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A comparative quantitative research on Brazilian and American Examiners' and Inspectors' disapproval rates of pilot flight proficiency checks for Personnel Licensing

Luiz Rafael Andrade da Silva

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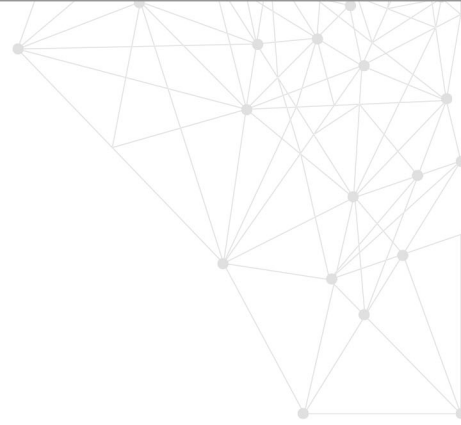
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End of Studies Project Memoir



ABSTRACT

The contracting States of the Convention on International Civil Aviation (1944) shall ensure the validity of issued licences; therefore, flight proficiency check is used to grant its privileges, maintain holder's competency, and shall be conducted by personnel authorized by the Licensing Authority: Examiners (outsourced) or Inspectors (employees).

This study compared the disapproval rates of pilots in flight proficiency checks among Examiners and Inspectors from Brazil and The United States of America from 2014 to 2019, focusing on initial exams for license issuance of private pilot, commercial pilot, air transport pilot, as well as instrument and flight instructor ratings.

The need for this comparison arose from the inspectorate's anecdotal perception of Authority's lack in safety culture, standardization, oversight, and Inspectors' pilot training, associated to low disapproval rates on checks. To investigate this assumption, data were collected, classified, and analyzed using the Two Proportions Z-test.

The Brazilian rates were 0.53% vs. 1.94%; $p < 0.01$ (General) and 0.75% vs. 2.77%; $p < 0.01$ (Personnel Licensing), while the American rates were 23.10% vs. 24.37%; $p < 0.022$ (Personnel Licensing); consequently, the comparison between countries resulted in $p < 0.001$.

This study revealed regulatory noncompliance; thus, proposed corrections, regulations revision, Inspectors' pilot training, and standardization, as defences or enhancements opportunities towards Safety and Standards implementation to respond to the practical drift and prevent accidents. Ultimately, the Proficiency Check Dashboard was developed and proposed as a data-driven tool for oversight prioritization and intensification on Examiners, as a practical result of this study.

Keywords: Flight proficiency check, Standards, Disapproval rates, Examiner, Inspector, Qualification, Oversight

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I wish to thank the Operations Standards Superintendent, MSc. João Garcia, for allowing the use of the pilot flight proficiency check's dataset during this research.

I want to pay my special regards to the ANAC's Flight Inspectors, in particular to Mr. Adriano Baumgartner and Mr. Adriano Sousa, and many other ANAC's colleagues such as Mr. Luiz Beltrão and Mr. Raphael Santos, as well as managers, especially Mr. João Hirae, superintendents and directors directly involved in the creation of the PCIV – ANAC's Flight Inspectors Training Programme, for the motivation of its accomplishment and the possibilities of its implementation toward aviation safety.

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THE INTERSHIP'S SUBJECT

Problematics

There is an anecdotal perception among the Civil Aviation Inspectors that the Brazilian Civil Aviation Authority – ANAC lacks safety culture, standardization, oversight, and Inspectors' pilot training that could be associated to low flight proficiency check's disapproval rates among pilots.

To investigate that premise, this study focused on answering the following research questions:

1. What is the status of the Brazilian pilot flight proficiency check's rates?
2. Is there a statistical difference between Examiners' rates and Inspectors' rates?
3. How different are the Brazilian pilot flight proficiency check's rates compared to the American rates?

In order to answer the research questions, this study compared the disapproval rates of pilots in flight proficiency checks applied by Examiners and Inspectors from the ANAC (Brazil) from 2014 to 2019, and compared them to the FAA's rates (United States of America) from the same period, focusing on initial checks for the issuance of the following: PPL – private pilot license, CPL – commercial pilot license, ATPL – air transport pilot license, Instrument and Flight Instructor ratings.

I declare that this thesis was written solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except otherwise stated by reference or acknowledgment, the work presented is entirely my own. It reflects my voluntary personal opinion on aviation safety data and safety information derived from, both protected in accordance with Section 5.3 of Annex 19 to the Convention on International Civil Aviation, not associated to ANAC's official opinion.

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Chapter 1 – INTRODUCTION

1.1 – The context description of pilot licensing

Since the Convention on International Civil Aviation, the contracting States agreed on certain international civil aviation principles at Chicago in 1944. The provision of international standards and procedures was present in Article 37, and the provision of certificates of competency and licenses for pilots was present in Article 32 (Convention on International Civil Aviation, 1944).

The provision of certificates of competency and licenses for pilots were present in Article 32 of the Convention (Convention on International Civil Aviation, 1944), and the SARPs – Standards and Recommended Practices for Personnel Licensing were first adopted as minimum standards in 1948 and designated as Annex 1 to the Convention on International Civil Aviation (ICAO, 2018).

The Annex 1 to the Convention on International Civil Aviation, on its Chapter 2, subsection A, section 1.2 General rules concerning licences, paragraph (a), has divided, among others, the flight crew into the following licences:

- private pilot;
- commercial pilot;
- multi-crew pilot;
- Airline transport pilot;
- remote pilot; to be included as of 3 November 2022 (ICAO, 2018)

The Annex 1 to the Convention on International Civil Aviation, on its Chapter 2, subsection A., paragraph 2.1.1 General rules concerning pilot licences and ratings (ICAO, 2018), has divided, among others, the aircraft — category ¹ into:

- Aeroplane;
- Helicopter;

¹ *Aircraft — category*. Classification of aircraft according to specified basic characteristics, e.g. aeroplane, helicopter, glider, free balloon. (ICAO, 2018)

Among the SARPs, the contracting States shall ensure the validity of issued licences. Therefore, flight proficiency checks are used to grant its privileges, to maintain the holder's competency² , and shall be conducted by personnel authorized by the Licensing Authority³. (ICAO, 2018)

The issuance of licences and certificates, the permanent character of licences, and the validity of certificates are provisioned by the Brazilian Federal Law 7.565/1986 – Brazilian Aeronautics Code Article 160 (The Federative Republic of Brazil, 1986).

The administrative sanctions referred to the licences and certificates are provisioned by the Brazilian Federal Law 7.565/1986 – Brazilian Aeronautics Code Article 289, II and III (The Federative Republic of Brazil, 1986) are divided into fine, suspension, and revocation.

1.2 – The context description of pilot flight proficiency checks

The SARPs – Standards and Recommended Practices for Personnel Licensing were first adopted as minimum standards in 1948 and designated as Annex 1 to the Convention. Among these standards, the contracting States shall ensure the validity of issued licences. Therefore, a flight proficiency check is used to grant its privileges, to maintain the holder's competency, and shall be conducted by personnel authorized by the Licensing Authority. (ICAO, 2018) The authorized personnel to conduct flight proficiency checks are Examiners (Designated) or Inspectors (Authority).

In order to license civil aviation personnel, ANAC follows the Standards and Recommended Practices provided by Annex 1 to the Convention on International Civil Aviation, ensuring confidence in safe air navigation.

The flight proficiency checks are provisioned by the Brazilian Federal Law 7.565/1986 – Brazilian Aeronautics Code Article 197 (The Federative Republic of Brazil, 1986) and the RBAC 61, RBAC 90, RBAC 91, RBAC 121, RBAC 135, RBAC 137, RBAC 141, and RBAC 142, according to the specific purpose or operation.

² *Competency*. A combination of skills, knowledge and attitudes required to perform a task to the prescribed standard. (ICAO, 2018)

³ *Licensing Authority*. The Authority designated by a Contracting State as responsible for the licensing of personnel. (ICAO, 2018)

To conduct flight proficiency checks, one shall be authorized by the Licensing Authority or designated by the training organization following criteria approved by Authority (ICAO, 2018).

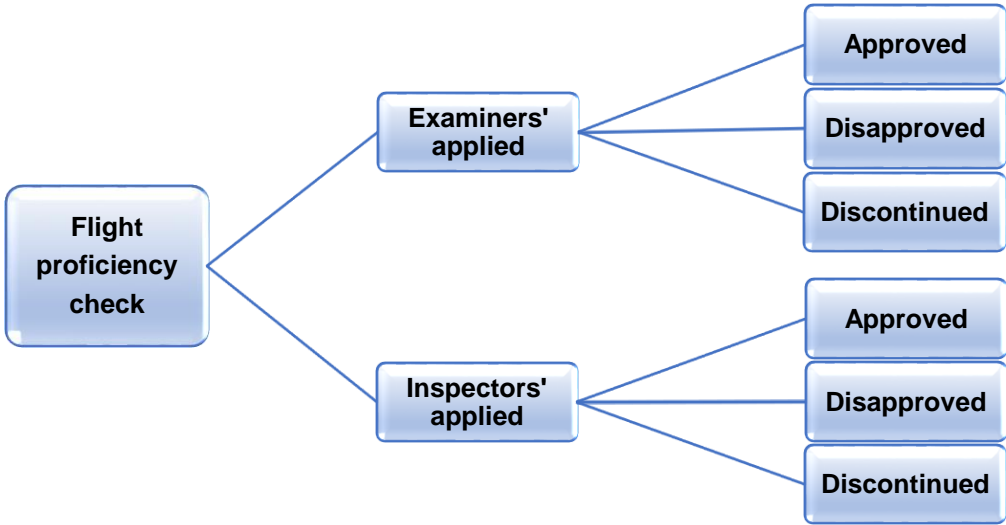
In other words, these professionals are also known as:

- Civil Aviation Inspector (ANAC's employee);
- Accredited Examiner (ANAC's outsourced);
- ASI – Aviation Safety Inspector (FAA's employee);
- DPE – Designated Pilot Examiner (FAA's outsourced);
- Flight Operations CASI – Civil Aviation Safety Inspector (ICAO's nomenclature) (ICAO, 2016);

Hereinafter, they will be classified as Inspectors or Examiners. The main difference between them lies in that Inspectors are part of the CAA – Civil Aviation Authority staff, supporting an Effective Inspectorate while performing their safety inspection, certification, and on-going surveillance duties, authorized by the State. In contrast, Examiners are outsourced within the industry to perform very specific duties on behalf of the CAA, e.g., pilot flight proficiency checks.

The tree diagram of pilot flight proficiency check is represented by the following diagram:

Diagram 1.1 – Tree diagram of pilot flight proficiency checks



Source: own elaboration.

The checks for license and ratings can be applied by Examiners outsourced from the industry such as: Approved Training Organisations (RBAC 141 and RBAC 142) and Air Operators (RBAC 90, RBAC 91, RBAC 121, RBAC 135 and RBAC 137), or by Inspectors, restricted by their experience level according to internal procedures, contained in MPR/SPO-002-R02 (ANAC, 2018). The exams result could be Approved, Disapproved or Discontinued, according to Items 6.3 and 11.4 of IS 00-002F (ANAC, 2020, pp. 4, 11).

In order to be designated by the ANAC as an Accredited Examiner, the candidate must fulfill the requirements presented in RBAC 183 – Brazilian Civil Aviation Regulation 183 – Personnel Accreditation (ANAC, 2018), being a qualified professional, or being as part of an organization's group. The Accredited Examiners are not paid by ANAC and are subjected to the Brazilian Federal Law 8.429/1992 (The Federative Republic of Brazil, 1992), by its Article 2, as public agents while temporarily performing ANAC's tasks.

Similarly, to be designated by the FAA as a Designated Pilot Examiner, the candidate must fulfill the requirements presented in 14 CFR PART 183 – REPRESENTATIVES OF THE ADMINISTRATOR (FAA, 1966), as a private person, or as an individual within an ODA – Organization Designation Authorization holder's group, though with additional requirements not covered by the ANAC.

According to Riley's future study's recommendations (Riley, 2004), a comparison could be made to determine similarities and differences among the failure rates of DPEs as compared to OI – Operations Inspectors. Riley's research found that 34% of initial applicants fail the CFI Certified Flight Instructor practical exam.

This recommendation was exactly the objective of the current study, by comparing the disapproval rates of pilots in flight proficiency checks among Examiners and Inspectors from ANAC (Brazil) and FAA (United States of America) from 2014 to 2019, focusing on initial exams for the issuance of the following pilot licenses: PPL, CPL, ATPL, Instrument and Flight Instructor ratings.

Unlike Riley's motivation based on a high percentage of failure, i.e., 65% (Riley, 2004, p. 1 apud Shain 1998), this research was based on the inspectorate anecdotal perception that the lack of some Authority's aspects such as safety culture, standardization, oversight, and Inspectors' pilot training could be associated to low disapproval rates in the flight proficiency checks.

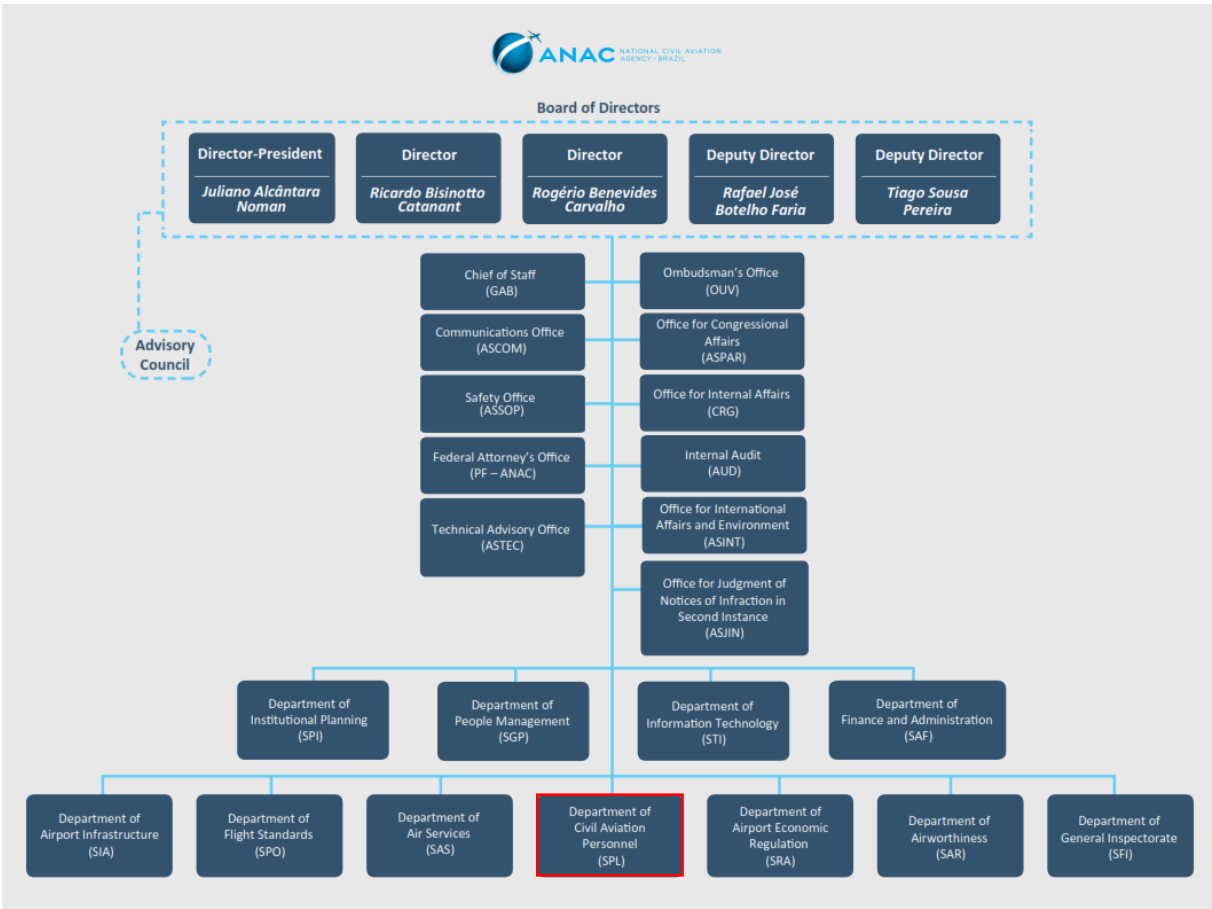
Chapter 2 – Work Environment and Student introduction

2.1 – Presentation of the ANAC – National Civil Aviation Agency

The ANAC is the Brazilian Civil Aviation Authority responsible for regulating, inspecting, licensing the civil aviation personnel and certifying aircraft, training organizations, air transport operators, manufacturers, maintenance organizations, and aerodromes in Brazil.

This project's work environment was limited to the SPL – Department of Civil Aviation Personnel, particularly working with the proficiency checks data of the following pilot licences: PPL, CPL, ATPL, as well as instrument and flight instructor ratings. The ANAC's Organizational Chart is presented below:

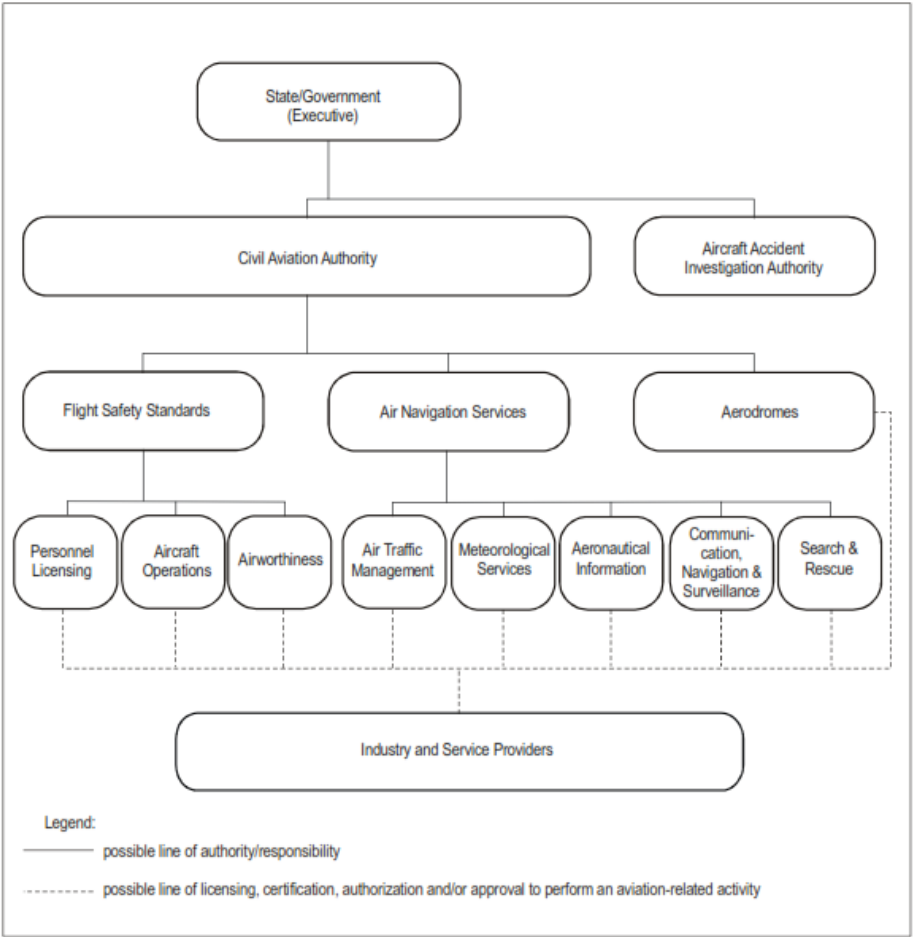
Diagram 2.1 – ANAC's Organizational Chart



Source: (ANAC, 2020) [our emphasis]

The ICAO has provided an example of the organizational structure of a State in Doc 9734 – Safety Oversight Manual – Part A – Second Edition (ICAO, 2006, pp. 3-9), as described in the following organizational structure:

Diagram 2.2 – Example of the organizational structure of a State civil aviation system



Source: (Figure 3-1, ICAO, 2006, p. 3-9)

The ANAC followed the above-mentioned structure with slight differences, considering that its Personnel Licensing and Airworthiness Departments were directly linked to the Board of Directors, and the Department of Flight Safety Standards is responsible for Aircraft Operations.

It is worth mentioning that the Brazilian airspace control is DECEA's – Department of responsibility, while regulating, inspecting, and managing the airspace, overseeing technical and operational organizations, licencing air navigation personnel, and providing Aeronautical Information Service, Air Traffic Management, Search and Rescue, Aeronautical Cartography, Aeronautical Meteorology, Air Navigations Aids, Aeronautical Telecommunication and its Flight Inspections (DECEA, 2020).

2.2 – The student’s position during the internship

The student put in practice the knowledge of the Advanced Master’s academic phase acting in the management of aviation safety data regarding the pilot flight proficiency check’s activities through knowledge and skills on project management, data analyses, and risk assessment.

2.3 – The student’s career experience

During the last twelve years, the student has been working full-time at the Brazilian National Civil Aviation Agency – ANAC as an Aviation Regulations Specialist, as well as an Inspector in the following areas: personnel licensing and training (PEL), including flight proficiency checks, flight crew licensing, ICAO English level assessment, and aircraft operations (OPS), including air transport operator and training organization certification.

Through specialized training in ANAC’s aviation regulations, familiarity with FAA and EASA, and the implementation to respond to USOAP – Universal Safety Oversight Audit Programme, especially the CE – critical elements CE-6, CE-7, and CE-8, the student have been able to manage and oversee the safety of a significant amount of air transport operators and training organization by the usage of SMS – Safety Management System, CCs – compliance checklists, technical audits, findings, and CAPs – corrective action plans.

This technical training, his graduation in Civil Aviation (Aeronautics), his prior experience as an ATCo – Air Traffic Controller and as Commercial Pilot of airplane (with ATP and helicopter Commercial Pilot theoretical knowledge) led him up to the accomplishment of the assigned tasks. As a subject matter expert, team leader, and Inspector-Instructor, the student has been adopting and implementing ICAO – International Civil Aviation Organization’s provisions and SARPs nationwide, particularly those from Annexes 1, 6, 10, 18, and 19 to the Convention on International Civil Aviation.

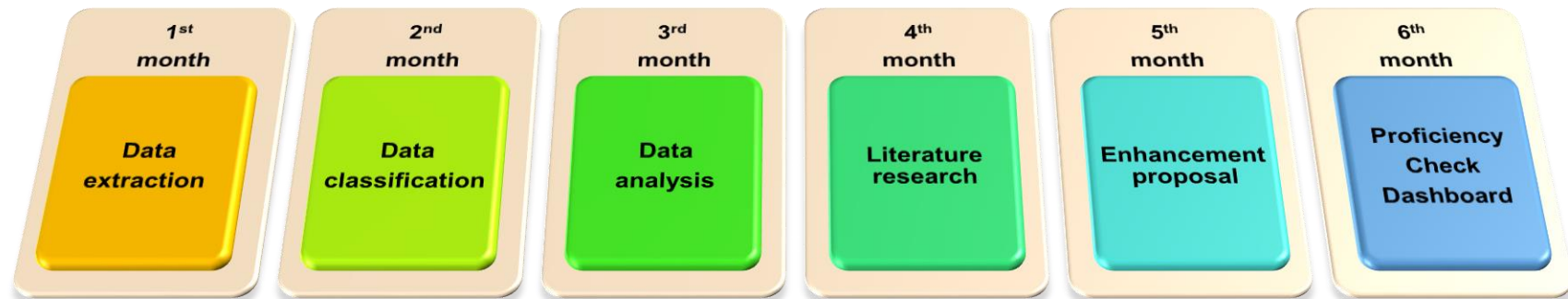
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Chapter 3 – The Project Plan’s timeline and the Work Plan

3.1 – The initial scheduled Project Plan

The study was structured in order to follow 6 monthly steps, which initial project plan’s timeline was according to the following diagram:

Diagram 3.1 – Project Plan’s timeline



Source: own elaboration.

Each step was detailed in Section 3.2 – .

3.2 – The Work Plan

3.2.1 – Data extraction

For the purpose of this scientific research, data privacy has been guaranteed by Article 31, § 3º, II of the Brazilian Federal Law 12.527/2011 (The Federative Republic of Brazil, 2011).

Since 2012, the ANAC's data about flight proficiency checks come from SACI – Civil Aviation Information Integrated System available for the Civil Aviation Inspectors. The Examiners and Inspectors constantly feed this database after every flight proficiency check or up to 5 days later as provisioned by the IS 00-002F (ANAC, 2020). Due to the large size of the data (130.243 flight proficiency checks), the extraction had to be done by semesters and then combined. Otherwise, the data would get corrupted. The FAA publishes a comprehensive annual study on the U.S. Civil Airmen Statistics to meet its demands and the demands of other government agencies and the industry. The data range is from 2005 to 2019, and it became more detailed since 2014.

In order to properly compare the ANAC's data with the FAA's detailed data, and to better define the research scope, both data would range from 2014 to 2019.

3.2.2 – Data classification

The data mentioned above contained: Examinee's CANAC – ANAC's Code; Examiner's CANAC; Rating; Flight date; IFR rating; Result; Input date; and Licence.

For this research's scope, it was vital to use the fields Examiner's CANAC; Flight Instructor rating; Flight date; IFR rating; Result; and Licence.

First, the data classification aimed to present a general rate, including initial and recurrent flight checks. Then, to separate it into two sample groups: Examiners and Inspectors. Finally, to focus on the flight proficiency checks required for Personnel License issuance of PPL – private pilot licence, CPL – commercial pilot licence, ATPL – air transport pilot licence, instrument rating, and flight instructor rating.

The fields Examinee's CANAC, Rating (except for the instrument rating and flight instructor rating), and Input date were not intended to be used in this study, although these fields could be used for other purposes or during the oversight.

The FAA's data contained in Table 19 – ORIGINAL AIRMEN CERTIFICATES APPROVED/DISAPPROVED BY CATEGORY AND CONDUCTOR of the U.S. Civil Airmen Statistics (FAA, 2014 to 2019) were presented with many fields other than the ones used in this comparison: Pilot – Total; Private; Commercial; Airline Transport; Rotorcraft (only); Flight

Instructor Certificates; Examiner and Inspector (both with Approved; Disapproved; Total and Percent Approved).

For proper comparison with the FAA's data, the ANAC's data were classified, whenever possible, using the template of the published U.S. Civil Airmen Statistics, without the prejudice of the in-depth analyses of the comprehensive ANAC's data.

3.2.3 – Data analysis

At first, the ANAC's classified data allowed us to analyze the general flight proficiency check status compared to the FAA's.

Then, ANAC's data, which were split into two sample groups (Examiners and Inspectors), allowed us to analyze the difference of disapproval rates and shares.

Finally, the subdivision into licences allowed us to analyze the Inspectors' direct participation in the personal licensing for pilots and further risk assessments.

3.2.4 – Literature research

The literature research was based on the Convention on International Civil Aviation and its Annex 1, Annex 6, Annex 19, ICAO's Doc Series such as Doc 7300, Doc 8335, Doc 9374, Doc 9379, Doc 9859, Doc 9941 and Doc 10070, national and foreign regulations, RBAC 01, RBAC 61, RBAC 141, RBAC 183, IN 137, IS 183-001D, IS 00-002 (A to F), 14 CFR PART 61, 14 CFR PART 183, ORDER 8000.95, ORDER 8900.1, ORDER 8900.2B, ORDER 8900.2C, Notice 8900.442, and Notice 8900.485.

3.2.5 – Enhancements proposals

The enhancements proposals aimed to allow ANAC to strengthen the defences, present in the James Reason's Model, with technology, training, and regulations, present in Snook's Theory, to avoid accidents related to the practical drift of pilot flight proficiency checks' oversight.

3.2.6 – Proficiency Check Dashboard

The creation of the Proficiency Check Dashboard was proposed by the student, using the dataset from the SACI – Civil Aviation Information Integrated System, as an outcome of

this project, in order to better present the results, providing a widened view on the subject, and to make viable future oversights.

Chapter 4 – In-depth analysis of the pilot flight proficiency check’s disapproval rates

4.1 – The pilot flight proficiency check’s rates analysis

This study used quantitative analysis for data collection of ANAC’s pilot flight proficiency check from 2014 to 2019. The data were collected from the SACI – Civil Aviation Information Integrated System and represents a total of 130.243 pilot flight proficiency checks, most of them from the general aviation (RBAC 91) and for licensing or rating purposes, both initial or recurrent (RBAC 141 and RBAC 142), hereinafter called as general.

The purpose of this collection was to determine the general flight proficiency check’s disapproval rate of the Brazilian applicants, to provide situational awareness of this critical task, to build a foundation in order to assist the Managers in their decision-making processes as well as allowing subsequent analysis to identify possible safety threats or possible enhancements by the technical personnel.

The pilot flight proficiency check’s general database had no distinction between Accredited Examiners and Civil Aviation Inspectors; thus, in order to divide into these two groups, it was necessary to individually link the Inspectors’ names contained in a few different civil servant training lists from the Operations Focal Point of HR – Human Resources to their respective ANAC’s code. This process made it possible to merge lists containing only names into a list of the Civil Aviation Inspectors’ operations information, useful for the data extraction and division into two groups.

Therefore, the two groups were populated by 698 Examiners and 51 Inspectors. Due to a system error, there is another category (Others) included in the Examiners’ group as 1 Examiner (with a total of 1.986 checks).

It is worth mentioning that the classification into Civil Aviation Inspectors or Accredited Examiners might not be exhaustive due to the criteria established by the Operations Focal Point of HR and due to the error in the SACI, identified by the student. The system did not register their ANAC’s code (7 Inspectors were found and there are many other unknown Examiners), so their data were grouped into the Others category.

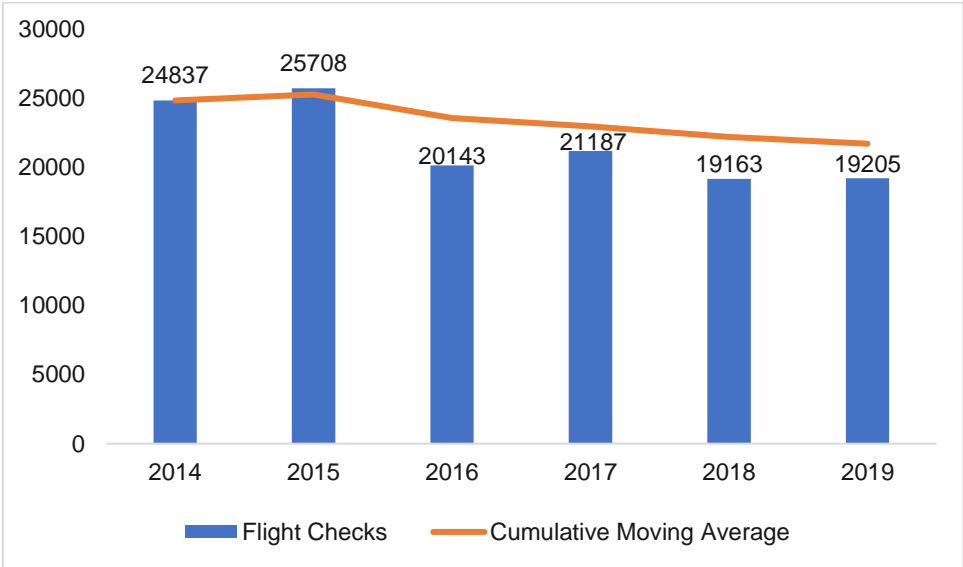
Among the total of 130.243 pilot flight proficiency checks, the database permitted to classify those required for initial personnel licensing purposes, which represents the population

N= 24.307, including PPL – private pilot licence, CPL – commercial pilot licence, ATPL – air transport pilot licence, Instrument and Flight Instructor ratings.

4.1.1 – General rates

The following Figure represents ANAC’s general pilot flight proficiency checks’ histogram from 2014 to 2019:

Figure 4.1 – ANAC’s general pilot flight proficiency checks’s histogram (2014 – 2019)



Source: own elaboration.

The ANAC’s general pilot flight proficiency checks approval and disapproval rates from 2014 to 2019 are expressed by the following table:

Table 4.1 – Results of ANAC’s general pilot flight proficiency checks (2014 – 2019)

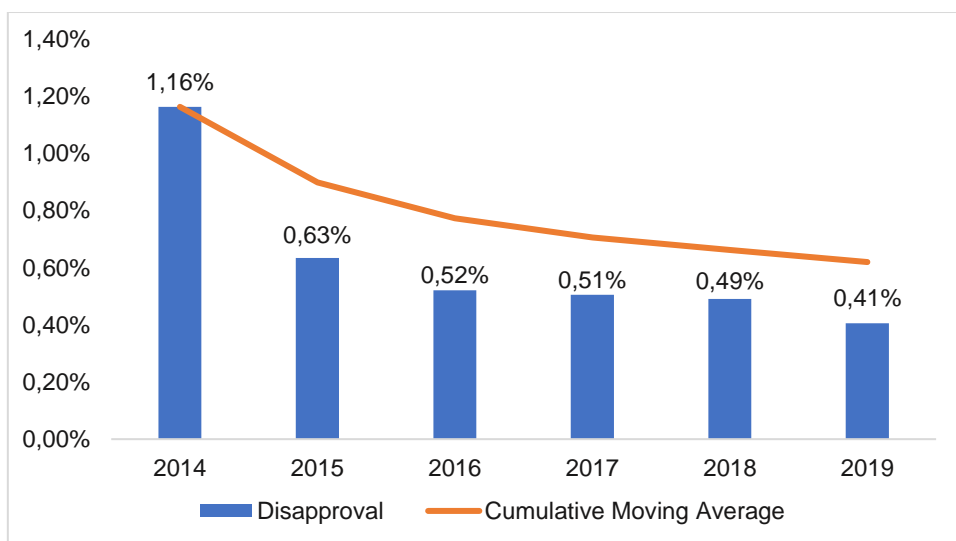
Approved	Percent	Disapproved	Percent	Total
129407	99,36%	836	0,64%	130243

Source: own elaboration.

The disapproval rate of 0.64% confirmed the Inspectorate's sense of presumed low disapproval rate that motivated this study, among other issues.

The ANAC’s general pilot flight proficiency checks’ disapproval rate from 2014 to 2019 is expressed according to the following table, and its disapproval mean dropped year after year, until it reached 0.41% in 2019, as follows:

Figure 4.2 – ANAC’s general pilot flight proficiency checks’ disapproval histogram (2014 – 2019)



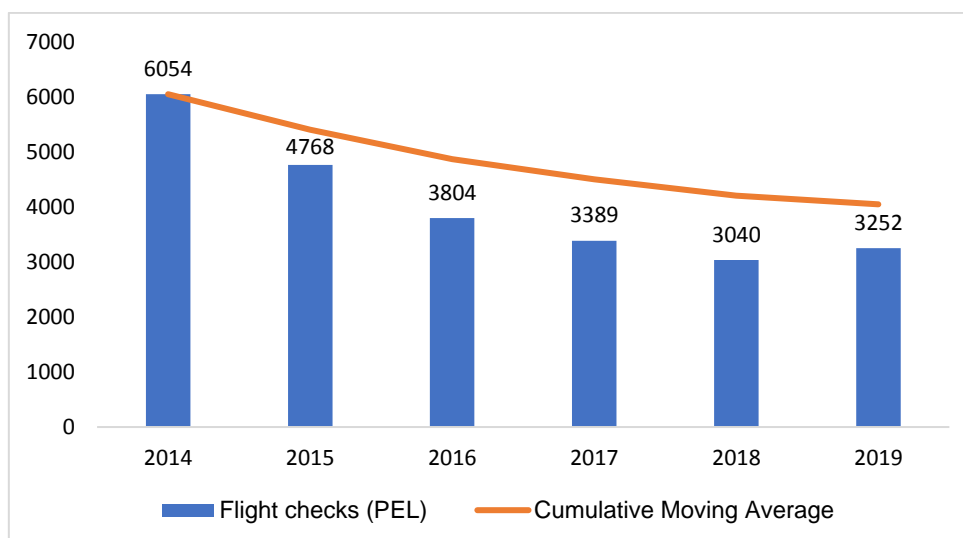
Source: own elaboration.

4.2 – Personnel Licensing rates

The pilot flight proficiency checks for personnel licensing purposes considered herein were only those required for the initial licensing or rating and do not include the recurrent flight checks considered in the previous section General rates.

Therefore, the pilot flight proficiency check’s histogram for licensing was represented by the following figure:

Figure 4.3 – ANAC’s pilot flight proficiency checks’s histogram for licensing (2014 – 2019)



Source: own elaboration.

The following table represented the results of pilot flight proficiency check for licensing:

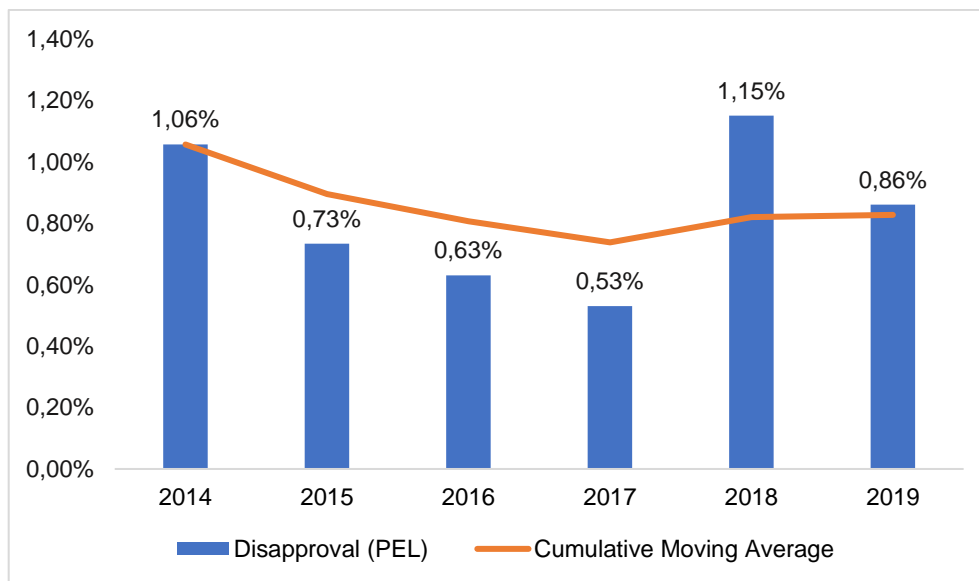
Table 4.2 – Results of ANAC’s pilot flight proficiency checks for licensing (2014 – 2019)

Approved	Percent	Disapproved	Percent	Total
24103	99,16%	204	0,84%	24307

Source: own elaboration.

The following figure represents the pilot flight proficiency check’s disapproval histogram for licensing:

Figure 4.4 – ANAC’s pilot flight proficiency checks’ disapproval histogram for licensing (2014 – 2019)



Source: own elaboration.

Every disapproval rate shown in the figure above is higher than the general disapproval rate, which includes several thousand recurrent checks, as expected for being an initial check.

4.2.1 – The ANAC’s Airplane PPL – private pilot licence

The ANAC’s Airplane PPL – private pilot licence rates are demonstrated, as follows:

Table 4.3 – Results of ANAC’s PPL – private pilot licence approval by Examiners (2014-2019)

Examiner Approved	Examiner Disapproved	Examiner Total
11594	87	11681
99.26%	0.74%	

Source: own elaboration.

Table 4.4 – Results of ANAC’s PPL – private pilot licence approval by Inspectors (2014-2019)

Inspectors Approved	Inspectors Disapproved	Inspectors Total
33	1	34
97.06%	2.94%	

Source: own elaboration.

4.2.2 – The ANAC’s Airplane CPL – commercial pilot licence

The ANAC’s Airplane CPL – commercial pilot licence rates are as follows:

Table 4.5 – Results of ANAC’s CPL – commercial pilot licence approval by Examiners (2014-2019)

Examiner Approved	Examiner Disapproved	Examiner Total
6779	44	6823
99.36%	0.64%	

Source: own elaboration.

Table 4.6 – Results of ANAC’s CPL – commercial pilot licence approval by Inspectors (2014-2019)

Inspectors Approved	Inspectors Disapproved	Inspectors Total
150	5	155
96.77%	3.23%	

Source: own elaboration.

4.2.3 – The ANAC’s Airplane ATPL – Airline transport pilot licence

The ANAC’s Airplane ATPL – Airline transport pilot licence rates are demonstrated, as follows:

Table 4.7 – Results of ANAC’s ATPL – airline transport pilot licence by Examiners (2014-2019)

Examiner Approved	Examiner Disapproved	Examiner Total
552	14	566
97.53%	2.47%	

Source: own elaboration.

Table 4.8 – Results of ANAC’s ATPL – airline transport pilot licence by Inspectors (2014-2019)

Inspectors Approved	Inspectors Disapproved	Inspectors Total
810	22	832
97.36%	2.64%	

Source: own elaboration.

4.2.4 – The ANAC’s Rotorcraft rates (PPL – private pilot licence , CPL – commercial pilot licence, ATPL – air transport pilot licence)

The ANAC's Rotorcraft – PPL – private pilot licence, CPL – commercial pilot licence, ATPL – air transport pilot licence rates are demonstrated, as follows:

Table 4.9 – Results of ANAC's Rotorcraft – PPL – private pilot licence, CPL – commercial pilot licence, ATPL – air transport pilot licence rates by Examiners (2014-2019)

Examiner Approved	Examiner Disapproved	Examiner Total
4160	30	4190
99.28%	0.72%	

Source: own elaboration.

Table 4.10 – Results of ANAC's Rotorcraft – PPL – private pilot licence, CPL – commercial pilot licence, ATPL – air transport pilot licence rates by Inspectors (2014-2019)

Inspectors Approved	Inspectors Disapproved	Inspectors Total
25	1	26
96.15%	3.85%	

Source: own elaboration.

4.2.5 – The rates of ANAC's Instrument rating

The rates of ANAC's Instrument Rating are demonstrated, as follows:

Table 4.11 – Results of ANAC's Instrument rating by Examiners (2014-2019)

Examiner Approved	Examiner Disapproved	Examiner Total
9103	36	9139
99.61%	0.39%	

Source: own elaboration.

Table 4.12 – Results of ANAC's Instrument rating by Inspectors (2014-2019)

Inspectors Approved	Inspectors Disapproved	Inspectors Total
425	8	433
98.15%	1.85%	

Source: own elaboration.

4.2.6 – The rates of ANAC's Flight Instructor rating

The rates of ANAC's Flight Instructor rating are demonstrated, as follows:

Table 4.13 – Results of ANAC's Flight Instructor rating by Examiners (2014-2019)

Examiner Approved	Examiner Disapproved	Examiner Total
18228	59	18287
99.68%	0.32%	

Source: own elaboration.

Table 4.14 – Results of ANAC’s Flight Instructor rating by Inspectors (2014-2019)

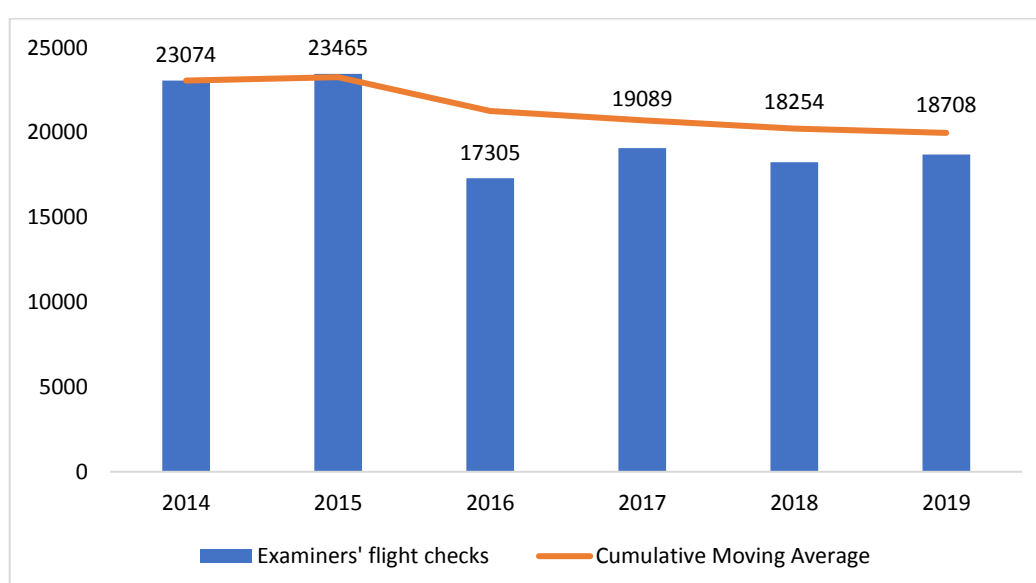
Inspectors Approved	Inspectors Disapproved	Inspectors Total
534	4	538
99.13%	0.87%	

Source: own elaboration.

