CZECH TECHNICAL UNIVERSITY IN PRAGUE

FACULTY OF TRANSPORTATION SCIENCES

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IMPLEMENTATION OF 100 KSA INTO AIRLINE TRANSPORT PILOT TRAINING

Master's thesis

2020

ČESKÉ VYSOKÉ UČENÍ TECHNICKÉ V PRAZE

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děkan

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K621 ....Ústav letecké dopravy

ZADÁNÍ DIPLOMOVÉ PRÁCE
(PROJEKTU, UMĚLECKÉHO DÍLA, UMĚLECKÉHO VÝKONU)

Jméno a příjmení studenta (včetně titulů):

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Kód studijního programu a studijní obor studenta:

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Zásady pro vypracování

Při zpracování diplomové práce se řiďte následujícími pokyny:

- Současná podoba ATPL(A) teorie dle Nařízení Komise (EU) 1178/2011
- Vysvětlení ED Decision 2018/001/R
- Implementace do distanční modulové teorie ATPL(A)
- Implementace do integrované teorie ATPL(A)
- Kvalifikace instruktorů

Rozsah grafických prací: dle pokynů vedoucího diplomové práce

Rozsah průvodní zprávy: minimálně 55 stran textu (včetně obrázků, grafů a tabulek, které jsou součástí průvodní zprávy)

Seznam odborné literatury: ED Decision 2018/001/R

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Příručky výcviku a osnovy ATO F AIR

Vedoucí diplomové práce: **Ing. Vladislav Pružina, Ph.D.**
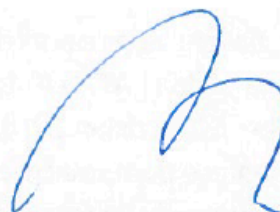
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MASTER'S THESIS ASSIGNMENT
(PROJECT, WORK OF ART)

Student's name and surname (including degrees):

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Code of study programme code and study field of the student:

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Guides for elaboration

During the elaboration of the master's thesis follow the outline below:
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- Explanation of ED Decision 2018/001/R
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- Integrated ATPL(A) Theory Implementation
- Instructors' Qualification

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a) date of first anticipated submission of the thesis based on the standard study duration and the recommended study time schedule
b) in case of postponing the submission of the thesis, next submission date results from the recommended time schedule

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I confirm assumption of master's thesis assignment.

....
Bc. Filip Bartůněk
Student's name and signature

Prague .... December 16, 2019

Prohlášení

Předkládám tímto k posouzení a obhajobě diplomovou práci zpracovanou na závěr studia na ČVUT v Praze Fakultě dopravní.

Prohlašuji, že jsem předloženou práci vypracoval samostatně a že jsem uvedl veškeré použité informační zdroje v souladu s Metodickým pokynem o dodržování etických principů při přípravě vysokoškolských závěrečných prací.

Nemám závažný důvod proti užívání tohoto školního díla ve smyslu § 60 Zákona č. 121/2000 Sb., o právu autorském, o právech souvisejících s právem autorským a o změně některých zákonů (autorský zákon).

V Praze 18. 5. 2020

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Bc. Filip Bartůněk

Poděkování

Na tomto místě bych rád poděkoval vedoucím diplomové práce panu Ing. Vladislavu Pružinovi, Ph.D. a panu Doc. Ing. Jakubu Hospodkovi, Ph.D. za cenné připomínky, odborné rady a metodické vedení práce.

CZECH TECHNICAL UNIVERSITY IN PRAGUE

Faculty of Transportation Sciences

IMPLEMENTATION OF 100 KSA INTO AIRLINE TRANSPORT PILOT TRAINING

master's thesis

May 2020

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ABSTRAKT

Předmětem diplomové práce „Implementace 100 KSA do výcviku dopravních pilotů" je kompletní zpracování nové evropské legislativy týkající se zavedení nového předmětu 100 KSA (Knowledge, Skills and Attitudes) do teoretického výcviku pro získání průkazu způsobilosti dopravního pilota letounů. Od sumarizace požadavků předpisu, přes zapracování 100 KSA do výuky teorie, stanovení podoby přezkoušení z daných kompetencí a matematických znalostí, požadovaného výcviku lektorů až po konkrétní kroky při změně dokumentace ATO.

ABSTRACT

The subject of the diploma thesis "Implementation of 100 KSA into Airline Transport Pilot Training" is the complete processing of new European legislation relating to introduction of a new subject 100 KSA (Knowledge, Skills and Attitudes) into theoretical training for obtaining an Airline Pilot Transport Licence. From summarizing the requirements of the regulation, through the incorporation of 100 KSA into theory lessons, determining the form of assessments of the given competencies and mathematical knowledge, the required training of instructors to specific steps in changing the ATO documentation.

KLÍČOVÁ SLOVA

pilotní výcvik, teorie, znalosti, dovednosti, přístup, KSA, kompetence, schválená organizace pro výcvik, ATO, licence dopravního pilota letounů, ATPL, letoun, instruktor teoretických znalostí, TKI, letecká škola

KEY WORDS

pilot training, theory, knowledge, skills, attitudes, KSA, competency, approved training organisation, ATO, airline transport pilot licence, ATPL, aeroplane, theoretical knowledge instructor, TKI, flight school

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LIST OF ABBREVIATIONS

ADDIE	Analyse, Design, Develop, Implement and Evaluate	*Analyzovat, Navrhnout, Vyvinout, Implementovat a Vyhodnotit*
AIP	Aeronautical Information Publication	*Letecká informační příručka*
AltMoC	Alternate Means of Compliance	*Alternativní způsoby shody*
AM	Accountable Manager	*Odpovědný vedoucí*
AMC	Acceptable Means of Compliance	*Přijatelné způsoby shody*
AMSL	Above mean sea level	*Nad střední hladinou moře*
ARA	Authority Requirements for Aircrew	*Požadavky úřadu pro posádky letadel*
ATIS	Automatic Terminal Information Service	*Automatická informační služba koncové řízení oblasti*
ATO	Approved Training Organization	*Schválená organizace pro výcvik*
ATP(A)	Airline Transport Pilot - aeroplanes	*Dopravní pilot - letouny*
ATPL(A)	Airline Transport Pilot Licence - aeroplanes	*Licence dopravního pilota - letouny*
ATS	Air Traffic Services	*Letové provozní služby*
AUP	Aispace Used Plan	*Plán využití vzdušného prostoru*
Avgas	Aviation gasoline	*Letecký benzín*
BK	Basic knowledge	*Základní znalost*
CAA	Civil Aviation Authority	*Úřad pro civilní letectví*
CAP	Civil Aviation Publication (UK CAA)	*Civil Aviation Publication (UK CAA)*
CBIR	Competency Based Intrument Rating	*Přístrojová kvalifikace založená na kompetencích*
cos	cosine	*kosinus*
CPL(A)	Commercial Pilot Licence - aeroplanes	*Licence obchodního pilota - letouny*
CRM	Crew Resource Management	*Řízení zdrojů posádky*
CTKI	Chief Theoretical Knowledge Instructor	*Vedoucí instruktor teoretické výuky*
CZ	Czech Republic	*Česká republika*
Doc	Document	*Dokument*
DSA	Delta System Air	*Delta System Air*
EASA	European Union Aviation Safety Agency	*Evropská agentura pro bezpečnost v letectví*
ECQB	European Central Question Bank	*Evropská centrální databáze otázek*
ED	Executive Director	*Výkonný ředitel*
EDD	Executive Director Decision	*Rozhodnutí výkonného ředitele*
EIR	Enroute Instrument Rating	*Traťová přístrojová kvalifikace*

EOBT	Estimated Off-Block Time	*Předpokládaný čas zahájení pojíždění*
Etc.	Et cetera	*A tak dále*
EU	European Union	*Evropská Unie*
FA	Formative assessment	*Formativní hodnocení*
FAF	Final approach fix	*Fix konečného přiblížení*
FCL	Flight Crew Licencing	*Licencování letových posádek*
FI	Flight Instructor	*Letový instruktor*
FIR	Flight Information Region	*Letová informační oblast*
FL	Flight level	*Letová hladina*
FM	Frequency modulation	*Frekvenční modulace*
FMS	Flight Management System	*Flight Management System*
FNPT	Flight Navigation and Procedure Trainer II	*Letový trenažér navigace a postupů*
FPL	Flight plan	*Letový plán*
ft	feet	*stopy*
ft/min	feet per minute	*stopy za minutu*
GEN	General	*Všeobecný*
GM	Guidance Material	*Poradenský materiál*
GS	Ground speed	*Traťová rychlost*
(H)	Helicopter	*Helikoptéra*
hPa	hectopascal	*hektopascal*
HT	Head of Training	*Vedoucí výcviku*
ICAO	International Civil Aviation Organization	*Mezinárodní organizace pro civilní letectví*
IFR	Instrument Flight Rules	*Pravidla pro let podle přístrojů*
IMC	Instrument Meteorological Conditions	*Meteorologické podmínky pro let podle přístrojů*
IR(A)	Instrument rating - aeroplanes	*Přístrojová kvalifikace - letouny*
ISD	Instructional Systems Design	*Instructional Systems Design*
IT	Information Technology	*Informační technologie*
kg	kilogram	*kilogram*
km	kilometer	*kilometr*
KSA	Knowledge, Skills and Attitudes	*Znalosti, Dovednosti a Přístup*
kt	knot	*námořní uzel*
LMS	Learning Management System	*Systém pro řízení výuky*
LO	Learning objective	*Cíl učení*

