AB-INITIO PILOT TRAINING MODEL COMBINATING SCENARIO-BASED TRAINING WITH SIMULATOR AND REAL FLIGHT

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ABSTRACT

Flight Training has a huge importance in a pilot`s career, as it is from there that their careers will begin. Over time, new aircraft were being created, each time having more advanced technologies, arising the need to evolve such flight training. From this, training based on flight simulation was implemented, with this new training possibilities were integrated, as well as bringing greater safety to the pilots, since risky maneuvers that before could only be trained in the real flight, can now be trained in the flight simulator. Also with these technological advances, there was a need to modify the training method, which was initially activated in the repetition of maneuvers, until an acceptable level of execution was reached. The evolution of this training was the Scenario-Based Training (SBT), where several structured situations are created with the aim of making the pilot student follow his decision-making process. The present work discusses how to combine the TBC and the flight simulator together with the real flight to bring greater efficiency to the training of a student pilot taking the Private Pilot (PPL) course. At this point the article shows a proposed syllabus that will be validated by questionnaires using the design science research.

Keywords: Flight Training, Flight Simulator, Scenario Based Training, ab-initio flight training, Private Pilot course.

1. INTRODUCTION

Flight training is the first step in a pilot's formation, it is in this step that he will acquire the basic technical and non-technical skills to deal with his career.

This foundation must be really solid, mitigating future problems that could occur if the formation was bad. One of the technical abilities that can be cited is the climb, turn and descent maneuvers, even upset recoveries. The non-technical ones are such as in-flight management.

Allerton (2009) told that in the beginning of aviation, the flight training was transferred between pilots in an informal way, sometimes forgetting to forward small tips about the flight experience. Since then, the aviation industry is searching for ways to evolve the training process, in this process, means such as flight simulators and scenario-based flight training are being utilized and are the main focus of this paper.

2. FLIGHT TRAINING

2.1. Flight Instruction

In Brazil, the flight training is conducted based on syllabus that must be according with RBAC 61 (ANAC, 2020a) and IS 141-007 (ANAC, 2020b).

Anac requires at least 35 flight hours, and allows a maximum use of 5 hours of flight simulator training, but the flight school can choose if it will be used and where. Also, the main countries were also researched, and their data about flight training hours and simulator use are on Table 1.

The majority of the flight schools of Brazil uses a former syllabus called MCA 58-3 (Comando da aeronáutica, 2004) (Table 2).

MCA 58-3 which is composed by four phases of training, where on the first phase, called Pre-solo, is the first contact of the pilot with the aircraft, where he will learn how to take off an aircraft, climb, make turns, descent, land and how to manage an emergency in-flight. The pre-solo phase ends with the first solo flight of the student pilot.

The second phase is known as Improvement, where it is expected that the pilot learns more about the aircraft's limits and perform takeoffs and landings in fields with limited length or obstacles. In this step there are also some solo-training to increase the pilots self confidence.

After the improvement comes the navigation phase, where new airports will be introduced to the student and also on how to move from the origin airport to the destination one. And finally, is the night flying phase, that sometimes it is done apart from the normal structure or sometimes a mission in some of the previous phases, depending on where the pilot flies.

Table 1 Flight hours requirement for private pilot license around the world.

Aeronautical authority	Total hours	Hours with Flight Instructor	Solo flight hours	Flight simulator hours	Types of flight simulator used
ANAC	35 h	20 h	10 h	Max 5 h	ATD, FTD
FAA	35 h	20 h	5 h	Max of 15% of the flight time	FFS
				Max of 20% of the flight time	ATD
EASA	45 h	25 h	10 h	5 h	ATD, FTD
CASA	35 h	Do not specify	10 h	Do not specify	ATD, FTD

Table 2 Data about flight schools in Brazil.

