# Development of Laboratory Facility for Turboshaft Rotary Wing Aircraft

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***Abstract-*** ***The aviation industry faces many challenges and one of them is aircraft maintenance graduates who were unprepared and unqualified aviation maintenance personnel, as institutions offering these courses focus on fixed-wing aircraft during theoretical lectures and laboratory hands-on whilst most graduates find jobs in the general aviation sector where rotary wing aircraft are common. The Philippine State College of Aeronautics (PhilSCA) is an educational establishment that offers Aircraft Maintenance Technology and Helicopter Maintenance Operations as part of its curricula yet the mode of delivery is at a theoretical level and has yet to become a well-rounded program with targeted learning modalities; the establishment of a well-equipped turboshaft rotary wing aircraft laboratory is a step to prepare students and the faculty alike in the ever emerging field of aviation technology. This study has demonstrated the use of feedback from various individuals affiliated with—academe and civil aviation; Philippine State College Aeronautics' faculty from the Aircraft Maintenance Technology Department, Civil Aviation Authority of the Philippines (CAAP) personnel from the Training Organization Certification and Inspection Division (TOCID) Department and its existing standards, Philippine Civil Aviation Regulations (PCAR) and Commission on Higher Education (CHED) requirements to develop a comprehensive laboratory facility for turboshaft rotary wing aircraft. The study determines the following: governing bodies' pre-requisite for the establishment of the laboratory facility, the level of instruction on Helicopter Maintenance Operations at the institution, and the likelihood of all-inclusive laboratory development. A four-point Likert survey was used in this study and was used on CHED standards and CAAP standards where the level of suitability, level of agreement, and level of awareness of the participants on the Helicopter Maintenance Operations laboratory inception was précised. There were 30 participants in this study who answered the survey questionnaire by using the mean distribution of the participants, the significant difference between CAAP and CHED Standards, and the summary mean distribution of the participants' responses on the requirements approved facilities for the laboratory. The positive agreement on the institutional pre-requisite of laboratory facility, suitability of the school's existing tools and equipment, and awareness on improvement on personnel and acquisition of technology. By using the frequency and percentage distribution, mean distribution of the participants on the requirements of the approved facilities for the laboratory, the conclusions, suggestions, and recommendations were ranked on their popularity and mentions from the research contributors, purchase of a helicopter unit as part of the laboratory facility equipment came in as first whilst an improvement on current was ranked last. The Key Informant Interview (KII) questionnaire was disseminated to select participants (as well as alumni) of the aircraft maintenance technology program from PhilSCA, an opine on student curricula, field experience, and observation as a fresh graduate to a certified aircraft mechanic was a purview during the interview. A cost-benefit analysis was included by the researcher to determine whether the benefit to the institution, its students, and its faculty outweighs the expenses of the laboratory facility development. The development of the turboshaft laboratory facility will benefit both students and faculty of the institutions. It is economical and will help PhilSCA to achieve the vision and mission to produce world-class Aeronautics professionals. The goal of the institution is to give and provide accredited training that can be applied for EASA or FAA license approval.***

## I. INTRODUCTION

The aviation industry is vital, students studying aircraft maintenance technology should be familiar with the tools, equipment, and engine components of an aircraft. According to Xun (2018), students are required to use a variety of laboratory settings, including those for the aircraft's airframe, engine, aircraft sheet metal processing, composite materials processing, electricity and electronics, non-destructive testing, aircraft system, maintenance procedures, and advanced manufacturing (Arias et al., 2014). A laboratory room is a space that offers controlled environments for the conduct of scientific or technological study, experimentation, and measurements that usually a student can practice and enhance their skills to be prepared once they will absorb into a company or in the field.

Facilities, Equipment, and Materials were under the supervision of the Philippine Civil Aviation Regulations (PCAR) Part 3 "Approved Training Organizations". It states all the requirements and standards for facilities and working environment that shall be appropriate for the task to be performed. The Approved Training Organizations must possess or be in possession of the required information, technical data, equipment, training devices, and materials in order to conduct the courses for which it has received approval.