LT	Local Time	*Místní čas*
m	meter	*metr*
m/s	metres per second	*metr za sekundu*
MCC	Multi-Crew Cooperation	*Spolupráce vícečlenné posádky*
MEP	Multi-engine piston	*Vícemotorový pístový*
METAR	Meteorological Aerodrome Report	*Letištní meteorologická zpráva*
MFD	Multi-function display	*Multifunkční displej*
mm	milimeter	*milimetr*
MPL	Multi-Crew Pilot Licence	*Licence pilota ve vícečlenné posádce*
MT	Maths test	*Matematický test*
MTOW	Maximum take-off weight	*Maximální vzletová hmotnost*
NAA	National Aviation Authority	*Národní letecký úřad*
NASA	National Aeronautics and Space Administration	*Národní úřad pro letectví a vesmír*
NM	nautical mile	*námořní míle*
No.	number	*číslo*
NOTAM	Notice to airman	*Zpráva pro letce*
OFP	Operational Flight Plan	*Provozní letový plán*
OM	Operations Manual	*Provozní manuál*
ORA	Organisation Requirements for Aircrew	*Požadavky organizace pro posádky letadel*
PAPI	Precision Approach Path Indicator	*Světelná soustava indikace sestupové roviny pro přesné přiblížení*
PBN	Performance Based Navigation	*Navigace založená na výkonnosti*
PC	personal computer	*osobní počítač*
PFD	Primary flight display	*Primární letový displej*
PPL(A)	Private Pilot Licence - aeroplanes	*Licence soukromého pilota - letouny*
QNH	sea-level air pressure	*tlak vzduchu na hladině moře*
R/T	Radiotelephony	*Radiotelefonie*
SA	Summative assessment	*Sumativní hodnocení*
sin	sine	*sinus*
SMS	Short message service	*Služba krátkých textových zpráv*
TAF	Terminal Aerodrome Forecast	*Letištní předpověď*
TAS	True air speed	*Pravá vzdušná rychlost*
TEM	Threat and Error Management	*Řízení hrozeb a chyb*
TK	Theoretical Knowledge	*Teoretické znalosti*

TKI	Theoretical Knowledge Instructor	*Instruktor teoretické výuky*
TOD	Top of Descent	*Bod zahájení klesání*
UK	United Kingdom	*Spojené království*
UPRT	Upset Prevention and Recovery Training	*Výcvik prevence a vybírání nezvyklých poloh*
UTC	Universal Time Coordinated	*Světový koordinovaný čas*
UUP	Updated Used Plan	*Aktualizovaný plán využití vzdušného prostoru*
VFR	Visual Flight Rules	*Pravidla pro let za viditelnosti*
WOCL	Window of circadian low	*Oblast nízkého cirkadiánního rytmu*
Z	Zulu = Universal Time Coordinated	*Světový koordinovaný čas*
ZLP		*Způsobilost leteckého personálu*

1   INTRODUCTION

Theoretical preparation of students who seek to be professional pilots is a fundamental part of the whole educational process to get Air Transport Pilot License (ATPL). But it is a common phenomenon that during the training, the main goal is neglected. What competencies should have the graduate after leaving the flight school with Commercial pilot licence with Multi-engine piston, Instrument and Performance Based Navigation ratings (CPL(A)/MEP/IR/PBN) ready for type rating? The only one competence evaluated now deeply within theory is knowledge and in practical training – handing and radiotelephony (R/T) communication. But that is not enough. Pilot must be, as a person, ready for this complex profession with all necessary competencies, ready to work in real aviation environment. Pilot shall have at least Satisfactory level of competencies like: Application of Procedures, Communication, Aircraft Flight Path Management (manual control and automation), Leadership and Teamwork, Problem Solving and Decision Making, Situation Awareness and Workload Management, as recognised by International Civil Aviation Organization (ICAO) in Doc 9995 "Manual of Evidence-based Training". Many quality theoretical knowledge and flight instructors took these competencies into account without any decision from European Union Aviation Safety Agency (EASA), but not all of them, not in every flight school, because it was not mandatory and there was no institute in the legislation to use during training, which would allow for continuous assessment of student pilots and which would allow for making clear decisions about whether they should continue their training, or not.

Data from a large operator show that out of 3500 fully licenced applicants approximately 50 percent of them failed the selection process, where key competencies are evaluated. This is a confirmation of the facts mentioned in previous paragraph. [23]

Another drawback in theoretical training is practical application of acquired knowledge into skills and general connection between theory and practice. That is something what shall be changed and improved. The main goal in every case must always be kept in mind – to train complex and competent professional pilot.

The next reason, why change was urgently needed, is that the last significant technical update of the syllabus and related learning objectives (LOs) for the airline transport pilot licence (ATPL), multi-crew pilot licence (MPL), commercial pilot licence (CPL), and instrument rating (IR) theoretical knowledge courses for aeroplane was conducted in 2006. With regards to the new technologies and the development of training philosophy there was an urging need to review, amend, and update these LOs, where necessary. [1]

ED Decision 2018/001/R, issued in the beginning of year 2018, brings us opportunity to change this situation by implementation of fully new learning objectives: Area 100 KSA – Knowledge,

Skills and Attitudes and by a wide revision of learning objectives in all subjects. Area 100 KSA can be recognised from airlines point of view as Threat and Error Management (TEM) and Crew/Cockpit/Company Resource Management (CRM) training introduction incorporated into initial pilot training. Together with scenario-based training, connections across the subjects, group works, etc. brings significant improvement in learning philosophy.

1.1 MOTIVATION

Motivation to write this diploma thesis is to set up concept how Area 100 KSA can be implemented to ATP(A) theoretical training based on general requirements stated in ED Decision 2018/001/R, since no complex guidance for Approved Training Organizations (ATOs), which could be immediately use in practice, is not available. As Chief Theoretical Knowledge Instructor (CTKI) of F AIR CZ/ATO-001 I intend to directly use this thesis in flight school operations. Because this thesis is created under the supervision of Department of Air Transport, it can be used for Bachelor's degree programme Professional Pilot at Faculty of Transportation Sciences of Czech Technical University in Prague as well. In general, this diploma thesis can be fully used by any ATO in the Czech Republic, or abroad, to implement Area 100 KSA into their training and to be fully ready within transition period, which ends in January 2022.

1.2 GOAL OF DIPLOMA THESIS

The mail goal of this diploma thesis is a guidance for ATOs for specific incorporation of Area 100 KSA into ATP(A) theory subjects, including related formative and summative assessments and mental maths test, together with necessary instructions for training of theoretical knowledge instructors and changes to ATO training documentation. All proposed changes are based on previous experience with pilot training environment and are ready for immediate use in flight school operations.

2 CURRENT FORM OF ATP(A) THEORY

In this chapter I briefly summarize current form of the two types of ATP(A) theoretical training course – Modular ATP(A)-650 and Integrated ATP(A)-750. The aim of both courses is the same, to successfully educate the student to the level of theoretical knowledge required for obtaining the Airline Transport Pilot Licence.

2.1 MODULAR ATP(A)-650 THEORY COURSE

Modular ATP(A) theory course is aimed at Private Pilot Licence (PPL(A)) holders and includes all learning objectives for IR(A), CPL(A) and ATPL(A) theoretical knowledge. It can be approved as distance-learning course as well.

Course consists of minimum 650 hours which are divided between 14 subjects. No minimum hours per subject are prescribed by EASA regulations, but minimum hours specified for integrated course can be used as a guidance. The modular course is mostly in the form of distance-learning. In this case, minimum hours allocated to classroom instruction with approved TKI shall not be less than 10% of the total duration of the course, it means minimum of 65 hours. Classroom instruction shall be included in all subjects and can be provided by a videoconference between the lector and students. The remaining 90% is provided as self-study with specific syllabi on weekly basis (usually includes books and other training materials provided by ATO, such as videos, animations, pictures, illustrations, schematics, etc.) and student's progress in acquired knowledge is controlled by self-evaluation and progress tests provided by IT solutions, such as flight school's examination portal. Student must have opportunity to contact the TKI for questions. Detailed requirements are available in Part-ORA to Commission Regulation (EU) No. 1178/2011. After completion of self-study part, with all tests passed, final classroom instruction with TKI is performed in the form of consultation, usually as weekend blocks. The subject is finished by a final exam test. [8]

Entry requirements according to training manual: [8]

- PPL(A) licence
- Medical certificate class 1 or 2
    - Class 1 is required for CPL and IR subsequently, so it is highly recommended to applicants to obtain class 1 already to be sure that their medical status is sufficient.
- Minimum age 17 years old

- Achieved at least primary education and proven knowledge of mathematics and physics (based on high school-leaving certificate or university exam result – 75% as minimum … if not possible, applicant shall pass the entry test provided by flight school)
- Proven sufficient language knowledge based on course language
    o In case of English course, applicant shall be holder of ICAO level 4 or higher or to pass the entry test provided by flight school

Minimum length of the course is 26 weeks, maximum is 18 months. [8]

In case of holders of the following qualifications/licences, the amount of required theory hours is reduced: [8]

- holders of IR(A): ATP(A)-500   (min. 20 weeks)
- holders of CPL(A): ATP(A)-400   (min. 18 weeks)
- holders of CPL(A) and IR(A): ATP(A)-250   (min. 16 weeks)

Certificate of completion of theoretical instruction of all subjects is issued by ATO when student finished whole course. This certificate is valid 12 months. Within that time, student must make first attempt for official ATP(A) theory examination at Civil Aviation Authority (CAA). (Student can obtain certificate for particular subjects as soon as successfully finish them already during the course and start passing final official examination at CAA earlier.) [8]

Distance modular course is advantageous especially for students who do not have time to pass the course in integrated form, where they would be required to attend lessons during the week and students shall be full-time focused on studying. And as modular, the course itself is a separate training and can be done at a different ATO than practical training.