4.3 – The ANAC’s Accredited Examiners’ rate

The Accredited Examiners (sample n_1), outsourced by ANAC as explained in Chapter 1 –, performed the pilot flight proficiency checks, from 2014 to 2019, as the following:

Figure 4.5 – ANAC’s general pilot flight proficiency checks performed by Accredited Examiners (2014 – 2019)



Source: own elaboration.

Analyzing Figure 4.5, there was a decrease in the Examiners’ flight check in 2016, larger than the expected decrease of all flight checks for that year, as shown in the table below:

Table 4.15 – ANAC’s PPL – private pilot licence check by Examiners – 2016’s decrease

	2015	2016
Checked by Examiners	23465	17305
Percent	91%	86%

Source: own elaboration.

In 2015, the Examiners were responsible for 91% of the flight checks, while in 2016, they were responsible for 86%. The reason for the above-mentioned decrease is due to an increase in the Inspectors' flight checks performed in 2016, represented in the Table 4.18 of Section 4.4 – later on.

The ANAC's general pilot flight proficiency checks performed by Examiners were represented as follows:

Table 4.16 – Results of ANAC's general pilot flight proficiency checks performed by Accredited Examiners (2014-2019)

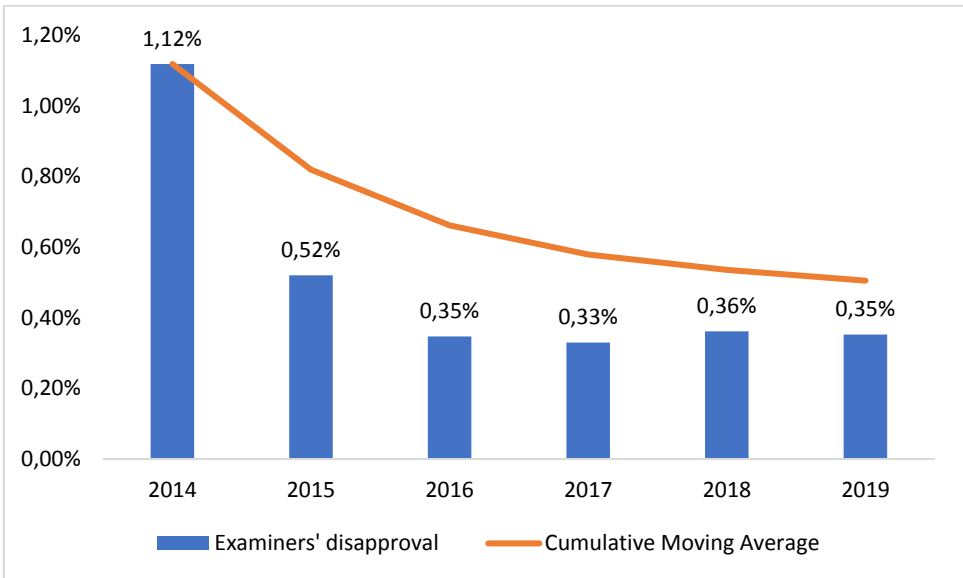
Examiner Approved (Percent)	Examiner Disapproved (Percent)	Examiner Total
119260	635	119895
99.33%	0.67%	

Source: own elaboration.

The table above shown that Examiners approved 119.260 candidates (99.33%), while disapproved 635 (0.67%).

The ANAC's general pilot flight proficiency checks disapproved by Examiners were represented, as follows:

Figure 4.6 – ANAC's general pilot flight proficiency checks Accredited Examiners' disapproval (2014 – 2019)



Source: own elaboration.

The table above clearly shown a decreasing tendency in the Examiners' disapproval rate since 2014, which approximately kept stable at 0,35%.

4.4 – The ANAC's Civil Aviation Inspectors' rate

The Brazilian Civil Aviation Inspector is a professional, usually a civil servant, accredited by the CAA – Civil Aviation Authority as provisioned by the Article 197 of the Brazilian Federal Law 7.565/1986 – Brazilian Aeronautics Code (The Federative Republic of Brazil, 1986) and by the Article 1, Sections XIX and XX of the Brazilian Federal Law 10.871/2004 (The Federative Republic of Brazil, 2004), which performs safety oversight duties provisioned by the Article 66 of the Brazilian Federal Law 7.565/1986 – Brazilian Aeronautics Code (The Federative Republic of Brazil, 1986), including the pilot flight proficiency checks, and defined as aircraft crew by the Article 156 of the Brazilian Federal Law 7.565/1986 – Brazilian Aeronautics Code (The Federative Republic of Brazil, 1986) while providing the specialized air services provision by Section VIII of the Article 201 of the Brazilian Federal Law 7.565/1986 – Brazilian Aeronautics Code (The Federative Republic of Brazil, 1986) and as provisioned by the Article 5, Section IV of the Brazilian Federal Law 13.475/2017 – Aircrew (The Federative Republic of Brazil, 2017), requiring licence, rating and medical certificate to be accredited to their duties as provisioned by the Article 159 of the Brazilian Federal Law 7.565/1986 – Brazilian Aeronautics Code (The Federative Republic of Brazil, 1986), in order to abide to International Treaties, Conventions and Acts as provisioned by the Article 1 of the Brazilian Federal Law 7.565/1986 – Brazilian Aeronautics Code (The Federative Republic of Brazil, 1986).

From 2014 to 2019, the general pilot flight proficiency checks performed by ANAC's Civil Aviation Inspectors were according to the following figure:

Table 4.17 – ANAC's general pilot flight proficiency checks performed by Civil Aviation Inspectors (2014 – 2019)

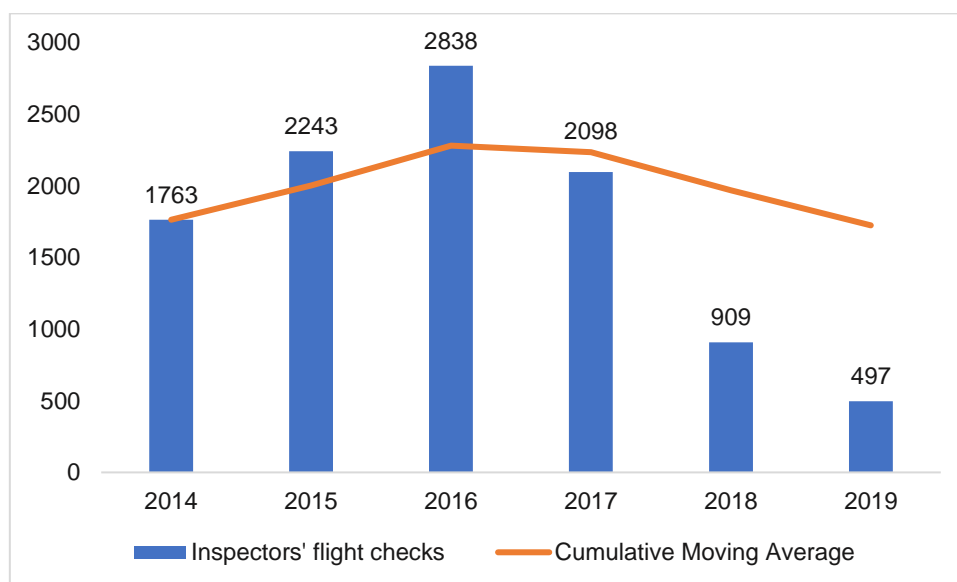
Inspector Approved (Percent)	Inspector Disapproved (Percent)	Inspector Total
10147	201	10348
(98.1%)	(1.9%)	

Source: own elaboration.

The table above showed that Inspectors approved 10.147 candidates (98.1%), while disapproved 201 (1.9%).

The ANAC's general pilot flight proficiency checks performed by ANAC's Civil Aviation Inspectors (2014 – 2019) were as follows:

Figure 4.7 – ANAC's general pilot flight proficiency checks performed by Civil Aviation Inspectors (2014 – 2019)



Source: own elaboration.

Table 4.18 – ANAC's PPL – private pilot licence check by Inspectors – 2016's increase and 2019's decrease

	2015	2016	2019
Checked by Inspectors	2243	2838	497
Percent	8.7%	14.1%	2.6%

Source: own elaboration.

The Figure and Table above showed the peak of the pilot flight proficiency check performed by the Inspectors in 2016, reaching the largest percentage of 14.1% and the lowest point in 2019, reaching the smallest percentage of 2.6%, which only represents 17.5% of the 2016's number of checks.

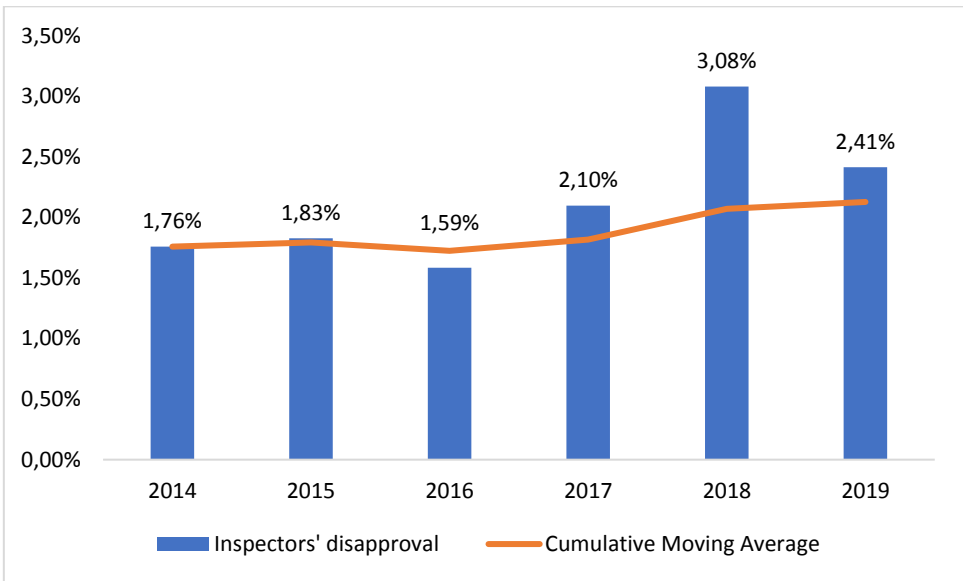
This drastic decrease is due to ANAC's efforts to outsource the pilot flight proficiency checks. Many Inspectors also avoided performing pilot flight proficiency checks due to the Safety Recommendations A - 134/CENIPA/2014 - 05 and A - 134/CENIPA/2014 - 06 proposed by CENIPA – Accident Investigation Authority (CENIPA, 2014) who pointed out the Inspectorate's lack of training for conducting pilot flight proficiency check, even being

provisioned by Section 17.13 of the RBHA – Brazilian Requirements for Aeronautical Certification 17, revoked by the Resolution 472 of 6th June 2018.

Additionally to lack of Inspectorate’s technical training, there is lack of rating, medical certificate, and safe work environment, which represents that ANAC’s safety culture might be hazardous to aviation and might threaten its safety.

The ANAC’s general pilot flight proficiency checks disapproved by Inspectors were represented, as follows:

Figure 4.8 – ANAC’s general pilot flight proficiency checks Inspectors’ disapproval (2014 – 2019)



Source: own elaboration.

The figure above showed a large increase of disapprovals by Inspectors in 2018 and a slight increase tendency since 2014, contrasting to the opposite large decrease of Examiners’ rates.

4.5 – The Null Hypotheses

4.5.1 – ANAC’s Null Hypothesis of the general pilot flight proficiency check

Considering the ANAC’s Null Hypothesis H_0 , i.e., no differences between the ANAC’s samples n_1 – Accredited Examiners and n_2 – Civil Aviation Inspectors ($H_0: \mu_1 - \mu_2 = 0$), it was necessary to analyze the data using quantitative descriptive analyses and the statistical Two Proportions z -Test.

The ANAC's descriptive statistics on the disapproval rate of general pilot flight proficiency check from 2014 to 2019 are demonstrated, as follows:

Table 4.19 – ANAC's descriptive statistics – general pilot flight proficiency checks (2014 – 2019)

Mean	0,006419
Standard Error	0,000221
Median	0
Mode	0
Standard Deviation	0,07986
Population Variance	0,006378
Kurtosis	150,8054
Skewness	12,36135
Range	1
Minimum	0
Maximum	1
Sum	836
Count	130243
Confidence Level (95,0%)	0,000434

Source: own elaboration.

Analyzing the descriptive statistics of ANAC's general pilot flight proficiency checks, the Count is the number of checks (population size) $N= 130243$; the Sum is the number of Disapproved checks (statistical success events) $\sum x_i= 836$; the mean is $\mu= 0.006419$; the Standard Deviation is $\sigma= 0,07986$, and the Population Variance is $\sigma^2= 0,006378$, and the Confidence Level for mean is 95%.

The ANAC's Accredited Examiners' descriptive statistics on the disapproval rate of general pilot flight proficiency check from 2014 to 2019 are as follows:

Table 4.20 – ANAC's Accredited Examiners' descriptive statistics of general pilot flight proficiency checks (2014 – 2019)

Mean	0,005296
Standard Error	0,00021
Median	0
Mode	0
Standard Deviation	0,072583
Sample Variance	0,005268
Kurtosis	183,8241
Skewness	13,63162
Range	1
Minimum	0
Maximum	1
Sum	635
Count	119895
Confidence Level (95,0%)	0,000411

Source: own elaboration.

Analyzing the descriptive statistics of ANAC's Accredited Examiners' general pilot flight proficiency checks, the Count is the number of checks (sample size) $n_1 = 119895$; the Sum is the number of Disapproved checks (statistical success events) $\sum X_1 = 635$; the mean is $\bar{x}_1 = 0.006419$; the Standard Deviation is $s_1 = 0,072583$; and the Sample Variance is $s_1^2 = 0,005268$; and the Confidence Level for mean is 95%.

The ANAC's Civil Aviation Inspectors' descriptive statistics on the disapproval rate of general pilot flight proficiency check from 2014 to 2019 are demonstrated, as follows:

Table 4.21 – ANAC's Civil Aviation Inspectors' descriptive statistics of general pilot flight proficiency checks (2014 – 2019)

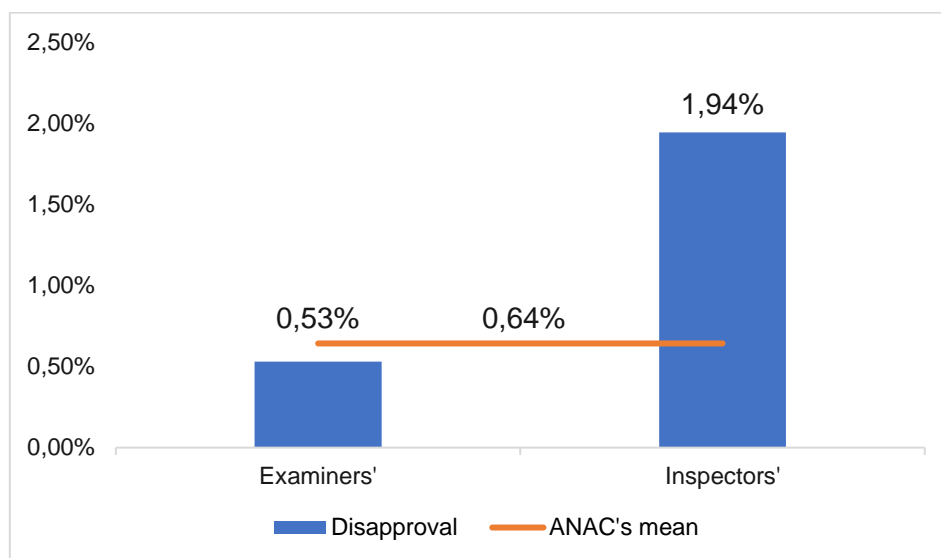
Mean	0,019424
Standard Error	0,001357
Median	0
Mode	0
Standard Deviation	0,138017
Sample Variance	0,019049
Kurtosis	46,52545
Skewness	6,965376
Range	1
Minimum	0
Maximum	1
Sum	201
Count	10348
Confidence Level (95,0%)	0,00266

Source: own elaboration.

Analyzing the descriptive statistics of ANAC's Civil Aviation Inspectors' general pilot flight proficiency checks, the Count is the number of checks (sample size) $n_2= 10348$; the Sum is the number of Disapproved checks (statistical success events) $\sum X_2= 201$; the mean is $\bar{x}_2= 0.019424$; the Standard Deviation is $s_2= 0.138017$; the Sample Variance is $s_2^2= 0.019049$; and the Confidence Level for the mean is 95%.

Highlighting both ANAC's samples $n_1=$ Examiners and $n_2=$ Inspectors disapproval means, there is the following graph:

Figure 4.9 – Comparison of ANAC's Examiners' and Inspectors' disapproval means for general pilot flight proficiency checks (2014 – 2019)



Source: own elaboration.

Analyzing the ANAC's tables and figure above, from 2014 to 2019, the Examiners' general disapproval mean \bar{x}_1 was 0.53%, while the Inspectors' \bar{x}_2 was 1.94%, the equivalent to 366% of the Examiners' mean.

Analyzing the dataset of both ANAC's samples $n_1 =$ Examiners and $n_2=$ Inspectors using the Two Proportions z -Test with a significance level α of 5%, and considering that the dataset of approval or disapproval results as a binomial distribution, the assumption of normality was assessed using the CLT – Central Limit Theorem, which the mean of any random variable will be approximately normally distributed as sample size increases according to the CLT. Therefore, with a sufficiently large sample size ($n > 50$), deviations from normality will have little effect on the results (Pituch & Stevens, 2015). Therefore, it was possible to calculate, with the formula below, the following values:

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

Table 4.22 – ANAC’s Two Proportions z -Test n_1 – Accredited Examiners and n_2 – Civil Aviation Inspectors general pilot flight proficiency checks (2014 – 2019)

	ANAC’s Examiners	ANAC’s Inspectors
Mean	0,005296301	0,019424043
Known Variance	0,005268	0,019049
Observations	119895	10348
Hypothesized Mean Difference	0	
z	-10,29064864	
P(Z<=z) one-tail	0,0000000000	
z Critical one-tail	1,644853627	
P(Z<=z) two-tail	0,0000000000	
z Critical two-tail	1,959963985	

Source: own elaboration.

Considering that the calculated z value is -10.29064864 and the z Critical two-tail value is 1,959964, i.e., $|z| > |z_{\text{Crit}}|$ and the p-value less than 0,001, then the Null hypothesis (H_0) for general pilot flight proficiency check could be rejected, and there is a statistically highly significant difference between the ANAC’s Accredited Examiners and Civil Aviation Inspectors proportions for general pilot flight proficiency check.

4.5.2 – ANAC’s Null Hypothesis of pilot flight proficiency check for licensing

Considering the ANAC’s Null Hypothesis of pilot flight proficiency check for licensing H_0 , i.e., no differences between the ANAC’s samples n_3 – Accredited Examiners and n_4 – Civil Aviation Inspectors ($H_0: \mu_3 - \mu_4 = 0$), it was necessary to analyze the data using quantitative descriptive analyses and the statistical Two Proportions z -Test.

The ANAC’s descriptive statistics on the disapproval rate of pilot flight proficiency check for licensing from 2014 to 2019 are demonstrated, as follows:

Table 4.23 – ANAC's descriptive statistics of pilot flight proficiency checks for licensing (2014 – 2019)

Mean	0,008392644
Standard Error	0,000585144
Median	0
Mode	0
Standard Deviation	0,091228011
Population Variance	0,00832255
Kurtosis	114,1841579
Skewness	10,77843972
Range	1
Minimum	0
Maximum	1
Sum	204
Count	24307
Confidence Level (95,0%)	0,001146918

Source: own elaboration.

Analyzing the descriptive statistics of ANAC's pilot flight proficiency checks for licensing, the Count is the number of checks (population size) $N= 24307$; the Sum is the number of Disapproved checks (statistical success events) $\sum x_i= 204$; the mean is $\mu= 0.008392644$; the Standard Deviation is $\sigma= 0,091228011$, and the Population Variance is $\sigma^2= 0,00832255$, and the Confidence Level for mean is 95%.

The ANAC's Accredited Examiners' descriptive statistics on the disapproval rate of pilot flight proficiency check for licensing from 2014 to 2019 are as follows:

Table 4.24 – ANAC's Examiners' descriptive statistics of pilot flight proficiency checks for licensing (2014 – 2019)

Mean	0,007523646
Standard Error	0,000566603
Median	0
Mode	0
Standard Deviation	0,086413897
Sample Variance	0,007467362
Kurtosis	127,9496269
Skewness	11,39906247
Range	1
Minimum	0
Maximum	1
Sum	175
Count	23260
Confidence Level (95,0%)	0,001110579

Source: own elaboration.

The ANAC's Civil Aviation Inspectors' descriptive statistics on the disapproval rate of pilot flight proficiency check for licensing from 2014 to 2019 are as follows:

Table 4.25 – ANAC's Inspectors' descriptive statistics of pilot flight proficiency checks for licensing (2014 – 2019)

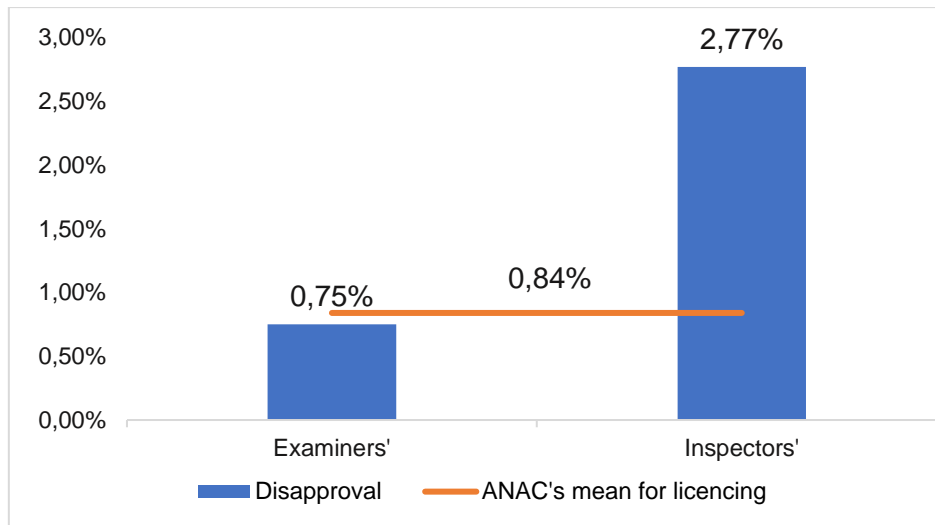
Mean	0,02769819
Standard Error	0,00507412
Median	0
Mode	0
Standard Deviation	0,16418509
Sample Variance	0,02695674
Kurtosis	31,286873
Skewness	5,7642963
Range	1
Minimum	0
Maximum	1
Sum	29
Count	1047
Confidence Level (95,0%)	0,0099566

Source: own elaboration.

Analyzing the descriptive statistics of ANAC's Civil Aviation Inspectors' pilot flight proficiency checks for licensing, the Count is the number of checks (sample size) $n_4 = 1047$; the Sum is the number of Disapproved checks (statistical success events) $\sum X_4 = 29$; the mean is $\bar{x}_4 = 0.02769819$; the Standard Deviation is $s_4 = 0.16418509$; the Sample Variance is $s_4^2 = 0.02695674$; and the Confidence Level for the mean is 95%.

Highlighting both ANAC's samples $n_3 =$ Examiners and $n_4 =$ Inspectors disapproval means for licensing, there is the following graph:

Figure 4.10 – Comparison of ANAC’s Examiners’ and Inspectors’ disapproval means for pilot flight proficiency checks for licensing (2014 – 2019)



Source: own elaboration.

Analyzing the figure above, from 2014 to 2019, the Examiners’ disapproval mean for licensing was 0.75%, while the Inspectors’ was 2.77%, the equivalent to 369% of the Examiners’ mean.

Analyzing the dataset of both ANAC’s samples $n_3 =$ Examiners and $n_4 =$ Inspectors using the Two Proportions z -Test with a significance level α of 5%, and considering that the dataset of approval or disapproval results as a binomial distribution, the assumption of normality was assessed using the CLT – Central Limit Theorem, which the mean of any random variable will be approximately normally distributed as sample size increases according to the CLT. Therefore, with a sufficiently large sample size ($n > 50$), deviations from normality will have little effect on the results (Pituch & Stevens, 2015). Therefore, it was possible to calculate, with the formula below, the following values:

$$z = \frac{(\bar{x}_3 - \bar{x}_4) - (\mu_3 - \mu_4)}{\sqrt{\frac{\sigma_3^2}{n_3} + \frac{\sigma_4^2}{n_4}}}$$

Table 4.26 – ANAC’s Two Proportions z -Test n_3 – Accredited Examiners and n_4 – Civil Aviation Inspectors pilot flight proficiency checks for licensing (2014 – 2019)

	ANAC’s Examiners	ANAC’s Inspectors
Mean	0,007523646	0,02769819
Known Variance	0,007467	0,026957
Observations	23260	1047
Hypothesized Mean Difference	0	
z	-3,951395028	
P(Z<=z) one-tail	3,88485E-05	
z Critical one-tail	1,644853627	
P(Z<=z) two-tail	7,7697E-05	
z Critical two-tail	1,959963985	

Source: own elaboration.

Considering that the calculated z value is -3,951395028 and the z Critical two-tail value is 1,959964, i.e., $|z| > |z_{\text{Crit}}|$ and the p-value less than 0,001, then the Null hypothesis for licensing (H_0) could be rejected, and there is a statistically significant difference between the ANAC’s Accredited Examiners and Civil Aviation Inspectors proportions of pilot flight proficiency check for licensing.

4.6 – ANAC’s Accredited Examiners’ and Civil Aviation Inspectors’ Licensing rates comparison

In order to test the Null Hypothesis, this study used the Two Proportions z-Test to examine whether there was a significant difference between the Examiners’ and Inspectors’ disapproval proportions of ANAC’s pilot flight proficiency checks for licensing – PPL, CPL, and ATPL (2014 – 2019).

Considering the dataset of approval or disapproval results as a binomial distribution, and that the assumption of normality was assessed using the CLT – Central Limit Theorem, in which the mean of any random variable will be approximately normally distributed as sample size increases according to the CLT. Therefore, with a sufficiently large sample size ($n > 50$), deviations from normality will have little effect on the results (Pituch & Stevens, 2015).

In order to compare the pilot flight proficiency checks for licensing applied by Accredited Examiners with those applied by Civil Aviation Inspectors from 2014 to 2019, this study identified among the population $N = 24.307$ the frequency of events classified into Examiners or Inspectors and Approved or Disapproved, and applied the Bayes Theorem as the following tables:

Table 4.27 – ANAC’s frequency of pilot flight proficiency checks for licensing – PPL, CPL, and ATPL (2014 – 2019)

Event	Approved	Disapproved	Row Total
Examiners' check	23085	175	23260
Inspectors' check	1018	29	1047
Column Total	24103	204	24307

Source: own elaboration.

The total Disapproval events were considered the statistical success (k) and resulted in 204 flight checks for licensing.

The Examiners’ sample size (n_3) was 23.260 flight checks for licensing, while the Disapproval events were considered the statistical success (k_1) and resulted in 175 flight checks for licensing.

The Inspectors’ sample size (n_4) was 1047 flight checks for licensing, while the Disapproval events were considered the statistical success (k_2) and resulted in 29 flight checks for licensing.

The probabilities of being checked by Examiners or Inspectors were demonstrated as follows:

Table 4.28– ANAC’s prior probabilities of being checked by Examiners or Inspectors for licensing – PPL, CPL, and ATPL (2014 – 2019)

Event	Approved	Disapproved	Row Total
Examiners' check	94,97%	0,72%	95,69%
Inspectors' check	4,19%	0,12%	4,31%
Column Total	99,16%	0,84%	100,00%

Source: own elaboration.

The prior probability of the pilot flight proficiency checks for licensing being assigned to Examiners was 95.69%, while the prior probability to Inspectors was only 4.31%.

The ANAC’s disapproval rate of pilot flight proficiency check for licensing regardless of the division between Examiners or Inspectors was expressed at 0.84%.

The conditional probabilities of Approval or Disapproval divided by Examiners or Inspectors are as follows:

Table 4.29 – ANAC’s conditional probabilities of being checked by Examiners or Inspectors for licensing – PPL, CPL, and ATPL (2014 – 2019)

P[I E]	P[I E] = p[E,I] / P [E]		Row Total
	Approved	Disapproved	
Examiners' check	99,25%	0,75%	100,00%
Inspectors' check	97,23%	2,77%	100,00%

Source: own elaboration.

The Examiners’ disapproval probability was 0.75%, while the Inspectors’ was 2.77%

The probabilities of Approval or Disapproval based on the entire population N of the ANAC’s pilot flight proficiency checks for licensing – PPL, CPL, and ATPL (2014 – 2019) were demonstrated as follows:

Table 4.30 – ANAC’s posterior probabilities of being checked by Examiners or Inspectors for licensing – PPL, CPL, and ATPL (2014 – 2019)

P[E I]	Approved/Total	Disapproved/Total
	Approved	Disapproved
Examiners' check	95,78%	85,78%
Inspectors' check	4,22%	14,22%
Column Total	100,00%	100,00%

Source: own elaboration.

From the above tables, it was possible to conclude the following:

- the ANAC has outsourced 95,69% and insourced 4,31% of the pilot flight proficiency checks for licensing – PPL, CPL, and ATPL (2014 – 2019);
- the differences between the Examiners’ and Inspectors’ disapproval rates (0,75%, 2,77%) which represents a difference of 369%;
- From the 95,69% of the checks, the Examiners approved 95,78%;
- From the 4,31% of the checks, the Inspectors approved 4,22%;
- Even with 95,69% of the checks, the Examiners were only responsible for 85,78% of disapprovals;
- With only 4,31% of the checks, the Inspectors were responsible for 14,22% of disapprovals;
- Considering the Examiners and Inspectors approval rates, the expectation seems consistent with the Null Hypothesis H_0 because the Examiners’ and Inspectors’

approval rates were closer to the share of performed checks, 0.001%, and 2.1%, respectively.

- Considering the Examiners' and Inspectors' disapproval rates, the expectation does not seem consistent with the Null Hypothesis H_0 because the Examiners' and Inspectors' disapproval rates were not closer to the share of performed checks, 11.6% and 69.7%, respectively.

Therefore, the data let us infer that Inspectors were 369% harsher while performing flight checks and, even performing only 4.31% of the licensing flight checks, they were responsible for 14.22% of the disapprovals, better assuring that the standards and safety were met.

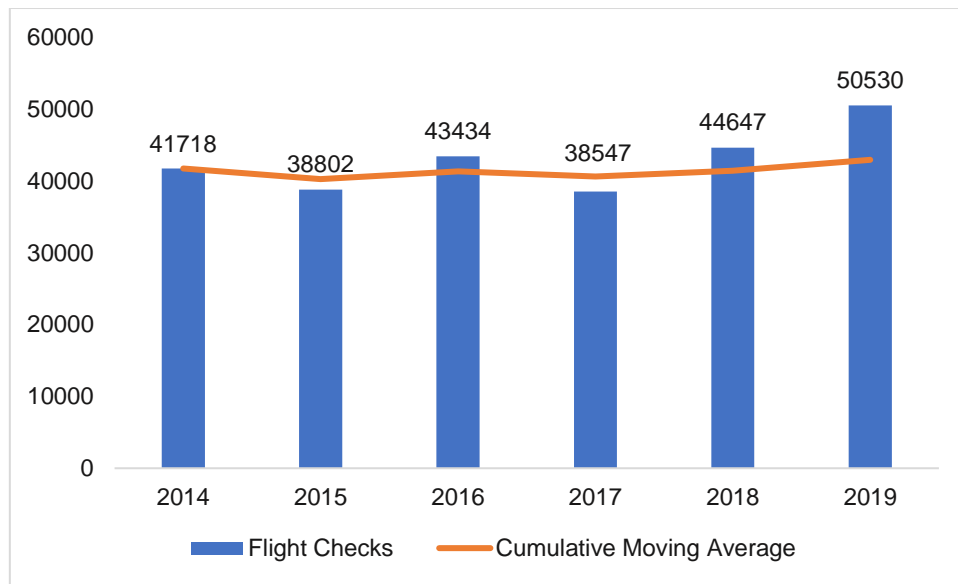
4.7 – Other State rates

4.7.1 – The United States of America's rates

Since 2014, The United States of America publishes through the FAA's – Federal Aviation Administration annual reports on the U.S. Civil Airmen Statistics (FAA, 2014 to 2019). The 2014's report contains simplified data from 2005 to 2013, which do not separate Examiners' results from Inspectors' results, and for this reason, they were not used in this research.

From 2014 to 2019, these reports included a distinction between DPE – Designated Pilot Examiner and ASI – Aviation Safety Inspector on Table 19 – ORIGINAL AIRMEN CERTIFICATES APPROVED/DISAPPROVED BY CATEGORY AND CONDUCTOR (FAA, 2014 to 2019). Therefore, they were combined to provide statistics for the two samples n_3 – Examiners and n_4 – Inspectors about PPL – private pilot licence, CPL – commercial pilot licence, ATPL – air transport pilot licence for the categories aeroplane and helicopter (grouped), and Flight Instructor Rating, as follows:

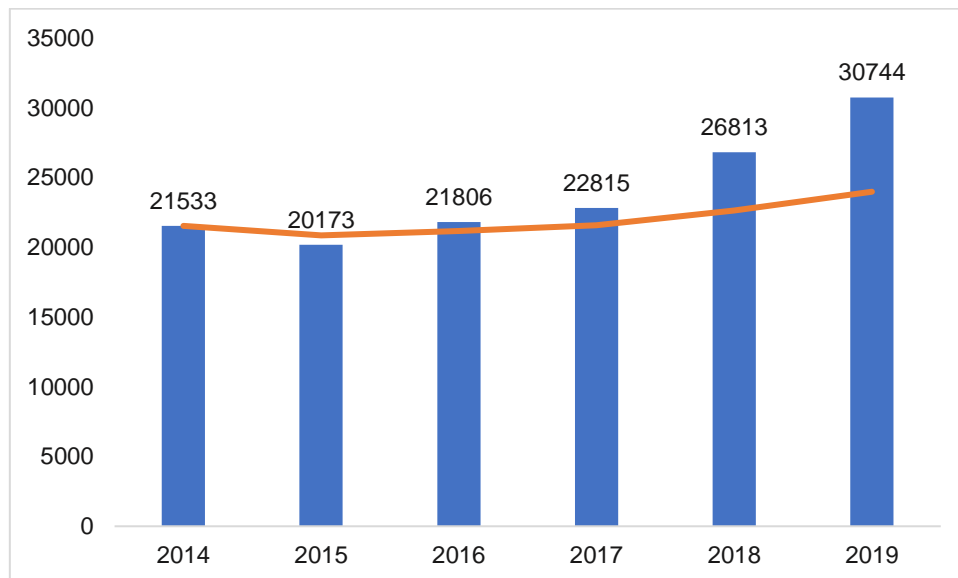
Figure 4.11 – FAA's pilot licensing proficient flight checks histogram (2014-2019)



Source: own elaboration.

The total issued FAA's Instrument rating was published in Table 21 of the ORIGINAL AIRMEN CERTIFICATES ISSUED BY CATEGORY (FAA, 2014 to 2019), as follows:

Figure 4.12 – FAA's Instrument rating histogram (2014-2019)



Source: own elaboration.

4.7.2 – FAA’s Null Hypothesis of pilot flight proficiency check for licensing

With the purpose of also testing the FAA’s Null Hypothesis for licensing pilot flight proficiency check H_0 , i.e., no differences between the FAA’s samples n_5 – Designated Pilot Examiners and n_6 – Aviation Safety Inspectors, it was necessary to extract the data from Table 19 – ORIGINAL AIRMEN CERTIFICATES APPROVED/DISAPPROVED BY CATEGORY AND CONDUCTOR of the FAA’s – Federal Aviation Administration annual reports on the U.S. Civil Airmen Statistics (FAA, 2014 to 2019), transform them into individually approved and disapproved data classified into Examiners’ and Inspectors’ and analyze these data using quantitative descriptive analyses and the statistical Two Proportions z -Test.

Table 4.31 – FAA’s descriptive statistics pilot flight proficiency checks for licensing (2014 – 2019)

Mean	0,2312648
Standard Error	0,0007816
Median	0
Mode	0
Standard Deviation	0,421642
Population Variance	0,177782
Kurtosis	-0,3751
Skewness	1,2747165
Range	1
Minimum	0
Maximum	1
Sum	67305
Count	291030
Confidence Level (95,0%)	0,0015319

Source: own elaboration.

Analyzing the descriptive statistics of FAA’s pilot flight proficiency checks for licensing, the Count is the number of checks (population size) $N= 291030$; the Sum is the number of Disapproved checks (statistical success events) $\sum x_i= 67305$; the mean is $\mu= 0.2312648$; the Standard Deviation is $\sigma= 0,421642$, and the Population Variance is $\sigma^2= 0,177782$, and the Confidence Level for mean is 95%.

The Examiners’ descriptive statistics on the disapproval rate of pilot flight proficiency check from 2014 to 2019 are demonstrated, as follows:

Table 4.32 – FAA’s Examiners’ descriptive statistics pilot flight proficiency checks for licensing (2014 – 2019)

Mean	0,2309953
Standard Error	0,0007897
Median	0
Mode	0
Standard Deviation	0,4214701
Sample Variance	0,1776371
Kurtosis	-0,37051
Skewness	1,2765158
Range	1
Minimum	0
Maximum	1
Sum	65802
Count	284863
Confidence Level (95,0%)	0,0015477

Source: own elaboration.

Analyzing the descriptive statistics of FAA’s pilot flight proficiency checks for licensing, the Count is the number of checks (population size) $n_5 = 284863$; the Sum is the number of Disapproved checks (statistical success events) $\sum X_5 = 65802$; the mean is $\bar{x}_5 = 0.2309953$; the Standard Deviation is $s_5 = 0.4214701$; and the Population Variance is $s_5^2 = 0.1776371$; and the Confidence Level for the mean is 95%.

The Inspectors’ descriptive statistics on the disapproval rate of pilot flight proficiency check from 2014 to 2019 are demonstrated, as follows:

Table 4.33 – FAA’s Inspectors’ descriptive statistics pilot flight proficiency checks for licensing (2014 – 2019)

Mean	0,2437166
Standard Error	0,0054674
Median	0
Mode	0
Standard Deviation	0,4293585
Sample Variance	0,1843487
Kurtosis	-0,57411
Skewness	1,1941844
Range	1
Minimum	0
Maximum	1
zSum	1503
Count	6167
Confidence Level (95,0%)	0,0107181

Source: own elaboration.

Analyzing the descriptive statistics of FAA’s Inspectors’ pilot flight proficiency checks for licensing, the Count is the number of checks (sample size) $n_6 = 6167$; the Sum is the number

of Disapproved checks (statistical success events) $\Sigma X_6 = 1503$; the mean is $\bar{x}_6 = 0.2437166$; the Standard Deviation is $s_6 = 0.4293585$; the Sample Variance is $s_6^2 = 0.1843487$; and the Confidence Level for the mean is 95%.

Analyzing the FAA’s tables above, from 2014 to 2019, unlike ANAC’s samples means, the FAA’s Inspectors’ disapproval mean \bar{x}_6 is only 5.5% higher than the Examiners’ mean \bar{x}_5 .

Analyzing the dataset of both FAA’s samples $n_5 =$ Examiners and $n_6 =$ Inspectors using the Two Proportions z -Test with a significance level α of 5%, and considering that the dataset of approval or disapproval results as a binomial distribution, the assumption of normality was assessed using the CLT – Central Limit Theorem, which the mean of any random variable will be approximately normally distributed as sample size increases according to the CLT. Therefore, with a sufficiently large sample size ($n > 50$), deviations from normality will have little effect on the results (Pituch & Stevens, 2015). Therefore, it was possible to calculate, with the formula below, the following values:

$$z = \frac{(\bar{x}_5 - \bar{x}_6) - (\mu_5 - \mu_6)}{\sqrt{\frac{\sigma_5^2}{n_5} + \frac{\sigma_6^2}{n_6}}}$$

Table 4.34 – FAA’s Two Proportions z-Test n_5 – Examiners and n_6 – Inspectors pilot flight proficiency checks for licensing (2014 – 2019)

	FAA’s Examiners	FAA’s Inspectors
Mean	0,2309953	0,2437166
Known Variance	0,177637	0,184349
Observations	284863	6167
Hypothesized Mean Difference	0	
z	-2,302847	
P(Z<=z) one-tail	0,0106437	
z Critical one-tail	1,6448536	
P(Z<=z) two-tail	0,0212875	
z Critical two-tail	1,959964	

Source: own elaboration.

Considering that the calculated z value is -2,302847 and that the z Critical two-tail value is 1,959964, i.e., $|z| > |z_{\text{Crit}}|$ and the p-value is 0,0212875, then the Null hypothesis (H_0) could be rejected, and there is a statistical difference between the FAA’s Designated Pilot Examiners and Aviation Safety Inspectors proportions of pilot flight proficiency check for licensing.

The FAA’s pilot flight proficiency checks rates for licensing (2014 – 2019) were:

Table 4.35 – FAA’s pilot flight proficiency checks’ rates for licensing (2014 – 2019)

Approved	Percent	Disapproved	Percent	Total
223725	76.87%	67305	23.13%	291030

Source: own elaboration.

The FAA’s Examiners’ pilot flight proficiency checks’ rates for licensing (2014 – 2019) were:

Table 4.36 – FAA’s Examiners and Inspectors pilot flight proficiency checks rates for licensing (2014 – 2019)

Approved	Percent	Disapproved	Percent	Total
219061	76,90%	65802	23,10%	291030

Source: own elaboration.

The FAA’s Inspectors’ pilot flight proficiency checks’ rates for licensing (2014 – 2019) were:

Table 4.37 – FAA’s Examiners and Inspectors pilot flight proficiency checks rates for licensing (2014 – 2019)

Approved	Percent	Disapproved	Percent	Total
4664	75,63%	1503	24,37%	291030

Source: own elaboration.

4.7.3 – The Commonwealth of Australia’s rates

In order to provide another source of data for comparison, electronic mails were exchanged by the student and the Australian CASA – Civil Aviation Safety Authority from September 14, 2020 through November 25, 2020, but without success in receiving the data due to the specificities of the Australian Authority’s oversight activities, summarized in the last correspondence as:

*After thorough consultation I have been advised that **Australia may not be the ideal data source for your research, given the manner in which we oversight these activities.** Generally speaking, CASA does not ordinarily perform ‘every day’ flight tests and proficiency checks that industry Flight Examiner Rating holders ordinarily perform. Rather, **our oversight focus is on Flight Examiner Rating (FER) flight test and proficiency checks** – which industry do not ordinarily perform. Where we do perform other ‘every day’ flight tests and proficiency checks, **the sample size is very small and is not CASA’s core or usual business.** As such **CASA is unable to provided data which you have requested.** (Cameron 2020, pers. comm., 25 Nov)*

Unfortunately, CASA was unable to provide data for the intended comparison.