Philippine State College of Aeronautics (PhilSCA) purchased new equipment and materials that can be used for the aircraft systems and powerplant laboratory subjects. They purchased four new Lycoming Engines that are now stored at the newly constructed laboratory facility. Presently, it is now operational, and it is used during the supplemental classes that are conducted by the Aircraft Maintenance Technology Department. The Civil Aviation Authority of the Philippines (CAAP) requires all aviation school to finish the curricular hands-on laboratory for all subjects under the Philippine Civil Aviation Regulation (PCAR). According to Engr. Jeq Zyrius A. Sudweste, Dean of the Institute of Engineering and Technology. He said that this coming November 2022, the new purchased materials will be delivered and can be used for all the laboratory activities and that equipment and materials could help all the students and professors to improve all the qualities and learnings for the benefit of both school and students and the future of the aviation.

The foundation of training for aviation professionals is practice-based learning. Students must utilize their theoretical and conceptual knowledge when performing maintenance operations, maintenance planning, and repairing fixed-wing aircraft and rotary-wing aircraft (Henley, 2017). The subject instructors are the one who will deliver the syllabus of instruction and laboratory plans for laboratories. Laboratories has a long tradition and practice-oriented laboratories are essential in the part of the aviation education curriculum (Ng & Chu, 2021). Additionally, laboratory instruction strives to help students enhance their technical expertise, practical abilities, and field-specific knowledge. In contrast with the laboratory facility and with the quality of education. The Philippine State College of Aeronautics (PhilSCA) aims that all of the students are qualified and able to be part of the big growing companies that they wanted to be part of.

There is no aircraft that is capable of withstanding neglect to the point where it is secure without a reliable inspection and maintenance program. An airplane is affected by aging processes like fatigue, wear, and corrosion as well as random breakdowns (Aubin B R 2004). Aircraft maintenance can be defined in a number of ways and the following may help understand the different aspects: Those actions required for restoring or maintaining an item in a serviceable condition including servicing, repair, modification, overhaul, inspection, and determination of condition (CAA 2017). According to the Maintenance, Repair and Operations Handbook of Hessburg in 2021, maintenance is the action necessary to sustain or restore the integrity and performance of the airplane (Hessburg, 2021). Also, maintenance is the process of ensuring that a system continually performs its intended function at its designed-in level of reliability and safety (Kinnison and Siddiqui, 2013). Philippine State College of Aeronautics has the following AMT laboratories and shops that can accommodate students and it is located at the ground floor near to the hangar. The tool room, skill test, the airframe, composite, powerplant laboratories and the simulation laboratory. This is where our students and

faculty conduct actual airplane mechanical structure workshops and experiments. The only lacking facility for the AMT laboratory is under PCAR subject which is the Helicopter.

The primary focus of the study is to develop a laboratory facility for the subject helicopter maintenance operation based on the standard of Civil Aviation Authority of the Philippines and the standard of the Commission on Higher Education.

## II. PROCEDURE

- Research Design

This study aims to evaluate what are the requirements to develop a laboratory facility for the subject of Helicopter Maintenance Operations in the Aircraft Maintenance Technology Program of the Philippine State College of Aeronautics (PhilSCA).

In this study, a mixed method of research was utilized. Mixed methods research provides a complete picture than a solitary quantitative or qualitative study since it incorporates the benefits of both disciplines. A descriptive research strategy was used to illustrate objective measurements and statistical analysis using survey questionnaires. Quantitative research methods are fundamentally concerned with gathering and evaluating structured data that may be represented quantitatively.

- Population and Sampling

The study used purposive sampling technique, also known as judgmental, selective, or subjective sampling. It is a form of non-probability sampling in which researchers rely on their own judgment when choosing members of the population to participate in their surveys.

The participants of the study were the twenty-five (25) Instructors from the Aircraft Maintenance Technology Department, Institute of Engineering and Technology, Philippine State College of Aeronautics, Villamor Campus and five (5) from the Civil Aviation Authority of the Philippines (CAAP) personnel from Training Organization Certification and Inspection Division (TOCID) Department. Then, three (3) participants of the Key Informant Interview who has the experience from the field of Aircraft Maintenance.

- Data Gathering Procedure

A 4-point Likert survey was used to determine the approved facility for turboshaft rotary wing aircraft for the subject helicopter maintenance operations. In addition, the researcher constructed a questionnaire to gather data, subject to validation.

The variables of the study are the CAAP and CHED approved facilities adapted from the Commission on Higher Education (CHED), Philippine Civil Aviation Regulation (PCAR) Part 3 IS 3.2.7 Approved Training organization and PCAR Part 6 IS: 6.3.1.2, Approved Maintenance Organization.