2.2   INTEGRATED ATP(A)-750 THEORY COURSE

Course consists of minimum 750 hours which are divided between 14 subjects and can include: classroom work, interactive video, slide or tape presentations, learning carrels, computer-based training, and other media as approved by the competent authority. Minimum hours per subject are prescribed by EASA regulations. This course usually contains initial theory in the beginning, in the extent of PPL theory (approx. 100 hours), which is required before student starts practical training, and Multi-Crew Cooperation (MCC) theory (minimum 25 hours) before practical simulator MCC lessons in the end of the integrated course. Both additional theory blocks are added to 750 hours, so in total, theory can consist of 875 hours or more. [7]

The main advantage of the integrated course in general is that whole pilot training with the purpose to gain the professional pilot licence is undergone in one ATO. It means that theory

and practical training is organized according to schedule of one training organization. There can be exceptions, when theory is provided by another organization like in the case of cooperation of the Czech Technical University in Prague and partner flight schools: F AIR and DSA. But in that case coordination agreement shall be signed and the whole training is running according to training and operations manuals of particular ATOs.

Integrated course is mainly intended for students with no previous aviation experience, who have decided for future career as professional pilots. This course is intensive, so it requires daily attendance at the ATO and following strict schedule. On the other hand, it is possible to get CPL(A)/MEP/IR/PBN licence in the minimum time of 12 months.

Entry requirements according to training manual: [7]

- Medical certificate class 1 is recommended before entry, but not required
    o Class 1 is required for CPL and IR subsequently, so it is highly recommended to applicants to obtain class 1 already to be sure that their medical status is sufficient. Before the first solo flight at least Medical class 2 is required.
- Minimum age 17 years old
- Achieved at least primary education and proven knowledge of mathematics and physics (based on high school-leaving certificate or university exam result – 75% as minimum … if not possible, applicant shall pass the entry test provided by flight school)
- Proven sufficient language knowledge based on course language
    o In case of English course, applicant shall be holder of ICAO level 4 or higher or to pass the entry test provided by flight school

Minimum length of the course is 12 months, maximum is 36 months, together with practical integrated course. [7]

Certificate of completion of theoretical instruction of all subjects is issued by ATO when student finished whole course. This certificate is valid 12 months. Within that time, student must make first attempt for official ATP(A) theory examination at CAA. (Student can obtain certificate for particular subjects as soon as successfully finish them already during the course and start passing final official examination at CAA earlier.) [7]

Usually, students from Integrated course have better chance and better results in passing of ATP(A) exams at CAA, because their training is all the time under supervision of ATO and is more intensive when compared to the modular course.

As you can see, in the summary of both courses, integrated and modular, the course objective is to gain only one competence, **knowledge**. Required learning objectives for both courses are based on AMC/GM to Part-FCL after Amendment 2. [9]

3 ED DECISION 2018/001/R

3.1 OVERVIEW OF CHANGES

This Decision contains the updated learning objectives for the theoretical knowledge syllabus and related final official examination, and introduces the threat and error management concept and improving teaching methodologies. The updated LOs reflects today's aviation technologies and operational environment and ensure that trained pilots are more prepared for their career with necessary knowledge and understanding relevant to modern aircraft concepts and current industry needs. The Decision also introduces new area of learning objectives, 100 KSA „Knowledge, skills and attitudes", whose goal is to improve the pilots' KSA contained in the core personal competencies. These skills focus on the pilots' ability to apply their knowledge and understanding across subjects and to demonstrate technical and non-technical skills. These learning objectives will not be the subject of examinations at CAA, but ATOs are obliged to assess students and ensure that they achieved at least satisfactory level of competencies before they are allowed to start their final theoretical knowledge examinations. The new concept of updated pilot training will contribute to the overall enhancement of the pilots' core competencies and together with the gradual introduction of competency-based training to practical training will highly improve pilots' ability to fulfil tasks and make informed decisions. [1]

As we can see in the Figure 1, from rulemaking task until publication, it took 3 years and another 4 years is transition period – more information in chapter 4. [1]

Figure 1 - EASA rulemaking process of ED Decision 2018/001/R [1]

Besides the changes explained in the following chapters, ATOs are required to produce a training plan for each of their courses based on the instructional systems design (ISD) methodology as specified in AMC2 ORA.ATO.230, the ADDIE model example is explained in chapter 4. [1]

The general description of ATP(A) theory requirements in AMC1 to Appendix 3 "Training courses for the issue of a CPL and an ATPL" were amended as follows. Area 100 KSA and more detailed description of teaching methods were added.

The 750 hours of instruction, which also cover the Area 100 KSA, may include in suitable proportions: [4]

- classroom work
- lessons
- tutorials
- demonstrations, including those supported by demonstration equipment
- exercises carried out as groups or individuals and based on pre-flight and en-route planning, communications, presentations and projects
- exercises that use demonstration equipment or training devices
- directed study including workbook exercises or assignments
- aerodrome or aviation industry field trips
- computer-based training and e-learning elements
- progress tests, Area 100 KSA assessments and mental maths test(s)
- other training methods, media and tools approved by the competent authority

ATP integrated course for aeroplanes - the 750 hours of instruction division was changed – new minimum hours requirements are in Table 1: [4]

Table 1 - Minimum of hours per each ATP(A) subject [4]

Nr.	Subject	Minimum hours
1	Air Law	35
2	Aircraft General Knowledge	100
3	Flight Performance and Planning	120
4	Human Performance and Limitations	35
5	Meteorology	60
6	Navigation	90
7	Operational Procedures	25
8	Principles of Flight	55
9	Communications	20

This is a recommendation, as stated in AMC1 to Appendix 3 of Part-FCL. Different subdivision can be approved by appropriate CAA. But if ATO will follow this table, approval of training syllabus will be assured from this point of view. [4]

Division of hours between:

- 021 and 022 in category Aircraft General Knowledge
- 031 and 032 and 033 in category Flight Performance and Planning
- 061 and 062 in category Navigation

is absolutely a subject of ATO's decision.

The sum of minimum hours stated in the table above is 540 hours. 210 hours remaining from the total 750 can be divided into the particular subjects based on ATO's experience and final decision as shall be stated in training manual.

Minimum recommended hours for ATP(A)-650 modular theoretical knowledge course for aeroplanes are not stated, but minimums for integrated course can be used. The remaining 110 hours from the total 650 can divided at ATO's discretion. Only the minimum hours of classroom instruction are required by ORA.ATO.305, it's at least 10% of total hours, that means 65 hours. [25]

This Decision came into force on 7th of February 2018, but changes mentioned above shall apply by 31st of January 2022 at the latest. [2]

All documents related to this Decision are available at EASA website:

https://www.easa.europa.eu/document-library/agency-decisions/ed-decision-2018001r

3.2 CHANGES IN LEARNING OBJECTIVES

Because the last significant change of learning objectives was done in 2006, the scope of the current update has been really wide. Some LOs were completely deleted, some were moved between LO categories, or even between subjects. Many duplicate LOs in multiple subjects were removed. And finally, new learning objectives were added. All changes follow current and future aviation industry needs and general development in aviation. During the rulemaking process more than 1000 comments were received by EASA, mostly related to proposed amended LOs. [1]

From the linguistic side, the learning objectives and corresponding testing questions are written in more „understandable" English than before, because candidates are tested for subject knowledge, not for their English level – we have ICAO English exam for that purpose. EASA took into consideration that some students have a primary language other than English. Thanks to that we can expect that translation to local languages (if applicable) will be easier for Civil Aviation Authorities, with a smaller number of mistakes or misunderstandings. But ICAO English level 4 is expected on „operational level", which is equated to Common

European Framework of Reference for Languages band B1 „Independent User – Threshold or Intermediate". However, words, terms and phrases which are on a higher level and are used in learning objectives, can be expected in examination questions. [24]

Full summary of the main changes in each of subjects is available in Explanatory Note to ED Decision 2018/001/R.