4.8 – The Federative Republic of Brazil and The United States of America comparative analyses

In order to compare the Brazilian and the American licensing rates of the pilot flight proficiency checks, it was necessary to straighten the scope to the 2014 to 2019 range, combine the FAA's yearly published data into the following licences and ratings: PPL – private pilot licence , CPL – commercial pilot licence, ATPL – air transport pilot licence, Instrument and Flight Instructor ratings, using the same criteria, represented by the Table 4.38 and Table 4.39 on the following page:

Table 4.38 – FAA's pilot flight proficiency checks for licensing (2014-2019)

Category of Certificates	Examiner Approved	Examiner Disapproved	Examiner Total	Examiner Percent Approved	Inspector Approved	Inspector Disapproved	Inspector Total	Inspector Percent Approved
Private	99853	35426	135279	73,81%	331	188	519	63,78%
Commercial	48208	15287	63495	75,92%	245	78	323	75,85%
Airline Transport	39147	4899	44046	88,88%	1336	267	1603	83,34%
Rotorcraft (only) ⁴	10970	1237	12207	89,87%	192	14	206	93,20%
Flight Instructor Certificates	20883	8953	29836	69,99%	2560	956	3516	72,81%
Instrument rating ^{5 7 8}	143884 ⁵	–	–	–	143884 ⁵	–	–	–
Licensing Total ⁶	219061	65802	284863	76,90%	4664	1503	6167	75,63%

Source: own elaboration.

Table 4.39 – ANAC's pilot flight proficiency checks for licensing (2014-2019)

Category of Certificates	Examiner Approved	Examiner Disapproved	Examiner Total	Examiner Percent Approved	Inspector Approved	Inspector Disapproved	Inspector Total	Inspector Percent Approved
Private	11594	87	11681	99,26%	33	1	34	97,06%
Commercial	6779	44	6823	99,36%	150	5	155	96,77%
Airline Transport	552	14	566	97,53%	810	22	832	97,36%
Rotorcraft (only) ⁴	4160	30	4190	99,28%	25	1	26	96,15%
Flight Instructor rating ^{7 8}	18228	59	18287	99,68%	534	4	538	99,26%
Instrument rating (only) ^{7 8}	9103	36	9139	99,61%	425	8	433	98,15%
Instrument rating (additional) ^{7 8}	28059	188	28247	99,33%	5747	112	5859	98,09%
Licensing Total ⁹	23085	175	23260	99,47%	1018	29	1047	98,06%

Source: own elaboration.

⁴ Helicopters' PPL, CPL, and ATPL.

⁵ Original and additional ratings, due to FAA' unclassified data of Examiners' and Inspectors' approved/disapproved totals.

⁶ Licensing Total, including airplane's and helicopter's PPL, CPL, ATPL and Flight Instructor Certificates.

⁷ Airplane's and Helicopter's.

⁸ Not included in Licensing Total due to unclassified data.

⁹ Licensing Total, including airplane's and helicopter's PPL, CPL, ATPL.

Comparing the above tables, there is an enormous difference between the FAA’s and ANAC’s approval rates. While the FAA’s Examiners’ approval mean is 76.90%, the ANAC’s Examiners’ approval mean is 99.47%. A similar difference is present in the FAA’s Inspectors’ approval mean of 75.63%, compared to ANAC’s Inspectors’ approval mean of 98.06%. Therefore, even knowing that many variables could interfere in the results shown, it is possible to infer that the FAA’s Examiners disapprove 22.57 percentage points more than ANAC’s Examiners, in the same manner, FAA’s Inspectors disapprove 22.43 percentage points more than ANAC’s Inspectors.

Analyzing the dataset of both ANAC’s Examiners n_3 and FAA’s Examiners n_5 using the Two Proportions z -Test with a significance level α of 5%, and considering that the dataset of approval or disapproval results as a binomial distribution, the assumption of normality was assessed using the CLT – Central Limit Theorem, which the mean of any random variable will be approximately normally distributed as sample size increases according to the CLT. Therefore, with a sufficiently large sample size ($n > 50$), deviations from normality will have little effect on the results (Pituch & Stevens, 2015). Therefore, it was possible to calculate, with the formula below, the following values:

$$z = \frac{(\bar{x}_3 - \bar{x}_5) - (\mu_3 - \mu_5)}{\sqrt{\frac{\sigma_3^2}{n_3} + \frac{\sigma_5^2}{n_5}}}$$

Table 4.40 – ANAC’s Examiners n_3 and FAA’s Examiners n_5 Two Proportions z-Test of pilot flight proficiency checks for licensing (2014 – 2019)

	ANAC’s Examiners	FAA’s Examiners
Mean	0,0075236	0,2309953
Known Variance	0,0074674	0,1776371
Observations	23260	284863
Hypothesized Mean Difference	0	
z	-229,928	
P(Z<=z) one-tail	0	
z Critical one-tail	1,6448536	
P(Z<=z) two-tail	0	
z Critical two-tail	1,959964	

Source: own elaboration.

Considering that the calculated z value is -229.928 and the z Critical two-tail value is 1,959964, i.e., $|z| > |z_{\text{Crit}}|$ and the p-value less than 0,001, then the Null hypothesis (H_0) could

be rejected, and there is a statistically highly significant difference between the ANAC's Accredited Examiners and FAA's Designated Pilot Examiners.

Analyzing the dataset of both ANAC's Inspectors n_4 and FAA's Inspectors n_6 using the Two Proportions z -Test with a significance level α of 5%, and considering that the dataset of approval or disapproval results as a binomial distribution, the assumption of normality was assessed using the CLT – Central Limit Theorem, which the mean of any random variable will be approximately normally distributed as sample size increases according to the CLT. Therefore, with a sufficiently large sample size ($n > 50$), deviations from normality will have little effect on the results (Pituch & Stevens, 2015). Therefore, it was possible to calculate, with the formula below, the following values:

$$z = \frac{(\bar{x}_4 - \bar{x}_6) - (\mu_4 - \mu_6)}{\sqrt{\frac{\sigma_4^2}{n_4} + \frac{\sigma_6^2}{n_6}}}$$

Table 4.41 – ANAC's Inspectors n_4 and FAA's Inspectors n_6 Two Proportions z -Test of pilot flight proficiency checks for licensing (2014 – 2019)

	ANAC's Inspectors	FAA's Inspectors
Mean	0,0276982	0,2437166
Known Variance	0,0269567	0,1843487
Observations	1047	6167
Hypothesized Mean Difference	0	
z	-28,96007	
P(Z<=z) one-tail	0	
z Critical one-tail	1,6448536	
P(Z<=z) two-tail	0	
z Critical two-tail	1,959964	

Source: own elaboration.

Considering that the calculated z value is -28.96007 and the z Critical two-tail value is 1,959964, i.e., $|z| > |z_{\text{Crit}}|$ and the p-value less than 0,001, then the Null hypothesis (H_0) could be rejected, and there is a statistically highly significant difference between the FAA's and ANAC's Examiners and FAA's and ANAC's Inspectors.

Therefore, comparing both Two Proportions z -Test from FAA's and ANAC's Examiners and FAA's and ANAC's Inspectors, i.e., z scores -229.928 and -28.96007, the large difference between the categories relatively shows how many standard deviations they are from their means.

Once again, there is evidence to reject that the Null hypothesis (H_0), meaning no differences between the ANAC's n_3 – Accredited Examiners and n_4 – Civil Aviation Inspectors of pilot flight proficiency check for licensing ($H_0: \mu_3 - \mu_4 = 0$) could be rejected, and there is a statistically significant difference between ANAC's Accredited Examiners and Civil Aviation Inspectors.

4.9 – FAA's initiatives

4.9.1 – Oversight

The FAA's Order 8000.95 CHG 5 contains the oversight policy of Designees, as follows:

2. General.

a. Oversight Principles.

(1) **Promote Safety.** A primary responsibility of the FAA is to promote safety through **systematic oversight** of industry stakeholders, **including designees**. Information generated from oversight programs permits the FAA **to identify safety hazards, mitigate risk, and enhance aviation safety**. In order for oversight programs to be effective, they **must be carefully planned and executed** during the conduct of specific inspection activities.

(2) **Evaluate Performance.** The objective of an oversight program is **to ensure that the designee performs to the standards and expectations set forth by the FAA in its policies and regulations**. Oversight is **not merely an isolated event** or series of activities. **Oversight results should be considered in total to provide a high-level perspective of a designee's performance over time.** (FAA, 2020) [our emphasis]

The FAA considers that the designee oversight is not an isolated event; on the contrary, it is a high-level perspective of a designee's performance over time that promotes safety and permits safety hazards identification, risk mitigation, and safety enhancements.

The FAA has a DMS – Designee Management System for AVS – Aviation Safety, which includes several designee categories such as Pilot Examiners, Aviation Medical Examiners, Mechanic Examiners, Aircraft Dispatch Examiners, Aircrew Examiners, Manufacturing Examiners, Engineering Representatives, Airworthiness Representatives-Maintenance, and Parachute Rigger Examiners. The DSM's oversight activities allow designee suspension, and termination, and provide key information to better visibility into designee activity.

...system for managing all aspects of the lifecycle of individual representatives of the Administrator, otherwise referred to as designees...

to consolidate independent designee management policies into **one AVS-level policy that looks holistically at oversight and management of designees.**

...

application for designation; selection of an individual for appointment; appointment and orientation of new designees; **oversight activities; suspension and termination.** For some organizations, **DMS will also provide key information leading to better visibility into designee activity at all levels.** (FAA, 2018) (FAA, 2018) [our emphasis]

4.9.2 – The SEED Program

The FAA's SEED – Special Emphasis Evaluation of a Designee is contained in the Order 8900.1 CHG – change 669 V 13 CH 5 and express:

The SEED Program. A SEED is a team-focused, indepth evaluation of a part 183 designee. The SEED program was developed as a tool to support a comprehensive designee oversight system. Using a data-driven approach, this program focuses FAA resources on designees who exhibit indicators that potentially pose a higher risk to FAA certification processes. (FAA, 2019) [our emphasis]

The FAA uses a data-driven approach to support a comprehensive designee oversight system, focusing on higher risk indicators.

The SEED Inspections are planned considering the following:

SEED Inspections.

SEED inspections concentrate resources on five primary areas, which are explained in detail later in this section. These include:

- 1) **Pre-surveillance analysis of airman testing data** from internal FAA sources and publicly accessible data regarding the designee's activities.
- 2) **Comprehensive review of the designee's responsible Flight Standards office records and past certification data.**
- 3) **Structured interviews of recently tested airmen.**
- 4) **Observation of a test performed by the designee.**
- 5) *Information gathering from members of the aviation community and/or other sources.* (FAA, 2019) [our emphasis]

The SEED team members eligibility requirements are the followings:

*For DPE SEEDs, at least one team member must **observe a practical test** being administered by the DPE to an actual applicant. This observation must be an exam that has progressed to the flight portion of the test. **Unless the observation is being conducted from a required crewmember station, any qualified Operations ASI may conduct the complete evaluation** (both ground and flight).*

*NOTE: For the purposes of this section, **qualified means that the ASI holds at least a Commercial Pilot Certificate (and the appropriate type rating in the case of an aircraft which requires a type rating) in the same aircraft category and class as the aircraft in which the test is being administered.** It is not necessary for the ASI to be current in the aircraft, nor to be a participant in the Flight Standards Flight Program. **For ASIs conducting evaluations for DPEs who conduct the majority of their tests in two-place aircraft, and the ASI is acting as the applicant for the flight portion of the evaluation, the ASI must be current in the aircraft** per Volume 1, Chapter 3, Section 6. (FAA, 2019) [our emphasis]*

The FAA uses qualified Operations Inspector, which means they hold at least Commercial Pilot Certificate, appropriate class or type rating, and, for two-place aircraft, current in the aircraft.

4.10 – Analysis of the difficulties

4.10.1 – ANAC’s regulation

The following ANAC’s regulations are intended to demonstrate the difficulties for the Inspectors and Examiners that perform pilot flight proficiency checks, and the major difficulty is that ANAC does not abide by their own regulations regarding the Inspectors’ compliance, as required.

Instead, it is common that the regulations that contained these requirements are revoked and, sometimes, replaced by others that do not mention the need for Inspectors’ pilot technical training, such as:

- RBHA – Brazilian Requirements for Aeronautical Certification 17, revoked by the Resolution 472 of 6th June 2018;
- IAC – Civil Aviation Instruction 3201-0198, revoked by Resolution 422 of 2nd May 2017

The above-mentioned revocation took place a few years after the CENIPA – Accident Investigation Authority’s Safety Recommendations A - 134/CENIPA/2014 - 05 and A - 134/CENIPA/2014 - 06 (CENIPA, 2014, pp. 157, 158), who pointed out the Inspectorate’s lack

of training for conducting pilot flight proficiency checks, even being provisioned by Section 17.13 of the RBHA – Brazilian Requirements for Aeronautical Certification 17. Additionally to the lack of Inspectorate’s technical training, there is the lack of rating, medical certificate, safe work environment, which represents that the ANAC’s safety culture might be hazardous to aviation and might threaten its safety.

A - 134/CENIPA/2014 - 05

Review the criteria for the definition of similarity, which enable Civil Aviation Flight Inspectors and accredited examiners to conduct evaluations of pilots in various types of aircraft, taking into account the compatibility of the avionics and airborne systems.

A - 134/CENIPA/2014 - 06

Make sure that all Civil Aviation Flight Inspectors and accredited examiners are kept up-to-date on the aircraft utilized for the evaluation of pilots. (CENIPA, 2014)

Therefore, the following regulations were chosen due to their scarcely mentions to the Inspectors’ pilot flight proficiency check activity and its associated outsourced activity performed by Examiners, which have better described licence and rating requirements.

4.10.1.1 – RBAC – Brazilian Civil Aviation Regulation 01 EMD – amendment 08

According to Section 01.1 of the RBAC – Brazilian Civil Aviation Regulation – amendment 08, the definition of Designated Servant is the accredited person by the Civil Aviation Authority to perform the civil aviation oversight activities, previously denominated INSPAC – Civil Aviation Inspector.

4.10.1.2 – RBAC – Brazilian Civil Aviation Regulation 183 EMD – amendment 01

According to Section 183.11 of the RBAC 183 Amendment 1, the ANAC might accredit qualified professionals for executing flight proficiency checks. (ANAC, 2018)

According to Section 183.75 (a) of the RBAC 183 Amendment 1, in order to apply the ANAC required checks, the societies may only use people that meet the following minimal requirements: ... (2) appropriate CMA – Medical Certificate; and (3) compatible licences and ratings of applied checks (ANAC, 2018).

According to Section 183.77, (b) of the RBAC 183 Amendment 1, the control and expiry date of the CMA and ratings is the societies' responsibility, as well as forbid the Examiners' prerogatives after the expiry date of the CMA and ratings (ANAC, 2018). It is worth mentioning that the Examiner's definition is any person that is accredited or designated by ANAC to conduct pilot proficiency checks, according to Item 4.1 of IS 00-002F (ANAC, 2020), which includes the Inspectors.

Although the ANAC requires that the Accredited Examiners hold valid CMA and ratings, the same ANAC does not maintain valid its own Inspectors' CMAs and ratings, since its foundation, back in 2005. On the contrary, the ANAC revoked, by the Resolution 422 of 2nd May 2017, regulations that previously established INSPAC licences and ratings and that the Flight Inspectors must keep flight currency at least every 30 days, while recommended every 15 days (IAC – Civil Aviation Instruction 3201-0198) (DAC, 1998).

4.10.1.3 – RBAC – Brazilian Civil Aviation Regulation 61 EMD – amendment 13

According to Section 61.2 of the RBAC 61 Amendment 13, the ANAC defines Rating as an authorization associated with a licence or certificate, where qualifications and expiry date are specified. (ANAC, 2020)

According to Section 61.3, (i), (2), of the RBAC 61 Amendment 13, there is the provision of the Accredited Examiners and Civil Aviation Inspectors (INSPAC) being properly rated and qualified. (ANAC, 2020)

According to Section 61.17 of the RBAC 61 Amendment 13, the pilot's licence is permanent, and the holder's prerogative may only be exercised when the following requirements are met: (1) valid CMA; (2) valid ratings; (3) recent flight experience (90 days). (ANAC, 2020)

According to Section 61.31, (c), (5), (ii), the hours of pilot flight proficiency check must be registered by the Civil Aviation Inspector (INSPAC) or the Accredited Examiner responsible for the check in the CIV – Logbook and CIV Digital – Electronic Logbook. (ANAC, 2020)

4.10.1.4 – RBAC – Brazilian Civil Aviation Regulation 67 EMD – Amendment 4

According to Section 67.15, (a), (b), and (c) of RBAC 67 Amendment 4, the Medical Certificate must obey the expressed validities, must take into account the requirements

compliance within RBAC 67 and the Medical Certificate holder must report to ANAC any psychophysical diminishment which could impede the exercise of licenses or ratings prerogatives without affecting safety. (ANAC, 2020)

4.10.1.5 – IS – Supplementary Instruction 00-002

According to Item 5.2.3.2 of the IS – Supplementary Instruction 00-002 A and B, the checks are conducted in a manner to allow the Inspector and Examiner to analyze all the technical aspects, considered as a minimum to the exercise of the licences prerogatives, in the manners of the ratings qualifications. (ANAC, 2011) (ANAC, 2012)

According to Item 5.2.3.17 of the IS – Supplementary Instruction 00-002 A and B, the Inspector may use the unoccupied pilot's seat, if rated, or, if not rated, a rated instructor must occupy the pilot's seat. (ANAC, 2011) (ANAC, 2012). However, the ANAC does not maintain the Inspectors rated.

In fact, due to the lack of CMA and ratings, the ANAC forces the Inspectors to act as merely observers, usually with very limited view of the pilot's seat or the aircraft's instrument panel, due to occupying a passenger's seat or crouching between the pilots' seat (without ergonomics and seat belt), compromising their safety and relying on an unknown pilot presented by the examinee.

Another problem of Inspectors lacking ratings is that the initial flight check for an examinee without a valid rating on a two-place aircraft have to be delegated to Examiners, thus reducing this sensitive licensing and oversight activities that must be done by the Inspectors.

According to Item 5.2.3.18 of the IS – Supplementary Instruction 00-002 A and B, the Inspector must occupy the student's pilot seat during the Flight Instructor exam. (ANAC, 2011) (ANAC, 2012)

According to Item 9.1, d), of the IS – Supplementary Instruction 00-002 C, D, E and F the PIC – Pilot in Command has to be defined and could be the candidate, the Examiner or a third pilot, if one comply with the requirements for the function, i.e. valid medical certificate, valid ratings, endorsements and currency. (ANAC, 2017) (ANAC, 2018) (ANAC, 2018) (ANAC, 2020)

Considering that the Inspectors have access to or occupy the pilot's seat as mentioned above, the Inspector's lack of Ratings and Medical Certificate poses a threat to their own safety and the safety of others.

Regrettably, there is no consensus on the official position regarding the lack of Ratings and Medical Certificate and the risk assessment lies on the Inspector's accountability, sometimes unpleasantly challenged by the Office for Internal Affairs or the Justice.

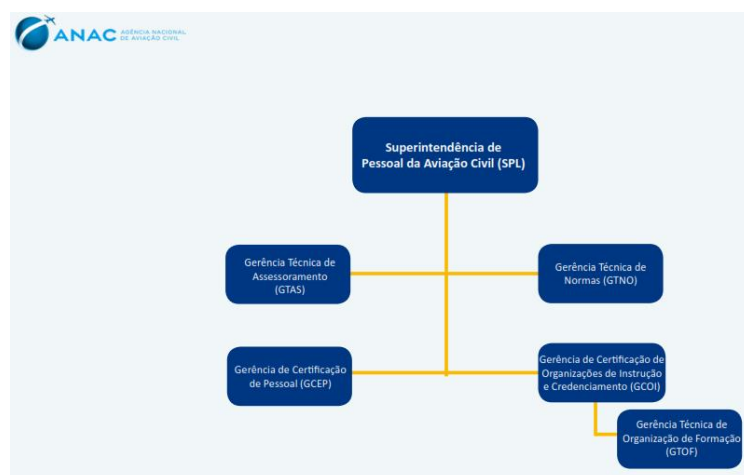
According to Item 5.3.1 of IS – Supplementary Instruction 00-002 C, D, E and F, the Examiner must act with professionalism, high level of knowledge and maintain his technical integrity even under pressure. (ANAC, 2017) (ANAC, 2018) (ANAC, 2018) (ANAC, 2020)

According to Item 5.3.3, a), b), ANAC require that the Examiners maintain outstanding professional standards, integrity and ethics and abide by this Supplementary Instruction and any applicable regulation. It is worth reminding that Section 61.3, (i), (2), of RBAC 61 requires that Accredited Examiners and Civil Aviation Inspectors (INSPAC) be properly rated and qualified.

4.10.2 – ANAC's PEL organizational structure, staffing and qualifications of key personnel

The most recent ANAC's organization restructure happened in August 2020 and according to Resolution 581 – ANAC's Internal Regulation. The PEL Department were created including the areas: Technical Advisory (GTAS), Technical Regulations (GTNO), Personnel Licensing (GCEP) and Approved Training Organization (GCOI).

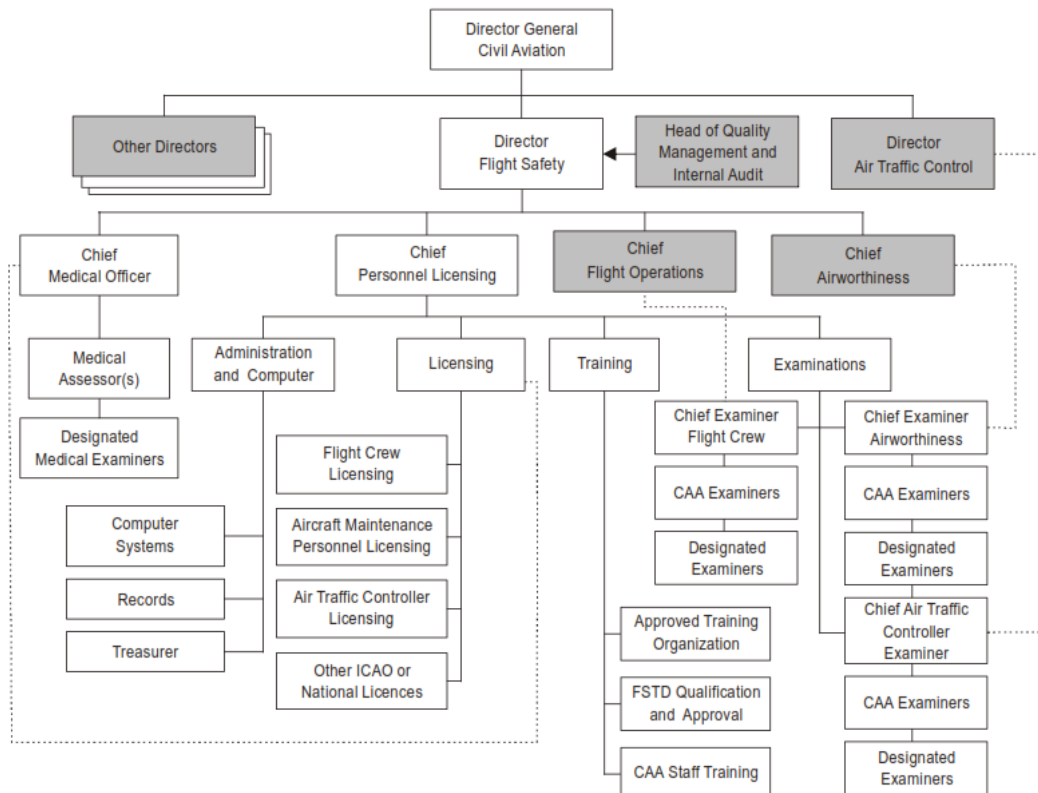
Figure 4.13 – SPL – Department of Civil Aviation Personnel organizational structure



Source: (ANAC, 2020)

According to Paragraphs 2.3.1.1 and 2.3.1.2 of Doc 9379 – Manual of Procedures for Establishment and Management of a State’s Personnel Licensing System, a PEL Office must be suitably organized and staffed with qualified personnel and a typical organizational structure were represented as follows:

Figure 4.14 – The organizational structure of a typical large PEL Office and its relation to other CAA directorates and offices



Source: Figure I-2-1., Doc 9379 (ICAO, 2012, pp. I-2-5)

It is worth mentioning the existence of Examinations branch in the ICAO’s recommended structure, which does not exist in the ANAC’s structure. Under this branch, there are several Chief professionals and their CAA Examiners or Designated Examiners.

According to Paragraph 2.4.1 of Doc 9379 – Manual of Procedures for Establishment and Management of a State’s Personnel Licensing System, the granting of licence privileges cannot be done satisfactorily if the qualifications of the person making the judgements are not at least equal to those required of the licence applicant:

2.4.1 The granting of licence privileges to participants in the civil aviation system cannot be done satisfactorily if the qualifications of the person making the judgements are not at least equal to those required of the licence applicant. ... However, the minimum qualification of the key personnel in all PEL Offices should be:

a) **The Chief of Personnel Licensing should have at least technical qualifications and expertise as a flight crew member or an airworthiness engineer or an air traffic control officer and a good understanding of the other areas of licensing concern. This individual should have a thorough knowledge of the licensing regulations, licensing practices and procedures, together with administrative ability and leadership qualities.**

b) **The Head of the Examination Section and the Chief Examiners should have extensive experience as an authorized examiner in a particular specialty as well as a thorough knowledge of licensing regulations, licensing practices and procedures, together with administrative ability and leadership qualities.**

c) **The Head of the Licensing Section should have extensive experience as an authorized person and/or licence holder in a particular specialty as well as a thorough knowledge of the licensing regulations, licensing practices and procedures, together with administrative ability and leadership qualities.**

d) **The Head of the Training Section should have extensive training experience as an authorized instructor in a particular specialty, as well as a thorough knowledge of the licensing regulations, licensing practices and procedures, together with administrative ability and leadership qualities.**

e) **The Chief Medical Officer should have extensive experience in regulatory civil aviation medicine as well as a thorough knowledge of medical requirements and medical best practice. This individual should have leadership qualities, administrative skills and the ability to make autonomous decisions concerning the medical fitness of applicants.**

f) **The Head of the Administrative Section should have extensive experience in business administration, as well as a thorough knowledge of the licensing regulations, licensing practices and procedures, together with leadership qualities.**

Unfortunately, one hypothesis for the current disapproval rates and the associated difficulties might be the lack of an Examinations branch, and technically qualified and licensed key personnel, as detailed, not making judgements in ANAC's PEL Office.

4.10.3 – Accident causation

In order to continue the difficulties analyses, it is important to briefly explain the Accident causation theory.

According to the Paragraph 2.3.1 of the Doc 9859 – Safety Management Manual, Fourth Edition:

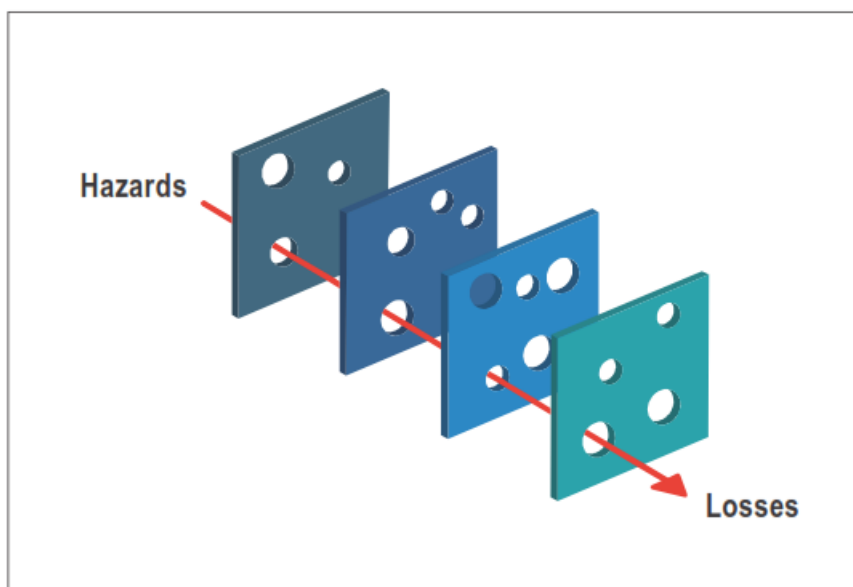
The Swiss-Cheese (or Reason) Model, developed by Professor James Reason and well known to the aviation industry, illustrates that accidents involve successive breaches of multiple defences.

...

Breaches in safety defences can be a delayed consequence of decisions made at the higher levels of the organization, which may remain dormant until their effects or damaging potential are activated by certain operating conditions (known as latent conditions). (ICAO, 2018) [our emphasis]

According to the Reason's Model, accidents involve the successive breaches of multiple defences, such as those mentioned in this research, i.e., lack of training, lack of medical certificate, lack of rating, lack of safety culture, and lack of oversight, as well as actions, inactions, active disapprovals, and latent conditions, represented as the holes in the slices, consequently, the slices represents the defences, mainly regulations, training, and technology, as follows:

Figure 4.15 – Concept of accident causation



Source: Figure 2-3, Doc 9859 (ICAO 2018, p. 2-7)

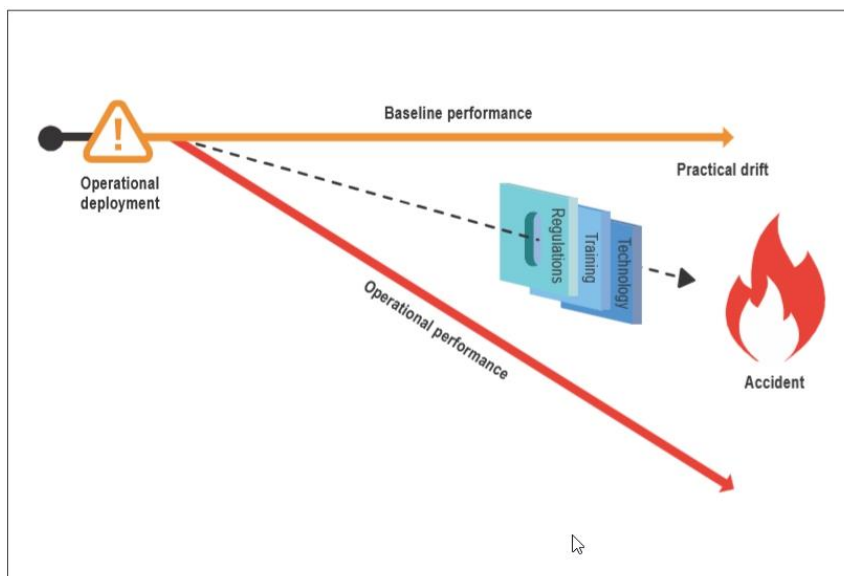
According to the Paragraph 2.3.8.1 of the Doc 9859 – Safety Management Manual, Fourth Edition:

2.3.8.1 Scott A. Snook's theory of practical drift is used to understand how performance of any system drifts away from its original design. Tasks, procedures, and equipment are often initially designed and planned in a theoretical environment, under ideal conditions, with an implicit assumption that nearly everything can be predicted and controlled, and where everything functions as expected. This is usually based on three fundamental assumptions that the:

- a) **technology** needed to achieve the system production goals is available;
- b) **personnel are trained, competent and motivated to properly operate the technology as intended;**
and
- c) **policy and procedures** will dictate system and human behaviour.

These assumptions underlie the **baseline (or ideal) system performance**, which can be graphically presented as a straight line from the start of operational deployment as shown in Figure 2-4. (ICAO, 2018) [our emphasis]

Figure 4.16 – Concept of practical drift



Source: Figure 2-4, Doc 9859 (ICAO 2018, p. 2-8)

According to Snook's theory of practical drift, any system's performance drifts away from its' original performance, represented by the distance from the Baseline and Operational arrows. The use of regulations, training, and technology reapproaches the Operational performance to the Baseline performance, serving as defences to avoid accidents.

4.10.4 – The latent conditions

Most of the difficulties explained in the previous section were considered latent conditions present in the system in a dormant state since ANAC's foundation. The purpose of this research was also to highlight these latent conditions and make mitigations possible, before an operational, organizational, or total system accident occur.

4.10.5 – ANAC's Safety Culture

For the first time, the ANAC's research on Safety Culture done in 2020 (ANAC, 2020), based on the SM ICG – Safety Management International Collaboration Group tool, pointed that 18% of the active human resources responded, i.e., 239 out of 1.342 civil servants.

This might be seen as low participation, worsen by the result of the respondents with:

- 12% stating that they do not act upon safety;
- 33% that they indirectly act upon safety;
- 55% directly act upon safety; in contrast to the 77% being in the target activity – safety.

Thus, this research seems to corroborate with the sense of lack of safety culture, especially whilst combined with the safety research results of general disagreement level at 38,8%, which seems to contrast with the 95.58% of EI – Effective Implementation of USOAP-CMA – Continuous Monitoring Approach of ICAO.

According to the Paragraph 3.1.1 of the Doc 9859 – Safety Management Manual, Fourth Edition:

Safety Culture has been described as 'how people behave in relation to safety and risk when no one is watching'. ***It is an expression of how safety is perceived, valued and prioritized by management and employees in an organization, and is reflected in the extent to which individuals and groups are:***

- a) ***aware of the risks and known hazards*** faced by the organization and its activities;
- b) ***continuously behaving to preserve and enhance safety;***
- c) ***able to access the resources required for safe operations;***
- d) ***willing and able to adapt when facing safety issues;***
- e) ***willing to communicate safety issues;*** and
- f) ***consistently assessing the safety related behaviours throughout the organization.*** (ICAO, 2018) [our emphasis]

According to the Paragraph 3.2.4 of the Doc 9859 – Safety Management Manual, Fourth Edition:

3.2.4 A positive safety culture relies on a high degree of trust and respect between personnel and management.

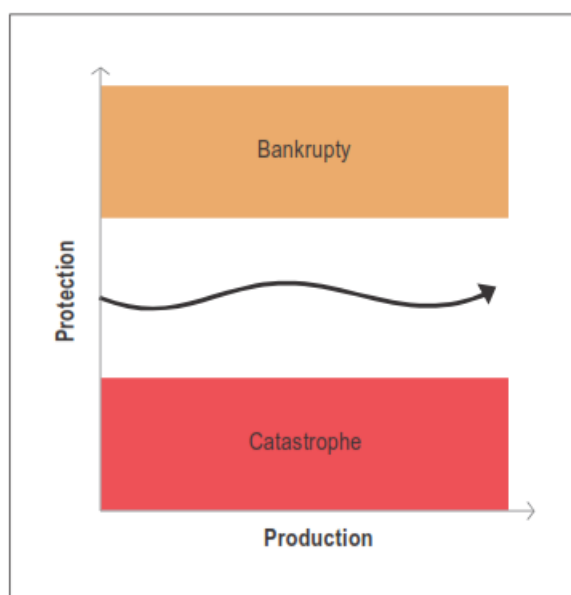
Time and effort are needed to build a positive safety culture, which can be easily damaged by management decisions and actions, or inactions. Continuous effort and reinforcement are needed. When leadership actively endorses safe practices, it becomes the normal way of doing things. The ideal situation is a fully implemented and effective SSP/SMS and a positive safety culture. Hence, an organization's safety culture is often seen as a reflection of the maturity of its SSP/SMS. Effective safety management empowers a positive safety culture and a positive safety culture empowers effective safety management. (ICAO, 2018) [our emphasis]

According to the Paragraph 3.2.5.1 of the Doc 9859 – Safety Management Manual, Fourth Edition:

SSPs and SMSs are sustained by safety data and safety information that is necessary to address existing and potential safety deficiencies and hazards, including safety issues identified by personnel. The success of a reporting system depends entirely on the continuous flow of information from, and feedback to, organizations and individuals. [our emphasis]

At ANAC's it is not uncommon that the safety perceived and practiced by the personnel seems jeopardized by the management, which acts towards the opposite direction of its own personnel, giving way to the Management Dilemma expressed in the following figure:

Figure 4.17 – Concept of a safety space



Source: (Figure 2-5 of Doc 9859, ICAO, 2018, P. 2-10)

4.11 – Methodological choices for problem resolution

The methodological choice for problem resolution chosen was the Six-step problem-solving model, used in Presentation of the different solutions to the identified problem and Presentation of the different possibilities to solve the problem, which basically consists of:

4. Identify the problem;
5. Analyze the problem;
6. Develop the solutions;
7. Select a solution;
8. Implement a solution;
9. Evaluate the results;

Chapter 5 – Presentation of the different solutions to the identified problem

5.1 – Presentation of the possible solutions and justifications

As seen in In-depth analysis of the pilot flight proficiency check’s disapproval rates, there was a statistically highly significant difference between ANAC’s Examiners and Inspectors regarding their test results, in particular the disapproval rates, which pieces of evidence could reject the null hypothesis $H_0: \mu_1 - \mu_2 = 0$, that assumed no differences between the ANAC’s Accredited Examiners and Civil Aviation Inspectors.

The main possible solutions identified to solve this situation lies in standardization and surveillance, which unveils other shades of problems discussed in this chapter.

5.1.1 – Standardization

Regarding standardization, the ANAC has periodically improved the pilot flight proficiency check standards through the issuance of the IS – Supplementary Instruction 00-002, according to the following table:

Table 5.1 – IS – Supplementary Instruction 00-002 history

IS – Supplementary Instruction	Order	Year
IS 00-002A	2.177/SSO	2011
IS 00-002B	1085/SSO	2012
IS 00-002C	63/SPO	2017
IS 00-002D	180/SPO	2018
IS 00-002E	1.450/SPO	2018
IS 00-002F	1.527/SPO	2020

Source: own elaboration.

Unlike the FAA, all the obsolete revisions of the regulations are not kept in the ANAC’s regulations’ portal as a history, which represents difficulty to the oversight and enforcement of past events.

The publication of obsolete revisions and the use of an Amendments’ record as an editorial practice would avoid the above-mentioned difficulties and would cope with the currency of Examiners and Inspectors in the regulations.

Regarding Examiners' training (supposedly initial), the ANAC has trained 261 Examiners in 2018 and 288 Examiners in 2019, with approval rates of 68.2% and 71.8%, respectively, according to the information available at the ANAC's TRAINAIR PLUS Training Center portal (ANAC, 2020).

According to Section 141.91 and 141.93 of RBAC 141, the published requirements demand 500 hours of instruction for airplane (or 250 hours for helicopter), an initial training, a flight proficiency check and subsequent certification administrative process and flight proficiency check every two years, contrasting with the recurrent training requested by the FAA in the Order 8900.2C:

*3. **Recurrent Training.** Each designee is encouraged to attend safety meetings, aviation seminars, and other programs that contribute to the technical skills required for the designation.*

The designee is responsible for ensuring their training currency. Only after successful completion of the initial training (or initial standardization seminar) can the designee register for the recurrent training seminar on the DRS. Attendance at a recurrent training seminar is mandatory. ... The designee must forward a copy of the Certificate of Completion to the managing FAA office.

*Note: **Designees may complete the Designated Pilot Examiner Initial Standardization seminar, conducted by the Designee Standardization Branch, in lieu of the recurrent training seminar to meet the recurrent requirement set forth in paragraph 3 above.***

*Note: **A designee must not exercise his or her designation privileges unless his or her training is current and up to date.***

*6. **Knowledge and Skill.** The determination that the designee's knowledge of and application of current procedures and standards are adequate for renewal of the designation may be based on oversight of the designee and the designee's attendance at a meeting or seminar conducted for the purpose of standardization. (FAA, 2018) [our emphasis]*

It is worth mentioning that, unlike Inspectors' recurrent training requirement every three years, there is no recurrent training requirement for maintaining the Examiners' accreditation.

The certification of Accredited Examiners, according to the SEI! – Electronic Information System, is divided into the following activities:

- Certification 141: Accredited Examiner (Training Organization);
- Training Organizations Certification: Examiner's accreditation (Training Organization);
- Training Center's certification: Examiner certification (Training Centers);
- Certification 135: Examiner's accreditation (Air Carrier);

- Certification 135: O135-010 - Examiner's accreditation inspection (Air Carrier);
- Certification 121: Pilot's Accredited Examiner (Airlines);
- Certification 121: O121-006 - Examiner's accreditation inspection (Airlines);

The Accredited Examiner's certification conducted from 2016 to 2019 is represented in the following table.

Table 5.2 – Accredited Examiners' Certification (2016 – 2019)

RBAC	2016	2017	2018	2019
141	225	673	470	257
142	44	203	69	36
135	57	222	355	209
121	58	278	190	309

Source: own elaboration.

Therefore, even with objective standards and balanced training to become Examiners, as mentioned above, the Examiners' disapproval rate was still significantly shorter than the Inspectors' rates, although it might seem an improvement from the 2017's 0.07% to 2018's 0.14% and 2019's 0.12% of disapproval rate for licensing, it barely avoided its downward movement towards 0%, while, in contrast, the spread from the Inspectors' rates were increasing, aggravated by its own increase.

5.1.2 – Surveillance

The continued surveillance of operators is a State obligation to confirm that they continue to meet the initial certification requirements and is functioning satisfactorily, as provisioned by Annex 6 and Annex 19 to the Convention on International Civil Aviation.

Concerning surveillance, according to the SEI! – Electronic Information System, the surveillance of pilots' Accredited Examiners are divided into the following activities:

- IIAC-506 - Accredited Examiner's Oversight Inspection of RBAC 141 (Approved Training Organisations);
- CTAC-504 - Accredited Examiner's Oversight Inspection of RBAC 142 (Training Centers);

- O135-506 - Accredited Examiner's Oversight Inspection of RBAC 135 (Air Carriers);
- O121-507 - Accredited Examiner's Oversight Inspection of RBAC 121 (Airlines);

The Accredited Examiner's oversight inspections conducted from 2016 to 2019 are represented in the following table.

Table 5.3 – Accredited Examiners' Oversight Inspections (2016 – 2019)

RBAC	2016	2017	2018	2019	Total
141	0	25	6	41	72
142	3	7	1	0	11
135	1	7	3	0	11
121	14	72	79	90	255

Source: own elaboration.

The following table represents the proportion of oversight per certification activities:

Table 5.4 – Accredited Examiner's oversight over certification proportion (2016 – 2019)

RBAC	2016	2017	2018	2019	Mean
141	0,0%	3,7%	1,3%	16,0%	5.25%
142	6,8%	3,4%	1,4%	0,0%	2.9%
135	1,8%	3,2%	0,8%	0,0%	1.45%
121	24,1%	25,9%	41,6%	29,1%	30,17%

Source: own elaboration.

The ANAC's surveillance of Accredited Examiners' mean, from 2016 to 2019, was considered insufficient because its activities varied from 1.45% (RBAC 135 – Air Carriers), 2.9% (RBAC 142 – Training Centers), 5.25% (RBAC 141 – Approved Training Organisations) to 30,17% (RBAC 121- Airlines) of the accreditation activities.

Considering the rates above, the second approach for the solution, an active surveillance following the model used in the FAA's SEED – Special Emphasis Evaluation of a Designee, seems to be more promising, since the past efforts were focused on Accredited Examiner's certification, creating a huge gap between certification and oversight.

Among the 229 civil servants of ANAC's OPS personnel, according to the Safety Culture Research (ANAC, 2020), the actual 51 Flight Inspectors (22%) seem to be adequate for the required oversight of the actual 698 Examiners if and only if properly assigned to

activities that require their competencies and knowledge, skills and attitudes, instead of the current misuse or underuse in nonspecialized or administrative activities, for which there are other qualified professionals.

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Chapter 6 – Presentation of the different possibilities to solve the problem

6.1 – Presentation of the chosen technical solution

6.1.1 – Technical Training, Oversight intensification, and Standardization

Considering the proportion of oversight per certification activities shown in Chapter 5 – as a low rate that requires improvement, the chosen solution lies in technical training, oversight intensification, and standardization.

Immediately, an active surveillance intensification would positively count on the 369% harsher Inspectors' results, compared to the Examiners' rate for licensing, as risk mitigation, while a proper solution, which requires Inspectors' pilot technical training, as provisioned in the PCIV – ANAC's Flight Inspectors Training Programme, follows its implementation steps.

In order to address technical training, active surveillance and standardization, it was necessary to assess the following CE – Critical Elements provisioned by the Annex 19 to the Convention on International Civil Aviation upfront:

- Qualified technical personnel – (CE-4)
- Technical guidance, tools and provision of safety-critical information – (CE-5)
- Licensing, certification, authorization and approval obligations – (CE-6)
- Surveillance obligations – (CE-7) (ICAO, 2016)

6.2 – Qualified technical personnel – (CE-4)

6.2.1 – Required training

To cope with the solution to the problem, prior to delivering an active surveillance, the Inspectorate must be trained in aircraft-specific subjects, qualified and current on at least one aircraft type.