- Statistical Treatment of Data

The following statistical tools for the interpretation of results according to sub-problems were Percentage and Frequency, Mean, Likert Scale and Mann-Whitney U Test to determine the significant differences between the CHED Standard and CAAP Standard for the approved facility for helicopter maintenance operation laboratory.

## III. RESULTS

Table 1
Frequency and Percentage Distribution of Demographic Profile of the Participants

| Particulars | Category | Frequency f | Percentage % |
|---|---|---|---|
| Employment Status | Contract of Service | 9 | 30.00 |
| | Regular/Permanent | 21 | 70.00 |
| | Total | 30 | 100 |
| Years in Service | Below 3 years | 8 | 26.70 |

| | | | |
|---|---|---|---|
| | 4-8 years | 15 | 50.00 |
| | 9 years and above | 7 | 23.30 |
| | Total | 30 | 100 |
| Company | CAAP | 5 | 16.70 |
| | PhilSCA | 25 | 83.30 |
| | Total | 30 | 100 |

Table 1 presented the demographic profile of the 30 participants who participated in the study. This research study used three demographic data as its variables: employment status, years in service, and company.

This research study used three demographic data as its variables: employment status, years in service, and company. According to the frequency and percentage distribution that is presented in the table, nine of the participants (or thirty percent) had an employment status of a contract of service, whereas 21 of the participants (or seventy percent) had a status as permanent.

The years of service of the participants are displayed in the table, it reveals that 26.70% of the participants, or eight of them, had less than three years of experience. 15 of the participants had been on duty for between 4 and 8 years, making up 50% of the total, while the remaining 23.3% had been in service for 9 years or more. It shows that most of the participants of the study are between 4 to 8 years of experience.

Table 2
Mean Distribution of the Participants on the Requirements of the Approved Facilities for Turboshaft Laboratory in terms of CAAP Standards

| INDICATOR | CAAP | PhilSCA | MEAN | VI | RANK |
|---|---|---|---|---|---|
| *2.1.1. Facilities* | | | | | |
| Housing and facilities must be provided appropriately for all planned work ensuring, in particular, protection from weather. | 4.00 | 3.56 | 3.63 | SA | 2 |
| The facilities and working environment must be appropriate for the task to be performed. | 4.00 | 3.60 | 3.67 | SA | 1 |
| The facilities, equipment, personnel and course content must meet the applicable requirements. | 4.00 | 3.52 | 3.60 | SA | 3 |
| Total Mean | 4.00 | 3.56 | 3.63 | SA | |
| *2.1.2. Aircraft Maintenance Laboratory* | | | | | |
| The laboratory has the equipment and materials that can be used to properly demonstrate the maintenance operation. | 4.00 | 3.40 | 3.50 | SA | 1 |
| Suitable facilities arranged to assure proper separation from the working space, for parts, tools and materials. | 4.00 | 3.28 | 3.40 | SA | 5 |
| Suitable space with the adequate equipment for disassembling, inspecting, assembling, troubleshoo,ting and timing engines. | 4.00 | 3.36 | 3.47 | SA | 2.5 |
| Suitable facilities for running engines. | 4.00 | 3.32 | 3.43 | SA | 4 |
| The staff involved has the proper training to handle maintenance activities. | 4.00 | 3.36 | 3.47 | SA | 2.5 |
| Total Mean | 4.00 | 3.28 | 3.45 | SA | |

| | | | | | |
|---|---|---|---|---|---|
| *2.1.3 Modernization of Equipment* | | | | | |
| All maintenance personnel follow the procedure | 4.00 | 3.28 | 3.40 | SA | 2 |
| Reviewing of already existing organizational, management or regulatory implications for any generated threats to public safety. | 4.00 | 3.32 | 3.43 | SA | 1 |
| The equipment should not be used if it is under assessment. | 3.80 | 3.28 | 3.37 | SA | 3 |
| Total Mean | 3.93 | 3.29 | 3.40 | SA | |
| *2.1.4 Calibration of Equipment* | | | | | |
| Pre-maintenance checks are performed before the hands-on laboratory. | 3.40 | 3.28 | 3.30 | SA | 3 |
| Annual review and calibrations for precisions instruments. | 3.80 | 3.28 | 3.37 | SA | 2 |
| Monitoring and update the logbooks that is used during the laboratory | 3.80 | 3.44 | 3.50 | SA | 1 |
| Total Mean | 3.67 | 3.33 | 3.39 | SA | |
| GENERAL WEIGHTED MEAN | 3.90 | 3.38 | 3.47 | Strongly Agree | |

Table 2 revealed the mean distribution of the participants about the requirement of the approved facilities for laboratory in terms of CAAP Standards. This requirement obtained a general weighted mean of 3.47, which was verbally interpreted as strongly agree.