3.3 BASIC KNOWLEDGE

Some of learning objectives are now labelled as BK (Basic Knowledge), see Figure 2, it means that these points of theory are base which is needed to understand for more complicated LOs, but BK LOs will not be separately tested during official final examination at CAA. [1]

SUBJECT 021 — AIRCRAFT GENERAL KNOWLEDGE — AIRFRAME, SYSTEMS AND POWER PLANT

Syllabus reference	BK	Syllabus details and associated Learning Objectives	Aeroplane		Helicopter			IR	CB-IR(A) and EIR	Remarks
			ATPL	CPL	ATPL/IR	ATPL	CPL			
(01)		Explain the working principle of a hydraulic system.	X	X	X	X	X			
(02)		Describe the difference in the principle of operation between a constant pressure system and a system pressurised only on specific demand.	X	X	X	X	X			
(03)		State the differences in the principle of operation between a passive hydraulic system (without a pressure pump) and an active hydraulic system (with a pressure pump).	X	X	X	X	X			
(04)	X	List the main advantages and disadvantages of system actuation by hydraulic or purely mechanical means with respect to: — weight; — size; — force.	X	X	X	X	X			
(05)		List the main uses of hydraulic systems.	X	X	X	X	X			

Figure 2 - Basic knowledge LO example [3]

Updated questions in ECQB are more focused on scenario-based situation and require higher level of understanding of particular LOs and its combinations. These LOs are built upon this basic knowledge. [1]

Examples: [3]

BK: Describe what is meant by the term 'map reading'.

BK: Define the term 'visual checkpoint'.

3.4 BENJAMIN BLOOM TAXONOMY

To ensure higher clarity in level of understanding, the Benjamin Bloom Taxonomy (see Figure 3) was introduced - variety of verbs are used throughout the theoretical knowledge (TK) syllabus and LOs.
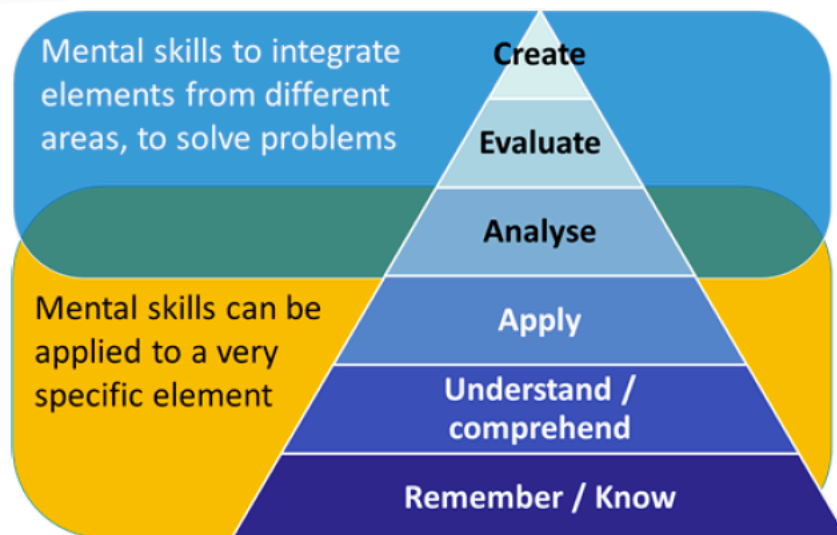
Figure 3 - Benjamin Bloom Taxonomy [24]

The level of knowledge or skill of learning objective achieved during the theoretical training is significantly identified by the verb which is used in the description of corresponding LO. This principle is based on Benjamin Bloom Taxonomy. [24]

The lowest level **„REMEMBER"** is signified by verbs like: **„STATE"**, **„LIST"**, **„DEFINE"** and **„RECALL"** [24]

Example:

State that some wind limitations may apply in case of contaminated runways. Those limitations are to be found in Part B of the Operations Manual — Limitations. [3]

List approach and landing illusions for slope of the runway, black-hole approach, and terrain around runway, and state the danger involved with recommendations to avoid or counteract the problems with high or low approach or flare at the wrong time. [3]

Define 'atmospheric pressure'. [3]

Recall the definition of the following terms: [3]

- *aircraft;*
- *heavier-than-air aircraft;*
- *State of Registry.*

The next level **„UNDERSTAND"** is signified by verbs like: **„DESCRIBE"** and **„EXPLAIN"** [24]

Example:

*Describe situations during the descent and approach in which a pilot could find that an aeroplane flies high or fast, and **explain** how the pilot can manage descent angle/excess energy.* [3]

The next level **„APPLY"** is signified by verbs like: **„CALCULATE"**, **„INTERPRET"**, **„RELATE"** and **„SOLVE"** [24]

Example:

Calculate the change of stall speed as a function of the load factor. [3]

Interpret marshalling signals. [3]

Give examples of visual illusions based on shape constancy, size constancy, aerial perspective, atmospheric perspective, the absence of focal or ambient cues, autokinesis, vectional false horizons, field myopia, and surface planes.

(connected to previous LO)

Relate these illusions to problems that may be experienced in flight and identify the danger attached to them. [3]

Solve V_{S1G} from the lift formula given varying C_L. [3]

The next higher level **„ANALYSE"** is signified by verbs like: **„PLAN"**, **„DISCUSS"**, **„EVALUATE"** and **„CREATE"** [24]

Example:

Plan … not found in the list of learning objectives.

Discuss the general features of a visual checkpoint and give examples. [3]

Evaluate the effect of wind and altitude on air distance. [3]

Create … not found in the list of learning objectives.

The use of this level of LOs is limited because of high demand for time and style itself which is not feasible for theoretical knowledge examination (computer electronic test). In that case, oral exam during final examination would be appreciated, as it was standard before or nowadays when ATPL theory is connected to university studies. [24]

In the Area 100 KSA there are used the verbs which signified combination of knowledge and skills, like:

„DEMONSTRATE"

Student needs to select and use appropriate knowledge, skills and attitudes to achieve effective outcome. [24]

For evaluation more core competencies must be assessed.

And **„SHOW"**

It is lower level then „demonstrate", student just present acquisition of the knowledge, skills and attitudes which can be normally assessed by one indicator. [24]

Example:

Demonstrate the ability to identify and assess accurately the general environment as it may affect the operation. [3]

Show the ability to offer and accept assistance, delegate when necessary and ask for help early. [3]

3.5   INTRODUCTION OF AREA 100 KSA

Fully new subject, or rather learning objectives area, is the Area 100 KSA. This new area is focused on the development of student's core competencies as recognised by ICAO Doc 9995 and which are possible to incorporate to theoretical knowledge instruction, except Application of Procedures and Aircraft Flight Path Management. [33]

Important definitions:

Competency: A combination of knowledge, skills and attitudes required to perform a task to the prescribed standard. [33]

Knowledge: specific information used to enable a person to apply skills and attitudes [36]

Skill: an ability to perform an activity or action [36]

Attitude: persisting internal mental state or disposition that influences an individual's choice of personal action toward some object, person or event and that can be learned [36]

Acquired skills should ensure pilot's ability to apply knowledge and understanding across theory subjects to demonstrate technical and soft skills in scenario-based situations. In this way, future airline pilots should build higher level of thinking already during their theoretical

knowledge training – their decision-making skills, problem-solving strategies and level of understanding of assimilated knowledge will be significantly enhanced. [1]

Area 100 KSA should be regarded as a concept underlying the whole theoretical knowledge training system – it is a training philosophy, not simply a new separate subject for classroom teaching. Learning objectives of this area shall be widely integrated into and throughout the entire training syllabus. [1]

As mentioned in the introduction to this chapter, these LOs will not be examined within European Central Question Bank (ECQB) system at CAA but will be assessed by the ATOs. Once the candidate will pass the summative assessments and mental maths test at satisfactory level or higher, then Head of Training (HT) and/or Chief Theoretical Knowledge can allow him/her to start final theoretical knowledge examination. [1]

The main 4 categories of learning objectives are presented at Area 100 KSA: [3]

1. ICAO CORE COMPETENCIES
2. CORE COMPETENCIES LEARNING OBJECTIVES
3. ADDITIONAL THREAT AND ERROR MANAGEMENT (TEM) RELATED LEARNING OBJECTIVES
4. MENTAL MATHS

The first two categories are about competencies which pilot shall be able to demonstrate as recognised by ICAO Doc 9995 "Manual of Evidence-based Training" available here:

https://www.icao.int/SAM/Documents/2014-AQP/EBT%20ICAO%20Manual%20Doc%209995.en.pdf

Learning objectives published in section 2 correspond with behavioural indicators published in ICAO Document mentioned above.

Competencies are described in more detail in chapter 5 of this thesis. The aim of Area 100 KSA implemented in ATP(A) theoretical training is to build these competencies in student-pilot already during the training to prepare him/her, from personality standpoint, for real aviation operations.

The third category is more focused on application of obtained knowledge and demonstrate skills to use the knowledge with correct attitude for the situation. Detailed exercises for this section are introduced in chapter 5.

Implementation of the last category - Mental Maths, together with testing is really appreciated because of real-life requirement of quick and correct calculation by heart during flight.

"Pilot is flying in flight level FL450 and needs to descend to FAF on 3 degrees slope. The airport elevation is 2500 ft AMSL. How far from FAF pilot needs to start descend when FAF is on 3 degrees glide path 10 NM from threshold?"