This technical training should be reassessed and improved as provisioned by Article 41, Item XIII of the ANAC's Internal Regulation 581 (RESOLUÇÃO N° 581) (ANAC, 2020) and

according to Annex 6 (ICAO, 2018) and Annex 19 (ICAO, 2016) to the Convention on International Civil Aviation, Doc 9734 (ICAO, 2017), Doc 8335 (ICAO, 2010) and Doc 10070 (ICAO, 2016).

According to Section 4 of Annex 6 – Operation of Aircraft – Part I – Eleventh Edition:

QUALIFIED TECHNICAL PERSONNEL

The State of the Operator shall require that the initial and recurrent training of the authority Inspectors include aircraft-specific subjects.

Note.— Guidance on experience and training for Inspectors is contained in the Manual of Procedures for Operations Inspection, Certification and Continued Surveillance (Doc 8335). (ICAO, 2018, p. APP 5–2) [our emphasis]

According to Section 4.1 of Annex 19 – Safety Management – Part A – Second Edition:

States shall establish minimum qualification requirements for the technical personnel performing safety-related functions and provide for appropriate initial and recurrent training to maintain and enhance their competence at the desired level. (ICAO, 2016) [our emphasis]

According to Paragraph 3.4.1.5 of DOC 9734 – Safety Oversight Manual – Part A – Third Edition:

The maintenance of licences and other skills or qualifications and of an acceptable level of proficiency and knowledge of civil aviation activities, limitations, equipment, systems, operations, etc. will permit civil aviation Inspectors to better assess the knowledge, techniques and overall competence of the civil aviation personnel and service providers. (ICAO, 2017) [our emphasis]

According to Paragraph 3.4.2.3 of DOC 9734 – Safety Oversight Manual – Part A – Third Edition:

The State authorities also need to provide the necessary financial resources and time for their technical personnel to receive the required training. (ICAO, 2017) [our emphasis]

According to Paragraph 3.4.2.5 of DOC 9734 – Safety Oversight Manual – Part A – Third Edition:

As a principle, a staff member can only be authorized to perform safety oversight duties in the area or subject where the staff member has satisfactorily completed the required training and maintains the required competence. (ICAO, 2017) [our emphasis]

According to Paragraph 3.4.2.9 of DOC 9734 – Safety Oversight Manual – Part A – Third Edition:

Periodic practical and theoretical specialized (technical) training will enable the State's technical personnel to achieve and maintain a high level of knowledge and expertise and thus undertake their duties and responsibilities in a more effective and efficient manner. (ICAO, 2017) [our emphasis]

According to Paragraph 3.5.2.1 of DOC 9734 – Safety Oversight Manual – Part A – Second Edition:

The State authorities must determine the minimum professional qualifications for their technical personnel performing safety oversight functions and also provide for the technical and administrative training necessary for them to effectively accomplish their duties and responsibilities. For example, in the area of pilot proficiency, at least one pilot Inspector should be qualified and current on at least one aircraft type operated by each Airline over which the CAA has jurisdiction or responsibility (ICAO, 2017) [our emphasis]

According to Paragraph 5.3.1 of DOC 8335 – Manual of Procedures for Operations Inspection, Certification and Continued Surveillance – Fifth Edition:

To effectively fulfil its responsibilities, the CAA Inspectorate needs to be properly organized and staffed with qualified personnel capable of accomplishing the required wide range of technical inspection activities. To adequately perform their duties, it is important that the CAA Inspectorate staff have the qualifications, operational or technical work experience, and training compatible with the operations that they are required to certificate or inspect and that their qualifications compare favourably with those of operator personnel they will encounter in their inspections. (ICAO, 2010) [our emphasis]

According to Paragraph 6.2.1 of DOC 8335 – Manual of Procedures for Operations Inspection, Certification and Continued Surveillance – Fifth Edition:

Ideally a CAA Inspector should be at least as qualified as the personnel to be inspected or supervised. To carry out in-flight inspections, a CAA Inspector should be qualified on the type of aircraft concerned or on a type of aircraft with similar operational characteristics, and also possess appropriate route experience. However, it is recognized that although a CAA Inspector should be qualified on either the type of aircraft flown or on a similar type of aircraft, it cannot be expected that in all cases the CAA Inspector would possess the same level of flying experience on that type as the personnel under inspection or, in the case of operator fleets with multiple types, that the Inspector should be qualified on all types. Furthermore, in the case of route inspections, an Inspector cannot be expected to possess actual flying experience on all of the routes on which inspections are conducted. The CAA Inspector should, however, at least be experienced on comparable routes and be adequately briefed on the particular route under inspection. (ICAO, 2010)[our emphasis]

According to Paragraph 6.2.2 of DOC 8335 – Manual of Procedures for Operations Inspection, Certification and Continued Surveillance – Fifth Edition:

CAA Inspectors may obtain aircraft type qualifications through courses conducted by aircraft manufacturers, approved flight schools or Airline operators' training courses. As a general rule, it is not desirable for the CAA Inspector to obtain qualifications from an operator under the CAA inspectional jurisdiction. The maintenance of an Inspector's pilot qualifications may, if necessary, be carried out using approved flight simulation training devices when such a procedure is approved by the DGCA. (ICAO, 2010)[our emphasis]

According to Section 1.1. STATE OBLIGATIONS of Doc 10070 –Manual on the Competencies of Civil Aviation Safety Inspectors – First Edition:

There are two types of States' obligations with regard to oversight: those that relate to supporting international civil aviation and those that relate to supporting CASIs to effectively perform safety oversight functions on behalf of the CAA. (ICAO, 2016) [our emphasis]

According to Paragraph 1.1.1 FULFILLING REGULATORY OBLIGATIONS TO SUPPORT INTERNATIONAL CIVIL AVIATION of Doc 10070 – Manual on the Competencies of Civil Aviation Safety Inspectors – First Edition:

The Convention and its supporting nineteen Annexes establish several key obligations for Contracting States. One of the obligations is oversight of various aviation entities and activities.

To accomplish these obligations, Annex 19 — Safety Management, Appendix 1 identifies eight critical elements (CE) (Figure1):

Figure 6.1 – The eight critical elements of a State safety oversight system



Source: (Figure 1, Page 1-1, Doc 10070, ICAO, 2016, p. 1-1)

Critical elements 4 and 5 are particularly related to the qualification of CASIs and the implementation of critical elements 6, 7 and 8. Of particular interest are the Standards associated to these critical elements 4 and 5 in Annex 19, namely:

CE-4 Qualified technical personnel

4.1 The State shall establish minimum qualification requirements for the technical personnel performing safety oversight functions and provide for appropriate initial and recurrent training to maintain and enhance their competence at the desired level.

CE-5 Technical guidance, tools and provision of safety-critical information

5.1 **The State shall provide appropriate facilities, comprehensive and up-to-date technical guidance material and procedures, safety-critical information, tools and equipment, and transportation means, as applicable, to the technical personnel to enable them to perform their safety oversight functions effectively and in accordance with established procedures in a standardized manner. (ICAO, 2016) [our emphasis]**

According to Paragraph 1.1.2 CAA OBLIGATIONS TO SUPPORT AN EFFECTIVE INSPECTORATE of Doc 10070 – Manual on the Competencies of Civil Aviation Safety Inspectors – First Edition:

The State must establish conditions that allow CASIs to discharge their duties. This requires the State to delegate specific powers of authority to CASIs supporting the accomplishment of their tasks. Some States codify the CASI's power of authority and degree of accountability into aviation law to enable CASIs to effectively carry out their assignments. Creating the conditions that allow CASIs to discharge their duties also requires the DGCA to:

- **establish clear and comprehensive workplace policies and procedures;**
- **provide a safe working environment; and**
- **supply CASIs with adequate workplace resources. (ICAO, 2016) [our emphasis]**

The ANAC's initiative to address the lack of practical and technical training of pilot Inspectors for over a decade, considered by the Inspectorate as an unsafe working environment, resulted in the PCIV – ANAC's Flight Inspectors Training Programme (ANAC, 2019), which was instituted by the Directorate under the Normative Instruction 137 (ANAC, 2019), although, none of the benefits have been applied to the Inspectorate staff due to the lack of proper outcome more than 18 months later.

It is worth mentioning that ANAC is the Owner of 564 aircraft under the following CNPJ – National Register of Legal Entities:

Table 6.1 – Quantity of aircraft owned by ANAC

<i>Legal Entity Name</i>	<i>CNPJ – National Register of Legal Entities</i>	<i>Quantity</i>
<i>National Civil Aviation Agency ANAC</i>	<i>07.947.821/0002-60</i>	<i>94</i>
<i>Federal Government -ANAC</i>	<i>07.947.821/0001-89</i>	<i>90</i>
<i>Federal Government ANAC</i>	<i>07.947.821/0013-12</i>	<i>8</i>
<i>Federal Government ANAC</i>	<i>00.394.429/0043-60</i>	<i>372</i>
	<i>Total</i>	<i>564</i>

Source: own elaboration.

Most of these aircraft were lent to nonprofit flying clubs prior to ANAC's foundation without due. Astonishingly, a few were received brand-new by ANAC from the manufacturer and shuttled to an airport which shortly became their graveyard. A similar situation happened to many other aircraft that were lent after the use of the aircrafts' available hours, mainly due to the cost of TBO – Time between overhauls which the flying clubs claim they cannot afford to pay.

The most important information about the ANAC's aircraft: none of them were used for Inspectors' training or currency maintenance, despite the easiness of its use.

To summarize the easiness of the aircraft use, the ANAC could be in charge of refueling and flying if it acts as a lessor of its owned aircraft, while the operator acts as a lessee, operating and maintaining the aircraft airworthiness whenever established in the lease term.

The usage of ANAC's owned aircraft in the Inspectors' training should be incentivized in order to comply with the above-mentioned SAPRs as a complementary in-company approach to the approved ANAC's Flight Inspectors Training Programme (ANAC, 2019).

6.3 – Technical guidance, tools, and provision of safety-critical information – (CE-5)

6.3.1 – Digitalization of Job aids – Pilot flight proficiency check forms

According to Item 7.2.4 of ICAO's DOC 9941 (ICAO, 2011), the job aids have to be prepared to assist the user to attain the performance objective or to replace training partially or completely. There are also several fundamental points when preparing a job aid, such as accessibility, conciseness, accuracy, durability and modifiability.

Therefore, the digitalization of check forms is recommended and could help Inspectors to better apply the standards and register results, preflight, in-flight, and postflight, compared to a paper form that requires a pen, a clipboard and is subject to adverse operational environment.

The electronic information gathered could be easily used to monitor both the Examiner and examinee performances, instead of being in a paper in which only the approved or disapproved information is commonly used while all the other written precious data is put in the second place.

6.3.2 – Preflight Operational Risk Management Form

It is recommended the creation of a Preflight Operational Risk Management Form, such as the FAA's Preflight Operational Risk Management Form (NON-AEG or AEG Flights Only), contained in Notice 8900.442 – Flight Standards Aviation Safety Inspector (Operations) Risk Management (FAA, 2017), in order to provide a safe working environment to the Inspectors. Considering the difficulties detailed in Chapter 4 –, the Form should also include risks associated to the lack of Inspectors' rating, currency, medical certificate and technical training while existent, for proper risk assessment in ANAC's work environment.

6.3.3 – Unifying systems

In order to reduce unnecessary rework, it is recommended that the different systems work together as a unified system, avoiding filling the same data repeatedly.

The current status, from the beginning to the end of the process, the Inspector's assignment is done via the SisCheck – Roster's Flight Check Management System, which contains the candidates' data and the destination; then, the Inspector shall fill itinerary data in the SICOS – Service Order System, which sends data to someone else, who have to insert data again in the SCDP – Allowance and Fare System after the pilot flight proficiency check, in which is produced a handwritten paper form, the Inspector shall fill the simplified Electronic PEF – Pilot Evaluation Form in the SACI – Civil Aviation Information Integrated System, and shall report travel administrative accountability via e-mail, which was already pre-approved in three different systems: SisCheck, SICOS, and SCDP, before the activity, even if no changes were required.

6.3.4 – Mobile APP – application

The use of the mobile APP as a tool to register the flight data brings many benefits, such as the enhancement of the flight proficiency check through pictorial debriefing, the possibility to conduct off-site flight checks' oversight, and to analyze the data in order to improve the ANAC's flight activities.

It is worth mentioning that the SDEA – Santos Dumont English Assessment (ICAO English level) requires the upload of massive size of video files in order to conduct off-site

oversight, according to Item 5.8.2 of the Supplementary Instruction 183-001D (ANAC, 2018), which is not the proposal, because the data file size is just several kB – kilobytes.

Unlike GNSS – Global Navigation Satellite System purposes, the proposed tracker's accuracy, integrity, continuity and availability is not relevant per se, because its intended for post-flight use, assisting during debriefings, and for off-site oversight activities which might accept deviation.

6.4 – Licensing, certification, authorization and approval obligations – (CE-6)

6.4.1 – Valuing the Civil Aviation Inspector's flight duties

According to Section 6 of Appendix 1 of Annex 19 to the Convention on International Civil Aviation, the State shall ensure that individuals meet the requirements to exercise the privileges of a licence:

States shall implement documented processes and procedures to ensure that individuals and organizations performing an aviation activity meet the established requirements before they are allowed to exercise the privileges of a licence, certificate, authorization or approval to conduct the relevant aviation activity. (ICAO, 2016) [our emphasis]

According to Chapter 10 of Annex 6 to the Convention on International Civil Aviation, the flight operations officer shall be licensed in accordance with the provisions of Annex 1 to the Convention on International Civil Aviation:

When the State of the Operator requires that a flight operations officer/flight dispatcher, employed in conjunction with an approved method of control and supervision of flight operations, be licensed, that flight operations officer/flight dispatcher shall be licensed in accordance with the provisions of Annex 1. (ICAO, 2018) [our emphasis]

According to Section 1.2 of Doc 10070, if the Inspectors do not acquire the necessary competencies, safety will be impacted. Also, the Inspectors should be valued by being a highly-trained team, which acquisition and maintenance of a balanced team should be funded by the State to ensure that safety levels are not compromised:

While it is appreciated that some States with limited aviation activity have difficulty finding suitable CASI candidates, not acquiring the necessary competencies within the CAA Inspectorate impacts safety. The DGCA should champion the acquisition and maintenance of a well-balanced CAA Inspectorate suitably funded by the State to ensure aviation safety levels are not compromised.

...

*An additional recruitment strategy would be to highlight the benefits of belonging to a **team of highly-trained professionals** working towards creating a safer and more efficient air transportation system for the country and its citizens **and the opportunity of further developing themselves professionally** (ICAO, 2016) [our emphasis]*

The implementation of the PCIV – ANAC's Flight Inspectors Training Programme is a huge step toward acquiring the necessary competencies for providing the safety duties, and the enabler could be the use of a Civil Aviation Inspector ratings according to the similarities established in the PCIV, i.e.:

1. single engine;
2. multi-engine;
3. normal category jet 1;
4. normal category jet 2;
5. transport category multi-engine;
6. transport category jet 1;
7. transport category jet 2;
8. transport category jet 3;
9. transport category heavy jet 1;
10. transport category heavy jet 2;
11. single engine helicopter;
12. turboshaft helicopter 1;
13. turboshaft helicopter 2;
14. multi-engine helicopter 1;
15. multi-engine helicopter 2;

Analyzing the 2018's internal surveys made by and for the flight Inspectors, during the PCIV project, there were 51 Civil Aviation Inspectors that could be eligible for conducting pilot flight proficiency checks, as soon as properly provided recurrent training, instead of being misapplied in nonspecialized tasks.

It is also possible to rescue 7 Civil Aviation Inspectors that once were eligible for conducting pilot flight proficiency checks, but who lost interest, mainly due to the lack of training, i.e., a 14% increase in the specialized staff.

The major Inspectorate capacity improvement lies in the use of 22 potential candidates that meet the entry-level requirements for becoming Civil Aviation Inspectors eligible for conducting safety oversight activities, including pilot flight proficiency checks, i.e., a 43% increase in the specialized staff.

In other words, the better use of the available specialized staff (flight Inspectors) could be improved by at least 57% compared to the current use. There would be plenty of space for other huge improvements if the flight Inspectors were assigned to oversight activities that require their competencies and KSA – knowledge, skills, and attitudes, instead of being misused or underused in nonspecialized activities.

6.5 – Surveillance obligations – (CE-7)

Once provided with qualified personnel from CE-4, the appropriate technical guidance, and tools from CE-5, the certification obligations from CE-6, it is time to focus on the Surveillance obligations – (CE-7).

The State shall proactively assure that the requirements are continuously met by the aviation personnel, which includes the surveillance of the designated personnel to perform safety oversight functions on its behalf, as provisioned by Annex 1, 6, and Annex 19 to the Convention on International Civil Aviation.

According to Section 8 of Annex 1 – Personnel Licensing – Twelfth Edition, States shall maintain an effective oversight programme:

*Contracting **States shall maintain an effective oversight programme** of the approved training organization to ensure continuing compliance with the approval requirements. (ICAO, 2018) [our emphasis]*

According to Section 1.2 of Annex 1 – Personnel Licensing – Twelfth Edition, the Contracting State shall ensure the validity of issued licences. Therefore, flight proficiency checks are used to grant its privileges, to maintain the holder's competency, and shall be conducted by personnel authorized by the Licensing Authority:

1.2.5 Validity of licences

1.2.5.1 A Contracting State, having issued a licence, shall ensure that the privileges granted by that licence, or by related ratings, are not exercised unless the holder maintains competency and meets the requirements for recent experience established by that State.

...

Note 1.— Until 2 November 2022, **the maintenance of competency of flight crew** or remote flight crew members, engaged in commercial air transport operations, **may be satisfactorily established by demonstration of skill during proficiency flight checks completed in accordance with Annex 6.** (ICAO, 2018) [our emphasis]

According to Section 9 of Annex 1 – Personnel Licensing – Twelfth Edition, with the purpose of conducting flight proficiency checks, one shall be authorized by the Licensing Authority or designated by the training organization in accordance with criteria approved by the Licensing Authority:

9. Evaluation and checking

When a State has authorized an approved training organization to conduct the testing required for the issuance of a licence or rating, **the testing shall be conducted by personnel authorized by the Licensing Authority or designated by the training organization in accordance with criteria approved by the Licensing Authority.** (ICAO, 2018) [our emphasis]

It is worth mentioning that the required flight proficiency checks face several constraints caused by the relationship between ANAC and DECEA – Department of Airspace Control, which publishes NOTAM – Notices to Airmen or AIP – Aeronautical Information Publication remark that prohibit ANAC’s pilot flight proficiency checks. DECEA’s position jeopardizes aviation safety when it prohibits and interferes in the required use of certain navigation aids or operational maneuvers during the pilot flight proficiency checks, as the following examples:

Figure 6.2 – Example of NOTAM – Notices to Airmen prohibiting training and ANAC's pilot flight proficiency check

D1613/20 **R** **D1597/20** 06/10/2020 19:45
AD PRB FLT DE TREINAMENTO E CHECK ANAC
📅 05/12/20 19:00 a 05/12/20 21:00 UTC

Figure 6.3 – Example of AIP – Aeronautical Information Publication remark prohibiting training and ANAC's pilot flight proficiency check

REGULAMENTOS PARA TRÁFEGO LOCAL

- a. PRB voo de treinamento de PROC IFR TGL, cheque ANAC ou demais tipos de voo que interfiram nos procedimentos de saída e de chegada do AD, MON TIL FRI 1300-1600 1900-2130, SAT 1300-1600, SUN 1900- 2130. Nos demais horários, essas OPS somente com prévia AUTH do respectivo Órgão ATS

b. PRB FLT LCA no circuito de TFC, treinamento de PROC IFR, de TGL ou demais tipos de treinamento que interfiram MOV AD de 0800-1500, 1800-0200

6.5.1 – Outsourcing responsibilities

Considering the information analyzed in In-depth analysis of the pilot flight proficiency check's disapproval rates, ANAC has 93% of outsourced professionals, while performing 92% of the general pilot proficient flight checks and 96% of the initial checks required for licensing.

Although it is normal practice to delegate some activities to designated personnel, the CAA is responsible for closely supervising the designated Examiners, according to the DOC 8335 and Doc 9734, as follows:

According to Paragraph 5.3.2 of DOC 8335 – Manual of Procedures for Operations Inspection, Certification and Continued Surveillance – Fifth Edition:

*It is **normal practice** for the DGCA to **delegate** responsibility for some activities to **designated personnel** of an operator. In the operational field this applies to type ratings, instrument ratings and pilot proficiency checks. Candidates for designated Examiner are proposed by the operator. **The qualification and approval of these designated personnel**, covering Examiner activity in both the aircraft and flight simulation training devices, as necessary, **need to be conducted by the CAA**. These approvals are normally conditional on continuing employment with the same operator. **The CAA is responsible for closely supervising** the subsequent activities of **the designated Examiners**. There should be **requirements for minimum annual numbers of examinations** to be conducted by each designated Examiner. There should also be **requirements**, on a periodic basis, **for the observation of ratings and proficiency checks conducted by designated Examiners so that the CAA can monitor performance and renew the designated Examiner's approval when necessary**.... (ICAO, 2010) [our emphasis]*

According to Paragraph 3.6.2.1 of DOC 9734 – Safety Oversight Manual – Part A – Third Edition:

*Whether the licensing functions are discharged by a fully developed personnel licensing office or are **outsourced, the final responsibility remains with the CAA**. As applicable and in compliance with national legislation and procedures, licensing activities should include, but are not limited to, the following:*

...

*c) approval, designation and **supervision** of individuals or organizations (including medical **Examiners**) **delegated to perform** specific **tasks on behalf of the personnel licensing office**, if applicable; (ICAO, 2017) [our emphasis]*

Therefore, the Examiners must be closely supervised, their conduction of proficiency checks should be observed, and their performance monitored by the Inspectors because the final responsibility remains with the ANAC. In order to accomplish the above-mentioned supervision, there must be issued requirements for minimum annual numbers of examinations and periodic observation of ratings and proficiency checks conducted by the designated Examiner.

6.5.2 – Surveillance of Accredited Examiners

As mentioned in Presentation of the different solutions to the identified problem, there were some oversight activities focused on the Accredited Examiners. The oversight must be intensified through the use of appropriate specialized personnel, i.e., flight Inspectors, and be planned and accomplished by the use of a data-driven approach.

One of the requirements emphasized during the oversight is the requirement to fill the electronic PEF – Pilot Evaluation Form provisioned by Item 12.2 of the IS 00-002F:

*... The **Examiner shall** also, within 5 days of the check accomplishment, **fill the electronic PEF – Pilot Evaluation Form (FAP)** at the website <https://sistemas.anac.gov.br/saci/>. (ANAC, 2020)[our emphasis]*

The dataset gathered from the above-mentioned requirement made possible the analyses contained in Chapter 4 and has proven its potential towards a data-driven safety oversight.

Nonetheless, through the data collected, it is clear that several Accredited Examiners were not abiding by the requirement provisioned by Item 12.2 of the IS 00-002F, for instance, the Airlines' Accredited Examiners, which are not exempted from the filling of the electronic PEF, even when using other systems such as SISHAB – Rating System.

The above-mentioned lack of conformity to the IS 00-002F reduces the proposed data-driven oversight capabilities and should be widely corrected.

6.6 – Regulation improvement

The proposal of regulation improvement regarding pilot flight proficiency checks to require recurrent training as explained in In-depth analysis of the pilot flight proficiency check's

disapproval rates; and establish a limit of two checks per day (initial, retests, discontinuances, or continuances) or one initial flight instructor check, similarly to the provisions of Section 2, Item 14, a., of the Order 8900.2C, as follows:

14. Structure of the Practical Test. The practical test consists of a demonstration of aeronautical knowledge and skill. The two demonstrations are not intended to be separate tests. They should be conducted concurrently.

*a. **Number of Practical Tests Per Day. A DPE may not conduct more than two practical tests in 1 calendar-day** (i.e., midnight to midnight), unless that DPE has received specific written permission from the managing FAA office. Initial tests, retests, discontinuances, or continuations of practical tests are all considered practical tests, and the DPE must have received specific written permission from the managing FAA office to do more than two practical tests in any 1 calendar-day. **In the case of a designee administering an initial flight instructor practical test, the designee will not conduct more than one test per day.** If the initial flight instructor test is not a complete practical test (i.e., a retest or continuance), the designee may conduct an additional test on the same calendar-day (FAA, 2018, pp. 7-27) [our emphasis]*

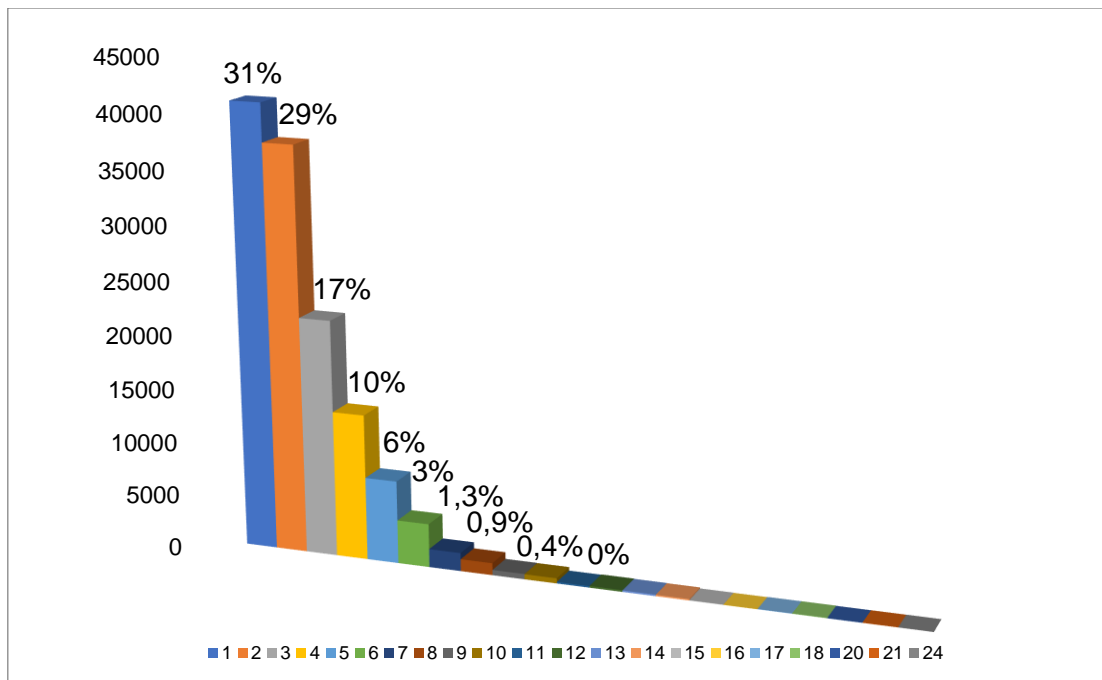
It is worth mentioning that the FAA has published the Notice 8900.485 - Removal of Designated Pilot Examiner Geographic Limitations and Other Restrictions, which allowed a temporary increase to up to three checks per day, but that was canceled in a one-year timeframe. Therefore, the following text is no longer valid:

(3) Number of Tests Allowed Daily. Managing offices will notify their DPEs that they are allowed to conduct up to three tests per day without additional approval and that there will be no limit on the number of retests that can be conducted per day. (FAA, 2018)

The proposed limitation to two checks per day aims to guarantee time availability to focus on the quality of the evaluation. Exceptions to this rule were incentivized considering the specifics of each pilot flight proficiency check, such as reducing to 1 flight instructor or Examiner checks or increasing to up to 3 when the operations environment permits.

In contrast to the FAA's reality, the lack of a limitation on the number of flight checks per days led to the following ANAC's scenario:

Figure 6.5 – ANAC's pilot flight proficiency check per day (2014-2019)



Surprisingly, the data showed that the number of flight checks per day varied from 1 to 24.

The majority of flight checks (60%) is performed in the categories of 1 and 2 per day. The supermajority of flight checks (77%) is performed in the categories of 1, 2, and 3 per day.

In order to identify the outliers regarding the number of flight checks per day, the IQR – Interquartile Range was used. The first quartile (Q1) was 1 flight check per day, the third quartile (Q3) was 3 flight checks per day. Using the IQR formula $IQR = Q3 - Q1$, the result was 2 flight checks per day. The outliers were found using two formulas:

$$\text{lower outliers} = Q1 - 1.5 IQR$$

$$\text{upper outliers} = Q3 + 1.5 IQR$$

There were no lower outliers in the data, but the upper outliers bound were at 6 flight checks per day. In other words, more than 6 flight checks per day were considered outliers, which represents 4% of the flight checks. The outliers should be mandatorily investigated for enforcement purposes or accreditation termination based on the premise that they might be a threat to safety.

To avoid extreme quantities of flight checks per day and to assure, at least, time availability that permits a minimum of quality during the flight checks, the regulation urges for a limitation on the number of flight checks, and the study's proposal lies in the IQR – Interquartile Range of 2 flight checks per day, which was exactly the same as the FAA's Order 8900.2C and compatible to the empirically perception of the Inspectorate experience that it should not be more than 4 flight checks per day.

As a matter of comparison, there is a limitation on the number of the exams for the SDEA – Santos Dumont English Assessment (ICAO English level) to up to four, preferably two in the morning and two in the afternoon, based on item 5.8.1, d), of the Supplementary Instruction 183-001D (ANAC, 2018). It is worth mentioning that these four exams are performed in an office, with air conditioning and noise isolation, unlike the harsh operations field conditions found in the equatorial and tropical regions of Brazil.

6.7 – Justification of the options which were chosen

The above-mentioned solutions were justified in order to abide by the ICAO SARPs, to identify the safety threats, to increase the defenses presented by the James Reason's Model, and to avoid the current Snook's practical drift on the pilot flight proficiency checks.

6.8 – Results obtained.

The results obtained came from the assessment of CE – Critical Elements provisioned by Annex 19 to the Convention on International Civil Aviation:

- Qualified technical personnel – (CE-4)
- Technical guidance, tools and provision of safety-critical information – (CE-5)
- Licensing, certification, authorization and approval obligations – (CE-6)
- Surveillance obligations – (CE-7) (ICAO, 2016)

The requirements for technical personnel qualification were detailed, based on the Annexes 1, 6, and 19 to the Convention on International Civil Aviation and several SARPs present in the ICAO Docs. The need for Inspectors' qualification, rating, and recent experience

was emphasized to the point of demanding urgent implementation of the PCIV – ANAC’s Flight Inspectors Training Programme.

Through the implementation of the proposed training, the ANAC would increase the flight Inspectors’ human resources by at least 57%, without any additional hiring. The pilot flight proficiency check and oversight capacities would increase largely if the required oversight was put in practice or the outsourcing policy was challenged by this research findings.

The enhancement of tools used by the flight Inspectors was proposed by the digitalization of job aids such as the PEF – Pilot Evaluation Form, which helps them on-site and, additionally, would collect comprehensive data to feed the system and improve oversight capabilities.

The licensing and rating of the flight Inspectors was proposed and justified based on the requirements and operational needs to properly perform flight activities, especially those that require the use of a two-seat aircraft.

The Proficiency Check Dashboard was proposed as a tool to assist the managers in their decision-making processes as well as allowing subsequent analysis to identify possible safety threats or enhancements by the technical personnel and for the data-driven oversight and standardization planning.

The oversight intensification proposed was possible and justifiable based on the collected pieces of evidence of the statistical differences between ANAC’s Examiners and Inspectors, while their disapproval rates were extremely different from the FAA’s disapproval rates, meaning that both Examiners and Inspectors need improvements towards the assessment of the pilot flight proficiency checks.

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Chapter 7 – Implementation

In order to implement the proposed solution of Technical Training, Oversight Intensification, and Standardization detailed in Chapter 6 –, it was advisable to consider the:

1. Assessment of proposed solution,
2. Allocation of requirements,
3. Assessment of organizational readiness,
4. Definition of transition requirements,
5. Validation of the solution, and
6. Evaluation of the solution performance.

7.1 – Implementation of Technical Training

Regarding the Technical Training, the PCIV – ANAC’s Flight Inspectors Training Programme is capable of fulfilling its needs, once fully implemented in its 5-year cycle. While this research was being performed, the initial implementation of the PCIV has started with resource allocation with an estimate of R\$ 1.743.806,00 for aircraft-related training (ground school, initial and recurrent) for at least 15 categories of aircraft and for 51 Inspectors. However, in order to fulfill the ICAO’s recommendation of Inspectors being “at least as qualified as the personnel to be inspected or supervised” (ICAO, 2010, pp. I-6-1), contained in Paragraph 6.2.1 of DOC 8335, the PCIV must include Flight Instructor training for the Inspectors responsible for the surveillance of RBAC 141 operations.

If properly implemented, the PCIV will provide the required Technical Training (TRN) and Capacity Development (CAP), which could be enough to comply with the Operations (OPS) and Personnel Licensing (PEL) requirements.

Inappropriately, the PCIV’s first round of technical training for single engine and multi-engine aircraft were exclusively held as ground school and as flight training using an AATD – Advanced Aviation Training Device, which do not fulfill the rating requirements of proficiency flight check in the aircraft, contained in Section 61.197 of RBAC 61 EMD13. Although the above-mentioned training were praised by the participant Inspectors, the lack of a proficiency flight check ruined the final objective of being rated and current in the aircraft.

It is worth mentioning that according to Section 61.197, (a), (2), (ii) of 14 CFR PART 61, the flight instructor who has served as a company check pilot, chief flight instructor, company check airman, or flight instructor in a part 121 or part 135 operation, or in a position involving the regular evaluation of pilots are granted certificate renewal without passing a practical test (FAA, 2020):

*§61.197 **Renewal requirements** for flight instructor certification.*

*(a) A person who holds a flight instructor certificate that has not expired **may renew that flight instructor certificate by—***

*(1) **Passing a practical test for—***

(i) One of the ratings listed on the current flight instructor certificate; or

(ii) An additional flight instructor rating; or

*(2) **Submitting a completed and signed application** with the FAA and satisfactorily completing one of the following renewal requirements—*

(i) A record of training students showing that, during the preceding 24 calendar months, the flight instructor has endorsed at least 5 students for a practical test for a certificate or rating and at least 80 percent of those students passed that test on the first attempt.

*(ii) A record showing that, within the preceding 24 calendar months, **the flight instructor has served as a company check pilot, chief flight instructor, company check airman, or flight instructor in a part 121 or part 135 operation, or in a position involving the regular evaluation of pilots.** (FAA, 2020) [our emphasis]*

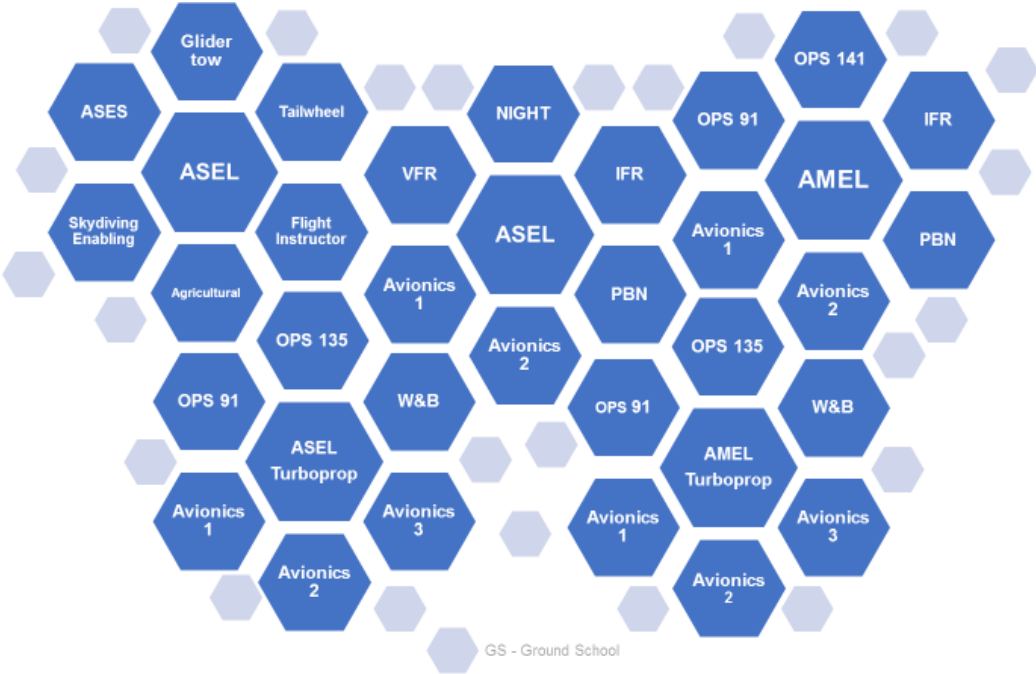
The alternative presented above, although not by any manner of means recommended by the author, could mitigate the lack of check and ratings among ANAC's Inspectors, by at least being verified and granted by the Authority.

Fortunately, the PCIV's first round of technical training for a normal category jet was held at a Training Center as ground school and as flight training using a FFS – Full Flight Simulator, which does fulfill the rating requirements of proficiency flight check in a Training Center, contained in Sections 61.213 and 61.215 of RBAC 61 EMD13.

As an enhancement proposal to the implementation of the PCIV – ANAC's Flight Inspectors Training Programme and further Inspectorate's training planning and control using it as a heatmap, the following diagram was presented, containing recommended additional training such as Emerging Technology, e.g. avionics (FMS – Flight Management System, HUD – Head-up Display, EFVS – Enhanced Flight Vision Systems) or Performance-Based Navigation, as required to the authority by the ICAO's Doc 10070, in order to support the

accomplishment of the Inspectors’ tasks, and recommended for the operators according to ATTACHMENT 2.B of Annex 6 – Part II:

Diagram 7.1 – Flight Inspector Training Honeycomb¹⁰ - ASEL, AMEL, and Turboprop



1.4 PREPARING CASIs FOR THE FUTURE

In order to comply with their oversight obligations, States need to ensure that: a) they have enough CASIs (tools are available on website xxx to support States in their CASI manpower planning process); and b) their CASIs are qualified and competent. This manual focuses on the latter in order to enhance the effectiveness of a State’s oversight activities today and to better prepare for their oversight needs of the future. (ICAO, 2016) [our emphasis]

Unconsciously, the Diagram 7.1, which recommended additional flight training, resembles the shape of a butterfly, a perfect metaphor for the Inspectors’ pilot training change of course, related to the training gap during the last 15 years of the ANAC’s existence, which represented the chrysalis stage, waiting to expand its wings.

Considering that the required organizational readiness is not yet fulfilled for Technical Training and subsequent Personnel Licensing, the proposed solution will be focused on Oversight Intensification and Standardization.

¹⁰ ASES – Airplane Single Engine Sea, ASEL – Airplane Single Engine Land, AMEL – Airplane Multi-Engine Land, VFR – Visual Flight Rules, IFR – Instrument Flight Rules, PBN – Performance-based Navigation, W&B – Weight and Balance, OPS 91 – General Aviation Operations, OPS 141 – Training Organization Operations, OPS 135 – Air Carrier Operations, GS – Ground School.

7.2 – Implementation of Oversight Intensification

The oversight intensification could be immediately implemented through the prioritization of flight Inspectors' assignments for the activities that require their KSA – knowledge, skills, and attitudes, such as the oversight of Accredited Examiners and pilot flight proficiency checks.

However, annually, the ANAC's middle-management proposes the next year's work plan to the top-management, who decides its implementation. That being said, the implementation requires the convincement of a few management levels before it is put into practice during the next year.

Ideally, in order to obtain the best results of the oversight intensification, the Inspectors shall receive a prior qualification, especially considering the last decade's gap and the extreme differences in the ANAC's and the FAA's disapproval rates.

Meanwhile, an immediate oversight intensification could still benefit from the 369% harsher Inspectors' disapproval rate, compared to the Examiners' rate, as mitigation.

A data-driven approach through the use of the Proficiency Check Dashboard, delivered by this study, could easily show the number of active Examiners, as well as their key performance indicators, in order to better plan the oversight activities.

Considering 2018 and 2019, there were 373 and 392 active Examiners, respectively, as well as 34 active Inspectors during both years. In 2019, there were 41 oversight activities focusing on the training organizations' Examiners, which represents roughly 10%.

The Examiners' oversight activities are divided into planned and on-demand, and the 2020's Annual Work Plan took into account an average of transport cost and DSA – daily subsistence allowance, from SCDP – Allowance and Fare System, as the following table:

Table 7.1 – Examiners' oversight activities: transport and DSA – daily subsistence allowance costs

2020's Annual Work Plan	Transport cost	Transport quantity	DSA cost	DSA quantity	Total
Planned	R\$ 671,00	2	R\$ 197,00	2	R\$ 1.736,00
On-demand	R\$ 743,00	2	R\$ 199,00	2	R\$ 1.884,00

Unfortunately, during 2020 there was no provision for the oversight of training organizations' Examiners, whereas, for the Airlines and Air Carriers, there were plans for 77 and 22 oversight activities, respectively.

Therefore, the solution proposed aims to prioritize and intensify the oversight of training organizations' Examiners by planning on-site activities to cover at least 20% of the active Examiners with a yearly budget of R\$ 149.296,00, in order to accomplish the surveillance of all Examiners in a 5-year cycle, as well as planning off-site activities and determining several accreditation terminations based on data-driven analysis that shows potential safety concerns.

7.3 – Implementation of Standardization

In order to implement Standardization, it was necessary to understand the current situation. Therefore, an online survey was conducted among ANAC's experts, exclusively sent to their professional e-mails. In spite of having only 51 Inspectors in the studied dataset, or 34 active Inspectors in 2019, the population that met the criteria for being Flight Inspector was 63, including those who decided to stop conducting pilot flight proficiency check, mainly for safety reasons, and excluding those who are not currently employed by the Civil Aviation Agency.

Therefore, the survey asked the ANAC's Inspectors, based on their professional experience, their perception related to the Inspectors and those related to the Examiners, though identical in content, except for the additional questions related to surveillance.

The final survey was comprised of 48 items, including 1 Multi select Multiple Choice Question for Operations Specifications, 38 5-point Likert Scales for the level of agreement on statements, 2 open boxes for statement inclusion and their associated 5-point Likert Scales for the level of agreement, 3 Single select Multiple Choice Questions for professional experience validity and 2 Multi select Multiple Choice Questions for enhancement proposals to fill the perceived safety gap.

The survey was distributed on 3rd February 2021, a reminder e-mail was sent on 8th February 2021, and data collection was terminated on 12th February 2021.

There were 50 responses to the survey comprised of 63 ANAC's experts, which resulted in the following expertise profile:

Figure 7.1 – Years of professional experience as pilot.

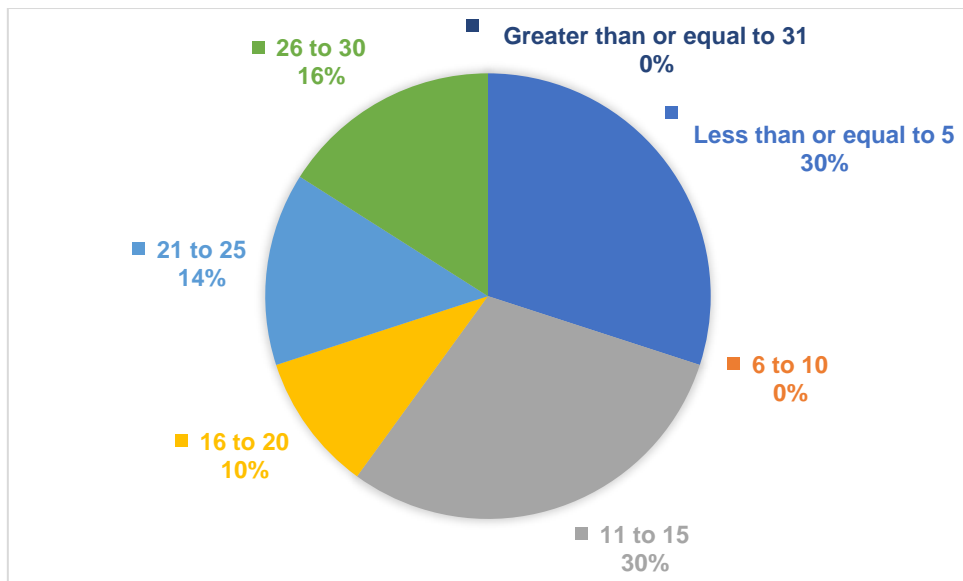


Figure 7.2 – Quantity of total flight hours.