In terms of facilities under CAAP Standards the statement that "the facilities and working environment must be appropriate for the task to be performed" has the highest mean with 3.67 points, and it can be found under the facilities category. While the statement that "the facilities, equipment, personnel, and course content must meet the applicable requirements" has the lowest mean score of 3.60, which when verbally interpreted means that both parties strongly agree with the statement, it also has the highest percentage of participants who disagree with it. This suggests that the facility, equipment, and improved working area could assist students in practicing their skills and potential in a more effective manner.

The statement that the aircraft maintenance laboratory "the laboratory has the equipment and materials that can be used to properly demonstrate the maintenance operation" had the highest mean score of 3.50 out of all of the statements related to the aircraft maintenance laboratory. In addition, the statement that "suitable facilities arranged to assure proper separation from the working space, for parts, tools and materials" has the lowest mean score of 3.40. Both statements can be read as meaning that they strongly agree with one another. This suggests that the appropriate facilities for the laboratory can be utilized to effectively illustrate the operation of maintenance and the hands-on activity.

The statement concerning the modernization of equipment that reads "monitoring and updating the logbooks that are used during the laboratory" has the highest mean score of 3.43. This is because it refers to the process of assessing whether or not any threats to public safety have been produced. While the statement that "the equipment should not be utilized if it is under assessment" received the lowest score of 3.37, both interpretations of the score indicate that the respondent strongly agrees with the statement. It suggests that the students could benefit from knowing the fundamental safety and regulation procedures for the laboratory in order to reduce the amount of human error that occurs.

Lastly, the statement under the Calibration of Equipment states that "monitoring and updating the logbooks that are utilized during the laboratory" has the highest mean score of 3.50 and can be found under the heading "calibration of equipment." The assertion

that "pre-maintenance checks are performed before the hands-on laboratory" has the lowest mean with 3.30, and both readings can be taken as strongly agreeing with the statements.

Table 3
Mean Distribution of the Participants on the Requirements of the Approved Facilities for Turboshaft Laboratory in terms of CHED Standards

| INDICATOR | CAAP | PhilSCA | MEAN | VI | RANK |
|---|---|---|---|---|---|
| *2.2.1. Classroom Accommodation* | | | | | |
| Safety rules, regulations and evacuation procedures shall be posted in conspicuous places and must be included in the orientation of classes. | 4.00 | 3.56 | 3.63 | SA | 1 |
| Allow students perform all the basic laboratory exercises required in the laboratory subject | 4.00 | 3.40 | 3.50 | SA | 2 |
| Allow students to perform laboratory activities on the same laboratory equipment at the same time | 3.80 | 3.36 | 3.43 | SA | 3 |
| Total Mean | 3.93 | 3.44 | 3.52 | SA | |
| *2.2.2. Demonstration of Equipment* | | | | | |
| There must be sufficient functional equipment, apparatus, supplies, tools and other materials for laboratory. | 3.80 | 3.48 | 3.53 | SA | 2 |
| The program must have a continuing modernization and upgrading instructional laboratories, facilities and equipment. | 3.80 | 3.56 | 3.60 | SA | 1 |
| The equipment must not be used if it is under assessment. | 3.20 | 3.40 | 3.37 | SA | 3 |
| Total Mean | 3.60 | 3.48 | 3.50 | SA | |
| *Suitability Facility* | | | | | |
| All facilities must comply with the National Building Code | 4.00 | 3.52 | 3.60 | SA | 2.5 |
| The school must have a sufficient number visual equipment. | 3.80 | 3.56 | 3.60 | SA | 2.5 |
| Facilities and resources must be available by the school for the use of students and faculty for research work | 3.80 | 3.64 | 3.67 | SA | 1 |
| Total Mean | 3.87 | 3.57 | 3.62 | SA | |
| GENERAL WEIGHTED MEAN | 3.80 | 3.50 | 3.55 | Strongly Agree | |

Table 3 presented the mean distribution of the participants on the requirements of the approved facilities for laboratory in terms of CHED Standards. These requirements obtained a general weighted mean of 3.55, which was verbally interpreted as strongly agreeing with the requirements.