4 OTHER ED DECISIONS CHANGING ATP(A) THEORY TRAINING

In this chapter I would like to briefly state the changes that are introduced by ED Decision 2018/011/R and ED Decision 2019/017/R related to ATP(A) theoretical training.

Based on both Decisions, EASA shall update ECQB to reflect changes made to LOs.

4.1 ED DECISION 2018/011/R

This Decision changed the Acceptable Means of Compliance and Guidance Material to Part-FCL and Part-ARA of Regulation (EU) No. 1178/2011 as follow up of Decision 2018/001/R. [27]

The main changes are related to:

1. Theoretical knowledge examinations for professional licences and instrument ratings has been updated with the numbers of questions and time allocations for the final TK examination per subject in accordance with the amended LO tables as published in Decision 2018/001/R (except Subject 090 Communications, which was published later, in ED Decision 2019/017/R as described in the next chapter). In general, more time is allocated in total for particular exams, because higher percentage of LOs in the new syllabus target higher level of understanding, therefore the examination questions are more complex – require from student to demonstrate the ability to apply the acquired knowledge, to solve the problems and understand scenario situations. In total 2:30 h were added to the entire examination time. Number of questions for ATPL(A) has slightly increased, 3 more questions during the entire examination. CAA in each country will determine how to manage exam provisions during the transition period, EASA anticipates that for the part of this transition period, the CAAs will offer exams based on both old and the new syllabi. [27]

2. Based on Decision 2018/001/R where Area 100 KSA was introduced, the AMC1 ARA.GEN.220(a)(5) „Record-keeping" is updated to require documentation about Area 100 KSA assessment completion. [27]

3. Slight changes were implemented to ATP(A) learning objectives. [27]

This Decision came into force on 7th of November 2018, but changes mentioned above shall apply by 31st of January 2022 at the latest (as ED Decision 2018/001/R). [26]

All documents related to this Decision are available at EASA website: https://www.easa.europa.eu/document-library/agency-decisions/ed-decision-2018011r

4.2 ED DECISION 2019/017/R

This Decision changed the Acceptable Means of Compliance and Guidance Material to Part-FCL and Part-ARA of Regulation (EU) No. 1178/2011 to introduce new subject 090 Communications, which replaced subjects 091 VFR Communications and 092 IFR Communications as follow up of Decision 2018/001/R and 2018/011/R. [29]

The main changes are related to:

1. New subject 090 Communications was introduced which replaced subjects 091 VFR Communications and 092 IFR Communications. Learning objectives were revised in the same manner as learning objectives in the ED Decision 2018/001/R and 2018/011/R. [29]

2. Theoretical knowledge examinations requirements for number of questions and time allocation in AMC1 ARA.FCL.300(b) were updated. Old 091 and 092 requirements were deleted and new table for Subject 090 Communication was inserted. [29]

3. Slight changes were implemented to ATP(A) learning objectives of almost all other subjects. [29]

This Decision came into force on 28th of August 2019 but shall apply by 31st of January 2022 at the latest (as ED Decision 2018/001/R). [28]

All documents related to this Decision are available at EASA website: https://www.easa.europa.eu/document-library/agency-decisions/ed-decision-2019017r

5 IMPLEMENTATION OF NEW REQUIREMENTS

5.1 TIMELINE OF IMPLEMENTATION

As it is evident from chapter 4, the changes to theoretical training are extensive, so EASA has set application of Decision 4 years after its publication (see Figure 4 from first half of 2018).

The first 2 years were used by EASA to update the ECQB based on changed learning objectives to provide to NAAs until January 2020 and to issue to corresponding decisions as mentioned in chapter 4. In the meantime, NAAs could start planning the next 2 years transition period until full application of the decision by January 2022. ATOs could start to prepare their updated courses. [1]
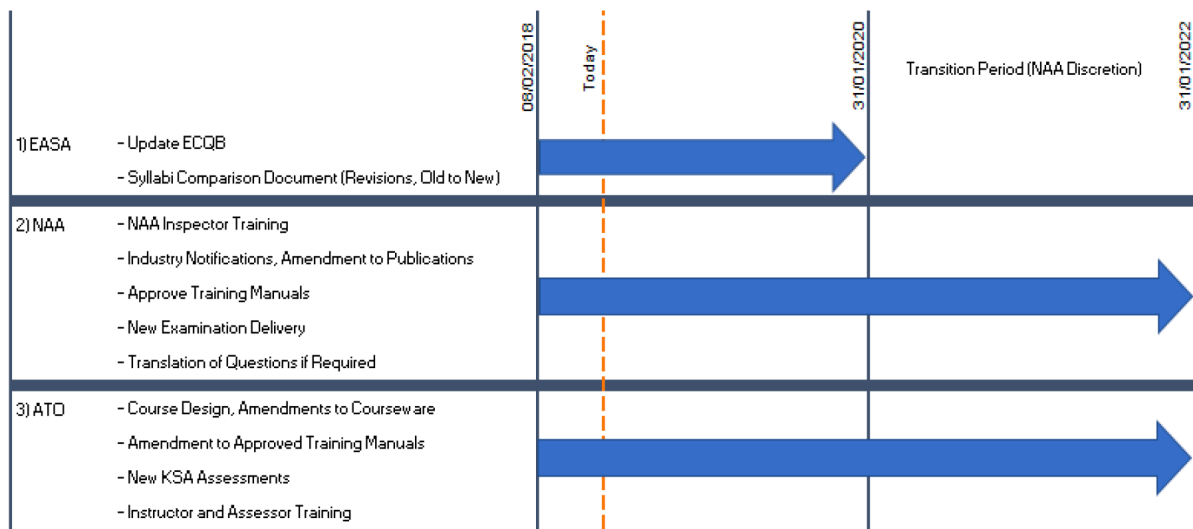

Figure 4 - Timeline of implementation of ED Decision 2018/001/R [30]

It is completely up to NAA to set an expiry date for the old syllabus examinations within transition period between January 2020 and January 2022. Termination of old syllabus shall correspond with the approval of new courses. Taking into account the rule that candidates have 18 months from first attempt to complete their exams, then the first attempt of student according to old syllabus can only be up to the summer of 2020, which implies that ATOs should start to teaching the new syllabus to newly arriving students around spring/summer 2020 as well. But the reality is different. Based on information from Bristol Ground School from UK: *"Clearly, the COVID-19 crisis will affect these dates but, even before it became an issue, some Authorities (the UK CAA and Austro Control that we know of) were slipping the last date to start the old syllabus exams until the end of this year (2020). This in turn implies a slip to the final implementation date. The UK CAA have yet to advise us, but Austro Control have already said that they will make the old syllabus exams available until June 2022. We would expect other Authorities to follow suit once the COVID-19 crisis passes."* [20]

Czech CAA requires from Czech ATOs implementation of 100 KSA if they require to approve ATP(A) theory as a new training course and recommend to all ATOs to update their current training manuals according to this decision as soon as possible. But exact date of expiration of old syllabus examinations is not officially published yet.

In any case, **31st of January of 2022** is the **deadline** for ATOs to provide ATP(A) theoretical training according to this decision and for NAAs to provide corresponding examination. [1]

5.2 COURSE DESIGN

ATO is required to create the plan of the training course based on instructional systems design (ISD) methodology.

One of the possible ISD models in use today is ADDIE Framework: **A**nalyse, **D**esign, **D**evelop, **I**mplement and **E**valuate, see Figure 5 for simple explanation of the phases. To prove that ISD is used, ATO should make documentation of particular phases of the course design. [5]

As stated in GM5 ORA.ATO.230(a): *„The purpose of using ISD to design training courses is to facilitate the students' efficient and effective acquisition of knowledge and skills based on current training needs."* [5]

Figure 5 - Course design - ADDIE Framework [5]

In other words, the ATO shall work with the training course over time and adjust it according to needs so that it still fulfills the same goal - to train a quality professional pilot according to current industry needs. In case of detection of deficiencies in training, it is necessary to take

adequate intervention. Records must be kept of all these steps – syllabus revisions, discussions with CAA, seminars/training for instructors, evaluation of progress tests within the whole group students, meetings of the ATO methodological board, etc.

Detail description of ISD is not scope of this diploma thesis, but can be found at EASA website: https://www.easa.europa.eu/sites/default/files/dfu/Presentations%20Day%201.zip - *file 7. F. Condron-ISD.pdf*

5.3 NEW LEARNING OBJECTIVES

Summarization of all changes in learning objectives was issued by EASA in Excel sheet with references to the old syllabus and to new syllabus with indicated changes. The list contains learning objectives for all licences/ratings – ATPL(A), CPL(A), ATPL(H)/IR, ATPL(H)/VFR, CPL(H), IR(A&H), CBIR, EIR. An excerpt from the comparison document is in the Figure 6. [22]

Figure 6 - Example of the LOs differences descriptions [22]

TK Syllabus Comparison Document (v2) is available in Excel format at EASA website, European Central Question Bank (ECQB) page:

https://www.easa.europa.eu/easa-and-you/aircrew-and-medical/european-central-question-bank-ecqb

The amendments to these AMCs as published in 2018 and 2019 are described as the "new syllabus" in this comparison document: [22]

- Amendment 4 to AMC/GM to Part-FCL, EDD 2018/001/R
- Amendment 6 to AMC/GM to Part-FCL, EDD 2018/011/R
- Amendment 8 to AMC/GM to Part-FCL, EDD 2019/017/R
- Amendment 6 to AMC/GM to Part-ARA, EDD 2018/011/R

- Amendment 8 to AMC/GM to Part-ARA, EDD 2019/017/R

Comparison is made with the TK syllabus and LOs as published in the ED Decisions listed below. These are described as the "old syllabus" in this comparison document: [22]

- Amendment 1 to AMC/GM to Part-FCL, EDD 2014/022/R for the CBIR(A) and EIR(A)
- Amendment 2 to AMC/GM to Part-FCL, EDD 2016/008/R for a professional licence (A or H), and the IR(A and H)

Comparison document can be simply used by theoretical knowledge instructors for familiarization with all changes in learning objectives and for updating of theory lessons content and learning materials.