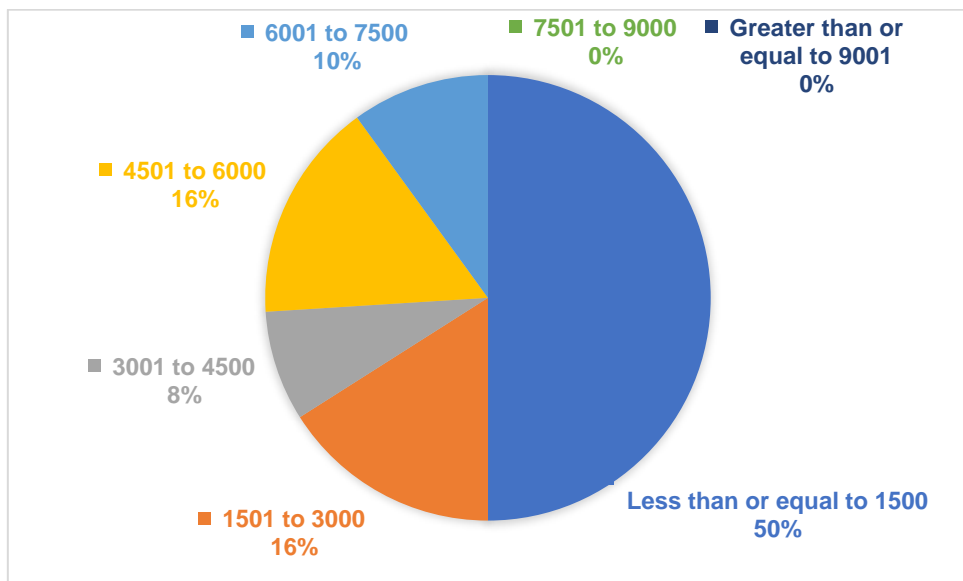
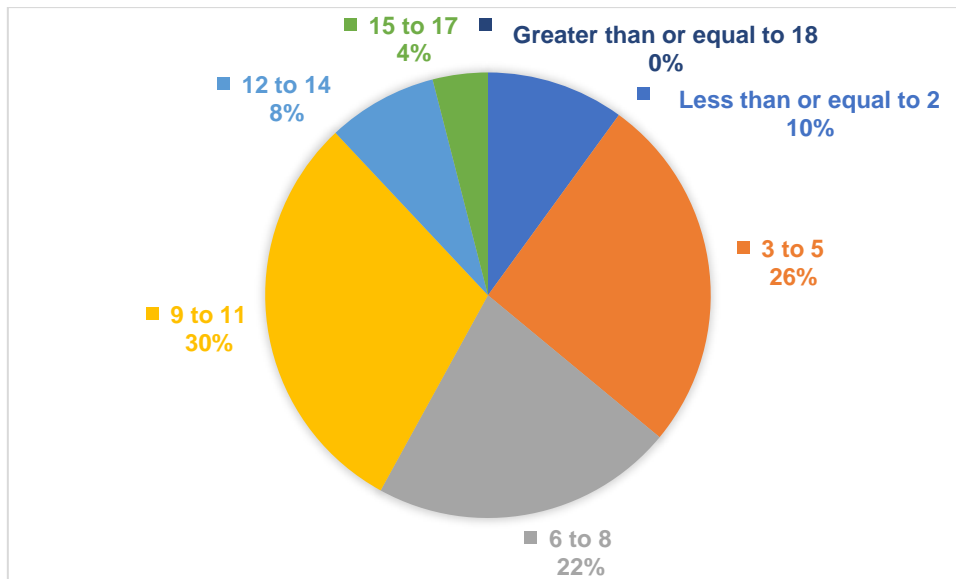


Figure 7.3 – Years of professional experience as ANAC’s Flight Inspector (if there is prior experience as ANAC’s Accredited Examiner, this period shall be added)



The interpretation of Figure 7.3, Figure 7.4, and Figure 7.5 were that even though experienced both as pilots and as Inspectors, there is a tendency to low quantities of total flight hours, compared to the FAA’s 1,500 flight hours as ASI job requirement or 500 flight hours for Sport Pilot DPE, or 2,000 flight hours for PPL, CPL, and ATPL DPE, according to Order 8900.2C, or compared to the recommended 5,000 flight hours of Paragraph 6.2.4 of ICAO’s DOC 8335 (ICAO, 2010, pp. I-6-2).

One hypothesis to this tendency was based on the difficulties shown in Chapter 4 –, i.e., the lack of flight hours log among Inspectors. The main reason is the absence of rating, medical certificate and currency, that must be provided by the CAA, which would constitute a violation to the requirements contained in Sections 61.3, 61.17, 61.21, and 61.31 of RBAC 61 EMD13, although the log is mandatory to Inspectors and Examiners as flight instruction hours based on the Section 61.31, (c), (5), (ii) and (iii) of RBAC 61 EMD13, translated in Section 4.10.1.3 – of this study, and transcribed in Portuguese, in order to emphasize, as:

(c) Registro das horas de voo na função:

...

(5) hora de voo em instrução: todas as horas de instrução de voo registradas como horas de instrução, seja de voo visual, de voo por instrumentos ou em dispositivos de treinamento por voo simulado, devem ser certificadas pelo instrutor de voo que tenha ministrado a referida instrução:

...

(ii) as horas realizadas no exame de proficiência devem ser registradas pelo INSPAC ou examinador credenciado responsável por tal exame, que informará se o aluno piloto foi aprovado ou reprovado, seu CANAC, nome e assinatura;

(iii) as pessoas citadas nos parágrafos (c)(5)(i) e (c)(5)(ii) desta seção que preencherem ou endossarem um lançamento na CIV ou CIV Digital com informações ou dados inexatos ou adulterados ficam sujeitas às providências administrativas previstas na Lei nº 7.565/86 – Código Brasileiro de Aeronáutica (CBA) ou na legislação complementar, além das sanções penais e civis cabíveis, uma vez que tal fato poderá comprometer a segurança de voo; e (Redação dada pela Resolução nº 378, de 18.03.2016) (ANAC, 2020) [our emphasis]

According to Paragraph 2.1.1.1 of Annex 6 – Part II, the pilot-in-command shall comply with the laws, regulations and procedures of those States in which operations are conducted (ICAO, 2018).

According to Paragraph 2.7.2.1 of Annex 6 – Part II, the pilot-in-command shall ensure flight crew member holds valid licence, are rated, and maintain competency:

*a) ensure that each flight crew member **holds a valid licence** issued by the State of Registry, or if issued by another Contracting State, rendered valid by the State of Registry;*

*b) ensure that flight crew members **are properly rated**; and*

*c) be satisfied that flight crew members **have maintained competency**. (ICAO, 2018) [our emphasis]*

The lack of flight hours log dates back to 2009, when a remarkable welcome meeting to newly hired pilots (with valid ratings and medical certificates as entry requirements), held by a former superintendent and latter director, who told them that they were not pilots from that time onward, nor must they act as pilot in command or occupy a pilot's seat, be rated or log their flight hours, subjected to conflict of interest and Office for Internal Affairs inquiries. Similar meetings were held periodically with the same superior understanding while often challenged by the Inspectorate.

Also, these pilots often took around three years to be assigned and to conclude their training as Flight Inspectors, even being experienced such as international B767 captains and B777 first officers, domestic B737 and A320 captains and first officers, and Air Carrier, SAE – Specialized Air Service, General Aviation or Flight instructors pilots, and, in the meantime, performing nonspecialized tasks and being misused or underused.

It is worth mentioning that the FAA considered each proficiency check as 5 hours of PIC – Pilot in Command currency experience, according to Order 8900.2B (FAA, 2016), superseded by Order 8900.2C (FAA, 2018), which requires 10 checks for currency requirement:

g. Former Aviation Safety Inspectors (ASI) ... may credit former ASIs (Operations) 5 hours of PIC currency for certain tests/checks administered. This recent PIC credit may be offered under the following three conditions:

...

(3) ...

(a) For each proficiency check that was administered under 14 CFR parts 121, 125, or 135, 5 hours of PIC currency within the preceding 12 calendar-months.

(b) For each proficiency check, 5 hours of PIC currency that was administered to a chief instructor, assistant chief instructor, or check instructor under 14 CFR part 141 within the preceding 12 calendar-months.

... (FAA, 2016)

g. Former Aviation Safety Inspectors (ASI) ... for PIC experience requirements in the past 12 calendar-months ...

(2) ASI (Operations) must have conducted a combination of at least 10 tests or checks ... (FAA, 2018) [our emphasis]

According to the ANAC's Inspectors' level of agreement on the surveyed statements, it was possible to perceive clear disparities between Inspectors and Examiners, when both professional categories were subject to the same regulations and to perform standardized pilot flight proficiency checks.

The survey's statements, attached to ANNEX 1 and ANNEX 2, were based on Pilot Technical Training (TRN), Operations (OPS), Capacity Development (CAP), Standards (STD), and Surveillance (SUR), with the level of agreement expressed in Figure 7.4 - Inspectors' survey on Inspectors' factors. and Figure 7.5 – Inspectors' survey on Accredited Examiners' factors.

The largest disparities, on the one hand, were related to the lack of Inspectors' Pilot Technical Training (TRN), Operations (OPS) requirements compliance, and Capacity Development (CAP), while, on the other hand, were related to the lack of Accredited Examiners' Capacity Development (CAP), Standards (STD) and Surveillance (SUR).

Fortunately, the PCIV – ANAC's Flight Inspectors Training Programme, if properly implemented, will provide the required Technical Training (TRN) and Capacity Development (CAP), which could be enough to comply with the Operations (OPS) requirements, if appropriately accepted by the Personnel Licensing (PEL) Department of the CAA, and should be periodically reassessed through similar surveys to keep the Programme operationally and technologically up-to-date.

Unfortunately, the Examiners are not subject to the same Capacity Development (CAP) requirements, applicable to the Inspectors, i.e., receive 3 (three) OJT – On-the-job training from ANAC; and receive theoretical recurrent capacity development from ANAC. If both Capacity Development were also applied to the Examiners, the standardization and the disapproval rates could converge to the Inspectors' higher values.

Also, according to the level of agreement on the Surveillance (SUR) statements, the Examiners are not exempted from conflict of interest and seldom subjected to surveillance during the accreditation validity. The possibility of a conflict of interest, in addition to the lack of surveillance and to the Inspectorate's *status quo*, worsen by the current management decisions on outsourcing pilot flight proficiency checks to private individuals, not even linked to a certified operator, nor surveilled, certainly endangers the aviation system and must be thoroughly regulated, standardized and supervised.

Figure 7.4 - Inspectors' survey on Inspectors' factors.

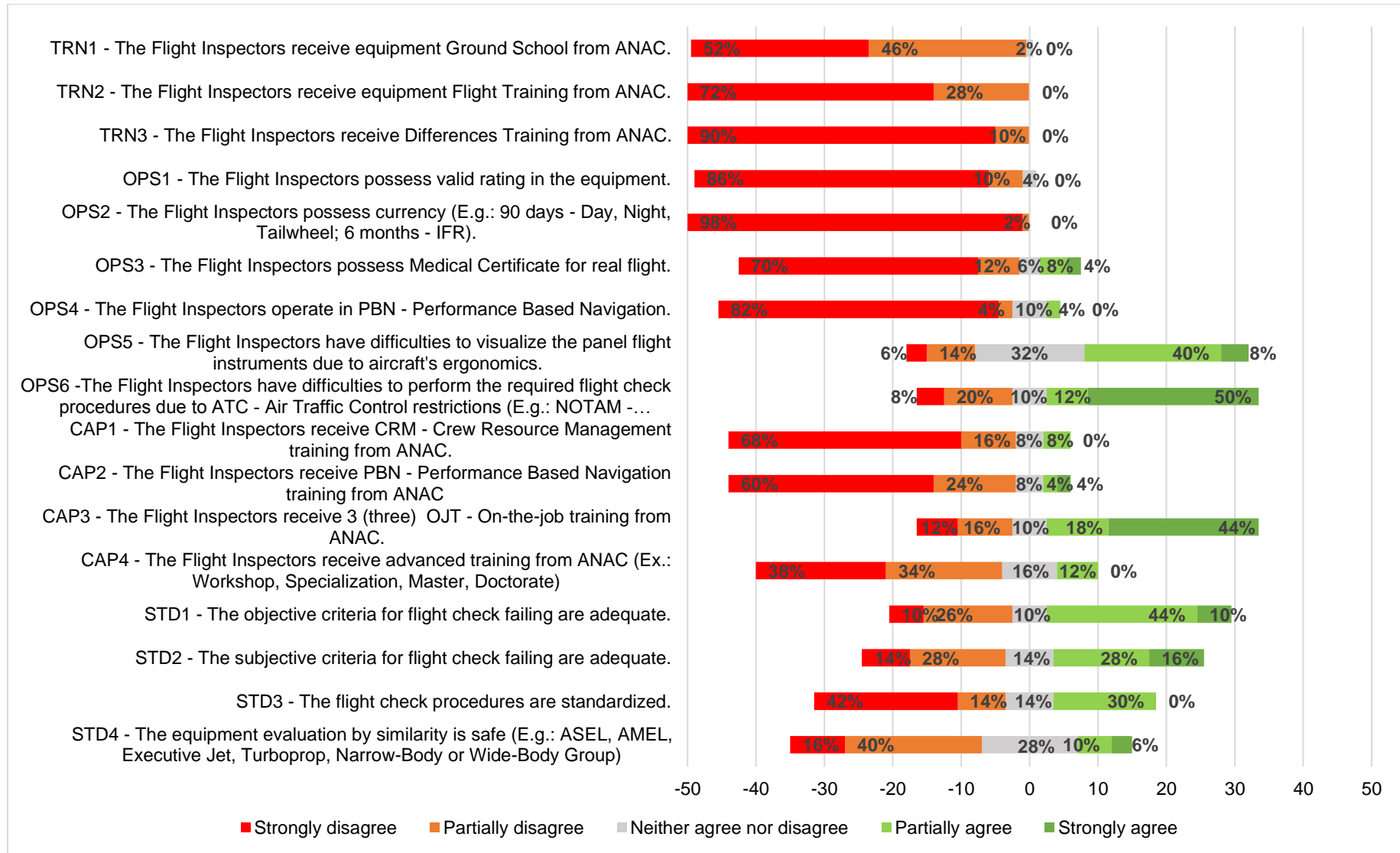
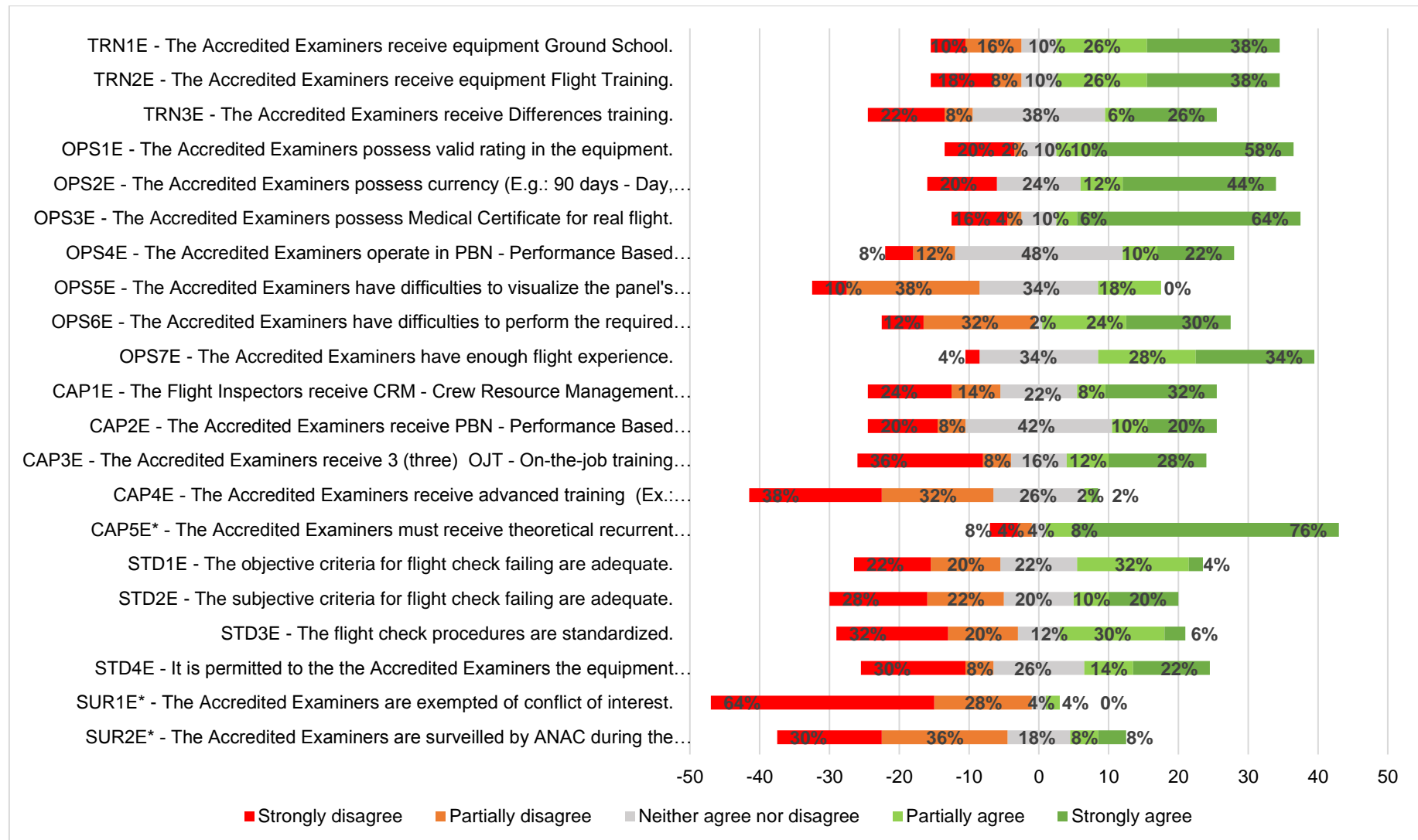


Figure 7.5 – Inspectors' survey on Accredited Examiners' factors.



7.3.1 – Inspectors' survey's validation

The above-mentioned survey was based on Dave Collingridge's six-step validation method, which includes Face validation, Pilot Test of the Questionnaire, Clean Collected Data, PCA – Principal Component Analysis, Cronbach's Alpha, and Question revision if needed (Aithal & Aithal, 2020, p. 11, apud Collingridge & Gantt, 2008).

The survey's construct was aligned to the Null Hypothesis of no differences between the ANAC's Accredited Examiners and Civil Aviation Inspectors ($H_0: \mu_1 - \mu_2 = 0$).

The Face validity was assessed by two non-experts (an Engineer and a Lawyer), by two ANAC's experts (an Air Traffic Controller and an Accident Investigator and Journalist, both Commercial Pilots), and a former ANAC's expert (an Airline Transport Pilot). The three ANAC's experts also validated the content, which reflected the information gathered from the literature reviewed in the previous chapters. Through their contribution, it was possible to spot understanding problems as well as leading statements during the Pilot Test, which were corrected prior to the distribution.

The survey's Construct Validity (Convergent and Discriminant Validities) could be verified by means of factor analysis conducted using PCA - principal component analysis with varimax rotation method as described below:

Table 7.2 – PCA - principal component analysis

	Component Loadings			
	Component			Uniqueness
	1	2	3	
TRN1			0.374	0.817
TRN2			0.503	0.708
OPS3			0.663	0.543
OPS4		-0.312	0.304	0.736
OPS5			0.439	0.732

Component Loadings

	<i>Component</i>			<i>Uniqueness</i>
	<i>1</i>	<i>2</i>	<i>3</i>	
<i>OPS6</i>			<i>0.584</i>	<i>0.593</i>
<i>CAP1</i>			<i>0.748</i>	<i>0.312</i>
<i>CAP2</i>	<i>-0.363</i>	<i>-0.551</i>	<i>0.373</i>	<i>0.425</i>
<i>CAP3</i>			<i>0.701</i>	<i>0.489</i>
<i>CAP4</i>		<i>-0.372</i>	<i>0.722</i>	<i>0.337</i>
<i>STD1</i>	<i>-0.303</i>	<i>0.712</i>		<i>0.390</i>
<i>STD2</i>		<i>0.846</i>		<i>0.222</i>
<i>STD3</i>		<i>0.649</i>		<i>0.538</i>
<i>TRN1E</i>	<i>0.916</i>			<i>0.151</i>
<i>TRN2E</i>	<i>0.909</i>			<i>0.169</i>
<i>TRN3E</i>	<i>0.942</i>			<i>0.109</i>
<i>OPS1E</i>	<i>0.885</i>			<i>0.173</i>
<i>OPS2E</i>	<i>0.919</i>			<i>0.152</i>
<i>OPS3E</i>	<i>0.666</i>			<i>0.459</i>
<i>OPS4E</i>	<i>0.778</i>		<i>-0.308</i>	<i>0.297</i>
<i>OPS5E</i>	<i>-0.672</i>			<i>0.528</i>
<i>OPS6E</i>	<i>-0.453</i>			<i>0.707</i>
<i>OPS7E</i>	<i>0.712</i>			<i>0.476</i>

Component Loadings

	<i>Component</i>			<i>Uniqueness</i>
	<i>1</i>	<i>2</i>	<i>3</i>	
<i>CAP1E</i>	0.907			0.118
<i>CAP2E</i>	0.862			0.180
<i>CAP4E</i>	0.485		0.430	0.579
<i>STD1E</i>		0.799		0.357
<i>STD2E</i>		0.754		0.288
<i>STD3E</i>		0.797		0.295

Note. 'varimax' rotation was used

*Source: own elaboration using
(The jamovi project, 2020) (R Core Team, 2019) (Revelle, W., 2019)*

The survey's Internal Consistency was measured by the Cronbach's Alpha α , for a questionnaire X, and κ number of items, σ_i^2 is the variance of item i, and σ_X^2 is the total variance of the questionnaire. The Cronbach's Alpha α were calculated using the following formula and represented in Table 7.3, Table 7.4, and Table 7.5:

$$\alpha = \frac{\kappa}{\kappa - 1} \left(1 - \frac{\sum_{i=1}^{\kappa} \sigma_i^2}{\sigma_X^2} \right)$$

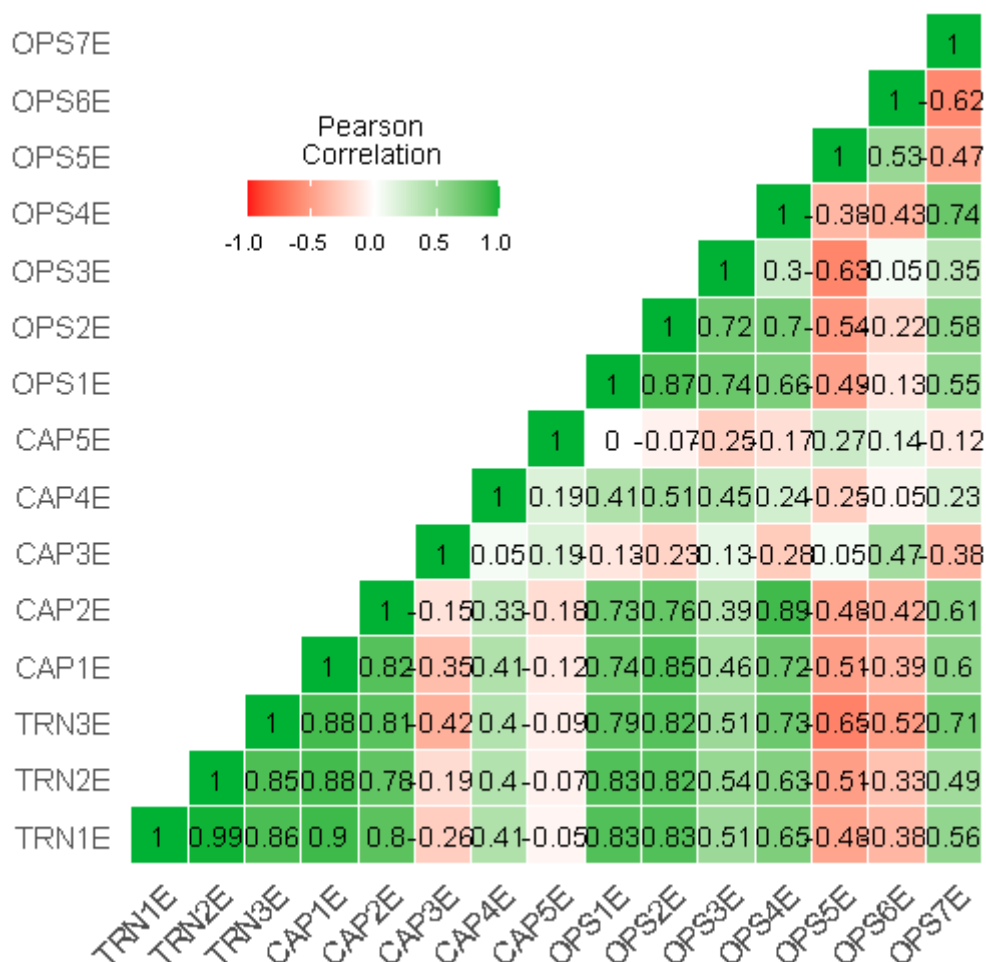
Table 7.3 – Reliability Analysis – Component 1

Scale Reliability Statistics

	Cronbach's α
scale	0.840

Note. items 'CAP3E', 'CAP5E', 'OPS5E', and 'OPS6E' correlate negatively with the total scale and probably should be reversed

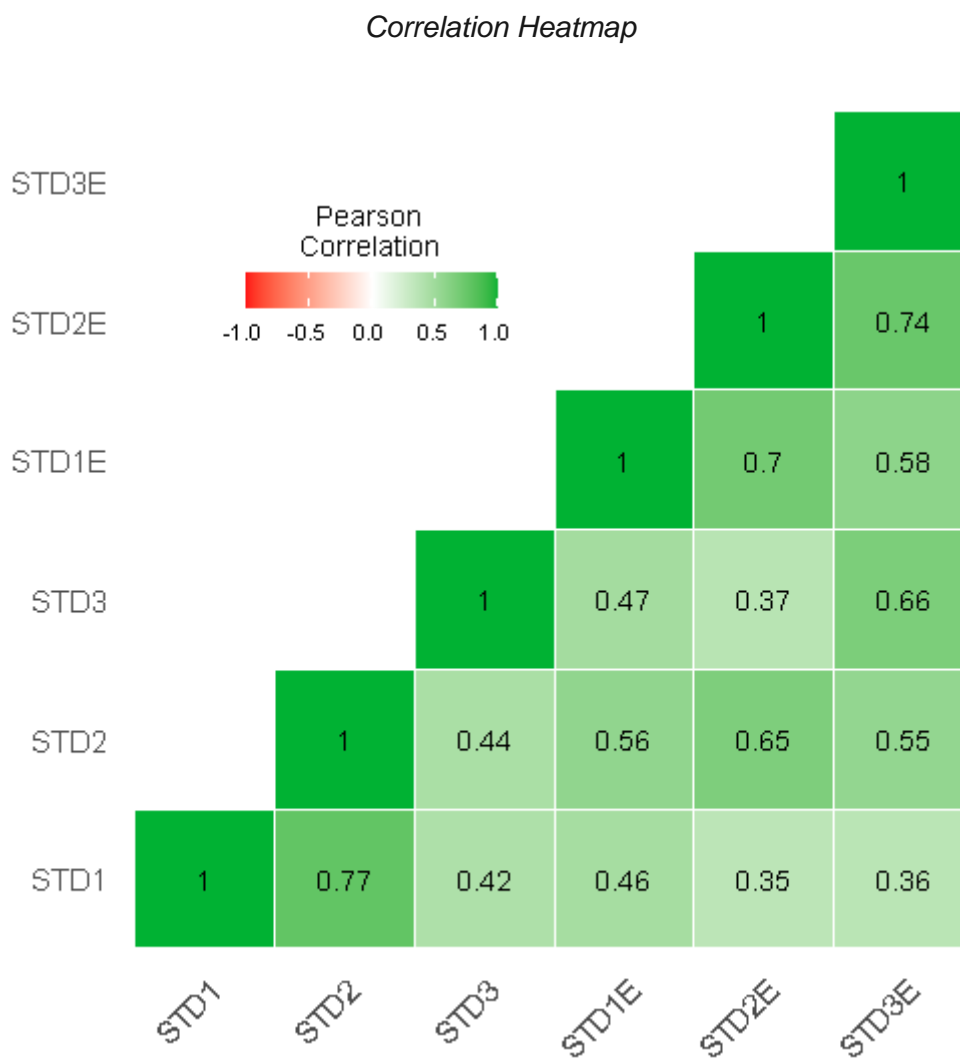
Correlation Heatmap



Source: own elaboration using
 (The jamovi project, 2020) (R Core Team, 2019) (Revelle, W., 2019)

Table 7.4 – Reliability Analysis – Component 2

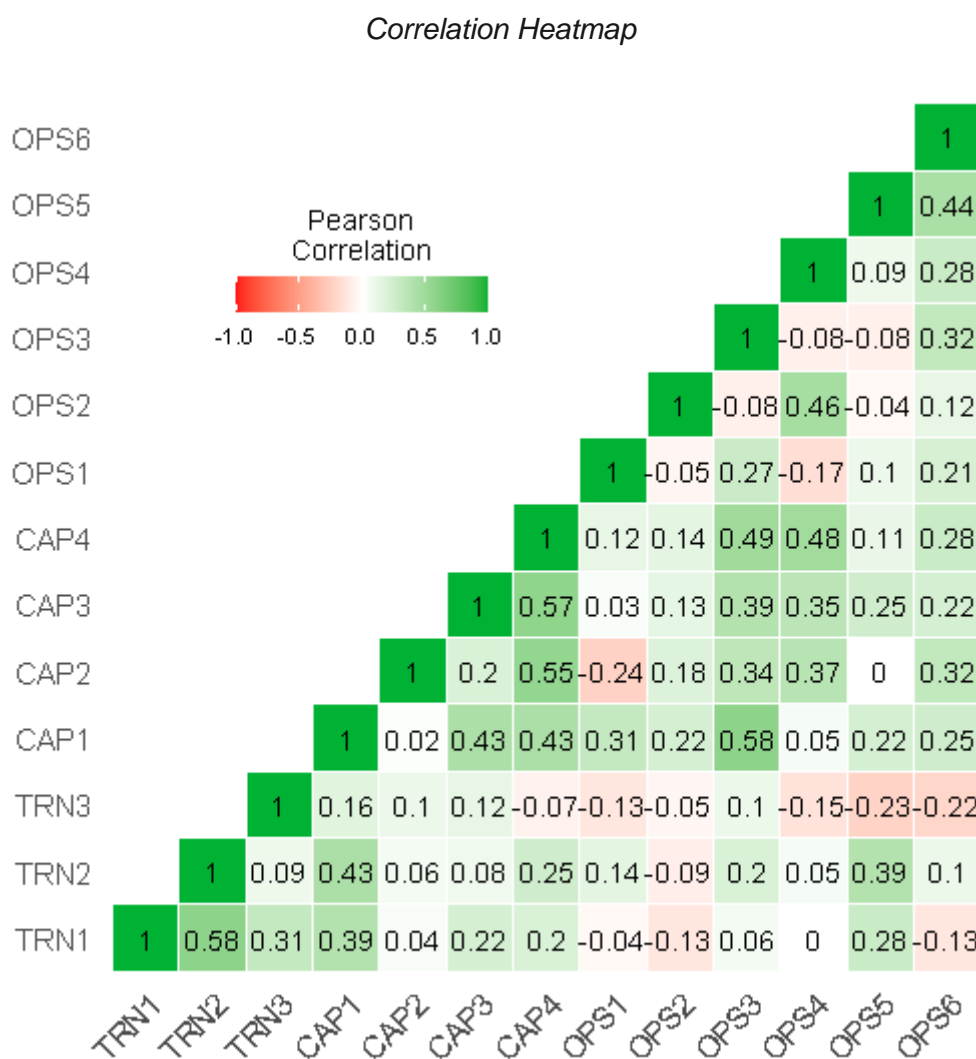
Scale Reliability Statistics	
	Cronbach's α
scale	0.876



Source: own elaboration using
 (The jamovi project, 2020) (R Core Team, 2019) (Revelle, W., 2019)

Table 7.5 – Reliability Analysis – Component 3

Scale Reliability Statistics	
	Cronbach's α
scale	0.741



Source: own elaboration using (The jamovi project, 2020) (R Core Team, 2019) (Revelle, W., 2019)

In order to test the Null Hypothesis of no differences between the ANAC's Accredited Examiners and Civil Aviation Inspectors ($H_0: \mu_1 - \mu_2 = 0$) into the Inspectors' Survey's data, it was used the Paired Samples T-Test as follows:

Table 7.6 – Paired Samples T-Test – Inspectors’ Survey

			statistic	df	p	Mean difference	SE difference	95% Confidence Interval		Effect Size	
								Lower	Upper		
TRN1	TRN1E	Student's t	-10.070	49.0	< .001	-2.1600	0.214	-2.5910	-1.7290	Cohen's d	-1.4241
TRN2	TRN2E	Student's t	-10.122	49.0	< .001	-2.3000	0.227	-2.7566	-1.8434	Cohen's d	-1.4315
TRN3	TRN3E	Student's t	-9.339	49.0	< .001	-1.9600	0.210	-2.3818	-1.5382	Cohen's d	-1.3207
OPS1	OPS1E	Student's t	-11.959	49.0	< .001	-2.6600	0.222	-3.1070	-2.2130	Cohen's d	-1.6912
OPS2	OPS2E	Student's t	-11.951	49.0	< .001	-2.5800	0.216	-3.0138	-2.1462	Cohen's d	-1.6901
OPS3	OPS3E	Student's t	-9.960	49.0	< .001	-2.3400	0.235	-2.8121	-1.8679	Cohen's d	-1.4086
OPS4	OPS4E	Student's t	-9.029	49.0	< .001	-1.9000	0.210	-2.3229	-1.4771	Cohen's d	-1.2768
OPS5	OPS5E	Student's t	5.315	49.0	< .001	0.7000	0.132	0.4353	0.9647	Cohen's d	0.7516
OPS6	OPS6E	Student's t	2.555	49.0	0.014	0.4800	0.188	0.1024	0.8576	Cohen's d	0.3613
CAP1	CAP1E	Student's t	-6.624	49.0	< .001	-1.5400	0.232	-2.0072	-1.0728	Cohen's d	-0.9368
CAP2	CAP2E	Student's t	-4.747	49.0	< .001	-1.3400	0.282	-1.9073	-0.7727	Cohen's d	-0.6713
CAP3	CAP3E	Student's t	2.588	49.0	0.013	0.7800	0.301	0.1743	1.3857	Cohen's d	0.3660
CAP4	CAP4E	Student's t	0.230	49.0	0.819	0.0400	0.174	-0.3091	0.3891	Cohen's d	0.0326
STD1	STD1E	Student's t	2.322	49.0	0.024	0.4200	0.181	0.0565	0.7835	Cohen's d	0.3283
STD2	STD2E	Student's t	1.908	49.0	0.062	0.3200	0.168	-0.0170	0.6570	Cohen's d	0.2699
STD3	STD3E	Student's t	-1.667	49.0	0.102	-0.2600	0.156	-0.5735	0.0535	Cohen's d	-0.2357

Source: own elaboration using (The jamovi project, 2020) (R Core Team, 2019) (Revelle, W., 2019)

Almost all factors have delivered a p-value less than 0.05, then the Null hypothesis (H_0) could be rejected, and there is a statistically significant difference between the ANAC’s Accredited Examiners and ANAC’s Inspectors, according to the data gathered from the Inspectors' survey's. The exceptions are mainly related to standardization factors, which is positive, although may require improvements.

The detailed comparison is contained in the ANNEX 3 – Inspectors’ Survey – Paired Samples T-test – Descriptive Plots.

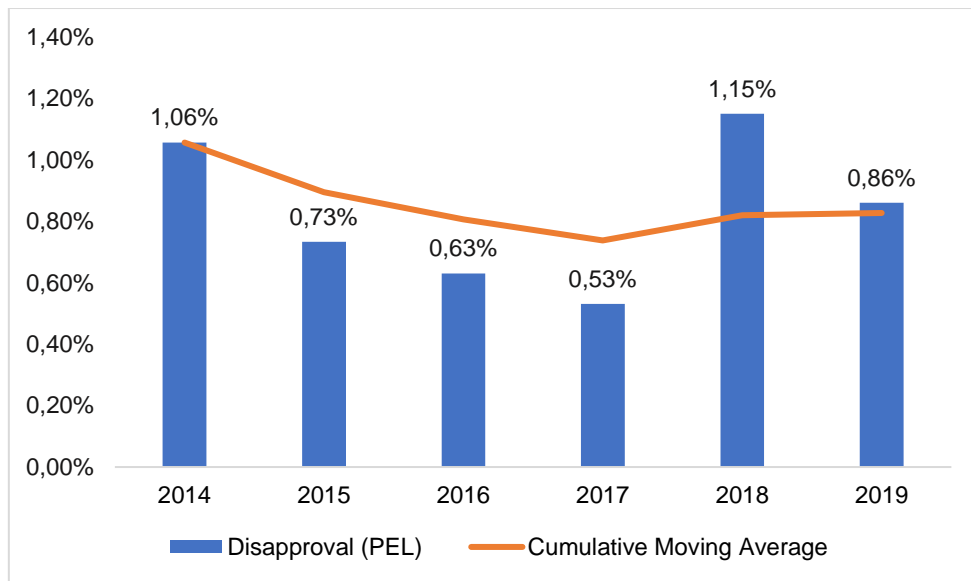
7.4 – Validation of the solutions against the initial needs

As a critical look at the oversight intensification and standardization proposed by this research against the initial needs, the short-term results might not even be noticed if there is no change in the current rotten safety culture. However, considering that each one of the 51 Inspectors available (or 80 Inspectors if proper training is provided) manage to supervise and standardize 2 (or 1) of the 698 Examiners in order to disapprove a single examinee due to a bad performance compared to the standards, we will see an increase greater than 100% based on the 2019’s disapproval rate, and this scenario is quite feasible, without even mentioning the Inspectors’ own rates increase. It is worth mentioning that to reach the FAA’s mean disapproval rate for licensing it is required an increase of 2825,67%, but the intention is not to pursue or establish a rate.

The oversight activities aimed at the Examiners from the RBAC 141 demonstrated in Table 5.3 – Accredited Examiners’ Oversight Inspections (2016 – 2019) Table 5.3 and in Table 5.4 represent an oversight intensification conducted in 2019 (with 41 inspections), motivated by the discussions between the student and his manager before this research was started and represented how easily it could be intensified if the managers were convinced of its needs.

The following figure represents the ANAC's disapproval rate histogram for licensing (2014 – 2019):

Figure 7.6 – The ANAC's disapproval rate histogram for licensing (2014 – 2019)

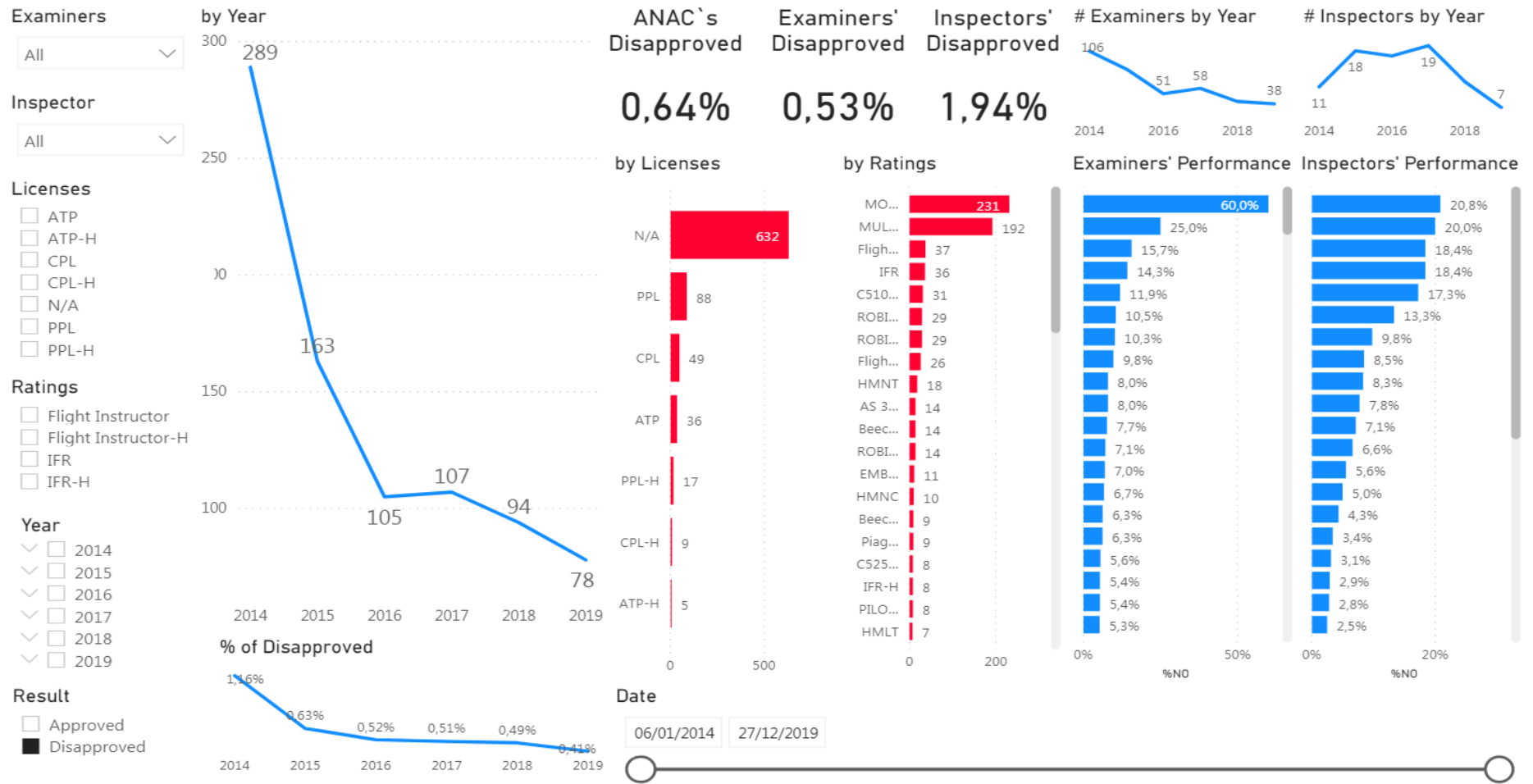


Source: own elaboration

The above-mentioned figure represents an increase of 117% in 2018's disapproval rate for licensing, after an oversight intensification held in 2017 (with 25 inspections), which also reverted its downward tendency.

