors accountable in terms of cancellations, along with internal audits.

Conclusion

Eastern Kentucky Aviation has the opportunity to optimize their resources by maximizing utilization, produce qualified pilots to meet the needs of the industry, and prepare students for rewarding and productive careers. With the aforementioned information and findings, there is an established point and assessment from which to continue adapting to the market as necessary.

The overall utilization rate of Eastern Kentucky University's fleet of aircraft from July 2018 to December 2020 was 16.68%. This is 70% of what Purdue University's utilization rate was for their aircraft, which was determined and excess capacity allowing for a 20% increase in enrollment. The conclusion here is that EKU Aviation has even more excess capacity, though the recommendation is to increase flight blocks per week versus new enrollment of students.

Through the recommendations of allowing each student to fly an additional block a week, employing a dispatcher to help maintain positive control over aircraft and cancellations, and better utilizing simulators when the aircraft cannot be flown, there will be great improvement in both the utilization of the fleet of aircraft and the optimization of the program overall.

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