In terms of classroom accommodation, the statement that "safety rules, regulations and evacuation procedures shall be posted in conspicuous places and must be included in the orientation of classes" had the highest mean score of 3.63. While the mean score for "allow students to perform laboratory activities on the

same laboratory equipment at the same time" is 3.43, which is the lowest score, both interpretations of this statement indicate that they strongly agree with the statement. It specifies that teachers are required to brief their classes on the necessary safety precautions, rules and regulations, and evacuation procedures prior to the students' participation in the laboratory activity. Similarly, the statement that "the program must have a continuing modernization and upgrading instructional laboratories, facilities and equipment" has the highest mean score of 3.60, and it can be found under the demonstration and equipment section, and the statement that "the equipment must not be used if it is under assessment" has a mean of 3.37, which can be understood to suggest that both participants strongly agree with this statement. It indicates that the program must continually modernize and upgrade its materials and equipment for all laboratory subjects in order to meet the requirements.

Lastly, the statement that "facilities and resources must be available by the school for the use of students and faculty for research work" has the highest mean with 3.67, which can be verbally interpreted as strongly agreeing with the statement. This statement is located under the suitable facilities and both " “all facilities must comply with the National Building Code” and “The school must have a sufficient number visual equipment” have a mean of 3.60, which indicates that both statements are both strongly agree. This implies that the structure must be in accordance with the national construction code, and that the institution possesses the resources that are available for use by both students and faculty members for the purposes of conducting research.

Table 4
Summary Mean Distributions of the Participants’ Responses on the Requirements of the Approved Facilities for Turboshaft Laboratory

| INDICATOR | MEAN | Verbal Interpretation | RANK |
|---|---|---|---|
| *.1. CAAP Standards* | | | |
| 2.1.1. Facilities | 3.63 | SA | 1 |
| 2.1.2. Aircraft Maintenance Laboratory | 3.45 | SA | 2 |
| 2.1.3. Modernization of Equipment | 3.40 | SA | 3 |
| 2.1.4. Calibration of Equipment | 3.39 | SA | 4 |
| Total Mean | 3.47 | Strongly Agree | |
| *2.2 CHED Standards* | | | |
| 2.2.1. Classroom Accommodation | 3.53 | SA | 2 |
| 2.2.2. Demonstration of Equipment | 3.50 | SA | 3 |
| 2.2.3. Suitable Facility | 3.62 | SA | 1 |
| Total Mean | 3.55 | Strongly Agree | |
| GENERAL WEIGHTED MEAN | 3.51 | Strongly Agree | |

Table 4 presented the summary mean distribution of the participants' responses on the requirements of the approved facilities for laboratory both CAAP Standards and CHED Standards. These requirements received the general weighted mean of 3.51, which was verbally interpreted as strongly agreeing with the requirements.

The CHED Standards ranked first with a total mean of 3.55 and were verbally interpreted as strongly agree, while the CAAP Standards ranked as second with a total mean of 3.47 and were verbally interpreted as strongly agree. Both of these scores indicate that participants strongly agree with the respective standards.

Table 5
Mann-Whitney U Test Result on the Significant Difference in the Assessment Between CAAP and PHILSCA Participants on the Requirements of the Approved Facilities for Turboshaft Laboratory in terms of CAAP Standards

| Indicator | Participant | N | Mean Rank | Mann-Whitney U | Wilcoxon W | Sig. | VI | $H_o$ |
|---|---|---|---|---|---|---|---|---|
| Facilities | CAAP | 5 | 22.50 | 27.5 | 352.5 | 0.049 | Significant | Reject the null hypothesis |
| | PhilSCA | 25 | 14.10 | | | | | |
| Aircraft Maintenance Laboratory | CAAP | 5 | 23.50 | 22.5 | 347.5 | 0.022 | Significant | Reject the null hypothesis |
| | PhilSCA | 25 | 13.90 | | | | | |
| Modernization of Equipment | CAAP | 5 | 24.80 | 16.0 | 341.0 | 0.007 | Significant | Reject the null hypothesis |
| | PhilSCA | 25 | 13.64 | | | | | |
| Calibration of Equipment | CAAP | 5 | 20.00 | 40.0 | 365.0 | 0.229 | Not Significant | Accept the null hypothesis |
| | PhilSCA | 25 | 14.60 | | | | | |