The evaluation of the proposed solution might expect a similar result, although intensified by the enhancements proposals and by the in-depth knowledge of the pilot flight proficiency check status, acquired during this research and available through the Proficiency Check Dashboard, which will provide valuable information such as the following figures:

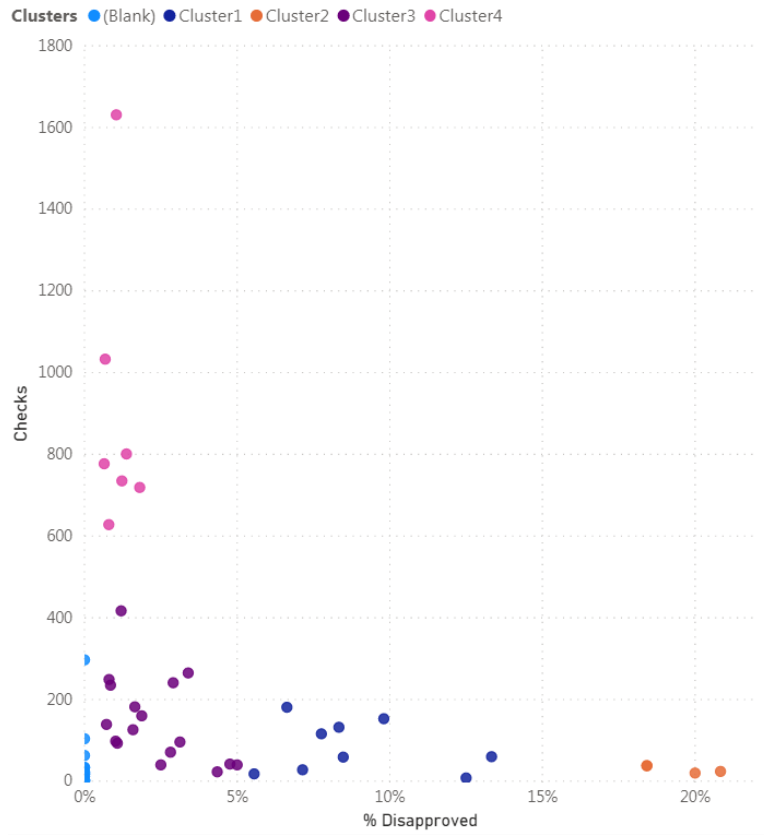
Figure 7.7 – Proficiency Check Dashboard – Disapproved slicer.



Source: own elaboration

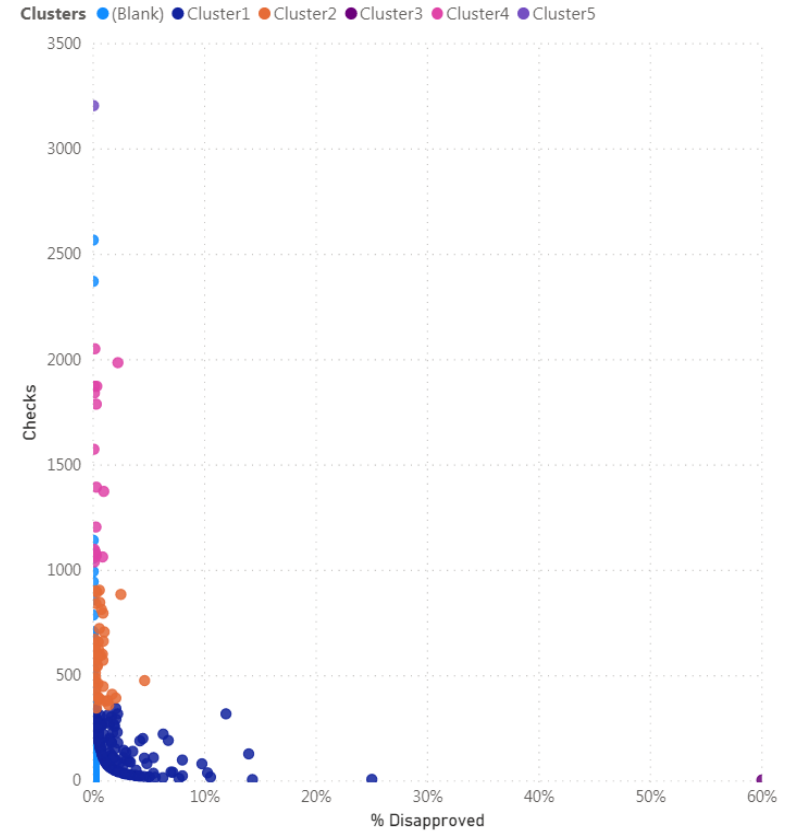
The information in Figure 7.7 clearly shows a decreasing tendency on the quantity of pilot flight proficiency check disapproval, ranging from 289 in 2014 to 78 in 2019. It also details disapprovals by licences and ratings, as well as the Examiners' or Inspectors' performance.

Figure 7.8 – Inspectors' disapproval percentage by the number of checks



Source: own elaboration.

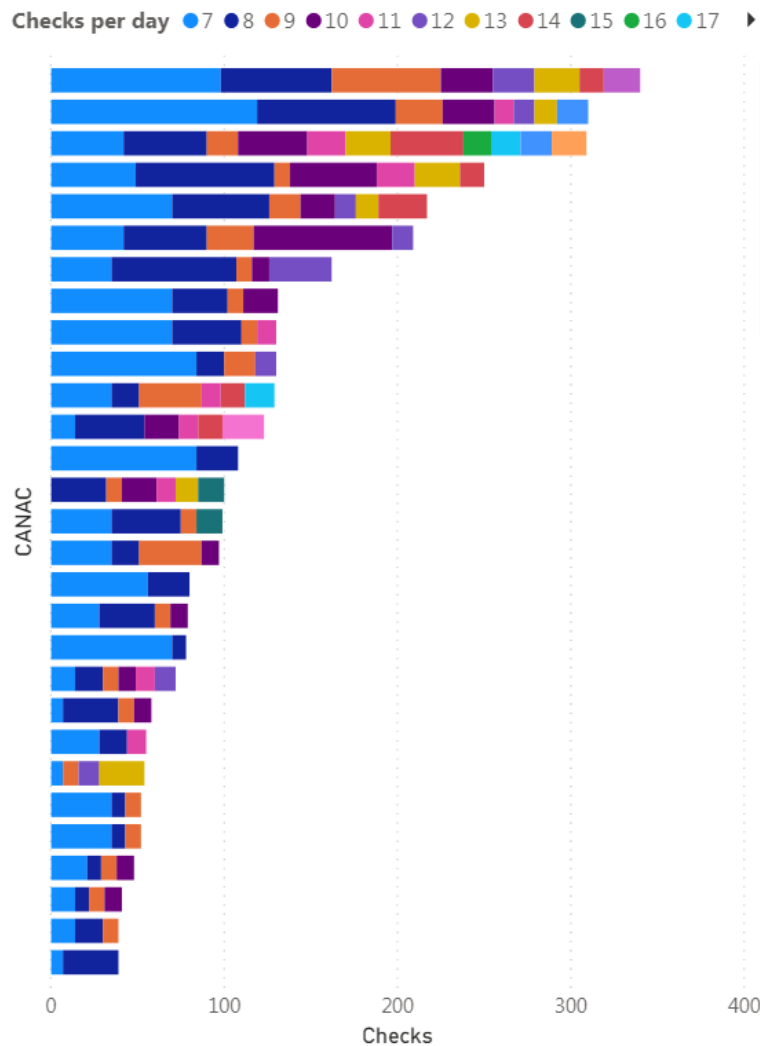
Figure 7.9 – Examiners' disapproval percentage by the number of checks



Source: own elaboration.

In Figure 7.8 and Figure 7.9 there are Scatter Plots showing each Inspector's or Examiner's quantity of pilot flight proficiency checks conducted and one's disapproval rate. The data were clustered to allow different approaches in order to standardize and surveil.

Figure 7.10 – Checks per day by CANAC.



Source: own elaboration

In the Figure 7.10 there is a list of Examiners and Inspectors who conducted more than 7 pilot flight proficiency checks per day. Although this study recommended a limitation on the number of flight checks per day to allow up to two, and minimum annual numbers of examinations, following the FAA's Order 8900.2C, and periodic basis observation of ratings and proficiency checks according to Paragraph 5.3.2 of DOC 8335, while there is no such limitation in the regulation, the above-mentioned list represents oversight candidates that must be surveilled in order to guarantee a minimum of quality and standardization during the exams.

The above-mentioned examples gathered from the Proficiency Check Dashboard will allow the manager to decide on oversight strategies and criteria to be followed by the Inspectors, as well as pursuing standardization and recommending capacity development for Inspectors and Examiners.

The proposed solutions aim to deliver a healthy environment for the pilot flight proficiency checks, and, likely mentioned in the FAA's Order 8900.2C, the Accredited Examiner's function is vital to ANAC and should be a symbiotic relationship.

7. Role of the Designee. Designees have been an important part of the FAA's support to the flying public for over 60 years. During that time, designees successfully completed thousands of certification activities on the FAA's behalf. The designee function is vital to enhancing the FAA's public service role and enhancing overall safety in the National Airspace System (NAS).

The FAA and its designees are in a symbiotic relationship. *The FAA appoints designees to leverage its workforce and provide certification services to the public, and the designee provides certification services to the public in accordance with FAA policy and guidance. One component of this relationship involves how the FAA views the designee, as well as how the designee views the FAA. (FAA, 2018) [our emphasis]*

Unfortunately, the mentioned symbiosis is not perceived by the Inspectors, who cannot trust without evidences, mainly due to the uncertainty presented by the lack of oversight of Examiners' activities and the possibility of a conflict of interest, according to the Inspectors' Survey presented in Figure 7.5.

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Chapter 8 – Critical viewpoint

8.1 – Done/planned;

During the internship, the intended project's plan was followed accordingly (100%), except to the continuity of the predicted sequence of months due to a 5-month interruption caused by the 2020's Pandemic's professional and personal constraints.

The data about ANAC's pilot flight proficiency check from 2014 to 2019 were extracted from the SACI – Civil Aviation Information Integrated System, while the data about FAA's pilot flight proficiency check from 2014 to 2019 were extracted from the U.S. Civil Airmen Statistics.

The classified data allowed us to perceive a general rate of ANAC's pilot flight proficiency check, the rates for licensing purposes, and, finally, the respective rates of Examiners and Inspectors.

The FAA's data allowed us to compare the rates of its pilot flight proficiency checks for licensing purposes and each rate divided by Examiners and Inspectors, consequently, compare to the corresponded ANAC's rates.

The comparative quantitative data analysis permitted an in-depth understanding of the problematics of the pilot flight proficiency checks' rates and the use of the Six-step problem-solving method.

Additionally to the project's plan, a survey was conducted among ANAC's experts in order to provide a qualitative analysis on the Inspectors' perception of the comparison between ANAC's Inspector and Accredited Examiners.

The different solutions identified were Technical Training, Standardization, and Surveillance, which, although put in practice before the research, were still considered insufficient to revert the downward tendency toward 0% for the pilot flight proficiency checks' disapproval rates.

The chosen solution to solve the problem relied on the safety pillars of Technical Training, Standardization, and Surveillance, which were assessed through the CE – Critical Elements provisioned by Annex 19 to the Convention on International Civil Aviation, which revealed deeper problems that affect the pilot flight proficiency checks.

The implementation of the chosen solution depends on the grounds that were considered inappropriate, requiring minimally: Qualified technical personnel – (CE-4) and Licensing, certification, authorization and approval obligations – (CE-6); to be able to perform appropriate Surveillance obligations – (CE-7).

Fortunately, the PCIV – ANAC’s Flight Inspectors Training Programme, approved by the ANAC’s Directorate in 2019, has come to overcome a decade’s gap in the technical personnel qualification to perform pilot flight proficiency checks and the associated oversight of Accredited Examiners, in its initial implementation state, however.

8.2 – Difficulties and constraints

The access to data or information must be prioritized in the ANAC because they seem to be compartmentalized in the many sectors and different systems as they were not intended to serve a common goal, i.e., safety, which basically possesses the same structure, despite being a pilot flight proficiency check based on the licensing requirements of RBAC 61 or operations requirements of RBAC 90, RBAC 91, RBAC 121, RBAC 135 or RBAC 137.

In order to further compare the pilot’s practical and theoretical disapprovals’ rates, the data directly from the database were requested several times to the respective managers, without success. Therefore, only the pilot’s practical rates were used from the SACI – Civil Aviation Information Integrated System, available for the Civil Aviation Inspectors, and with the Operations Standards Superintendent's authorization.

Unfortunately, the pilot’s theoretical disapprovals’ rates data were not shared, if existent at all, but certainly would have been higher than the practical rates, would have shown a significant difference, and would have emphasized the need to enhance the pilot flight proficiency checks, empirically-based among ANAC’s Experts.

A similar difficulty was faced with the Australian CASA when trying to provide another data source for comparison. Despite the fact that their outsourcing policies seem to be emphasized, they stated that oversight focuses on Flight Examiners’ flight test and proficiency checks, being a very small sample size, unable to provide data as requested.

The existence of several different and dissociated subsystems within SACI, such as PEL and SISHAB, or outside, such as SISCHECK, many sectorized spreadsheets and SharePoint pages owned by its managers not easily accessible to third parties, add difficulties to see the pilot flight proficiency check system as a whole. Some examples lie in the absence

of registered Examiners' accreditation checks or those checks required by the RBAC 121 (Airlines) and RBAC 135 (Air Charter) in the same dataset used in this research.

To conclude the data access difficulties, while the student was trying to step-up and deliver more than initially planned, by linking the Proficiency Check Dashboard directly to the daily up-dated database, during the internship's last week, an up-dated dataset was shared, containing slightly different quantities of pilot flight proficiency checks for the 2014-2019 period.

Table 8.1 – SACI's dataset compared to Internship's last week's shared dataset.

	Approved	Percent	Disapproved	Percent	Total
SACI's data	129407	99,36%	836	0,64%	130243
Internship's last week's data	129433	99.36%	840	0,64%	130273
Difference between datasets	26	0.00%	4	0.00%	30

Source: own elaboration.

Although it was not possible to understand the above-mentioned difference between datasets, there was no significant difference in the results of this research.

8.3 – How have I managed to succeed?

Through an effortful quest to analyze the pilot flight proficiency check's data under an academic method using a statistical perspective, started from scratch, while researching within regulations and ICAO's provisions and SARPs to provide based arguments to break the *status quo* bias' inertia.

Developing leadership and management skills to fulfill the project's timeline by gathering pieces of information about the pilot flight proficiency check's environment during several meetings with ANAC's personnel.

8.4 – What is still to be done?

The inner use of more proactive conduct to enable information-driven, risk-based, and result-oriented approach, such as the ICAO's USOAP CMA – Universal Safety Oversight Audit

Programme Continuous Monitoring Approach, not only while implementing a SSP – State Safety Programme, but whenever overseeing the aviation activities, such as the pilot flight proficiency check is still worthwhile.

8.5 – What are the remaining actions to achieve that would be useful to do in order to complete the study?

The benefits of the use of qualified technical personnel in charge of the intensified oversight duties rely on the proper implementation of the PCIV – ANAC’s Flight Inspectors Training Programme.

Also, the mandatory filing of the Electronic PEF – Pilot Evaluation Form by the RBAC 121 and 135 operators, as provisioned by Item 12.2 of the IS 00-002F, would allow a comprehensive analysis of the pilot flight proficiency check of all operators.

8.6 – How could this work be reused?

Although this work was a 2014 to 2019 pilot flight proficiency check rates’ screenshot from the ANAC and the FAA, not only it could be reused, but also its deliverables could be reused to better plan, technical training, standardization, oversight or accreditation activities, using updated data contained in the Proficiency Check Dashboard delivered by this study.

Another incentivized reuse of this work could be to manage all the other categories of Accredited Examiners such as Aviation Medical Examiners, Mechanic Examiners, Aircraft Dispatch Examiners, Aircrew Examiners, Manufacturing Examiners, Project Examiners, Airworthiness Examiners, and English Proficiency Examiners.

8.7 – Experience gained

The main academic experiences gained during this research were the use of a Methodology and the Statistics knowledge, acquired from scratch, which were applied to the aviation data, rejecting the null hypothesis, reinforcing the previous Inspectorate’s anecdotal sense, which was very pleasant to me.

While the main professional experiences gained were the management knowledge, including data-driven management to plan, execute, deliver and assess an entire project related to aviation safety, which might reach several operators and a huge quantity of operations, improving safety broadly.

Another experience that was reinforced during this study was my leadership skills, which were put to the test on every difficulty faced during the project or when the wind blew in the opposite direction of the intended safety.

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Chapter 9 – Discussion

9.1 – ANAC’s General rates

The analysis results of the ANAC’s 130.243 general pilot flight proficiency checks were 99.36% approved and 0.64% disapproved.

The analysis results of the general pilot flight proficiency checks of ANAC’s Examiners’ were 99.47% approved and 0.53% disapproved.

The analysis results of the general pilot flight proficiency checks of ANAC’s Inspectors’ were 98.06% approved and 1.94% disapproved, summarized by Figure 9.1:

Figure 9.1 – Proficiency Check Dashboard – ANAC’s general pilot flight proficiency checks’ disapproval (2014-2019)

ANAC's General Checks	ANAC's Disapproved	Examiners' Disapproved	Inspectors' Disapproved
130243	0,64%	0,53%	1,94%

Source: own elaboration.

The result of the Two Proportions z-Test showed that ANAC’s Examiners and Inspectors have a statistically highly significant difference due to the z-score of -10.29 and p-value less than 0.001, rejecting the Null hypothesis, as shown in Table 4.22. Therefore, considering that the z-score is the measurement of the difference between them, in units of the standard deviation, they did not perform the same. For this reason, standardization and oversight were recommended.

9.2 – ANAC’s Licensing rates

The analysis results of the ANAC’s 24.307 pilot flight proficiency checks for licensing were 99.16% approved and 0.84% disapproved.

The analysis results of the pilot flight proficiency checks for licensing of ANAC's Examiners' were 99.25% approved and 0.75% disapproved.

The analysis results of the pilot flight proficiency checks for licensing of ANAC's Inspectors' were 97.23% approved and 2.77% disapproved, summarized by the following figure:

Figure 9.2 – Proficiency Check Dashboard – ANAC's pilot flight proficiency checks' disapproval for licensing (2014-2019)

ANAC's Licensing Checks	ANAC's Disapproved	Examiners' Disapproved	Inspectors' Disapproved
24307	0,84%	0,75%	2,77%

Source: own elaboration.

The result of the Two Proportions z-Test showed that ANAC's Examiners and Inspectors have a statistically highly significant difference due to the z-score -3.95 and p-value less than 0.001, rejecting the Null hypothesis, as shown in Table 4.26. Therefore, considering that the z-score is the measurement of the difference between them, in units of the standard deviation, they did not perform the same. The Inspectors were 369% harsher while performing flight checks and, even performing only 4.31% of the licensing flight checks, they were responsible for 14.22% of the disapprovals, better assuring that the standards and safety were met.

In order to correct noncompliances to the SARPs and regulations, Inspector's pilot training, regulation revisions, standardization, and oversight prioritization and intensification were recommended.

9.3 – FAA's Licensing rates

The analysis results of the FAA's 291.030 pilot flight proficiency checks for licensing were 76.87% approved and 23.13% disapproved.

The analysis results of the pilot flight proficiency checks for licensing of ANAC's Examiners' were 76.90% approved and 23.10% disapproved.

The analysis results of the pilot flight proficiency checks for licensing of ANAC's Inspectors' were 75.63% approved and 24.37% disapproved, summarized by the following figure:

Figure 9.3 – Proficiency Check Dashboard – FAA's pilot flight proficiency checks' disapproval for licensing (2014-2019)

FAA's Licensing Checks	FAA's Disapproved	Examiners' Disapproved	Inspectors' Disapproved
291030	23,13%	23,10%	24,37%

Source: own elaboration.

The result of the Two Proportions z-Test showed that FAA's Examiners and Inspectors have a statistically significant difference due to the result of the z-score -2.30 and p-value 0.021, rejecting the Null hypothesis, as shown in Table 4.34. Therefore, considering that the z-score is the measurement of the difference between them, in units of the standard deviation, they did not perform the same, though with a smaller standard deviation than ANAC's.

9.4 – ANAC's and FAA's Comparison

The FAA's Examiners disapprove 22.57 percentage points more than ANAC's Examiners, based on the descriptive statistics.

The FAA's Inspectors disapprove 22.43 percentage points more than ANAC's Inspectors, based on the descriptive statistics.

The result of the Two Proportions z-Test showed that ANAC's Examiners and the FAA's Examiners have a statistically significant difference for licensing due to the result of the z-score -229.93 and p-value less than 0.001, rejecting the Null hypothesis, as shown in Table 4.40. Therefore, the z-score is the measurement, in units of the standard deviation, of the difference between them, considering they should not have differences.

The result of the Two Proportions z-Test showed that ANAC's Inspectors and the FAA's Inspectors have a statistically significant difference for licensing due to the result of the z-score -28.96 and p-value less than 0.001, rejecting the Null hypothesis, as shown in Table 4.41.

Therefore, the z-score is the measurement, in units of the standard deviation, of the difference between them, considering they should not have differences.

Comparing both Two Proportions z-Test from ANAC's and FAA's Examiners and ANAC's and FAA's Inspectors, i.e. z-scores -229.93 and -28.96, the large difference between the categories relatively shows how many standard deviations they are from their means.

In order to clearly show the differences between ANAC's and FAA's Examiners and ANAC's and FAA's Inspectors for each studied license and rating, refer to Table 4.38 and Table 4.39.

Although the differences between Brazilian and American Examiners and Inspectors were astonishing highly significant, the reasons were not the scope of this study and should be investigated in future studies. For the time being, they will be hanging in the air, with a sense that ANAC has room for improvement.

Chapter 10 – CONCLUSION

This research aimed at academically investigating an Inspectors' anecdotal perception that the Brazilian Civil Aviation Authority – ANAC lacks safety culture, standardization, oversight, and Inspectors' pilot training that could be correlated to low flight proficiency check disapproval rates among pilots.

To investigate that premise, this study focused on answering the following research questions:

1. What is the status of the Brazilian pilot flight proficiency check's rates?
2. Is there a statistical difference between Examiners' rates and Inspectors' rates?
3. How different are the Brazilian pilot flight proficiency check's rates compared to the American rates?

The study answered the research questions by the descriptive statistics and the comparative quantitative method Two Proportions z-Test used to identify differences among Brazilian and American Examiners and Inspectors on their pilot flight proficiency checks' results. The Null Hypotheses were Examiners and Inspectors have no differences in their results, even when comparing Brazilians with Americans.

As detailed in Chapter 1 – and Chapter 8 –, the project's plan was followed accordingly (100%), except to the continuity of the predicted sequence of months due to a 5-month interruption caused by the 2020's Pandemic's professional and personal constraints.

In fact, the student delivered more than previously planned by conducting an Inspectors' Survey, detailed in Chapter 7 –, which served to qualitatively better understand the current ANAC's Inspectorate perceptions on Standards, Technical Training and Surveillance.

Another attempt, which was to deliver more than previously planned by linking the Proficiency Check Dashboard to the updated database, was frustrated by the Technology Information Department, which did not allow the access to the student.

As detailed in Chapter 8 –, the access to data or information must be prioritized in the ANAC, because they seem to be compartmentalized in many sectors and in different systems, subjected to managers' will, as they were not intended to serve a common goal, i.e. safety, and should be inspired according to CENIPA's philosophy that states that in accident prevention there is no secrets, nor flags, present in Section 1.5 of NSCA 3-3 (CENIPA, 2013).

Due to the lack of proper register of the pilot flight proficiency checks by the Air Carriers and Airlines in the database used in this research, even being a mandatory requirement expressed in the IS 00-002F, this study had to be limited to general and licensing rates.

It is highly recommended similar studies, and implementation of the proposed solutions to the Air Carriers' and Airlines' Examiners, based on the brief observations of the SISHAB's SAE – Exam Authorization Request reprovals due to low pilot flight proficiency check's disapproval, not focused in this research because of the above-mentioned regulation noncompliance and data access difficulty.

Another incentivized reuse of this work could be to manage all the other categories of Accredited Examiners such as Aviation Medical Examiners, Mechanic Examiners, Aircraft Dispatch Examiners, Aircrew Examiners, Manufacturing Examiners, Project Examiners, Airworthiness Examiners, and English Proficiency Examiners, focusing on data-driven analysis, standardization, and surveillance, or better, developing and implementing an Accredited Examiner management system such as the FAA's DMS – Designee Management System.

Although this work was a 2014 to 2019 pilot flight proficiency check's rates' screenshot from the ANAC and the FAA, not only it could be reused, but also its deliverables could be reused to better plan standardization, oversight or accreditation activities, by using updated data direct from the database and the Proficiency Check Dashboard delivered by this study.

Once the Brazilian and the American pilot flight proficiency checks' status and the Examiners' and Inspectors' rates were known, this study researched and analysed the difficulties in Section 4.10 – , and proposed three possible solutions to solve them: Technical Training, Standardization and Surveillance.

Regarding Technical Training, the PCIV – ANAC's Flight Inspectors Training Programme is capable of fulfilling its needs, once properly and fully implemented in its 5-year cycle.

Inappropriately, the PCIV's first round for single engine and multi-engine aircraft did not fulfill the rating requirements, though, the quality was praised by the participant Inspectors.

Unlike the FAA, the ANAC does not use qualified Operations Inspector, which means they don't hold appropriate class or type rating, nor they are current in the aircraft, not even for two-place aircraft, which usually have only the unrated candidate and the Inspector (or Examiner).

Fortunately, the PCIV's first round of a normal category jet did fulfill the rating requirements.

Additionally, as an enhancement proposal to the implementation of the PCIV and further Inspectorate's training planning and control the Diagram 7.1 was presented.

Provided proper training, as required by and in accordance with Annex 6 and Annex 19 to the Convention on International Civil Aviation, and ICAO's Doc 9734, Doc 8335, and Doc 10070, the ANAC is capable of increasing by 57% the quantity of Flight Inspectors, without any additional hiring.

Regarding Standardization, the ANAC's standards were constantly evolving by the revisions of IS – Supplementary Instruction 00-002, whereas initial training for Examiners candidates was increasing.

The level of agreement on the surveyed statements of ANAC's Inspectors' perceptions showed clear disparities between Inspectors and Examiners, when both professional categories must perform standardized pilot flight proficiency checks.

The largest disparities, on the one hand, were related to the lack of Inspectors' Pilot Technical Training (TRN), Operations (OPS) requirements compliance, and Capacity Development (CAP), while, on the other hand, were related to the lack of Accredited Examiners' Capacity Development (CAP), Standards (STD) and Surveillance (SUR), detailed in Figure 7.4, Figure 7.5, ANNEX 1, ANNEX 2, and ANNEX 3.

Unfortunately, On-the-job training and recurrent training are not requirements to accreditation, unlike the Recurrent Training required by the FAA for renewal (every 12 months up to 36 months) and for ANAC's own Inspectors every three years.

Regulation revisions were recommended in order to require Recurrent Training and On-the-Job Training for Examiners, as it is required for the Inspectors, for standardization purposes. Also, there were recommendation to establish a limit of two checks per day (initial, retests, discontinuances, or continuances) or one initial flight instructor check, to guarantee time availability to focus on the quality of the evaluation, , similarly to the FAA's provisions of Section 2, Item 14, a., of the Order 8900.2C.

If both Capacity Development were also applied to the Examiners, the standardization and the disapproval rates could converge to the Inspectors' higher values. Therefore, a revision on the RBAC – Brazilian Civil Aviation Regulation 183 – Personnel Accreditation is recommended for that purpose.

Considering that the Inspectors have access to or occupy the pilot's seat, the Inspector's lack of ratings, currency and medical certificate poses a threat to their own safety and the safety of others.

Regrettably, there is no consensus on the official position regarding the lack of ratings, currency and medical certificate, and the risk assessment lies on the Inspector's accountability, sometimes unpleasantly challenged by the Office for Internal Affairs or the Justice.

In order to provide a proper risk assessment for the pilot flight proficiency check, it was recommended the creation of Preflight Operational Risk Management Forms, based on the FAA's model presented in ANNEX 4 and ANNEX 5, which count on shared accountability of the Risk Assessment Authority and the Inspector.

Regarding Surveillance, the ANAC's surveillance of Accredited Examiners, found from 2016 to 2019, was considered insufficient because its activities varied from 1.45% (RBAC 135 – Air Carriers), 2.9% (RBAC 142 – Training Centers), 5.25% (RBAC 141 – Approved Training Organisations) to 30,17% (RBAC 121 – Airlines) of the accreditation activities, as shown in Table 5.4.

The technical solution chosen was ANAC's surveillance intensification on Accredited Examiners. The recommendation of on-site activities to cover at least 20% of the active Examiners with a yearly budget of R\$ 149.296,00 to accomplish the surveillance of all Examiners in a 5-year cycle. It is also recommended the planning of off-site activities and determining several accreditation terminations based on data-driven analysis that shows potential safety concerns, such as the Proficiency Check Dashboard and other recommended enhancements proposed by the study, e.g., mobile-app to track and provide data for oversight purposes.

The oversight techniques could be improved if based on the FAA's oversight of designee policy and SEED - Special Emphasis Evaluation Designee program and based on data-driven information provided by the Proficiency Check Dashboard delivered by this study.

An active surveillance intensification would immediately count on the 369% harsher Inspectors' results compared to the Examiners' rate for licensing, as risk mitigation. Additionally, a proper solution, which requires Inspectors' pilot technical training, must follow its implementation steps as provisioned in the PCIV – ANAC's Flight Inspectors Training Programme.

Through the use of technology and digitalized job aids, such as the Pilot Flight Proficiency Check Forms and Preflight Operational Risk Management Forms, quantitative and qualitative data could be analyzed in the future.

Revising the regulations as remarked, abiding by current regulations, and following the initiatives present in the FAA's ORDER 8900.1 and ORDER 8900.2C would enhance Inspector's technical training, the standardization of Inspectors and Examiners, and the accreditation and the surveillance of Examiners.

This study proposed solutions that allow the ANAC to strengthen the defences, present in the James Reason's Model, with technology, training, and regulations, present in Snook's Theory, to avoid accidents related to the practical drift of pilot flight proficiency checks' conduction, Inspectors' and Examiners' standardization, accreditation and oversight.

This study made possible a data-driven approach for continued monitoring of pilot flight proficiency checks, including the ANAC's Examiners' and Inspectors' performances provided by the Proficiency Check Dashboard.

10.1 – Main conclusions

This study's main conclusions were that ANAC's Accredited Examiners did not perform as the ANAC's Inspectors, rejecting the Null Hypothesis of no difference among their pilot flight proficiency check's results.

All other Null Hypotheses were rejected; thus, ANAC's and FAA's Examiners and Inspectors presented statistically highly significant differences among them.

Based on the disapproval rates of Examiners and Inspector detailed in Chapter 4 –, and the revealed noncompliances to the ICAO's SARPs and State regulations presented in Chapter 6 –, and on the Inspectors' Survey presented in Chapter 7 –, this study concluded that:

1. ANAC's Accredited Examiners lack:
 - On-the-job Training;
 - Recurrent Training;
 - Standardization;
 - Oversight;

- Inspectorate's trust, mainly due to the uncertainty presented by the lack of oversight and the possibility of a conflict of interest.
2. The ANAC lacks:
- Standards and Regulations compliance;
 - Examiner and Inspector standardization;
 - Oversight activities;
 - Inspectors' Pilot Technical Training;
 - Inspectors' Currency (e.g., 90 days - Day, Night, Tailwheel; 6 months – IFR);
 - Inspectors' Medical Certificate;
 - Inspectors' flight hours log.

It is worth mentioning that the above factors were associated to noncompliance of established regulations, and disrespect to Safety Culture and ICAO's SARPs, and some would constitute, at least, violations of the requirements contained in Sections 61.3, 61.17, 61.21, and 61.31 of RBAC 61 EMD13.

GLOSSARY

AATD – Advanced Aviation Training Device
AIP – Aeronautical Information Publication
AMEL – Airplane Multi-Engine Land
APP – application
Approved Training Organisation
ASEL – Airplane Single Engine Land
ASES – Airplane Single Engine Sea
ASI – Aviation Safety Inspector
ATCo – air traffic controller
ATPL – air transport pilot licence
AVS – Aviation Safety
CAA – Civil Aviation Authority
CANAC – ANAC’s Code (Código ANAC)
CAPs – corrective action plans
CASA – Civil Aviation Safety Authority
CASI – Civil Aviation Safety Inspector
CCs – compliance checklists
CE – critical elements
CENIPA – Accident Investigation Authority (Centro de Investigação e Prevenção de Acidentes Aeronáuticos)
CHG – change
CIV – Logbook
CIV Digital – Electronic Logbook
CLT – Central Limit Theorem
CMA – Medical Certificate
CMA – Continuous Monitoring Approach
CPL – commercial pilot licence
DMS – Designee Management System
DPE – Designated Pilot Examiner
DSA – daily subsistence allowance
EMD – amendment
FAA – Federal Aviation Administration
FFS – Full Flight Simulator
GS – Ground School
HR – Human Resources
IAC – Civil Aviation Instruction
ICAO – International Civil Aviation Organization
IFR – Instrument Flight Rules
INSPAC – Civil Aviation Inspector
IQR – Interquartile Range
IS – Supplementary Instruction
kB – kilobyte
KSA – knowledge, skills, and attitudes
NOTAM – Notices to Airmen
ODA – Organization Designation Authorization

OI – Operations Inspectors
Operations, OPS 135 – Air Carrier Operations
OPS 141 – Training Organization Operations
OPS 91 – General Aviation Operations
PBN – Performance-based Navigation
PCA - principal component analysis
PCIV – ANAC’s Flight Inspectors Training Programme
PEF – Pilot Evaluation Form (FAP – Ficha de Avaliação de Piloto)
PIC – Pilot in Command
PPL – private pilot licence
RBAC – Brazilian Civil Aviation Regulation (Regulamentos Brasileiros da Aviação Civil)
SACI – Civil Aviation Information Integrated System (Sistema Integrado de Informações da Aviação Civil)
SACI – Sistema Integrado de Informações da Aviação Civil (Civil Aviation Information Integrated System)
SAE – Exam authorization request
SAE – Specialized Air Service
SARPs – Standards and Recommended Practices
SCDP – Allowance and Fare System
SDEA – Santos Dumont English Assessment
SEED – Special Emphasis Evaluation of a Designee
SEI! – Electronic Information System
SICOS – Service Order System
SisCheck – Roster’s Flight Check Management System
SISHAB – Rating System (Sistema de Habilitações)
SM ICG – Safety Management International Collaboration Group
SMS – Safety Management System
SPL – Department of Civil Aviation Personnel
SSP – State Safety Programme
USOAP – Universal Safety Oversight Audit Programme
VFR – Visual Flight Rules
W&B – Weight and Balance

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ANNEX 1 – Inspectors’ Survey’s statements – Inspectors’ factors

TRN1 - The Flight Inspectors receive equipment Ground School from ANAC.

TRN2 - The Flight Inspectors receive equipment Flight Training from ANAC.

TRN3 - The Flight Inspectors receive Differences Training from ANAC.

OPS1 - The Flight Inspectors possess a valid rating in the equipment.

OPS2 - The Flight Inspectors possess currency (E.g., 90 days - Day, Night, Tailwheel; 6 months - IFR).

OPS3 - The Flight Inspectors possess Medical Certificate for real flights.

OPS4 - The Flight Inspectors operate in PBN - Performance Based Navigation.

OPS5 - The Flight Inspectors have difficulties visualizing the panel flight instruments due to the aircraft's ergonomics.

OPS6 - The Flight Inspectors have difficulties performing the required flight check procedures due to ATC - Air Traffic Control restrictions (E.g., NOTAM - Forbidden ANAC Check, TGL, IFR Training Procedures, Circle-to-Land, RNAV, ILS, VOR, NDB Procedures).

CAP1 - The Flight Inspectors receive CRM - Crew Resource Management training from ANAC.

CAP2 - The Flight Inspectors receive PBN - Performance Based Navigation training from ANAC.

CAP3 - The Flight Inspectors receive 3 (three) OJT - On-the-job training from ANAC.

CAP4 - The Flight Inspectors receive advanced training from ANAC (Ex.: Workshop, Specialization, Master, Doctorate).

STD1 - The objective criteria for flight check failing are adequate.

STD2 - The subjective criteria for flight check failing are adequate.

STD3 - The flight check procedures are standardized.

STD4 - The equipment evaluation by similarity is safe (E.g., ASEL, AMEL, Executive Jet, Turboprop, Narrow-Body, or Wide-Body Group).

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ANNEX 2 – Inspectors’ Survey’s statements – Accredited Examiners’ factors

TRN1E - The Accredited Examiners receive equipment Ground School.

TRN2E - The Accredited Examiners receive equipment Flight Training.

TRN3E - The Accredited Examiners receive Differences Training.

OPS1E - The Accredited Examiners possess a valid rating in the equipment.

OPS2E - The Accredited Examiners possess currency (E.g., 90 days - Day, Night, Tailwheel; 6 months - IFR).

OPS3E - The Accredited Examiners possess Medical Certificate for real flight.

OPS4E - The Accredited Examiners operate in PBN - Performance Based Navigation.

OPS5E - The Accredited Examiners have difficulties visualizing the panel's flight instruments due to the aircraft's ergonomics.

OPS6E - The Accredited Examiners have difficulties performing the required flight check procedures due to ATC - Air Traffic Control restrictions (E.g., NOTAM - Forbidden ANAC Check, TGL, IFR Training Procedures, Circle-to-Land, RNAV, ILS, VOR, NDB Procedures).

OPS7E - The Accredited Examiners have enough flight experience.

CAP1E - The Flight Inspectors receive CRM - Crew Resource Management training.

CAP2E - The Accredited Examiners receive PBN - Performance Based Navigation training.

CAP3E - The Accredited Examiners receive 3 (three) OJT - On-the-job training from ANAC.

CAP4E - The Accredited Examiners receive advanced training (Ex.: Workshop, Specialization, Master, Doctorate).

CAP5E* - The Accredited Examiners must receive theoretical recurrent capacity development from ANAC.

STD1E - The objective criteria for flight check failing are adequate.

STD2E - The subjective criteria for flight check failing are adequate.

STD3E - The flight check procedures are standardized.

STD4E - It is permitted to the Accredited Examiners the equipment evaluation by similarity (E.g., ASEL, AMEL, Executive Jet, Turboprop, Narrow-Body, or Wide-Body Group).

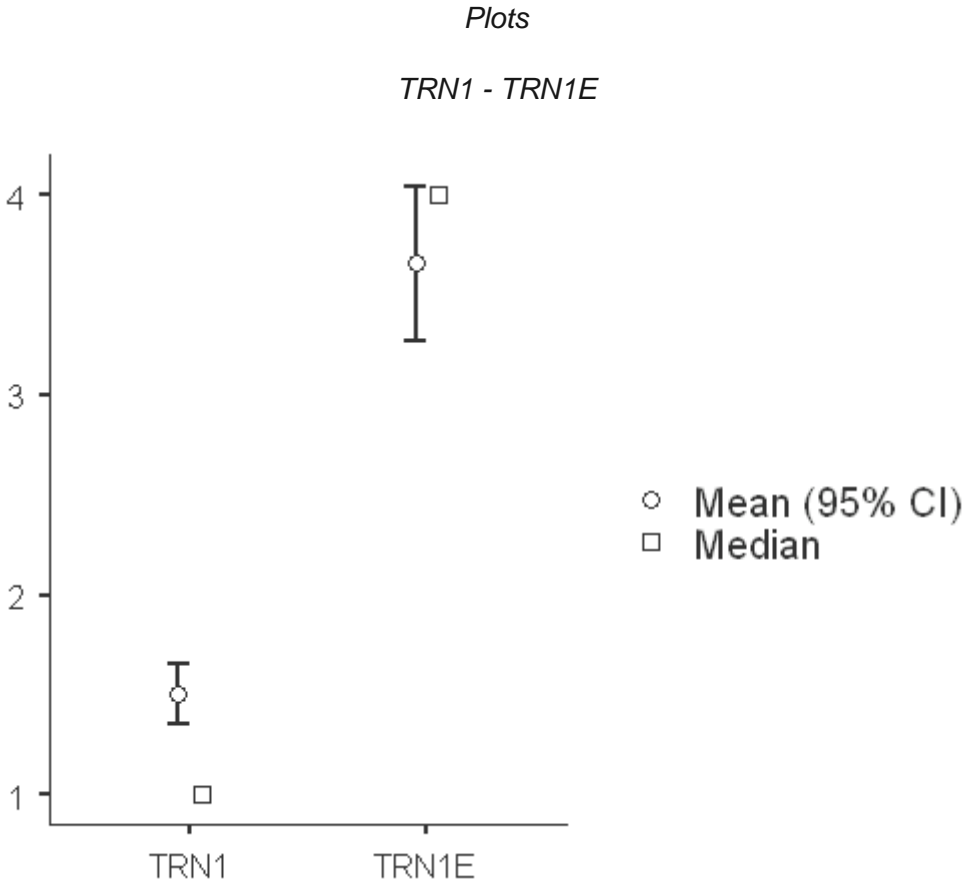
SUR1E* - The Accredited Examiners are exempted from conflict of interest.

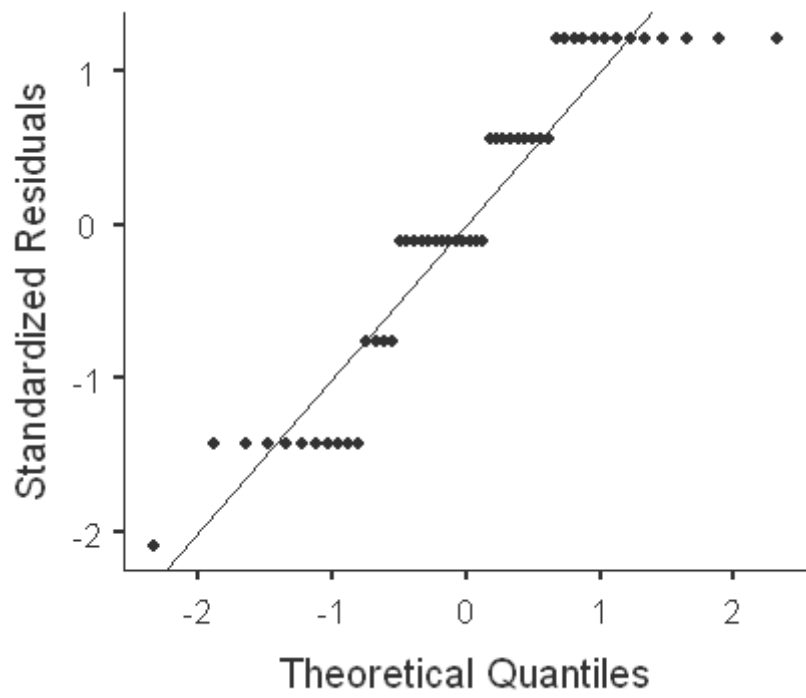
SUR2E* - ANAC surveils the Accredited Examiners during the accreditation validity.