Clean document with all final learning objectives should be soon available in Easy Access Rules for Flight Crew Licensing (Part-FCL) document from page 256 available at EASA website:

https://www.easa.europa.eu/sites/default/files/dfu/Easy_Access_Rules_for_Flight_Crew_Licensing_Part-FCL.pdf

5.3.1 LEARNING MATERIALS

Based on new published learning objectives the ATPL learning materials of all providers must be updated accordingly with appropriate Letter of conformance.

Following companies were asked during the preparation of this diploma thesis to comment their status of implementation new learning objectives and KSA:

- Jeppesen Boeing Courseware (https://www.peterssoftware.de/)
- CAE Oxford Aviation Interactive (http://www.caeoxfordinteractive.com/)
- Padpilot (http://padpilot.eu/)
- Civil aviation training Europe (https://www.cat-europe.com/en/)
- Bristol Ground School (https://www.bristol.gs/)

Example request sent:

„Dear provider,

I would like to ask you for the status of implementation of changes regarding the ATPL(A) Theory published in ED Decision 2018/001/R, ED Decision 2018/011/R and 2019/017/R to your training materials/coursewares.

How will you especially implement 100 KSA learning objectives? Will you prepare the assessments as part of your products?

Thank you for your kind answer,

Filip Bartunek"

Here are their answers:

Jeppesen Boeing Courseware:

„New books according to new syllabus will come to production in May 2020, now Jeppesen is speaking with their customers when to transfer their subscriptions from old to the new syllabus. KSA is not implemented directly, but there will some guidance/help for instructors." [19]

CAE Oxford Aviation Interactive:

„CAE are currently re-writing and re-designing all learning content for ATPL theoretical knowledge delivery.

The new EASA Syllabus material will be introduced in two phases, the first in Autum 2020 and the remainder of the material in Spring 2021. Our offering will consist of a full range of books along with eBooks, which will include digitial features, and a new e-learning platform delivering a range of e-learning activities and LMS functionality.

In regards to KSA 100 – it has not been made clear to me as yet how this subject will be incorporated in the material but I believe that it may be a set of guidance notes rather than a CBT as such, since it is an instructor led topic." [21]

Padpilot:

„Thank you once again for your e-mail. Our current focus is indeed to help our ATO partners with the transition from the current to the new EASA syllabus which is happening during the incoming months across Europe. We have just released our new EASA syllabus ATPL books in the Apple Book Store — we will keep both current and new editions available to our ATO partners so they can select the materials accordingly to their needs.

We provide the following elements to support the delivery of ATPL ground school courses:

For students:

- *EASA ATPL digital books (new syllabus edition available)*
- *EASA ATPL online progress tests (new syllabus edition available)*

For instructors:

- *EASA ATPL digital books (new syllabus edition available)*
- *EASA ATPL online progress tests — tracking of student's progress (new syllabus edition available)*

- *EASA ATPL classroom presentation slides (new syllabus edition drafts available)*
- *EASA ATPL training manual reference documentation (new syllabus edition available)*

…

I would like to draw attention to the following features of our books:

- *Simple and well written English — simple but helpful to students (especially who does not have English as first language).*
- *Relevant coverage of syllabus — the books go in more detail when the theory is relevant to current needs for an airline pilot career.*
- *Side-bar interactive icons — case studies and insights which link theory to practical examples and knowledge cross-reference.*
- *Threat and Error Management Flags — also linking theory to operations, providing awareness on why the theory is important to be understood.*
- *Summary and Quizzes at the end of each chapter — two ways to consolidate key knowledge.*

…

We also have spreadsheets of the new EASA syllabus mapping to our new books (indicating where we cover each learning objective in our books) — I forward the link from where you can download the latest version for the book provided above:

EASA ATPL Radio Navigation

https://drive.google.com/file/d/1WkbWWKs5NsUL6JoZOexD7ADdiV7xCoy8/view

…

Regarding KSA100, we have not developed anything directly related to its syllabus and assessments (there is no plan to work on this). What I can say is that the way in which we developed our new books will help students with a good understanding of knowledge so they are more prepared for the KSA assessments. The books contain Threat and Error Management "flags" and they will help with some LOs from KSA syllabus. Our new LMS will provide mental Mathematics tests which is also part of the KSA syllabus." [18]

Civil aviation training Europe:

„The majority of KSA100 is impossible to implement in a Distance Learning environment.

You will need to do those things in the classroom.

Nevertheless our plan is to give you some kind of "KSA100 Handbook" to help you." [17]

Bristol Ground School:

„I apologise for the delay in responding to you, we have been in the process of updating our material for the new syllabus. This is now ready. I have detailed below an overview of our school and what we can offer and I have attached a document regarding the new syllabus including KSA 100 and how we are implementing it. …" [20]

Implementation of 100 KSA by Bristol Ground School is described in separate document Introducing the new TK syllabus for 2020/2021, kindly provided by Bristol – I would like to summarize the main parts:

Bristol describes the main differences from previous syllabus, and generally welcomes the changes as positive and necessary. But some errors in the new syllabus were identified by Bristol. They have notified them to EASA through UK CAA, but without any answer yet. They highlight that new specimen aircraft data (known as UK CAA CAP) are not issued yet and not planned until the end of 2020. It is expected that ECQB 2020 will use existing ECQB 6 annexes and new specimen aircraft will be probably included in the next questions update, ECQB 2021.

Regarding the transition period, UK CAA and Austro Control announced that the possibility to start the old syllabus exams will be till the end of this year. It means that old syllabus exams must be available until June 2022. Due to COVID-19 crisis, it is expected that more CAAs across Europe will postpone option to pass old syllabus exams as well.

For AMC related to 100 KSA they proposed new Alternate Means of Compliance (AltMoC) and submitted through UK CAA to EASA. If adopted by Authority:

- permits continuous assessment, which they believe is a better training practice
- removes the need for all set-piece assessments except the last one
- permits the remaining summative assessment to be more focused on theoretical knowledge
- adopts the view that everybody starts with a satisfactory assessment in each LO, and that provided they don't fail, a basic pass is maintained

They introduce how theory admin system looks like regarding KSA assessments. [20]

As can be seen from answers above, that providers of learning materials mainly focused on changes related to learning objectives. Area 100 KSA will be supported only by some guidance for instructors. The exception is Bristol Ground School from UK which provides whole complex theory course, so Area 100 KSA is fully implemented based on AltMoC proposed by them.

If the flight school has its own ATPL learning materials, they need to allocate enough work hours to update them according to new list of learning objectives. To be sure that all learning materials are covered, it is recommended to have a compliance list of learning materials with

learning objectives (table of LOs with indicated page in book/presentation/exercise/lesson where is covered). It can be presented to CAA when auditing the ATO's theoretical training courses.

5.3.2 TESTING PORTALS

Official EASA question bank (ECQB) is not open for public. It is provided only directly to NAAs across Europe.

If a flight school is using the testing portals to examine the students during the training, it is needed to be assured that the questions provider is familiar with new regulations and updated question database accordingly.

I have checked the situation with Aviationexam, Czech based company, which is widely used by students across Europe for their preparation for final official ATPL exams at CAA.

Their plan is as follows: [31] [32]

- Transition to new LOs syllabus will be ready within summer 2020 as change in some CAAs is planned for June – both versions of questions bank will be available – old and new.
- Current questions in Aviationexam question bank will be redistributed according to the new syllabus.
- Mental Maths Test questions under 100 KSA subject category are already available, 96 questions in total covering all LOs including aviationexam additionals, at least 4 questions in every LO (see at Figure 7).
- No other changes are planned as the rest of KSA LOs must be evaluated during non-written tests.