CIAC	Totla of Training	Hours in Flight Simulator	Phase of flight sim adoption	Maneuvers done in sim	Flight simulator model	Type of flight simulator	Syllabus of reference
SAFE	46,5h	1,5h	End of the training	Basic IFR Maneuvers	SMGN20	AATD	Review 02 PPAP001
Aeroclube de São Paulo	41h	xx	Utilization on-demand	-	Redbird FMX, BR sim GA30	AATD	PPA Review 00
AeroTime	42,5h	5h	Pre-solo	Optional for repetition of maneuvers AFTER the real flight	BR simulations GA-18	AATD	PPA REV 00
Charlie 0	51,5h	5h	Pre-solo, Improvement e Navigation	2h on PS, 1h on AP, 2h on NAV	BR simulations GA-18	AATD	PPA Rev 00
Aeroclube de Santo Angelo	48h	5h	"Phase V"	Do not specify the maneuvers	Ecotroni ES-13	AATD	PPA Rev 00
Nav Treinamentos	50h	XX	Do not specify	Possibility of use to simulate different conditions weather and emergency	SBPA SIMULATORS & TECHNOLOGIES	AATD	PPA Rev 00
Aeroclube de Dourados	48,5h	7,5h	Fase 5	IFR Maneuvers	BR simulations GA-30	AATD	PPAP 001 A
Aeroclube de Guarapuava	43,5h	7,5h	Fase 5	IFR Maneuvers	MFSim Simuladores de Voo SMB58	AATD	PPAP 001 A

2.2. Flight Simulators

Minimal requirements for flight simulators are listed on ANACs requirement RBAC 60 (ANAC, 2020c) and IS 141-007 (ANAC, 2020b). These requirements divide the simulators in BATD, AATD, FSTD, FTD.

Each flight simulator type has its complexity and type of training. Also nowadays new technologies such as virtual reality or mixed reality headsets are being implemented in flight training.

Some studies have already been carried out with a focus on including training in simulators for initial students. Macchiarella, Brady, and Arban (2005) conducted a study to evaluate their university's training program.

The training program consisted of a curriculum with 60% of the training in a Frasca 172 flight simulation device (the C172), with a cabin and flight dynamics similar to the course's focus aircraft, part of the remaining 40% of the training.

For this study, the students, who had a maximum of 5 hours of flight time in a real aircraft, were separated into two groups, where one group would follow the already mixed training program (simulator + real aircraft); while the other group would only fly the aircraft. At the end of the study, the researchers concluded that there was actually greater effectiveness in the training of students who carried out the mixed training program, when compared to those who only flew the real aircraft.

In a subsequent study, Macchiarella, Arban and Doherty (2006) evaluated the effectiveness of transferring training from simulator sessions to real flight training.

For this, the study was carried out on the same flight and aircraft simulator model as Macchiarella, Brady and Arban (2005), a FRASCA 172 FTD with aerodynamic modeling very similar to that of the C172S, which was the aircraft used in the real flight part of the study. 38 students were needed in the initial phases of the flight, being separated into two groups, one with 18 students who carried out the training only on the aircraft;

and another with 20 students, which carried out the hybrid training program, combining flight simulator and real aircraft.

These authors ultimately deduced that knowledge transfer is the reason between the difference between the iterations of the control group of aircraft tasks (C) and the iterations of the experimental group of tasks performed (E) in relation to these iterations of the experimental group. of a simulator (EFTD).

2.3. Scenario Based Training (SBT)

With the development of onboard technology on new aircraft, the flight training needed to be improved, in the early days, these training was essentially based on maneuvers, where the pilot might complete then within certain specs. But nowadays the hole of in-flight management is needed, this is where the Scenario Based Training comes (Williams, 2011).

McMahon (2018) points that a simple scenario such as “taxi us to the main runway” or “follow that river” can be made during initial flight training and will be important in the future.

3. METHODS

The development of this work, represented by Figure 1.

It was carried out through a qualitative study using as a basis documentary and academic research on the use of flight simulators during training, their use in initial instruction or also at different levels of an aeronautical career, research the regulations available in the various aeronautical authorities in the countries.