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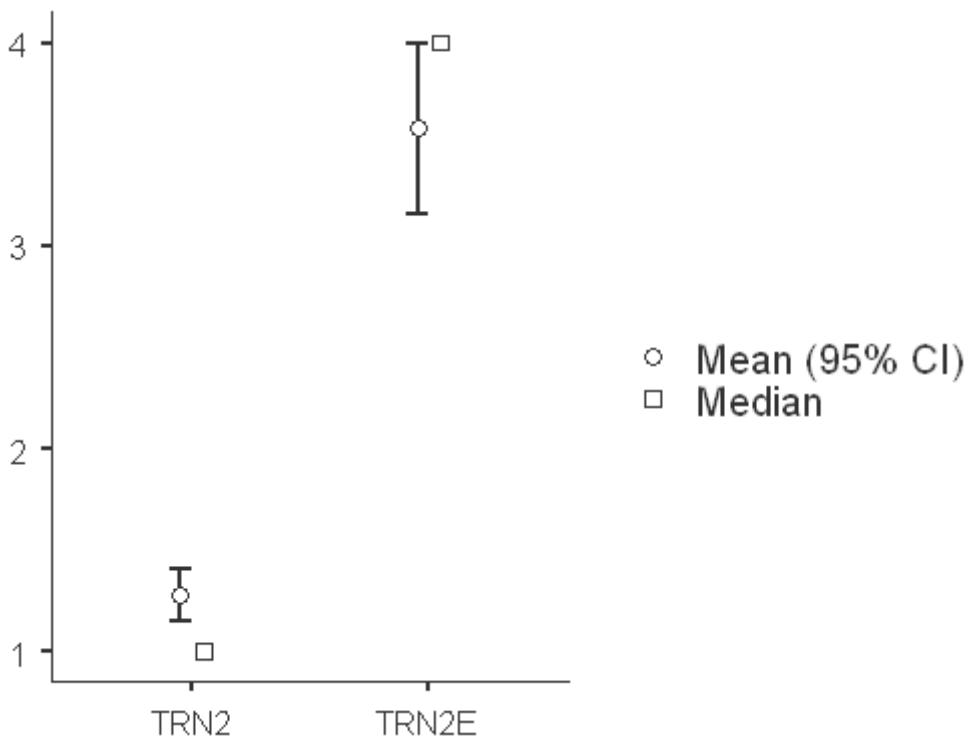
ANNEX 3 – Inspectors’ Survey – Paired Samples T-test – Descriptive Plots

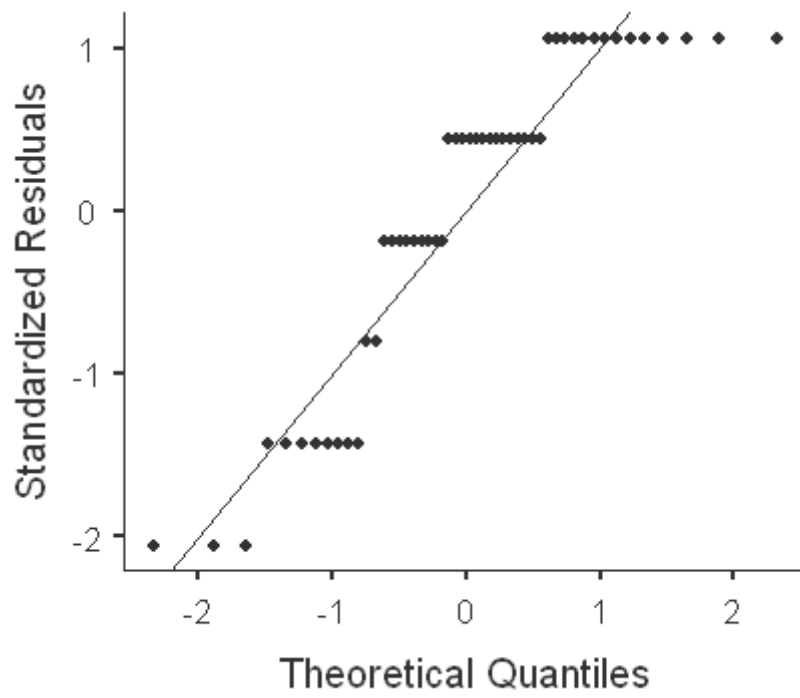
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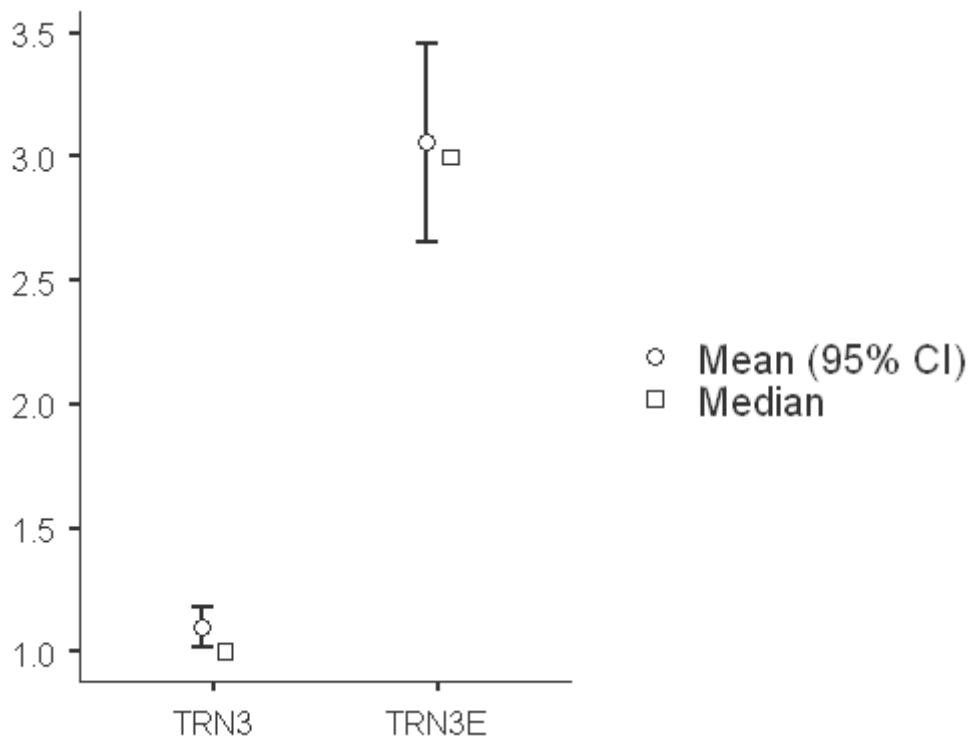


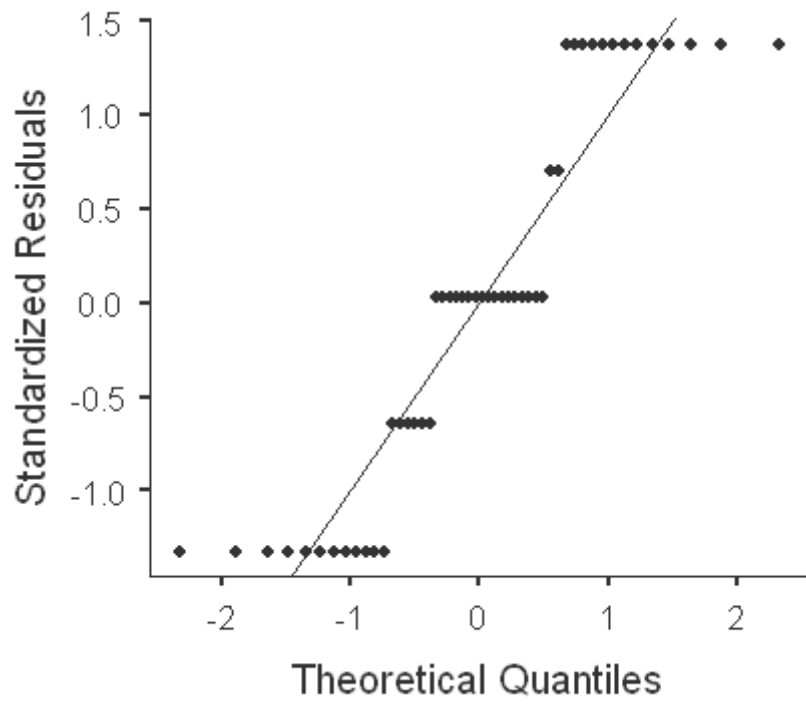
TRN2 - TRN2E



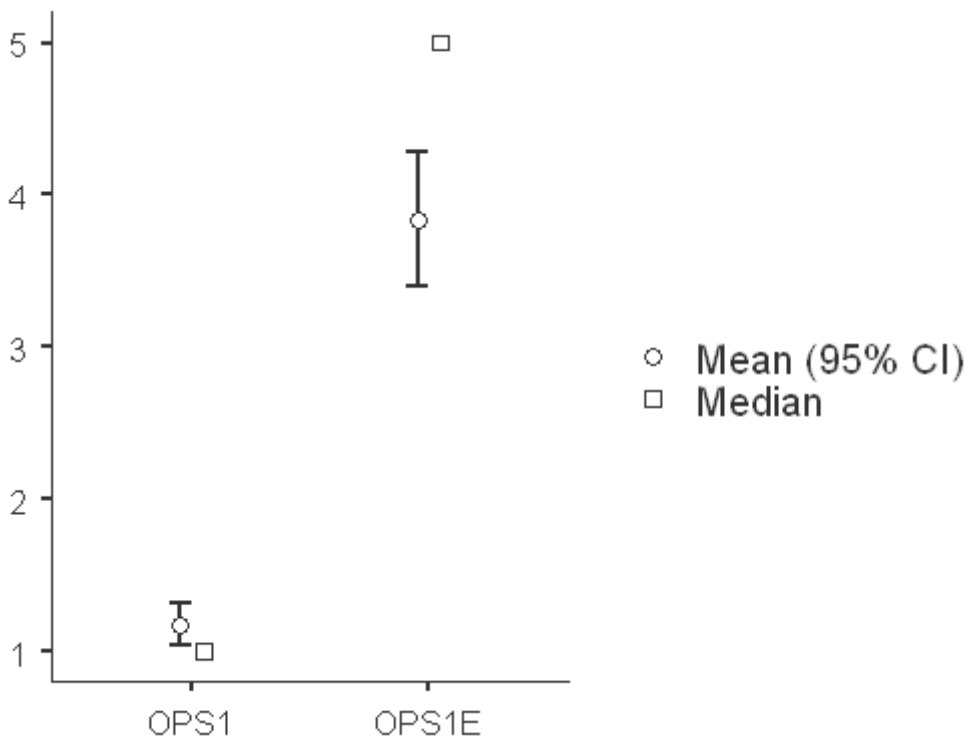


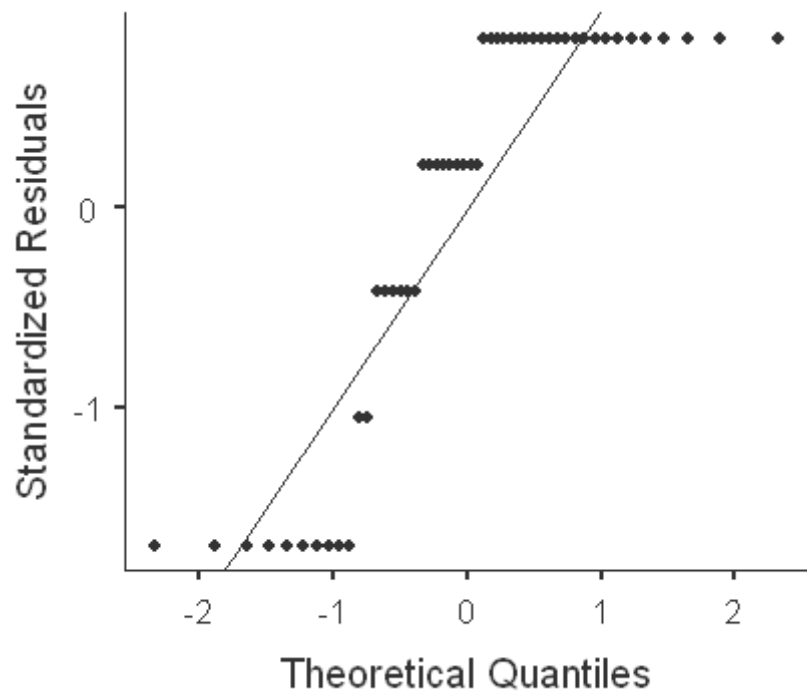
TRN3 - TRN3E



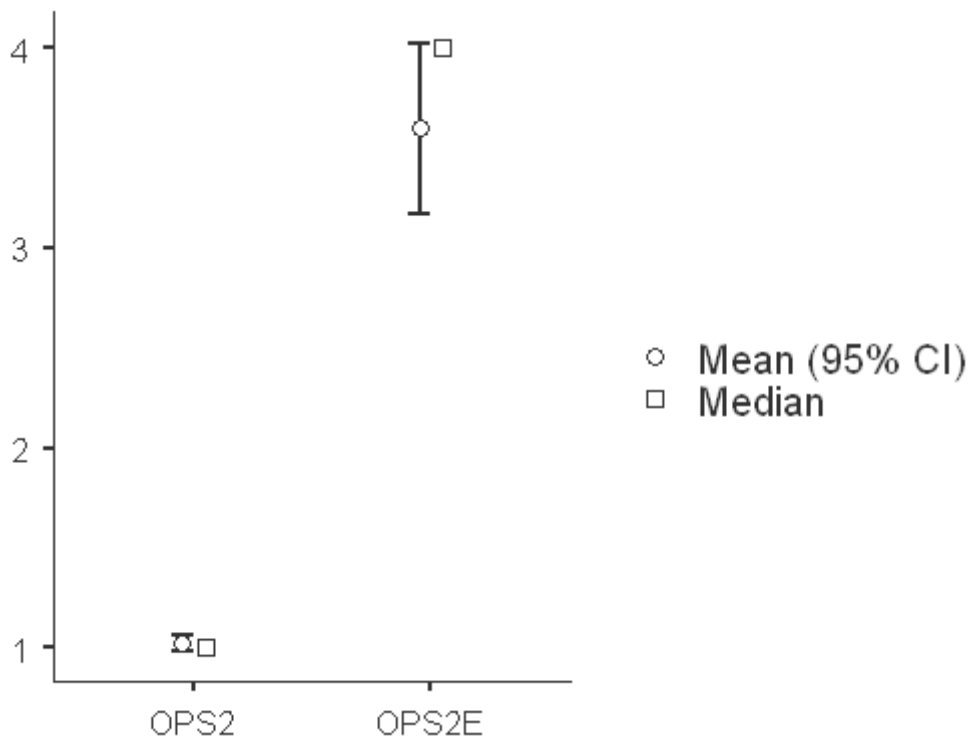


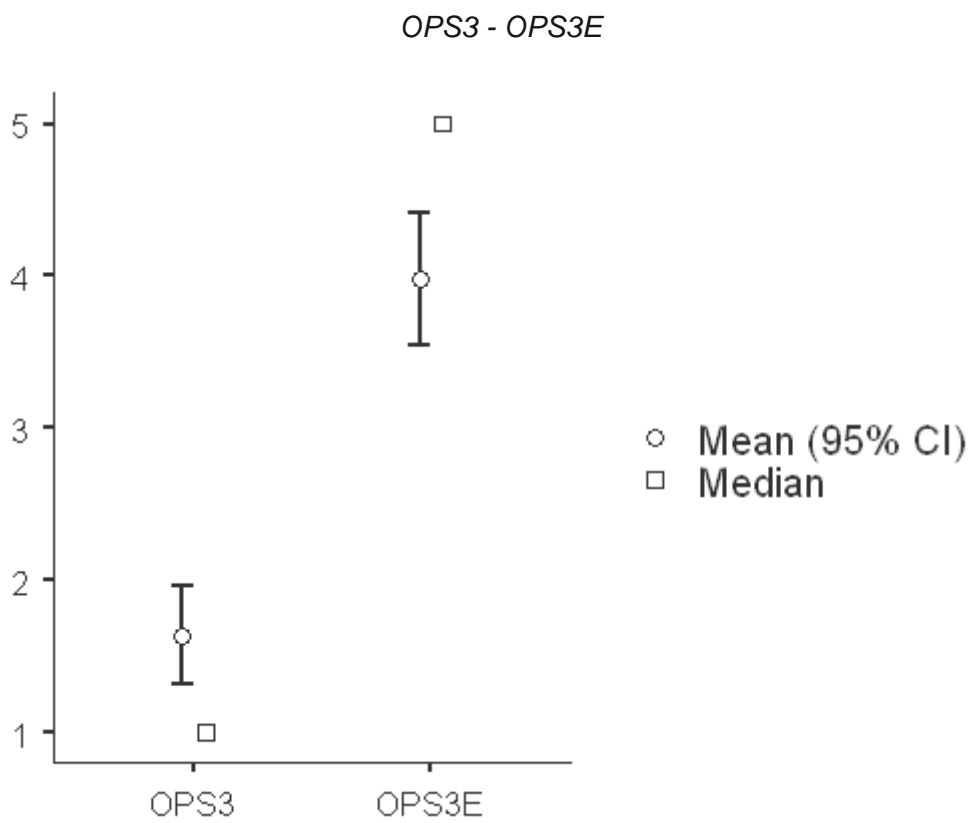
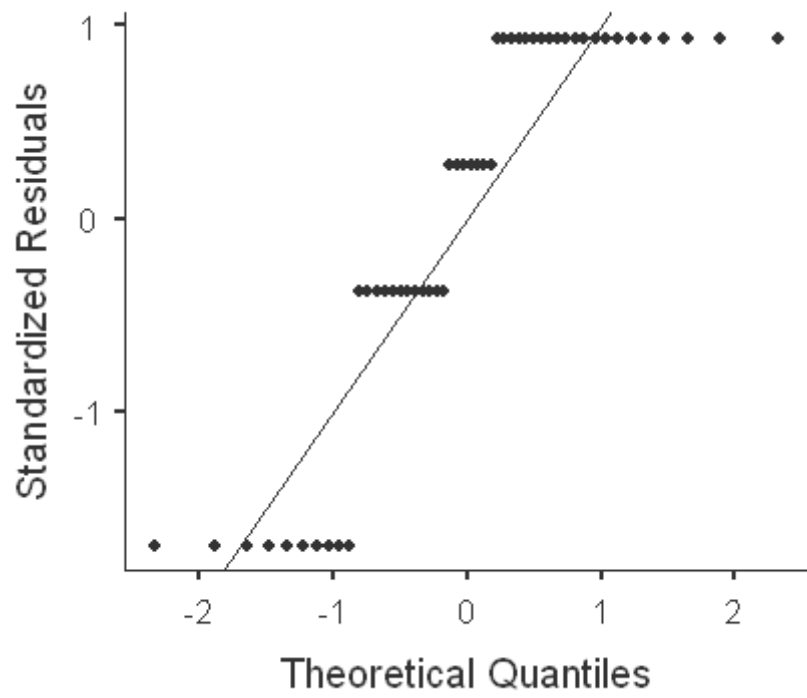
OPS1 - OPS1E