Table 5 presents the results of an analysis done to determine whether or not there is a statistically significant difference in the evaluations carried out by CAAP and PHILSCA participants with regard to the prerequisites for an approved laboratory facility in terms of CAAP Standards. It is lesser than 0.05 for the facilities (U = 27.5, W = 352.5, Sig. = 0.049), aircraft maintenance laboratory (U = 22.5, W = 347.5, Sig. = 0.022), and modernization of equipment (U = 16.0, W= 341.0, Sig. = 0.007). Both of them rejected the null hypothesis.

As a result, the CAAP and the PHILSCA are quite different from one another. The null hypothesis is supported because the calibration of the equipment (U = 40.0, W = 365.0, Sig. = 0.229) is greater than 0.05, and there is not a significant difference between the CAAP and the PHILSCA.

Table 6
Mann-Whitney U Test Result on the Significant Difference in the Assessment Between CAAP and PHILSCA Participants on the Requirements of the Approved Facilities for Turboshaft Laboratory in terms of CHED Standards

| Indicator | Participant | N | Mean Rank | Mann-Whitney U | Wilcoxon W | Sig. | VI | $H_o$ |
|---|---|---|---|---|---|---|---|---|
| Classroom Accommodation | CAAP | 5 | 22.90 | 25.50 | 350.5 | 0.037 | Significant | Reject the null hypothesis |
| | PhilSCA | 25 | 14.02 | | | | | |
| Demonstration of Equipment | CAAP | 5 | 16.80 | 56.00 | 381.0 | 0.746 | Not Significant | Accept the null hypothesis |
| | PhilSCA | 25 | 15.24 | | | | | |
| Suitable Facility | CAAP | 5 | 20.40 | 38.00 | 363.0 | 0.188 | Not Significant | Accept the null hypothesis |
| | PhilSCA | 25 | 14.52 | | | | | |

Table 6 shows the computed significant difference in the assessments carried out by participants of CAAP and PHILSCA with regard to classroom accommodation (U = 25.50, W = 350.5, Sig. = 0.037) in terms of CHED Standards. The null hypothesis cannot be accepted. Therefore, there is a considerable disparity between the CAAP and the PHILSCA. While the demonstration of equipment (U = 56.00, W = 381.0, Sig. = 0.746) and suitable facility (U = 38.00, W = 363.0, Sig. = 0.188) is greater than 0.05. Both systems are consistent with the null hypothesis, and there is no significant difference between the CAAP and the PHILSCA.

Table 7
Mann-Whitney U Test Result on the Significant Difference in the Assessment Between CAAP and PHILSCA Participants on the Requirements of the Approved Facilities for Turboshaft Laboratory

| Indicator | Participant | N | Mean Rank | Mann-Whitney U | Wilcoxon W | Sig. | VI | $H_o$ |
|---|---|---|---|---|---|---|---|---|
| CAAP Standards | CAAP | 5 | 24.80 | 16.00 | 341.0 | 0.007 | Significant | Reject the null hypothesis |
| | PhilSCA | 25 | 13.64 | | | | | |
| CHED Standards | CAAP | 5 | 20.70 | 36.50 | 361.5 | 0.152 | Not Significant | Accept the null hypothesis |
| | PhilSCA | 25 | 14.46 | | | | | |

Table 7 presents the computed significance difference between CAAP participants and PHILSCA participants who evaluated the requirements for approved laboratory facilities. If the value of CAAP Standards (U = 16.00, W = 341.0, Sig. = 0.007) which is lower than 0.05, then we can conclude that the null hypothesis cannot be true. Therefore, the CAAP and the PHILSCA are very different from one another in fundamental ways. As to CHED Standards (U = 36.50, W = 361.50 Sig. = 0.152) which is greater than 0.05, we will assume that the null hypothesis is correct. As a result of this, there is no significant difference between the CAAP and the PHILSCA.

## CONCLUSION

1. The majority of the participants came from the Aircraft Maintenance Technology Department of the Philippine State College of Aeronautics, and the majority of them were permanent employees with between four and eight years of experience.
2. The participants' evaluations of the requirements of the approved facilities for the laboratory showed strongly agree with the CAAP and CHED Standards.
3. There is no significant difference in the assessment of the participants with regard to the requirements in the development of the laboratory facility for the turboshaft rotary wing aircraft.
4. The benefit exceeds the cost incurred; the investment for the acquisition of new materials facility will help in the long term and is cost-effective.
5. The development of the turboshaft laboratory facility will benefit both students and faculty of the institutions. It is economical and will help PhilSCA to achieve the vision and mission to produce world-class Aeronautics professionals.