This paper will use the Design Science Research (DSR) method to create an ab-initio flight training syllabus that combine the flight simulator and scenario-based training with real flight training. For this, Kuechler and Vaishnavi (2008) points that is necessary to first be aware of what is the problem, then in the next step some suggestions can be made about this training syllabus, during the development process of DSR, the initial design of the project will be made and then evaluated, in this case using a semi-structured interview with flight instructors and flight students, then based in these results, the final product will be modified and presented.

The Figure 1 shows the proposed path to the final model of the work, where a data acquisition was made, then a research on how the Brazilian CIACs are doing flight training and a research about flight simulators.

Figure 2 shows the ANAC’s RBAC 141 system, where information about CIACs syllabus were gathered.

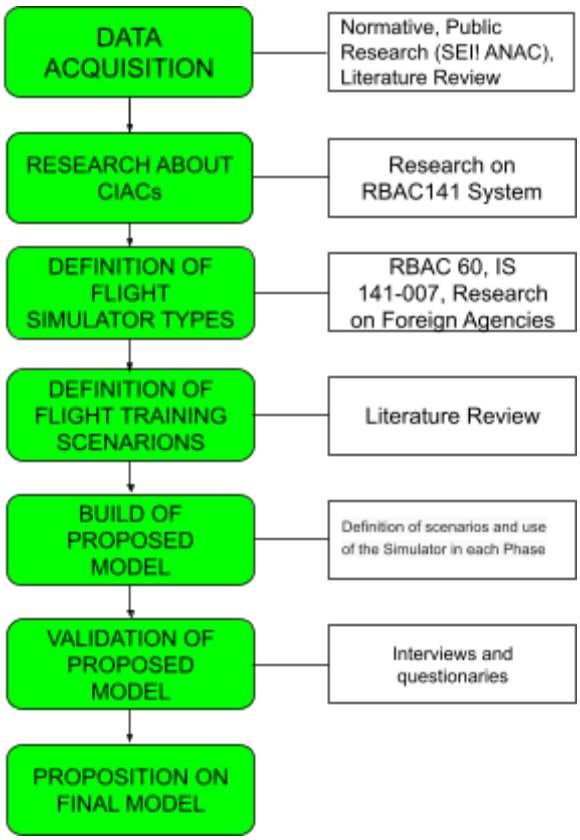


Figure 1 Proposed path.