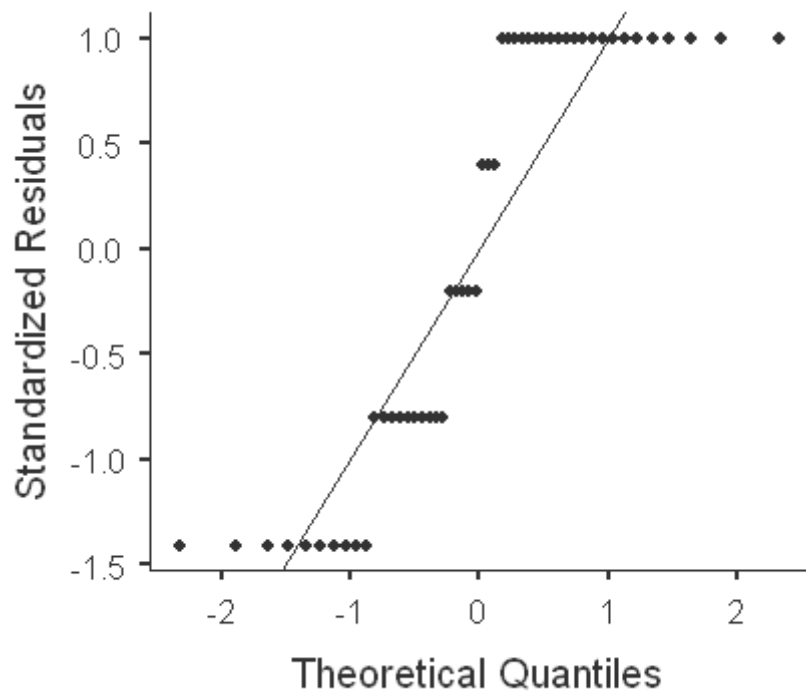




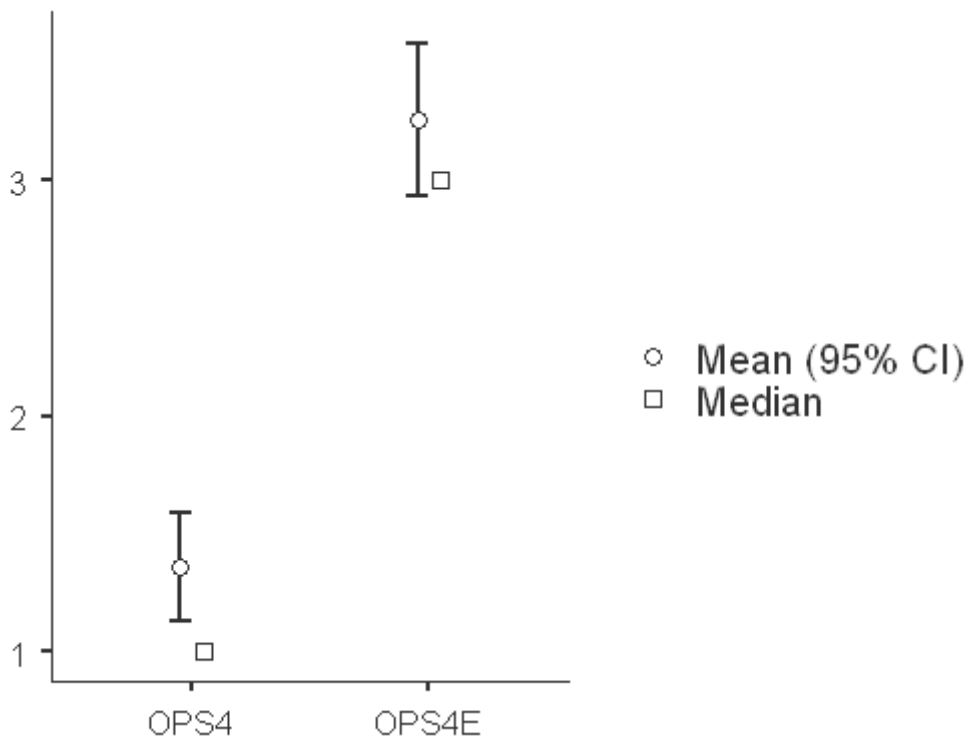
OPS2 - OPS2E

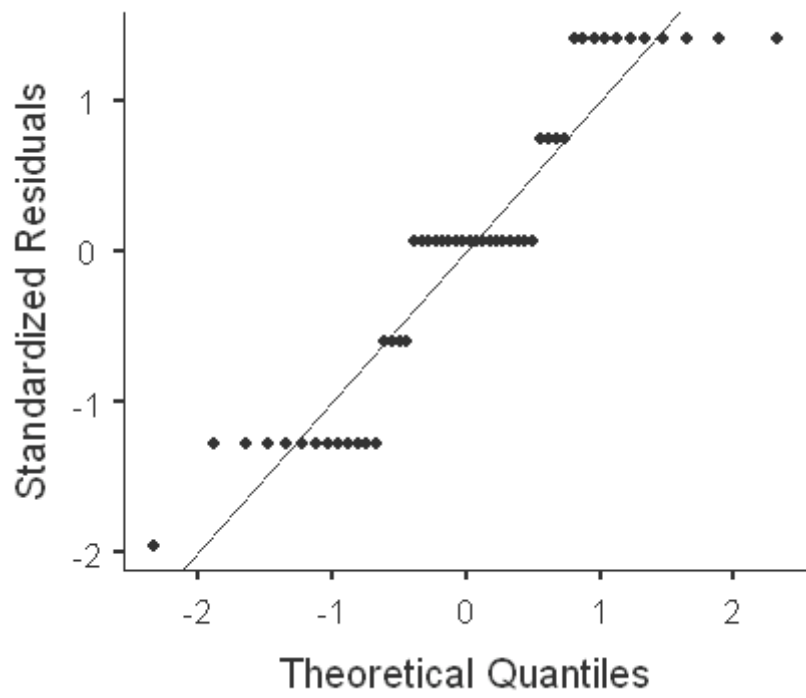




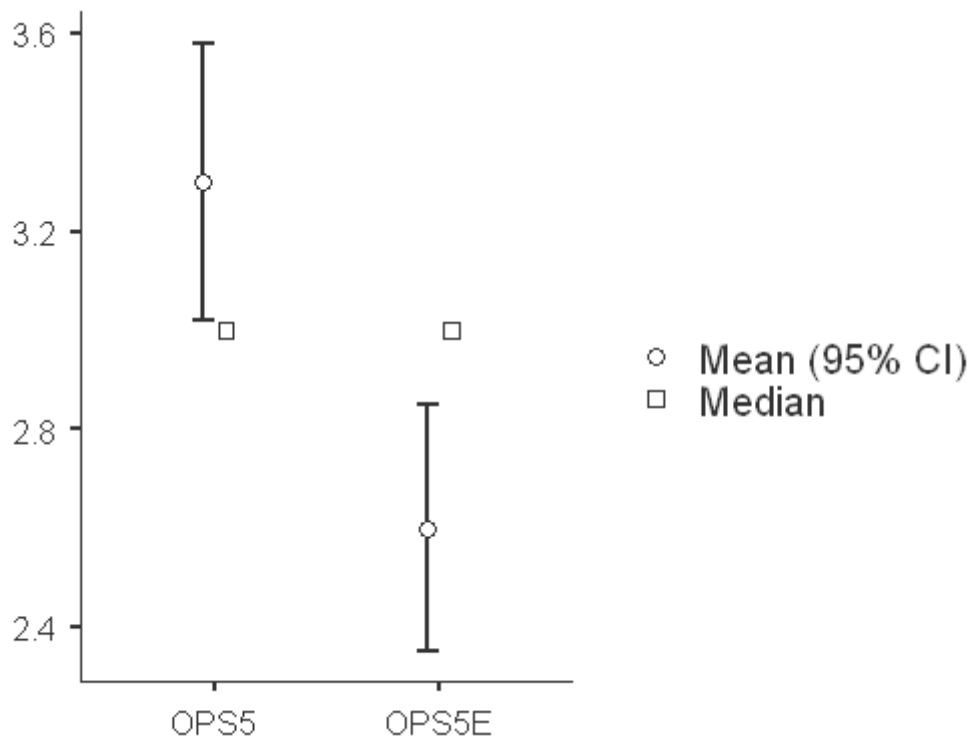


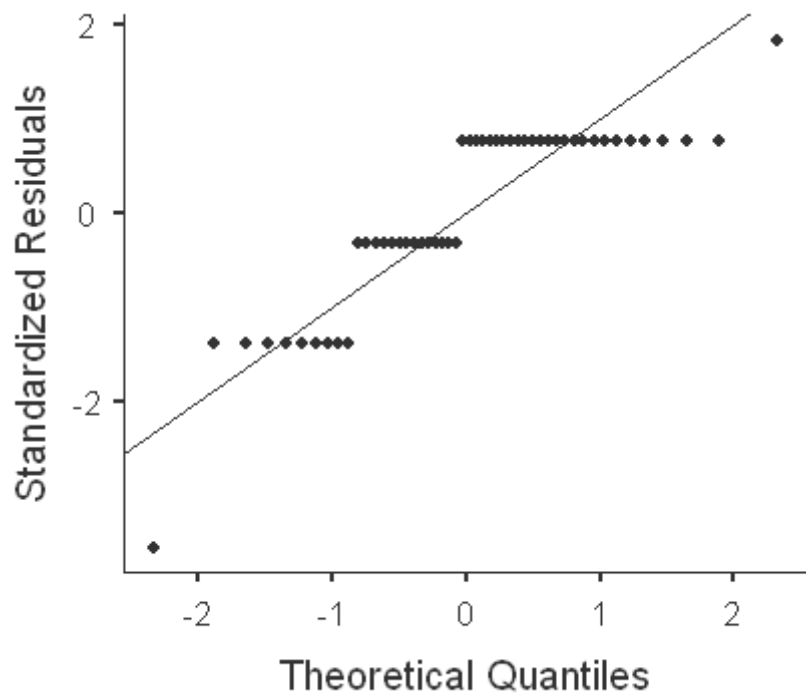
OPS4 - OPS4E



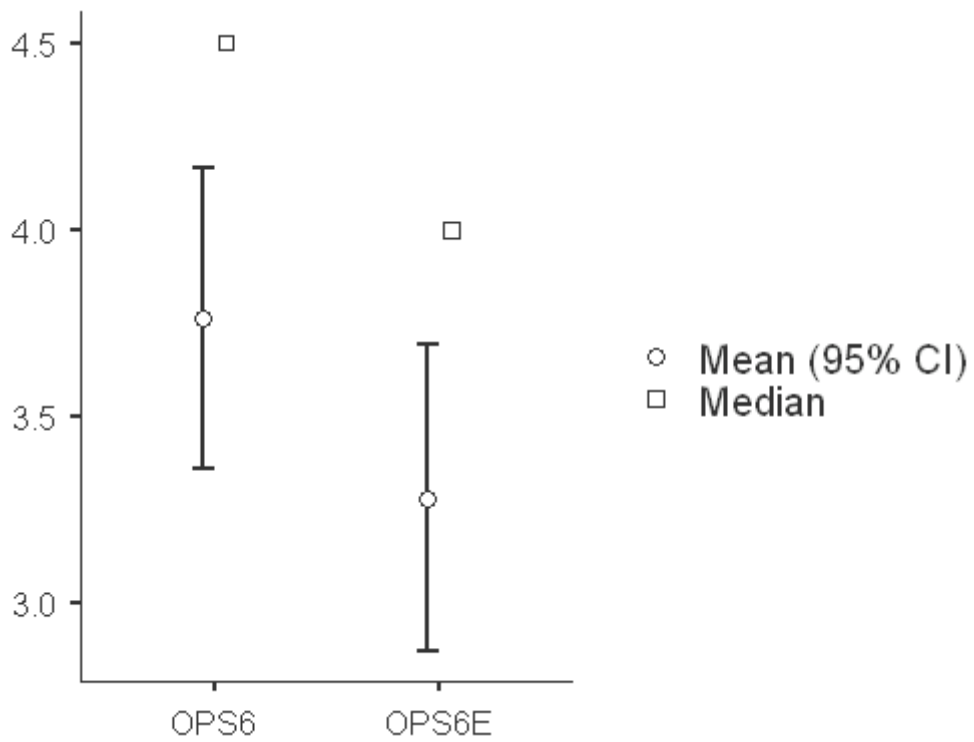


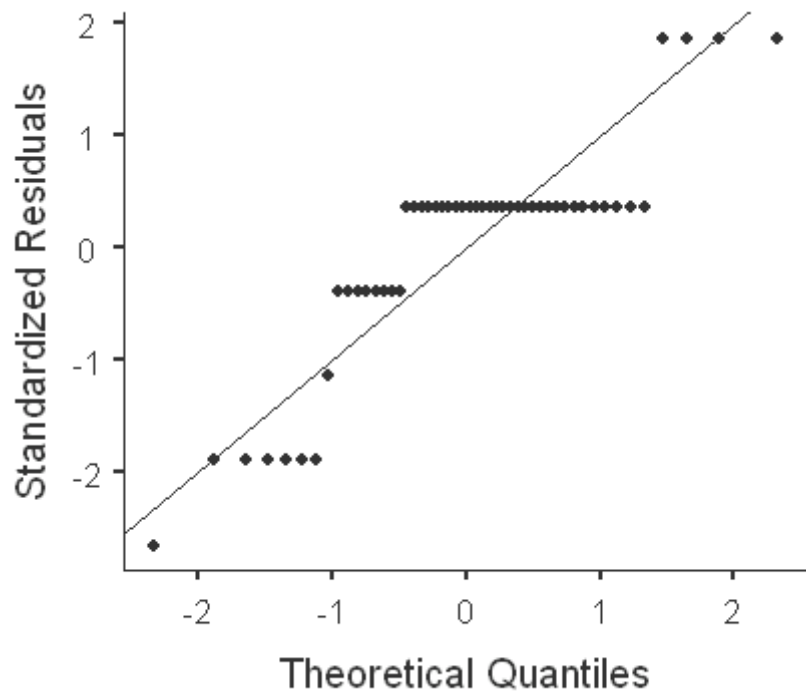
OPS5 - OPS5E



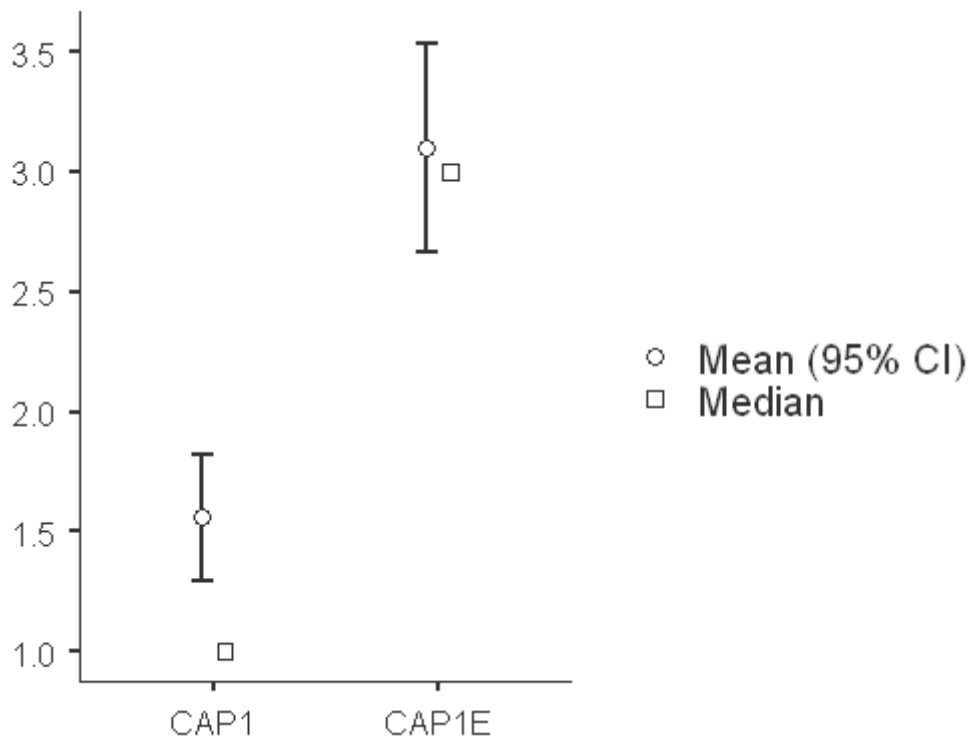


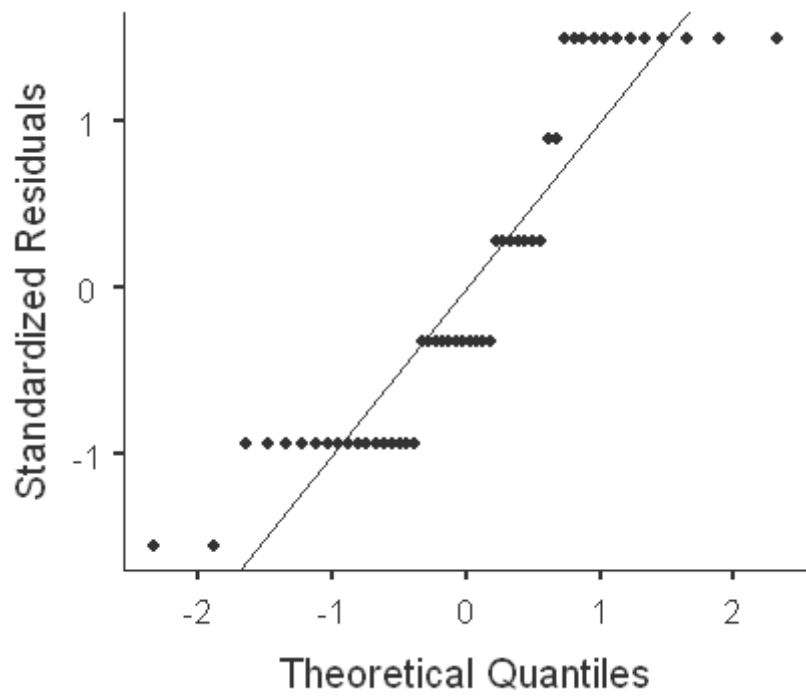
OPS6 - OPS6E



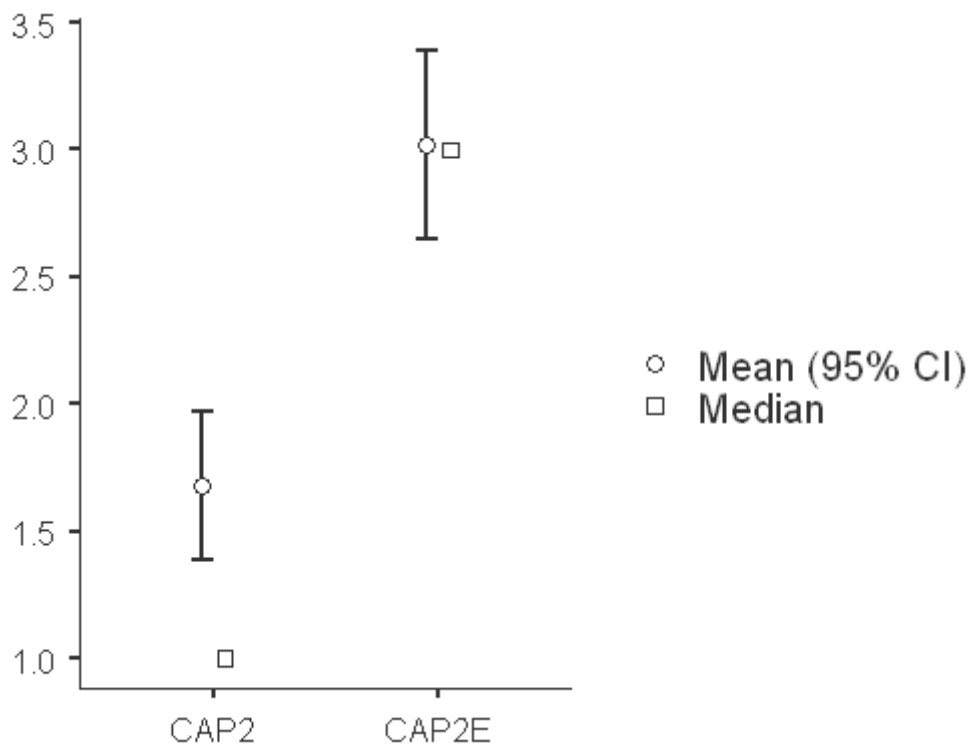


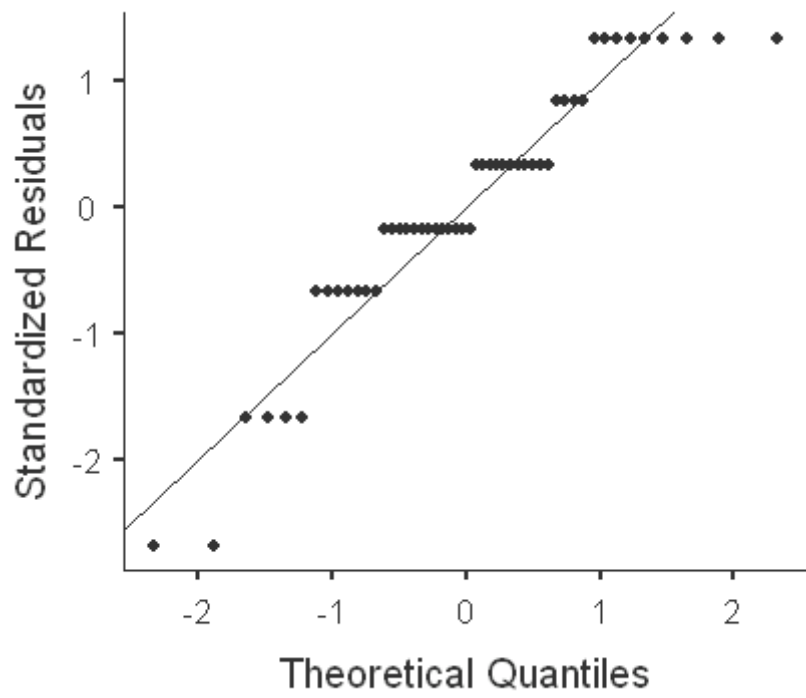
CAP1 - CAP1E



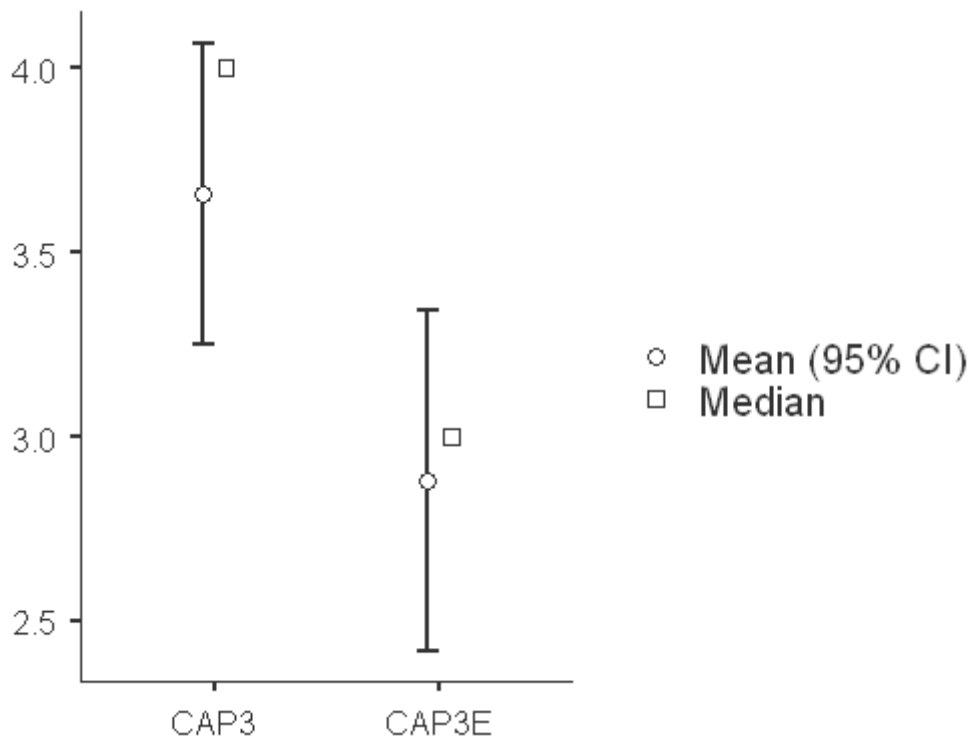


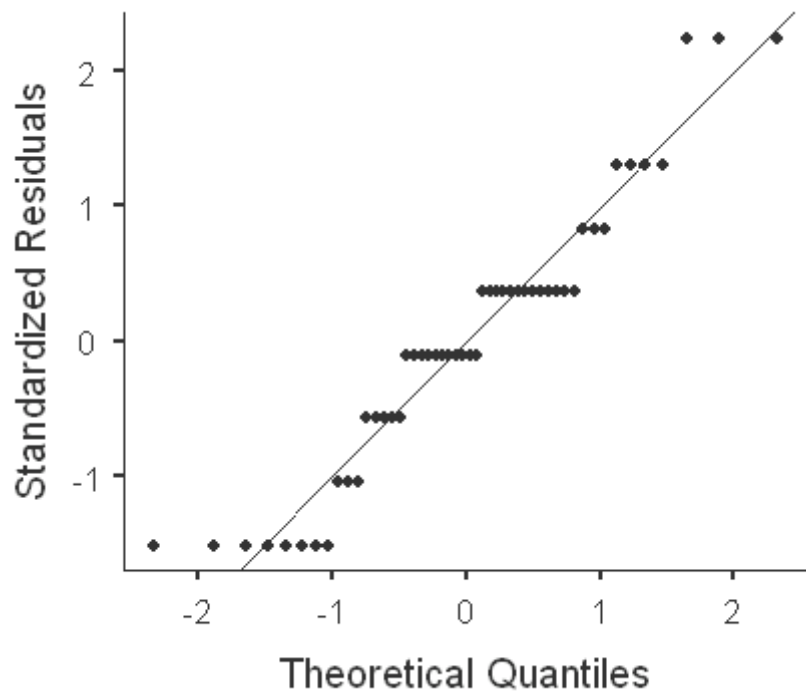
CAP2 - CAP2E



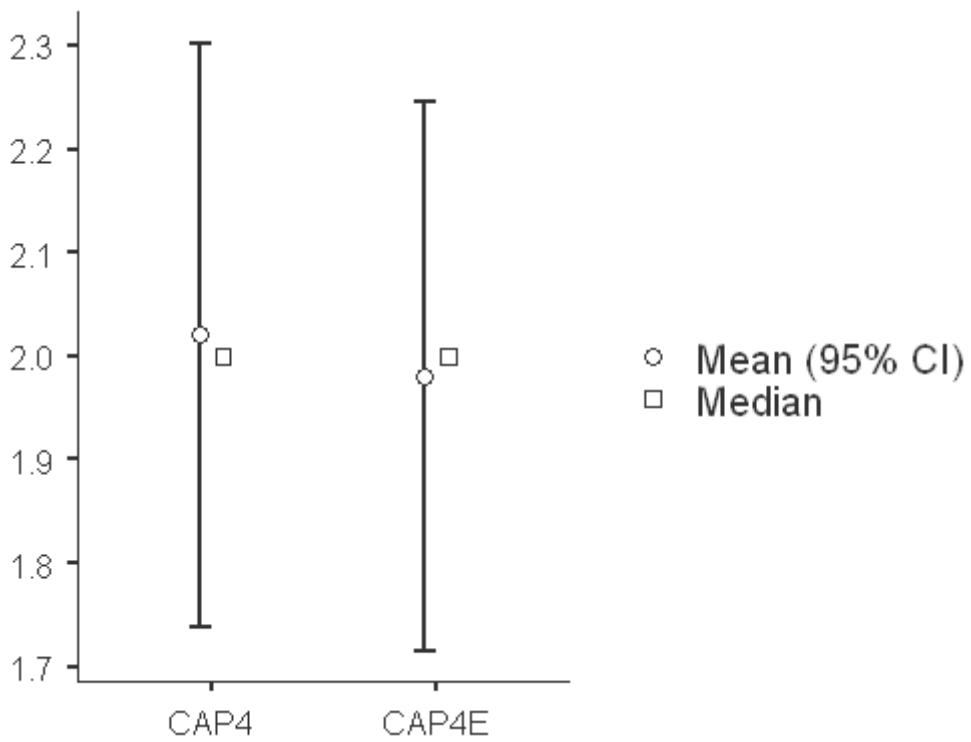


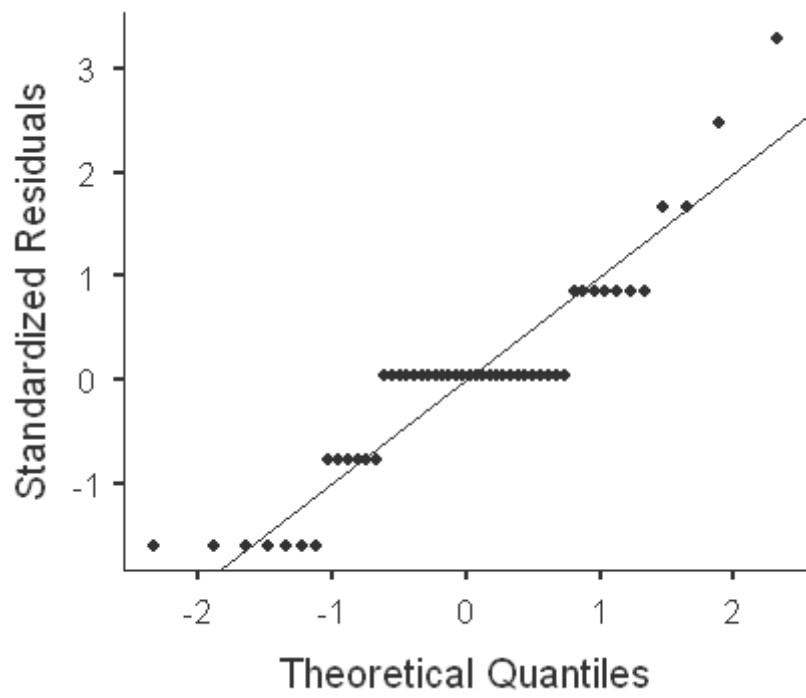
CAP3 - CAP3E



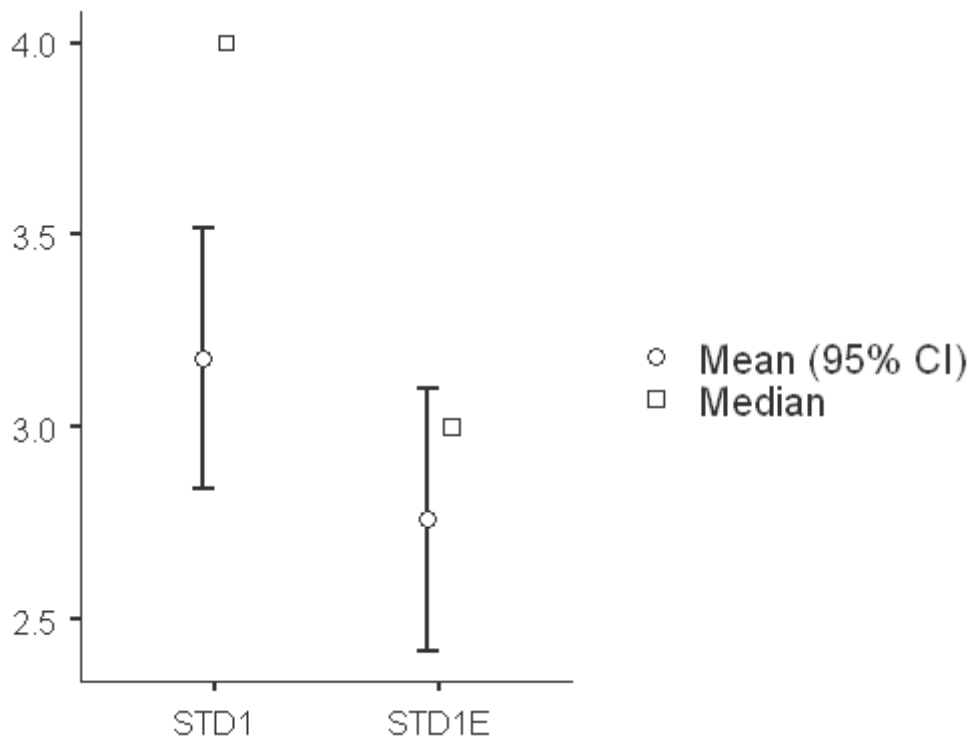


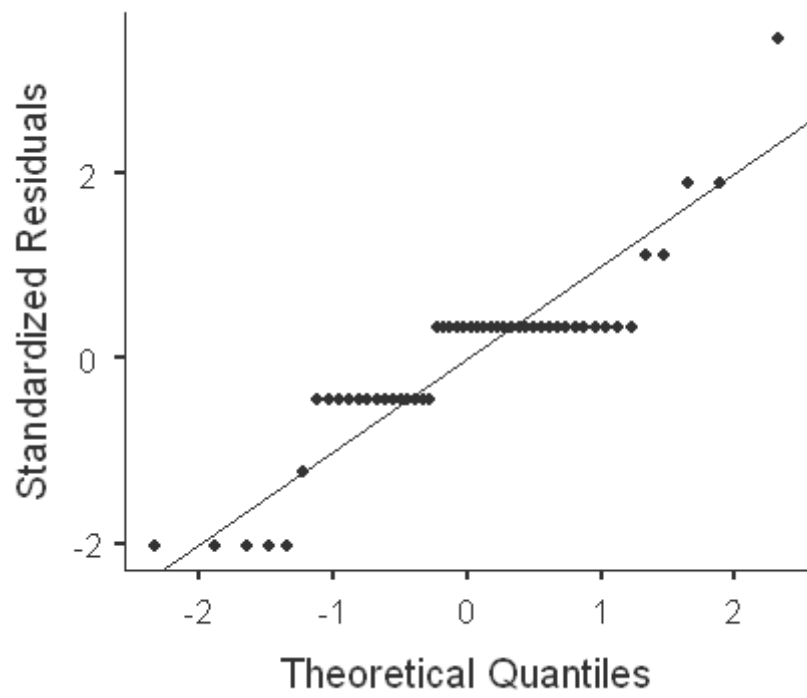
CAP4 - CAP4E



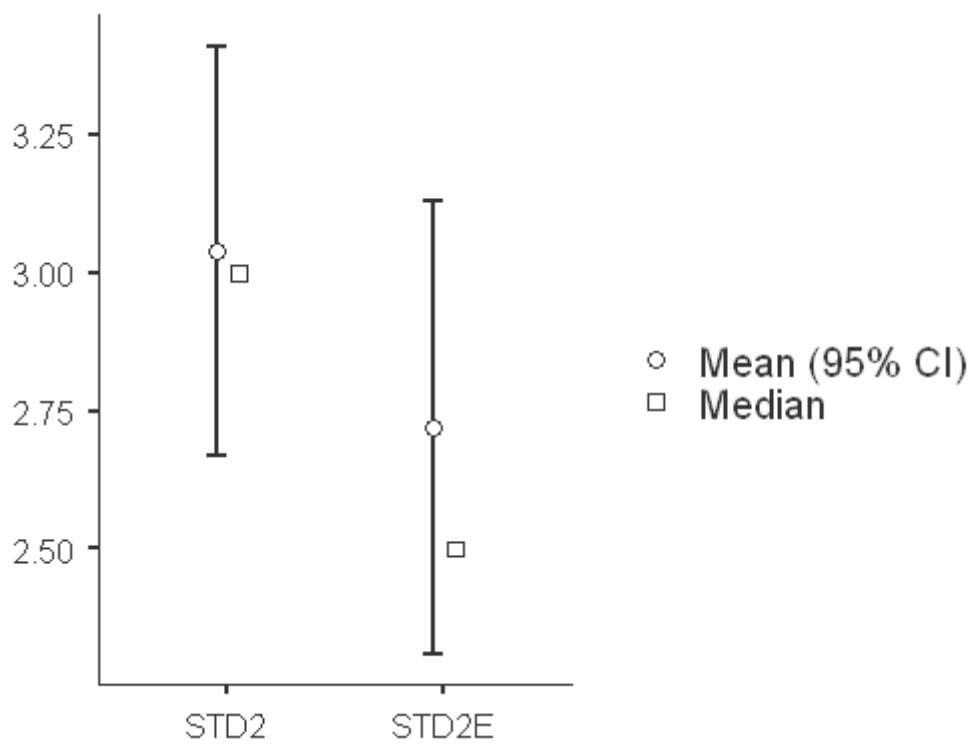


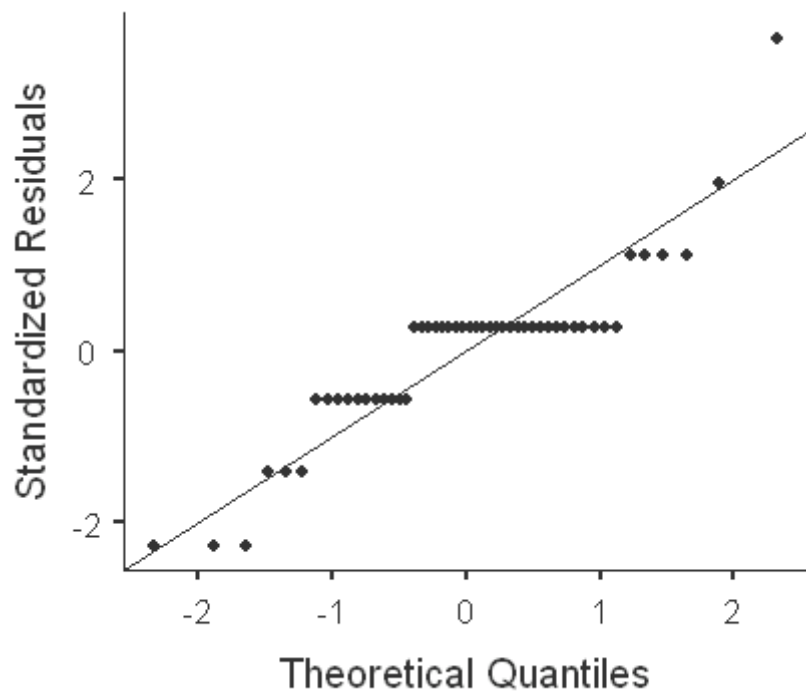
STD1 - STD1E



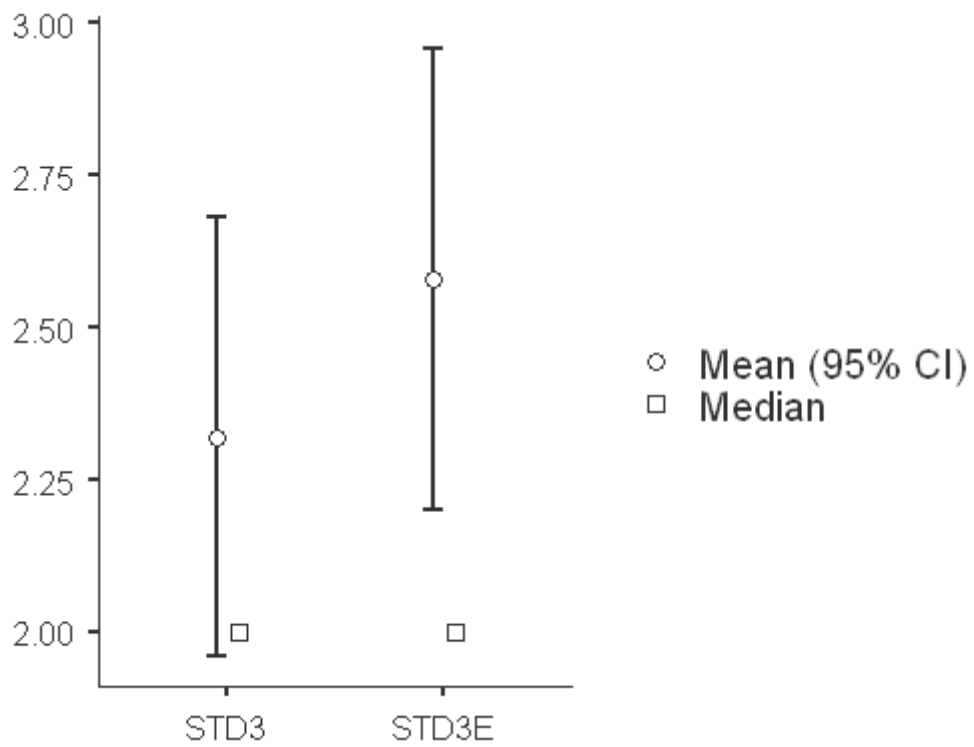


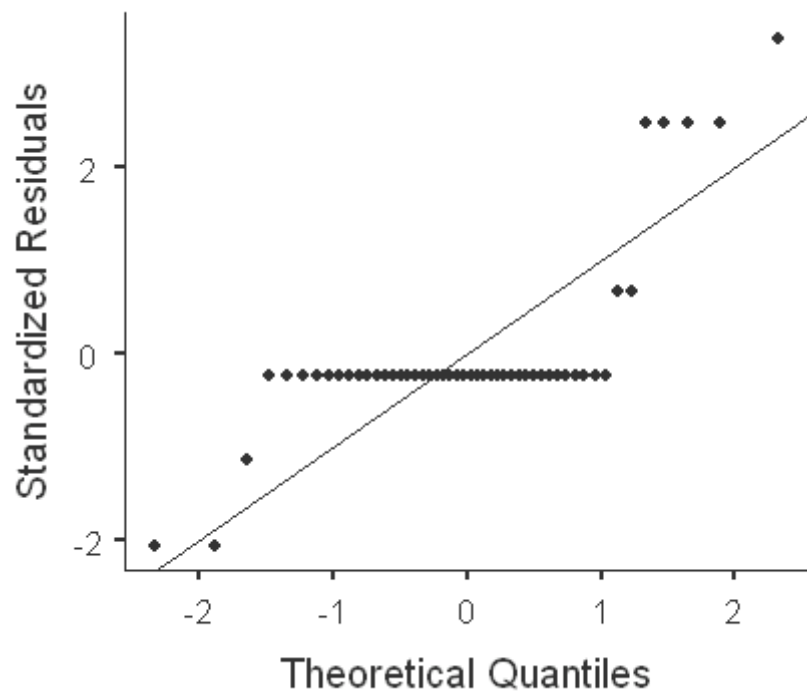
STD2 - STD2E





STD3 - STD3E





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ANNEX 4 – FAA’s Preflight Operational Risk Management Form (NON-AEG)

FLIGHT STANDARDS PREFLIGHT ORM WORKSHEET (NON-AEG)

Date: _____ Pilot: _____ Copilot/Additional Crew: _____ FTE/Other Crew: _____
 Office Code: _____ Departure ICAO: _____ Destination ICAO: _____ Aircraft Make/Model/Series: _____ SN/Registration Number: _____

1. Mission: (Select all that apply) <table style="width: 100%; border-collapse: collapse;"> <tr><td>14 CFR Part 121/135</td><td>2</td><td><input type="checkbox"/></td></tr> <tr><td>14 CFR Part 61</td><td>8</td><td><input type="checkbox"/></td></tr> <tr><td>14 CFR Part 141</td><td>8</td><td><input type="checkbox"/></td></tr> <tr><td>14 CFR Part 183</td><td>8</td><td><input type="checkbox"/></td></tr> <tr><td>49 U.S.C. § 44709</td><td>12</td><td><input type="checkbox"/></td></tr> <tr><td>Medical Flight Test</td><td>12</td><td><input type="checkbox"/></td></tr> </table>	14 CFR Part 121/135	2	<input type="checkbox"/>	14 CFR Part 61	8	<input type="checkbox"/>	14 CFR Part 141	8	<input type="checkbox"/>	14 CFR Part 183	8	<input type="checkbox"/>	49 U.S.C. § 44709	12	<input type="checkbox"/>	Medical Flight Test	12	<input type="checkbox"/>	0																																																
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Medical Flight Test	12	<input type="checkbox"/>																																																																	
2. Mission Complexity: (Select all that apply) <table style="width: 100%; border-collapse: collapse;"> <tr><td>Day</td><td>1</td><td><input type="checkbox"/></td></tr> <tr><td>VFR / IFR Currency</td><td>2</td><td><input type="checkbox"/></td></tr> <tr><td>Hood/NVG</td><td>3</td><td><input type="checkbox"/></td></tr> <tr><td>Density Altitude >2,500' above field elevation</td><td>4</td><td><input type="checkbox"/></td></tr> <tr><td>Night Unaided</td><td>5</td><td><input type="checkbox"/></td></tr> <tr><td>Touch & Go Landing(s)</td><td>2</td><td><input type="checkbox"/></td></tr> <tr><td>Glassy Water (Seaplane)</td><td>3</td><td><input type="checkbox"/></td></tr> <tr><td>Rough Water (Seaplane)</td><td>3</td><td><input type="checkbox"/></td></tr> <tr><td>Special Airport Qualification</td><td>4</td><td><input type="checkbox"/></td></tr> <tr><td>Autorotations (non-touchdown)</td><td>4</td><td><input type="checkbox"/></td></tr> <tr><td>Unimproved Airport/Landing Area</td><td>4</td><td><input type="checkbox"/></td></tr> <tr><td>Unprepared Landing Surface (FW) / Touchdown Autorotation (RW)</td><td>9</td><td><input type="checkbox"/></td></tr> <tr><td>Slope Landing (RW)</td><td>3</td><td><input type="checkbox"/></td></tr> <tr><td>Stalls</td><td>4</td><td><input type="checkbox"/></td></tr> <tr><td>Pinnacle Ops / Confined Area</td><td>4</td><td><input type="checkbox"/></td></tr> <tr><td>Water Ops / Ski Ops / Emergency Procedure Tng</td><td>5</td><td><input type="checkbox"/></td></tr> <tr><td>Spins / External Load Training / Aerobatics</td><td>7</td><td><input type="checkbox"/></td></tr> <tr><td>New Equipment (GPS, TAA, EFVS, EFB, etc.)</td><td>4</td><td><input type="checkbox"/></td></tr> <tr><td>SFAR Aircraft</td><td>4</td><td><input type="checkbox"/></td></tr> <tr><td>Brakes One Side Only</td><td>5</td><td><input type="checkbox"/></td></tr> <tr><td>Single or Throw-Over Controls</td><td>6</td><td><input type="checkbox"/></td></tr> <tr><td>Conventional (tailwheel) Landing Gear</td><td>6</td><td><input type="checkbox"/></td></tr> </table>	Day	1	<input type="checkbox"/>	VFR / IFR Currency	2	<input type="checkbox"/>	Hood/NVG	3	<input type="checkbox"/>	Density Altitude >2,500' above field elevation	4	<input type="checkbox"/>	Night Unaided	5	<input type="checkbox"/>	Touch & Go Landing(s)	2	<input type="checkbox"/>	Glassy Water (Seaplane)	3	<input type="checkbox"/>	Rough Water (Seaplane)	3	<input type="checkbox"/>	Special Airport Qualification	4	<input type="checkbox"/>	Autorotations (non-touchdown)	4	<input type="checkbox"/>	Unimproved Airport/Landing Area	4	<input type="checkbox"/>	Unprepared Landing Surface (FW) / Touchdown Autorotation (RW)	9	<input type="checkbox"/>	Slope Landing (RW)	3	<input type="checkbox"/>	Stalls	4	<input type="checkbox"/>	Pinnacle Ops / Confined Area	4	<input type="checkbox"/>	Water Ops / Ski Ops / Emergency Procedure Tng	5	<input type="checkbox"/>	Spins / External Load Training / Aerobatics	7	<input type="checkbox"/>	New Equipment (GPS, TAA, EFVS, EFB, etc.)	4	<input type="checkbox"/>	SFAR Aircraft	4	<input type="checkbox"/>	Brakes One Side Only	5	<input type="checkbox"/>	Single or Throw-Over Controls	6	<input type="checkbox"/>	Conventional (tailwheel) Landing Gear	6	<input type="checkbox"/>	0
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8. Alternate Airport Weather: (Select one) <table style="width: 100%; border-collapse: collapse;"> <tr><td>Alternate Not Required</td><td>0</td><td><input type="checkbox"/></td></tr> <tr><td>≥ 2000-3</td><td>1</td><td><input type="checkbox"/></td></tr> <tr><td>≥ 1000-3</td><td>4</td><td><input type="checkbox"/></td></tr> <tr><td>≥ IAP mins</td><td>6</td><td><input type="checkbox"/></td></tr> </table> Below 14 CFR 91.169 Requirements	Alternate Not Required	0	<input type="checkbox"/>	≥ 2000-3	1	<input type="checkbox"/>	≥ 1000-3	4	<input type="checkbox"/>	≥ IAP mins	6	<input type="checkbox"/>	0																																																						
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9. Surface Winds: (Depart & Arrive) (Select one) <table style="width: 100%; border-collapse: collapse;"> <tr><td>XW≤10 kt (FW) & Total Winds≤15 kt (ALL)</td><td>1</td><td><input type="checkbox"/></td></tr> <tr><td>XW≤15 kt (FW) & Total Winds≤20 kt (ALL)</td><td>3</td><td><input type="checkbox"/></td></tr> <tr><td>XW>15 kt (FW) or Total Wind>20 kt (ALL)</td><td>6</td><td><input type="checkbox"/></td></tr> <tr><td>>5 kt (Balloon)</td><td>6</td><td><input type="checkbox"/></td></tr> </table>	XW≤10 kt (FW) & Total Winds≤15 kt (ALL)	1	<input type="checkbox"/>	XW≤15 kt (FW) & Total Winds≤20 kt (ALL)	3	<input type="checkbox"/>	XW>15 kt (FW) or Total Wind>20 kt (ALL)	6	<input type="checkbox"/>	>5 kt (Balloon)	6	<input type="checkbox"/>	0																																																						
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10. EBC Currency: (In what time period) (Verified by Manager) <table style="width: 100%; border-collapse: collapse;"> <tr><td>0-30 Days</td><td>1</td><td><input type="checkbox"/></td></tr> <tr><td>31-60 Days</td><td>2</td><td><input type="checkbox"/></td></tr> <tr><td>61-90 Days</td><td>3</td><td><input type="checkbox"/></td></tr> <tr><td>90+ Days</td><td>4</td><td><input type="checkbox"/></td></tr> </table> 14 CFR 61.56/61.57/SFAR currency Yes <input type="checkbox"/> No <input type="checkbox"/>	0-30 Days	1	<input type="checkbox"/>	31-60 Days	2	<input type="checkbox"/>	61-90 Days	3	<input type="checkbox"/>	90+ Days	4	<input type="checkbox"/>	0																																																						
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13. Risk Level: Calculate total, and choose risk level <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center;">Less than 31 LOW</td> <td style="width: 33%; text-align: center;">31 to 45 MEDIUM</td> <td style="width: 33%; text-align: center;">Greater than 45 HIGH</td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> </table>	Less than 31 LOW	31 to 45 MEDIUM	Greater than 45 HIGH	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	0																																																												
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14. Outcome: Mission risk is acceptable? YES <input type="checkbox"/> NO <input type="checkbox"/>	Total																																																																		
Sign Here _____ Signature of Risk Acceptance Authority																																																																			
_____ Inspector Last Name																																																																			

Reset Form

Source: (FAA, 2017)

FLIGHT STANDARDS PREFLIGHT ORM WORKSHEET INSTRUCTIONS (NON-AEG)

Definitions & Abbreviations
<p>Pilot – The pilot (PIC or SIC) who is planned to be predominantly at the controls during critical phases of flight. Additional Crew (2-pilot aircraft) – The pilot who is planned to primarily serve as the pilot not flying (i.e. copilot, safety pilot, etc.). Additional Crew (single pilot aircraft) – A pilot or flight test engineer whose primary purpose is to serve as the PNF (i.e. copilot, safety pilot, etc.). (FW) – Item applies to fixed wing aircraft. (RW) – Item applies to rotorcraft aircraft.</p>
Instructions
<p>1. Mission. Choose the mission(s) for the flight. ASIs conducting enroute inspections need not complete an ORM worksheet. ASIs on flights for which the operator applies an approved risk management process need not complete an ORM worksheet.</p>
<p>2. Mission Complexity. Select risks from the list as applicable to the mission and enter each value in the right column. Not all mission risks are included in the block. Additional risks the ASI identifies should be added in block 11, "Uncalculated Risk Value".</p>
<p>3. Physiological Factors. Physiological is personal health and well-being. For example, if the ASI has a headache, the ASI might enter "3" in the column "Additional Crew". Enter the values for the pilot and additional crew in the right-hand column.</p>
<p>4. Runway Length. MRL is the largest of Critical Field Length (CFL); Accelerate-Stop Distance; Takeoff or landing over 50 ft obstacle distance; or Stop & Go distance. Calculate Minimum Runway Length (MRL) and compare to the runway available at each of the airports in the mission plan. Select the highest risk value among all planned airport operations and enter that value in the right-hand column. Do not consider touch and go runway requirements in this block.</p>
<p>5. Departure Weather. Select the category for departure weather depending on fixed wing aircraft (FW), rotorcraft aircraft (RW), and whether there is an Instrument Approach Procedure (IAP). Enter appropriate risk value for in the right-hand column.</p>
<p>6. Enroute Weather. For each hazard (thunderstorms, turbulence, precipitation, and icing), select the appropriate risk and enter that risk in the right-hand column. For example, if during the enroute portion of the mission the ASI expects to encounter light turbulence but no thunderstorms, precipitation, or icing, the ASI should enter a "1" in the right-hand column opposite the turbulence hazard. Zeros should be entered for the other hazards.</p>
<p>7. Destination Weather. Select fixed wing aircraft (FW) or rotorcraft aircraft (RW) and whether there is an Instrument Approach Procedure (IAP). Enter appropriate risk value for forecast destination weather in the right-hand column.</p>
<p>8. Alternate Weather. If an alternate is not required by 14 CFR §91.169, enter a zero in the right-hand column. If an alternate is required, enter the appropriate risk value for forecast alternate weather. If an alternate is not required, an alternate may be filed on the flight plan with a risk value of zero.</p>
<p>9. Surface Winds. Consider the wind expected at each of the airports in the mission plan and the landing runway's orientation. Consider both the wind velocity and the crosswind component. Enter the highest risk value for all planned airports. For example, the ASI should choose the row with risk of "3" if the wind is equal to 20 knots and the XW is less than 15 knots. For the purposes of this risk assessment worksheet, a maximum demonstrated crosswind is considered a limit. "ALL" means it applies to all categories and classes. For flight in a balloon, the wind must be less than 5 knots.</p>
<p>10. EBC Currency. Enter the risk value for the time period in which Event Based Currency (EBC) was completed. For example, if EBC was completed within the previous 30 days, the risk value would be "1".</p>
<p>11. Uncalculated Risk Value. Uncalculated risk is risk that was not accounted for in the worksheet. Risk is increased by adding the subjective value(s) based on the judgement of the ASI or the management team. This worksheet was not intended to capture all risk for all possible missions. This block is the ASI's opportunity to identify risks not identified elsewhere in the worksheet. These risks might come from the aircraft's condition, deferred maintenance items, equipment unfamiliar to the ASI, or something unusual about the mission, as examples. Uncalculated risk might relate to the IMSAFE checklist for Illness, Medication, Stress, Alcohol, Fatigue, Eating/Food. The risk should be listed in the block or on a separate sheet with a subjective risk value. Determine a risk value by comparing the risk to the risks in the first part of the worksheet. For example, the ASI is doing a 49 U.S.C. § 44709 and the helicopter for the flight just came out of an annual inspection. The ASI may decide to add a risk value of 5 by looking at the risk values for other items such as autorotations. Consider as many additional risk factors as are appropriate, and assign a subjective value to each. Briefly describe the risk(s), and enter the value(s) in the right-hand column, which will then be added to the total risk calculated to that point. Once this risk is identified, it may be mitigated in block 12.</p>
<p>12. Mitigated Risk Value. Mitigated risk is risk that is reduced by some method. Risk is decreased by subtracting a subjective value(s) based on the judgement of the ASI or the management team. This block is the ASI's opportunity to reduce risk identified earlier in the worksheet including the uncalculated risk in block 11. For example, if the mission will be conducted in a tailwheel aircraft, recent recurrent ASI tailwheel training may be a mitigation. The risk for flight in a tailwheel aircraft is "6" as assigned in block 2. The ASI may choose to reduce that risk by a subjective value of "4" based on the recurrent training. Briefly describe what the mitigation(s) are in block 12 or on an additional paper, and enter the total risk mitigation in the right-hand column. This value will be subtracted from the total risk calculated up to this point.</p>
<p>13. Risk Level. This block is the total risk reduced by mitigations in block 12. The result is the mission's risk level. If the final total is less than 30, the risk level is LOW. If the final total is between 31 and 45, the risk level is MEDIUM. If the final total is greater than 45, the risk level is HIGH.</p>
<p>14. Outcome. For LOW risk, the ASI's front line manager decides whether the risk is acceptable. For MEDIUM risk, the ASI's office manager decides whether the risk is acceptable. For HIGH risk, the mission should receive close scrutiny and mitigations to reduce the risk to MEDIUM or LOW. If the HIGH risk level cannot be reduced, the office manager will forward the mission specifics along with the ORM worksheet to the appropriate division manager who decides whether the mission's risk is acceptable. If the risk is acceptable, the flight is conducted. If the risk is not acceptable, the risk is either mitigated further or the flight is not conducted. The appropriate manager selects "YES" or "NO" and signs block 14. An ASI will never be forced to perform a job function in an aircraft in flight, regardless of the risk level, if the ASI considers the task unsafe.</p>

Source: (FAA, 2017)

ANNEX 5 – FAA’s Preflight Operational Risk Management Form (AEG Flights Only)

FLIGHT STANDARDS PREFLIGHT ORM WORKSHEET (AEG Flights Only)

Date: _____ Pilot: _____ Copilot/Additional Crew: _____ FTE/Other Crew: _____
 Office Code: _____ Departure ICAO: _____ Destination ICAO: _____ Aircraft Make/Model/Series: _____ SN/Registration Number: _____

1. Mission: (Select all that apply)		Experimental Aircraft	1	<input type="checkbox"/>	0
		Domestic OEM Operational Control	2	<input type="checkbox"/>	
		Foreign OEM Operational Control ODA	4	<input type="checkbox"/>	
		Operational Control	4	<input type="checkbox"/>	
		Non-OEM Applicant Operational Control	6	<input type="checkbox"/>	
2. Mission Complexity: (Select all that apply)		Steep Approaches	1	<input type="checkbox"/>	0
		Multiple Approaches	1	<input type="checkbox"/>	
		Hood/NVGS	3	<input type="checkbox"/>	
		Density Altitude >2,500' above field elevation	4	<input type="checkbox"/>	
		Night Unaided	5	<input type="checkbox"/>	
		OCONUS	2	<input type="checkbox"/>	
		Touch & Go Landing(s)	2	<input type="checkbox"/>	
		Glassy Water (Seaplane)	3	<input type="checkbox"/>	
		Rough Water (Seaplane)	3	<input type="checkbox"/>	
		Special Airport Qualification	4	<input type="checkbox"/>	
		Autorotations (non-touchdown)	4	<input type="checkbox"/>	
		Unimproved Airport/Landing Area	4	<input type="checkbox"/>	
		Unprepared Landing Surface (FW) / Touchdown	9	<input type="checkbox"/>	
		Autorotation (RW)			
		High Visibility/Publicity	1	<input type="checkbox"/>	
		AIR Medium Risk	11	<input type="checkbox"/>	
		AIR High Risk	21	<input type="checkbox"/>	
		Stalls	4	<input type="checkbox"/>	
		Pinnacle Ops / Confined Area	4	<input type="checkbox"/>	
		Water Ops / Ski Ops / Emergency Procedure Tng	5	<input type="checkbox"/>	
		Spins / External Load Training / Aerobatics	7	<input type="checkbox"/>	
		New Equipment (GPS, TAA, EFVS, EFB, etc.)	4	<input type="checkbox"/>	
		SFAR Aircraft	4	<input type="checkbox"/>	
		Brakes One Side Only	5	<input type="checkbox"/>	
		Single or Throw-Over Controls	6	<input type="checkbox"/>	
		Conventional (tailwheel) Landing Gear	6	<input type="checkbox"/>	
3. Physiological Factors:					0
		Pilot	Additional Crew		
	None	1	<input type="checkbox"/>	<input type="checkbox"/>	
	Minor	3	<input type="checkbox"/>	<input type="checkbox"/>	
	Major	5	<input type="checkbox"/>	<input type="checkbox"/>	
4. Runway		≥ (MRL+2,000'), or Rotorcraft	1	<input type="checkbox"/>	0
Length:		≥ (MRL+1,000')	4	<input type="checkbox"/>	
(Select one)		< (MRL+1,000')	6	<input type="checkbox"/>	
5. Departure Weather:		≥3,000-3	1	<input type="checkbox"/>	0
		≥2,000-3(FW)	2	<input type="checkbox"/>	
		≥1,000-3(RW)			
		≥ Approach minimums or 300-1 (no IAP) (FW)	5	<input type="checkbox"/>	
		≥ Approach minimums or 300-½ (no IAP) (RW)			
		< Approach minimums or 300-1 (no IAP) (FW)	9	<input type="checkbox"/>	
		< Approach minimums or 300-½ (no IAP) (RW)			

Reset Form

6. Enroute Weather: (Select one item for each hazard)					0	
Thunderstorms:	Numerous	Scattered	Few	Isolated		None
	8	6	3	1		0
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
Turbulence:	Severe	Moderate	Light	None		
	No-Go	3	1	0		
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Precipitation:	Heavy	Moderate	Light	None		
	7	3	1	0		
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Icing:	Severe	Moderate	Light	Trace	None	
	No-Go	6	3	1	0	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7. Destination Weather: (Select one)					0	
Fixed Wing	≥ 2,000-3	1	<input type="checkbox"/>			
	≥ IAP mins or 1,000-3 (no IAP)	4	<input type="checkbox"/>			
	< IAP mins or 1,000-3 (no IAP)	6	<input type="checkbox"/>			
Rotorcraft	≥ 1,000-2	1	<input type="checkbox"/>			
	≥ IAP mins or 500-1 (no IAP)	4	<input type="checkbox"/>			
	< IAP mins or 500-1 (no IAP)	6	<input type="checkbox"/>			
8. Alternate Airport Weather: (Select one)					0	
Alternate Not Required		0	<input type="checkbox"/>			
≥ 2000-3		1	<input type="checkbox"/>			
≥ 1000-3		4	<input type="checkbox"/>			
≥ IAP mins Below 14 CFR 91.169 Requirements		6	<input type="checkbox"/>			
9. Surface Winds: (Depart & Arrive) (Select one)					0	
XW≤10 kt (FW) & Total Wind≤15 kt (ALL)		1	<input type="checkbox"/>			
XW≤15 kt (FW) & Total Wind≤20 kt (ALL)		3	<input type="checkbox"/>			
XW>15 kt (FW) or Total Wind>20 kt (ALL)		6	<input type="checkbox"/>			
>5 kt (Balloon)		6	<input type="checkbox"/>			
10. EBC Currency: (In what time period) (Verified by Manager)					0	
0-30 Days		1	<input type="checkbox"/>			
31-60 Days		2	<input type="checkbox"/>			
61-90 Days		3	<input type="checkbox"/>			
90+ Days		4	<input type="checkbox"/>			
14 CFR 61.56/61.57/SFAR currency		Yes	No			
11. Uncalculated Risk Value: Enter a value for risk not accounted for above. State the risk(s). Add to the total.					+	
12. Mitigated Risk Value: Enter a value for risk that is mitigated. State the mitigation(s)? Subtract from the total.					-	
13. Risk Level: Calculate total, and choose risk level					0	
	Less than 31 LOW	31 to 45 MEDIUM	Greater than 45 HIGH	Total		
14. Outcome: Mission risk is acceptable? <input type="checkbox"/> YES <input type="checkbox"/> NO						
<div style="display: flex; justify-content: space-between; margin-bottom: 5px;"> Sign Here Sign Here </div> <div style="border: 1px solid black; width: 100%; height: 20px; background-color: #e0e0e0; margin-bottom: 5px;"></div> <div style="text-align: center; margin-bottom: 5px;">Signature of Risk Acceptance Authority</div> <div style="border: 1px solid black; width: 100%; height: 20px; background-color: #e0e0e0; margin-bottom: 5px;"></div> <div style="text-align: center;">Inspector Last Name</div>						

Source: (FAA, 2017)

FLIGHT STANDARDS PREFLIGHT ORM WORKSHEET INSTRUCTIONS (AEG FLIGHTS ONLY)

Definitions & Abbreviations
<p>Pilot – The pilot (PIC or SIC) who is planned to be predominantly at the controls during critical phases of flight.</p> <p>Additional Crew (2-pilot aircraft) – The pilot who is planned to primarily serve as the pilot not flying (i.e. copilot, safety pilot, etc.).</p> <p>Additional Crew (single pilot aircraft) – A pilot or flight test engineer whose primary purpose is to serve as the PNF (i.e. copilot, safety pilot, etc.).</p> <p>(FW) – Item applies to fixed wing aircraft.</p> <p>(RW) – Item applies to rotorcraft aircraft.</p> <p>Entries in bold text – Tactical assessment items which may be included in the AEG ASI’s day-of tactical assessment. All AEG flights require a tactical assessment. The ASI will sign the Tactical Assessment section of the form indicating the assessment was completed and did not result in a risk category (LOW, MEDIUM, HIGH) increase from the initial risk assessment.</p>
Instructions
<p>1. Mission. Choose the mission(s) for the flight. ASIs conducting enroute inspections need not complete an ORM worksheet. ASIs on flights for which the operator applies an approved risk management process need not complete an ORM worksheet.</p>
<p>2. Mission Complexity. Select risks from the list as applicable to the mission and enter each value in the right column. Not all mission risks are included in the block. Additional risks the ASI identifies should be added in block 11, “Uncalculated Risk Value”.</p>
<p>3. Physiological Factors. Physiological is personal health and well-being. For example, if the ASI has a headache, the ASI might enter “3” in the column “Additional Crew”. Enter the values for the pilot and additional crew in the right-hand column.</p>
<p>4. Runway Length. MRL is the largest of Critical Field Length (CFL); Accelerate-Stop Distance; Takeoff or landing over 50 ft obstacle distance; or Stop & Go distance. Calculate Minimum Runway Length (MRL) and compare to the runway available at each of the airports in the mission plan. Select the highest risk value among all planned airport operations and enter that value in the right-hand column. Do not consider touch and go runway requirements in this block.</p>
<p>5. Departure Weather. Select the category for departure weather depending on fixed wing aircraft (FW), rotorcraft aircraft (RW), and whether there is an Instrument Approach Procedure (IAP). Enter appropriate risk value for in the right-hand column.</p>
<p>6. Enroute Weather. For each hazard (thunderstorms, turbulence, precipitation, and icing), select the appropriate risk and enter that risk in the right-hand column. For example, if during the enroute portion of the mission the ASI expects to encounter light turbulence but no thunderstorms, precipitation, or icing, the ASI should enter a “1” in the right-hand column opposite the turbulence hazard. Zeros should be entered for the other hazards.</p>
<p>7. Destination Weather. Select fixed wing aircraft (FW) or rotorcraft aircraft (RW) and whether there is an Instrument Approach Procedure (IAP). Enter appropriate risk value for forecast destination weather in the right-hand column.</p>
<p>8. Alternate Weather. If an alternate is not required by 14 CFR §91.169, enter a zero in the right-hand column. If an alternate is required, enter the appropriate risk value for forecast alternate weather. If an alternate is not required, an alternate may be filed on the flight plan with a risk value of zero.</p>
<p>9. Surface Winds. Consider the wind expected at each of the airports in the mission plan and the landing runway’s orientation. Consider both the wind velocity and the crosswind component. Enter the highest risk value for all planned airports. For example, the ASI should choose the row with risk of “3” if the wind is equal to 20 knots and the XW is less than 15 knots. For the purposes of this risk assessment worksheet, a maximum demonstrated crosswind is considered a limit. “ALL” means it applies to all categories and classes. For flight in a balloon, the wind must be less than 5 knots.</p>
<p>10. EBC Currency. Enter the risk value for the time period in which Event Based Currency (EBC) was completed. For example, if EBC was completed within the previous 30 days, the risk value would be “1”.</p>
<p>11. Uncalculated Risk Value. Uncalculated risk is risk that was not accounted for in the worksheet. Risk is increased by adding a subjective value(s) based on the judgement of the ASI or the management team. This worksheet was not intended to capture all risk for all possible missions. This block is the ASI’s opportunity to identify risks not identified elsewhere in the worksheet. These risks might come from the aircraft’s condition, deferred maintenance items, equipment unfamiliar to the ASI, or something unusual about the mission, as examples. Uncalculated risk might relate to the IMSAFE checklist for Illness, Medication, Stress, Alcohol, Fatigue, Eating/Food. The risk should be listed in the block or on a separate sheet with a subjective risk value. Determine a risk value by comparing the risk to the risks in the first part of the worksheet. For example, the ASI is doing a 49 U.S.C. § 44709 and the helicopter for the flight just came out of an annual inspection. The ASI may decide to add a risk value of 5 by looking at the risk values for other items such as autorotations. Consider as many additional risk factors as are appropriate, and assign a subjective value to each. Briefly describe the risk(s), and enter the value(s) in the right-hand column, which will then be added to the total risk calculated to that point. Once this risk is identified, it may be mitigated in block 12.</p>
<p>12. Mitigated Risk Value. Mitigated risk is risk that is reduced by some method. Risk is decreased by subtracting a subjective value(s) based on the judgement of the ASI or the management team. This block is the ASI’s opportunity to reduce risk identified earlier in the worksheet including the uncalculated risk in block 11. For example, if the mission will be conducted in a tailwheel aircraft, recent recurrent ASI tailwheel training may be a mitigation. The risk for flight in a tailwheel aircraft is “6” as assigned in block 2. The ASI may choose to reduce that risk by a subjective value of “4” based on the recurrent training. Briefly describe what the mitigation(s) are in block 12 or on an additional paper, and enter the total risk mitigation in the right-hand column. This value will be subtracted from the total risk calculated up to this point.</p>
<p>13. Risk Level. This block is the total risk reduced by mitigations in block 12. The result is the mission’s risk level. If the final total is less than 30, the risk level is LOW. If the final total is between 31 and 45, the risk level is MEDIUM. If the final total is greater than 45, the risk level is HIGH.</p>
<p>14. Outcome. For LOW risk, the ASI’s front line manager decides whether the risk is acceptable. For MEDIUM risk, the ASI’s office manager decides whether the risk is acceptable. For HIGH risk, the mission should receive close scrutiny and mitigations to reduce the risk to MEDIUM or LOW. If the HIGH risk level cannot be reduced, the office manager will forward the mission specifics along with the ORM worksheet to the appropriate division manager who decides whether the mission’s risk is acceptable. If the risk is acceptable, the flight is conducted. If the risk is not acceptable, the risk is either mitigated further or the flight is not conducted. All <u>increases in risk category</u> (LOW, MEDIUM, HIGH) during tactical assessment must be coordinated with the appropriate manager. The appropriate manager selects “YES” or “NO” and signs block 14. An ASI will never be forced to perform a job function in an aircraft in flight, regardless of the risk level, if the ASI considers the task unsafe.</p>

Source: (FAA, 2017)