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REFERENCES

[1] Ackert S P (2010), Basics of Aircraft Maintenance Programs for Financiers (external link).

[2] Aerodynamics lab. (2022, February 26). KIIT School of Mechanical Engineering. https://mechanical.kiit.ac.in/lab/aerodynamics-lab/

[3] Aircraft hangar facilities. (2016, July 27). Alaska Structures.https://alaskastructures.com/products/aircraft-hangar-facilities/

[4] ALIAC - Air Link International Aviation College (October 7, 2021) – Laboratories and Facilities

[5] Ann, S., Pagsuyoin, T., Marie, D., & Delias, B. (n.d.). Session O4-002. Utm.My. Retrieved December 7, 2022, from http://eprints.utm.my/id/eprint/905/1/Session_O4-002.pdf

[6] Aravind, A. D. (2017). A Study on Understanding the Creation of Component Maintenance Manual Using Model-Based Definition (Doctoral dissertation, Purdue University).

[7] Arias et. al. (2014). Experimental activities in the laboratory of analytical chemistry under an inquiry approach. Journal of the Chilean Chemical Society. 59. 2747-2752. 10.4067/S0717-97072014000400023. escc.edu (n.d.) AMT – Powerplant Technology. ESCC. Retrieved from https://www.escc.edu/programs/powerplant-technology/

[8] Atılgan, R., Turan, Ö., Altuntaş, Ö., Aydın, H., & Synylo, K. (2013). Environmental impact assessment of a turboprop engine with the aid of exergy. Energy, 58, 664-671.

[9] Aubin B R (2004), Aircraft Maintenance - The Art and Science of Keeping Aircraft Safe, SAE International.

[10] Aviation hangar. (n.d.). Wbdg.org. Retrieved December 7, 2022, from https://www.wbdg.org/buildingtypes/aviation/aviation-hangar

[11] Aydin, E., Isilak, C., Suzer, A. E., & AtasoyMellema, G. M. (2018). Application of dupont's dirty dozen framework to commercial aviation maintenance incidents. Embry-Riddle Aeronautical University.

[12] Babiera (March 2018). Proposed Development Program for the Technical Instructors in PhilSCA: Inputs for quality Instructions. Master's thesis, Philippine State College of Aeronautics-Pasay.

[13] Bassett, W. E. (2020). The Relationship of the Dirty Dozen Precursors to Human Factor Error Found in Civilian Aircraft Maintenance to the Negative Trending of the EWIS System on Military Aircraft (Doctoral dissertation, Northcentral University).

[14] Bueno (September 2022). An Evaluation on Norms of Aircraft Mechanics in Selected Maintenance Repair Overhaul (MRO) Company. Master's thesis, Philippine State College of Aeronautics-Pasay.

[15] Boyd, D., & Hinkelbein, J. (2017). A Comparison of Malfunction-Related Accidents for General Aviation Aircraft Manufactured in 1970–1984 and 2000–2014. Journal of Aviation Technology and Engineering, 2(1), 26.

[16] Boyd, D., & Stolzer, A. (2015). Causes and trends in maintenance-related accidents in FAA-certified single engine piston aircraft. Journal of Aviation Technology and Engineering, 5(1), 17.

[17] Buyers T (2010), Optimizing airplane maintenance economics (external link), in Aero Q01_2010, Boeing

[18] CAA (2017), Leaflet 5-60 Condition Monitored Maintenance, in CAP 562 Civil Aircraft Airworthiness Information and Procedures (CAAIP) (external link), Issue 4, Amendment 3

[19] Causaren (September 2022). Safety Risk Management System on Maintenance Operation of Aviation Partnership Philippines (A+). Master's thesis, Philippine State College of Aeronautics-Pasay.

[20] Civil Aviation Regulation of the Philippines (2011). PCAR Part 5 IS 5.1 Airworthiness

[21] Civil Aviation Regulation of the Philippines (2011). PCAR Part 6-6.3 to IS to 6.5.1.8. Approved Training Organizations.