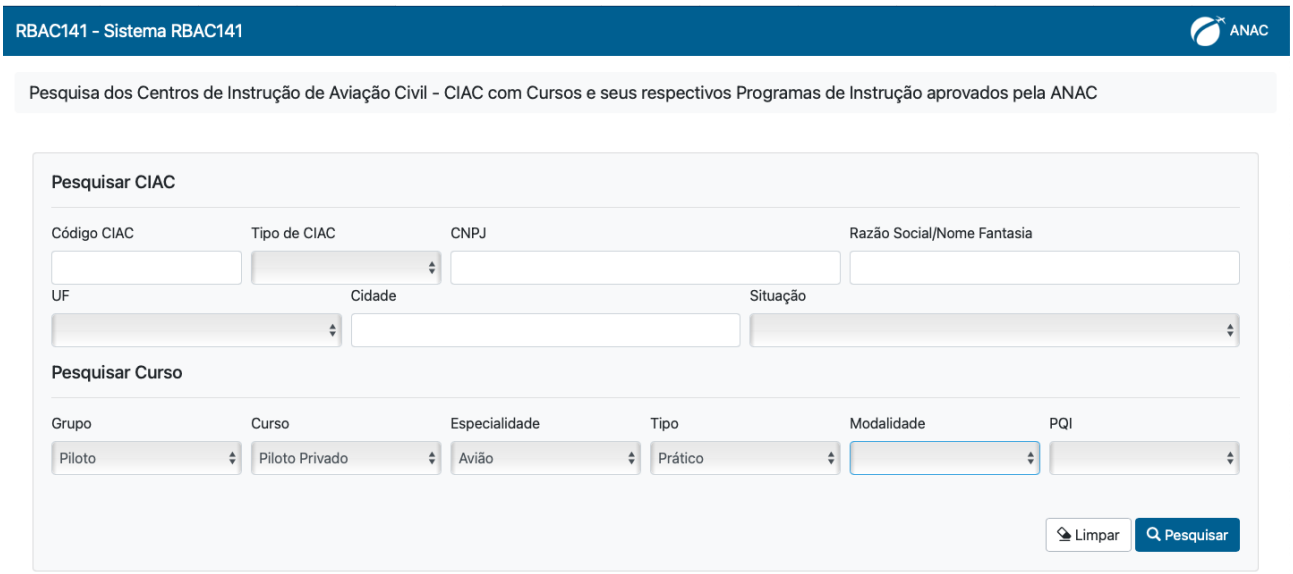


Figure 2 show the ANAC's RBAC 141 system.

During the first step of this study, along with the literature review, this is the proposed syllabus, where the phases of the training (PS, AP, NV, NO) have each one a scenario to be used (yellow box), a flight simulator use (orange box) and the real flight training part (green box).

Following the proposed syllabus a semi-structured questionnaire will be made, where flight instructors and alumni will be questioned about their experience using a flight simulator device and what they think about the suggested structure and based on their suggestions an improved syllabus will be made.

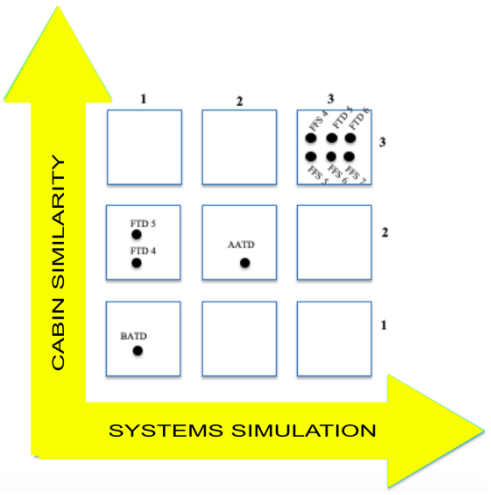


Figure 3 Cabin similarity X Systems Simulation

Figure 4 compares the External view on Y axis with the Flight Handling on X axis.

4. RESULTS

The following figures shows the comparative analysis of the flight simulators, which compares then in various aspects.

Figure 3 compares the similarity with the cabin on the Y axis and System simulations on X axis.

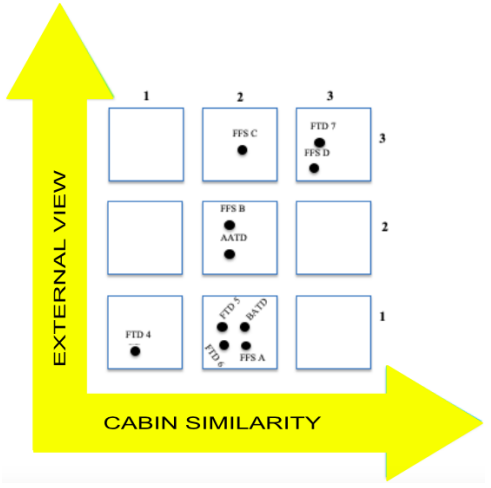


Figure 4 External view X Flight Handling

On Figure 5, Flight Handling was compared with System simulations.

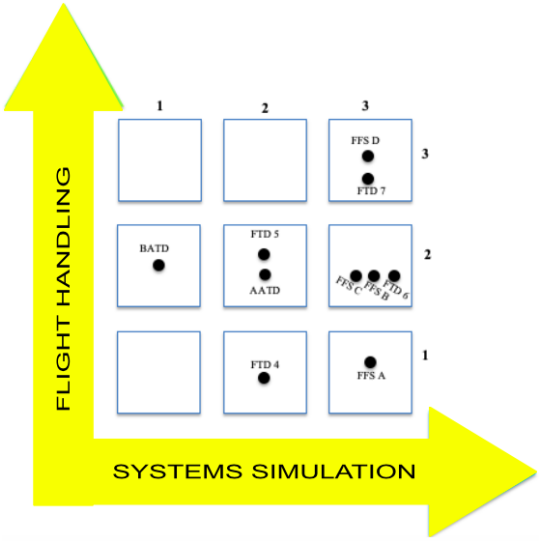


Figure 5 Flight Handling X Systems Simulation

Based on the state of the art use of the flight simulators along with the flight training, the following image shows the proposed syllabus, witch will be modified after the results from the questionnaire.