SUBJECT & AREAS	QUESTIONS
✓ 100-01 - Convert between volumes and masses of fuel using range of units.	9
✓ 100-02 - Estimate time, distance and speed.	17
✓ 100-03 - Estimate the rate of climb or rate of descent, distance and time.	6
✓ 100-04 - Add or subtract time, distance, and fuel mass.	5
✓ 100-05 - Calculate fuel burn given time and fuel flow.	4
✓ 100-06 - Calculate the time available (for decision-making) given relevant fuel information.	4
✓ 100-07 - Determine the top of descent using a simple method that is described by the approved training organisation (ATO).	4
✓ 100-08 - Determine the values that vary by a percentage, e.g. dry-to-wet landing distance and fuel burn.	5
✓ 100-09 - Estimate heights at distances on a 3-degree glideslope.	4
✓ 100-10 - Estimate headings using the 1-in-60 rule.	4
✓ 100-11 - Estimate headwind and crosswind components given wind speed and direction and runway in use.	6
✓ 100-12 - Aviationexam additionals	28

Questions 96 of 96 available

START TEST

Figure 7 - Aviationexam portal questions for 100 KSA Mental Maths Test [10]

5.4 AREA 100 KSA

Subject 100 KSA is a brand new approach to pilot training and education in general. It is not one new subject, but rather a list of soft and mental skills which the student should build during his/her study of ATP(A) theory. The requirements of EASA say that ATO need to assess the student on these KSA learning objectives and if student successfully passed, then allow him/her to sit at final theoretical examination at CAA.

In ED Decision 2018/001/R it is not exactly specified when and how the learning objectives should be taught and what should be the specific content. In the first place, ATO must explain and teach the students 100 KSA learning objectives. After that, ATO can assess the students from the related LOs. It is not possible to make only the assessment without any explanation of the problematics beforehand. Students first need to understand how soft and mental skills are important for professional pilot and how they can improve them during the pilot training.

KSA learning philosophy should be projected to the all of 13 ATP(A) subjects as indicated at Figure 8.

Figure 8 - 100 KSA implementation to ATP(A) subjects

During KSA exercises student should demonstrate combination of using the acquired knowledge from various subjects within the skills with positive/correct attitudes, as applicable. That's the fundamental difference from previous objective of theoretical courses where the only one competence was evaluated – knowledge.

In general, principle of application Area 100 KSA and the philosophy of the whole teaching process throughout the training should be:

> *"Tell me and I forget, teach me and I remember, involve me and I learn"* [24]

Area 100 KSA is building the imaginary bridge between theoretical and practical part of training, to get both parts necessary connected. It brings the classroom instruction much closer to the real aviation environment, the cockpit.

Knowledge and skills shall be combined by the pilot into a strategy, within the theoretical training using scenario-based situation, problem-solving and decision-making strategies, threat and error management, etc.

Aviation, due to its complexity, has to be a complete lifestyle for the pilot, which can differ based on the exact type of job:

- Flight instructor
- Flight examiner
- Airline pilot
- Pilot for aerial works
- Cargo pilot
- Ferry pilot
- Business aviation pilot
- Freelancer pilot
- And others

Every type of pilot job requires a slightly different soft and mental skills and different level of competencies. During initial pilot training we need to build in students the general skills and explain the differences.

5.4.1 AREA 100 KSA LEARNING OBJECTIVES

The following chapter describes all learning objectives covered in Area 100 KSA with extended explanation - in which subject and how to teach the students a particular LO. Combination of both theory explanations and exercises is used. Decision allows to use planning, scenario-based and simulated exercises, or assessed discussions, interviews, projects, essays and presentations during theory lessons and assessments. Example for exercises of LO can be directly used by an ATO or updated it according to their standard operating procedures and style of operations. [1]

Note: „Initial ATP" is a subject beyond standard requirement of 750 hours of ATP(A) theoretical training which covers the necessary knowledge before the student starts the practical training in ATO. The extent of Initial ATP is usually at least 100 hours and the content is similar to PPL(A) theory course. I would recommend implementing some of the 100 KSA learning objectives to this initial subject before student sits in the aircraft for the first time for practical training. In case of Distance ATP(A)-650 theory course where the student is already a holder of PPL(A) licence, „Initial ATP" is not applicable (see notes at related KSA LOs, how to cover in this type of course). [7] [8]

In addition, where applicable the integration of 100 KSA learning objectives to MCC theory is stated.

In case of modular distance-learning course, I propose teaching all 100 KSA LOs within classroom instruction or ATO can include them to an interactive computer-based training. In case of specific requirement, it is mentioned at particular LO.

100 01 00 00 ICAO CORE COMPETENCIES

100 01 00 01

Recognise the ICAO Core Competencies listed below and the associated competency descriptions (ICAO Doc 9995 'Manual of Evidence-based Training'):

- **Application of Procedures**

Identifies and applies procedures in accordance with published operating instructions and applicable regulations, using the appropriate knowledge. [33]

- **Communication**

Demonstrates effective oral, non-verbal and written communications, in normal and non-normal situations. [33]

- **Aircraft Flight Path Management, automation**

Controls the aircraft flight path through automation, including appropriate use of flight management system(s) and guidance. [33]

- **Aircraft Flight Path Management, manual control**

Controls the aircraft flight path through manual flight, including appropriate use of flight management system(s) and flight guidance systems. [33]

- **Leadership and Teamwork**

Demonstrates effective leadership and team working. [33]

- **Problem Solving and Decision Making**

Accurately identifies risks and resolves problems. Uses the appropriate decision-making processes. [33]

- **Situation Awareness**

Perceives and comprehends all of the relevant information available and anticipates what could happen that may affect the operation. [33]

- **Workload Management**

Manages available resources efficiently to prioritize and perform tasks in a timely manner under all circumstances. [33]

Initial ATP: Explain to students what each competency means and how they are important for pilot position. Familiarize students with assessment standards as implemented in ATO – chapter 5.4.2 of this diploma thesis. Use the competencies descriptions and examples mentioned in ICAO Doc 9995 "Manual of Evidence-based Training". [33]

If the ATO has implemented competency based into practical training as well, then explain how to these competencies will be evaluated during the practical training. What level the student needs to achieve during each task/phase of the training.

040, MCC: Discuss with students how their competencies have been built during the training, what they need to improve and focus on. Explain application of competencies at higher level – in airline/commercial environment and multi-crew.

Distance ATP(A)-650 theory course: this LO must be completed within classroom instruction – personally or distance.

100 02 00 00 CORE COMPETENCIES LEARNING OBJECTIVES

100 02 01 00 Communication

Communication in aviation is highly important part of successful and safe performance of flight. It doesn't include only radiotelephone communication with air traffic services but mainly communication with other persons and subjects involved in performance of flight – flight instructor, technician, sales, dispatch and planning department of ATO, other students-colleagues, etc. in flight training environment. In commercial aviation the communication is wider, but includes similar subjects – operations department, sales department, flight operations department, technical department, handling, other crew colleagues (captain/first officer, flight attendants).

Communication in general can be in various forms:

- Verbal
  - Oral
    - Face to face
    - Distance (via phone, via aircraft radio station)
  - Written
- Non-verbal

100 02 01 01

Show the ability to identify whether the recipient is ready and able to receive the information.

and

100 02 01 04

Show the ability to confirm whether the recipient correctly understands important information.

and

100 02 01 05

Show the ability to listen actively and show you understand the information you receive.

Initial ATP, 040: Explain to the students that communication is always two-way process. If the recipient doesn't receive information correctly or doesn't understand in full, it is not only his/her fault, but mainly of sender. Person, who is sender, must first be assured that recipient is ready and able to receive the information, it means recipient concentrate to the communication process and pay attention – examples:

- Has enough brain capacity to communicate (with regards to other tasks)
- Eye-to-eye contact in case of face to face communication
- Has good radio/phone/internet connection to be able fluently receive the information
- Recipient confirms verbally or non-verbally that is able to receive the information

Correct understanding of the information received by recipient is based not only on quality of communication process (signal, distance between persons, …), but also on recipient's knowledge and experience. For example: if instructor would tell student how to fly solely according instruments before passed the VFR phase of training. In this case information would be received, but not understood, so communication process is not completed and wrong. It means that sender based on feedback from recipient and known circumstances must evaluate if information is understood.

090: Repeat with students this LO with focus on phraseology procedures.

MCC: Repeat with students this LO with focus on multi-crew cooperation.

100 02 01 02

Show the ability to appropriately select what, when, how and with whom to communicate.

Initial ATP, 040: This LO is closely connected with LO "*100 02 03 06 Show the ability to set priorities appropriately*". It is important to communicate according to priorities – what and when.

The method of communication can be various:

- Verbal
  - o Oral
    - ▪ Face to face
    - ▪ Distance (via phone, via aircraft radio station)
  - o Written
- Non-verbal

Pilot should select the appropriate method according to objective/subjective circumstances and priority of information which is communicated. In the general, urgent information should be provided to recipient orally – face-to-face, phone, aircraft radio station, ... Information non-critical in time can be send in written format – e-mail, SMS, letter, datalink, …

The recipients need to be selected based on information which is communicated. Not everybody needs to know everything, it means that some information can be unnecessary and waste of time for some members of air operations. Or the level of communication can be divided based on importance for recipients. For example: Procedure of new airport must be in details explained to pilots and confirmation of understanding must be assured. But for other departments (like sales and operation) information that new airport is available for airline operations is enough, they don't need to know how to fly approach there.

090: Repeat with students this LO with focus on phraseology procedures.

MCC: Repeat with students this LO with focus on multi-crew cooperation.

100 02 01 03

Show the ability to communicate clearly, accurately and concisely.