[22] Critique & evaluation. (n.d.). CFI Notebook. Retrieved December 7, 2022, from https://www.cfinotebook.net/lesson-plans/fundamentals-of-instructing/critique-and-evaluation

[23] College of Aviation Labs and facilities. (n.d.). Erau.edu. Retrieved December 7, 2022, from https://daytonabeach.erau.edu/college-aviation/labs-facilities

[24] Cordovilla (September 2022). Aircraft Powerplant maintenance inspection and servicing hands-on activities: Basis for quality laboratory outputs. Master's thesis, Philippine State College of Aeronautics-Pasay.

[25] Dawson, S. (2021). SDG 4: Quality Education. https://doi.org/10.14293/s2199-1006.1.sor-socsci.cl6f5fl.v1

[26] Das, M. (2020, February 28). Development and control of laboratory helicopter. Amrita Vishwa Vidyapeetham. https://www.amrita.edu/publication/development-and-control-of-laboratory- helicopter/

[27] Federal Aviation Administration. (2000). Advisory Circular: Maintenance Resource Management Training.

[28] Federal Aviation Administration. (2018). Aviation Maintenance Technician Handbook-General Chapter 14: Human Factors, (p. 14-28).

[29] Flight Study. (2021, June 17). The learning process - aviation instructor. Blogger. https://www.flight-study.com/2021/06/introduction-to-learning-process.html

[30] Fotopoulos, V., Fanariotis, A., Orphanoudakis, T., & Skodras, A. N. (2015). Remote FPGA laboratory course development based on an open multimodal laboratory facility. Proceedings of the 19th Panhellenic Conference on Informatics.

[31] Hessburg J (2010), Air Carrier MRO Handbook McGraw-Hill helicopter. (n.d.). In Encyclopedia Britannica.

[32] Ilejay (September 2022). Correlation Study on the performance of aircraft mechanics and flight instructors in Plaridel Airport. Master's thesis, Philippine State College of Aeronautics-Pasay.

[33] International Air Transport Association (2021). Competence Based Training and Assessment (CBTA) Expansion with the Aviation Industry. Page 8&9.

[34] International Civil Aviation organization (2021) Airworthiness consideration Reference Doc 9760: Critical Elements 5 Technical Guidance, tools, And provision of safety critical information: Airworthiness Manual

[35] International Civil Aviation organization (2017). Competency Based Training and Assessment: Appendix 2 chapter 2. Doc. 10056.

[36] International Civil Aviation organization (2020). Cabin Safety Programme for 2020-2022.

[37] J. Ygbuhay (July 2021). Development of Specialized skills training program for aircraft maintenance technology instructors. Master's thesis, Philippine State College of Aeronautics-Pasay.

[38] Lam M (2002), An Introduction to Aircraft Maintenance, in Jacobs D, The handbook of Airline Economics, 2nd edition.

[39] Kinnison H A and Siddiqui T (2013), Aviation Maintenance Management, 2nd edition, McGraw-Hill

[40] Koopmans, C., & Mouter, N. (2020). Cost-benefit analysis. In N. Mouter (Ed.), Standard Transport Appraisal Methods (Vol. 6, pp. 1–42). Elsevier.

[41] Martin (March 2009). Level of Competency of Aircraft Maintenance Technology Ground Instructors of Philippine State College of Aeronautics. Master's thesis, Philippine State College of Aeronautics-Pasay.

[42] N. Jaime (May 2022). Utilization of Graduate and Industry Feedback of Cabin Maintenance Training Program for Curriculum Enhancement. Master's thesis, Philippine State College of Aeronautics-Pasay.

[43] United States Government Aviation Office (Gao). (2018). Aircraft maintenance: Additional FAA oversight needed of aging aircraft repairs (vol. II). Createspace Independent Publishing Platform.

[44] Ward, S., Beard, C., Retzlaff, S., Muia, M., Snyder, P., Martin, L., Kenville, K., Gordon, D., Airport Cooperative Research Program, Transportation Research Board, & National Academies of Sciences, Engineering, and Medicine. (2019). Developing innovative strategies for aviation education and participation. Transportation Research Board.

[45] Xun, Z. (2018). Laboratory Safety Training Design and Evaluation for Aeronautical Engineering Technology Students in Part 147 Program. NASA/ADS. https://ui.adsabs.harvard.edu/abs/2018PhDT.24Z/abstract