This proposed syllabus utilizes a former syllabus developed by brazilian DAC MCA 58-3 (Comando da aeronautica, 2004) with modifications in the use of the Flight Simulator and Scenario Based Training, as shown in Figure 6.

The former syllabus used only a task based training approach and wasn't helpful in the hole of managing the flight operation, only in doing some maneuvers to teach the pilot on how to fly.

Using a Scenario Based Training the pilot can learn how to do the maneuvers and also how to manage the flight, such as what to do in case of a medical emergency or their destination airport is closed. This scenarios will be shown in each of the phases of the syllabus.

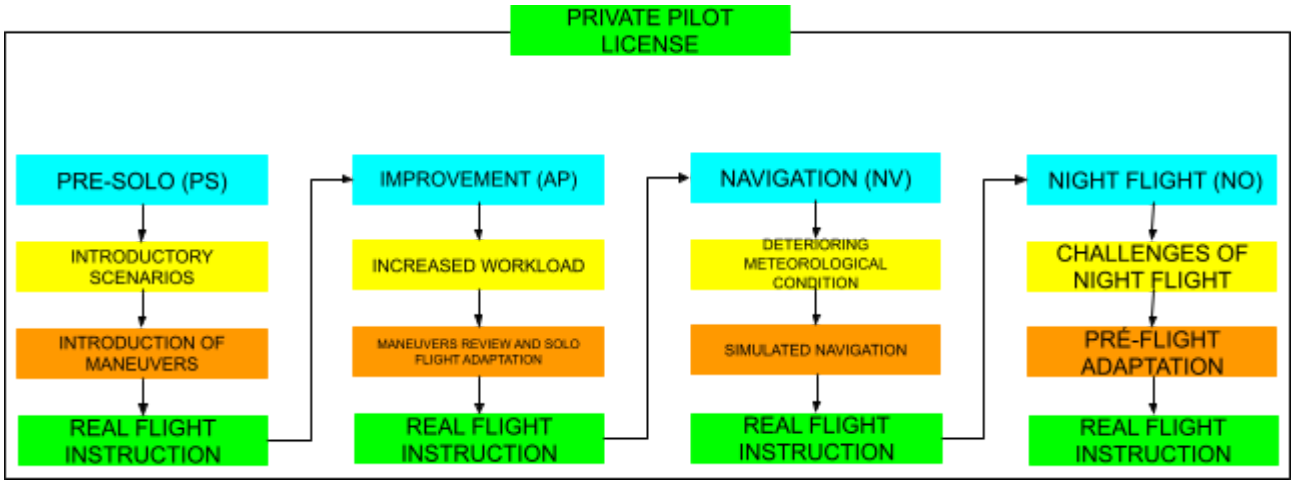


Figure 6 Proposed syllabus.

The use of Design Science research on this article was helpful because it came in first idea as the Figure 6 and then this proposition will be validated by means of a semi-structured questionnaire performed by flight instructors and flight students that have used a flight simulator in some time in their career.

5. FINAL CONSIDERATIONS

It is important to mention that the research about the flight simulator types played a very important role in this paper, because by this we could understand the differences between then and know in better in which phases each flight simulator could be used.

When we compare this new syllabus with the use of the flight simulator and the

scenario based training we can develop even more the pilot's hability to manage the flight, like a situation of a medical emergency or a destination airport closed can be put in the training program.

This paper isn't finished yet, a semi-structured interview will be done to acknowledge if the premisses about the steps and simulator use in the phases are coherent and what can be changed to improve this syllabus.

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