Initial ATP, 040: Explain to students that essential part of communication is how technically the information is built. Aviator is not philosopher, the information must be accurate, clear, brief and communicated quickly. Highlight that is very important to summarize and prepare the information before the pilot starts to communicate. Pilot shall to use the standard phrases not only during the radio communication with Air Traffic Services (ATS), but standard aviation

terms during communication with other aviation personnel. If the pilot is not assured that information which providing is accurate, it is necessary to warn about this fact the recipient or not provide this information. The reason is that use of such information can negatively influence the safety of flight.

090: Repeat with students this LO with focus on phraseology procedures.

MCC: Repeat with students this LO with focus on multi-crew cooperation.

100 02 01 06

Show the ability to ask relevant and effective questions.

Initial ATP, 040: The questions which pilot is asking must be relevant to the phase of flight which is currently in progress. The questions in aviation environment should be brief and clear. It's easy to recognise if pilot is not concentrated to the flight or other related activity, then losing the situation awareness and asking non-relevant questions or unnecessarily extensive questions, because is not familiar with information which were already stated within the crew.

090: Repeat with students this LO with focus on phraseology procedures.

MCC: Repeat with students this LO with focus on multi-crew cooperation.

100 02 01 07

Show the ability to adhere to standard radio-telephony phraseology.

Initial ATP, 090: Pilot must communicate via aircraft radio station using the correct phraseology as written in relevant regulation (in Czech Republic: L Phraseology). Using non-standard phrases is problematic, because the recipient can understand the message incorrectly due to different interpretation. Safety of flight could be significantly influenced.

Deviation from standard phraseology is acceptable only in emergency situation when pilot with high workload needs to report the problem and further intentions immediately. Then use of open language can be easier and faster.

100 02 01 08

Show the ability to accurately read, interpret, construct and respond to given documentation in English.

010, 020: Main language for aviation is English. Pilot must fully understand documentation provided for flight operations - like regulations, manuals, guidance, etc. Levels of aviation English knowledge are defined by ICAO, the minimum is level 4.

Let the students to study/read the relevant parts of aviation documentation in these subjects and then present the information to lector and other students. Ask them related questions.

100 02 01 09

Show the ability to correctly interpret non-verbal communication.

040: Non-verbal communication make up approximately 50% of the whole communication process. The proportion of non-verbal expression can differ based on situation, local culture and other aspects. Anyway, its understanding is important to have complete picture of communicating information. [6]

Non-verbal communication consists of: [6]

- Phonetics aspects of speech (volume, height, intonation, dynamics, speed, fluency, …)
- Facial expressions
- Eye contact
- Distance between sender and recipient
- Time management of speech
- Haptics
- Etc.

Discuss with students what meaning has each non-verbal expression in different situation.

For example:

1) No eye contact and discontinuous speech can be expression of nervousness or lack of knowledge.
2) Excellent time management, regular eye contact with recipient, appropriate distance can be expression of high experience, self-confidence, knowledge

Distance ATP(A)-650 theory course: this LO must be completed within classroom instruction – personally or distance.

090: Repeat with students this LO with focus on phraseology procedures.

MCC: Repeat with students this LO with focus on multi-crew cooperation.

100 02 01 10

Show the ability to use appropriate eye contact, body movement and gestures that are consistent with and support verbal messages.

040: Explain students that verbal communication is important to accompany with non-verbal expressions to provide complete information to recipient. The level of non-verbal expressions must be on acceptable level for recipient, avoid haptics, close distance to recipient and another non-professional means. Adjust the phonetics aspects of speech to type of recipient, his/her knowledge, skills and experience.

090: Repeat with students this LO with focus on phraseology procedures.

MCC: Repeat with students this LO with focus on multi-crew cooperation.

100 02 02 00 Leadership and teamwork

100 02 02 01

Show the ability to create an atmosphere of open communication that encourages participation.

and

100 02 02 02

Show the initiative and the ability to give directions when required.

and

100 02 02 03

Show the ability to admit mistakes and take responsibility.

and

100 02 02 04

Show the ability to anticipate and respond appropriately to others' needs.

and

100 02 02 05

Show the ability to carry out instructions when directed.

and

100 02 02 06

Show the ability to communicate relevant concerns and intentions.

and

100 02 02 07

Show the ability to give and receive feedback constructively.

and

100 02 02 09

Show the ability to engage others in planning and to allocate activities fairly and appropriately according to others' abilities.

and

100 02 02 10

Show the ability to address and resolve conflicts and disagreement in a constructive manner.

033: Create groups of students (2 students, as crew) and give them the task to make pre-flight preparation for VFR flight from their home base to another controlled airport in the country. 1 student is like a captain and another is a first officer. Explain to students that at first captain must to identify the task which are ahead of them to complete the pre-flight preparation successfully, he/she should give space to first officer for any questions or concerns. After that captain must distribute the tasks between them fairly with regard to lower experience of first officer and his/her concerns. During preparation itself if any disagreement or conflict come up, captain should take control of solving the issue and open discussion with the first officer. If no common solution is found out, captain has to decide on his/her responsibility. If concerns of the first officer during solving process are objectively right and against captain's intentions, he/she must be able admit mistake. If one of the crew doesn't know how to proceed with his/her task, explain them don't hesitate to ask the colleague for help.

During the exercise monitor the students and help them in application of these soft skills.

After completing the exercise, make debriefing with students and let them to give feedback to each other – what were weaknesses and strengths of both. Discuss their cooperation and find out what can be done better in next exercise. Lector should give feedback from his/her side as independent observer.

After finishing this exercise let them switch the roles and try again to plan different flight.

Distance ATP(A)-650 theory course: this LO must be completed personally in ATO.

100 02 02 08

Show empathy, respect and tolerance for others.

033: After finish of previous exercise and completing all LOs discuss with students how they expressed empathy, respect and tolerance to each other and to the lector. Highlight that these three skills are very important for high level CRM and productive cooperation in team of crew or whole company in general. Discuss with students that following of standard operating procedures of company is mandatory, but common sense must be always used together with human approach. Each must respect that beginning pilot has low experience and makes mistakes, cultural differences must be taken into account, etc.

The behaviour and cooperation in the team should follow philosophy: "There is no "I" in the team."

Distance ATP(A)-650 theory course: this LO must be completed personally in ATO.

100 02 02 11

Show the ability to project self-control.

040: Pilot's self-control must be maintained during whole flight and related operations. Explain to students that they must prepare themselves for different psychologically demanding situation in advance. With increasing aviation and life experience the person is more and more resistant to demanding situations. In any case, pilot can't jeopardize the safety of flight by his/her behaviour, which is affected by an unfavourable life situation or personal problems. If he/she is unable to maintain sufficient self-control, then he/she must declare that he/she is not fit to fly.

100 02 03 00 Problem-solving and decision-making

100 02 03 01

Show the ability to seek accurate and adequate information from appropriate sources.

and

100 02 03 02

Show the ability to identify and verify what and why things have gone wrong.

and

100 02 03 03

Show the ability to employ proper problem-solving strategies.

and

100 02 03 04

Show the ability to persevere in working through problems.

and

100 02 03 05

Show the ability to use appropriate and timely decision-making processes.

and

100 02 03 06

Show the ability to set priorities appropriately.

and

100 02 03 07

Show the ability to identify and consider options effectively.

and

100 02 03 08

Show the ability to monitor, review and adapt decisions as required.

and

100 02 03 09

Show the ability to identify and manage risks.

040: Go through all these Learning objectives in following exercise. Make debriefing with students and explain what they did wrong and right.

Air crash investigation

Select an air crash which happened in aviation industry in the past. Give students facts which were known before the official investigation started. Let them seek important information and identify what went wrong, what happened. Then ask them to propose options how to solve the situation, prioritize them and identify risks which can come.

Then show students the whole investigation which were completed with final results and discuss their outcomes with officials. Go through all LOs related to problem-solving and decision-making in this scenario situation.

Explain students problem-solving strategies, there is one example. Discuss if pilots in air crash applied this strategy.

DODAR: [12]

D – Diagnose (what is the problem)

O – Options (hold, divert, immediate landing etc.)

D – Decide (which option)

A – Act or Assign (carry out selected option and assign tasks)

R – Review (can involve addition of new information, and/or the ongoing result(s) of selected option)

Other type of problem-solving strategies can be used, based on TKI.

Distance ATP(A)-650 theory course: this LO must be completed personally in ATO.

100 02 04 00 Situation awareness

100 02 04 01

Demonstrate the ability to identify and assess accurately the general environment as it may affect the operation.

033: Explain to students that general overview of world and environment situation is necessary for safety of flight. It means that pilot cannot focus only on particular flight, but shall monitor and assess:

- Climate and weather development
- Political situation development
- Economic situation development
- Safety situation development
- Epidemic situation development (like COVID epidemic in 2020)

and follow related restrictions and manage threats for flight operations.

100 02 04 02

Demonstrate the ability to identify threats, errors and undesirable aircraft states.

033, 050: Show to student how to applicate this ability during pre-flight preparation in focus on meteorological information and finally during the flight. Use following examples.

1) Is it suitable to plan the VFR NIGHT flight from Prague to Nurnberg for 20:00 UTC on 18th of April, when synoptics map in the Figure 9 is available?
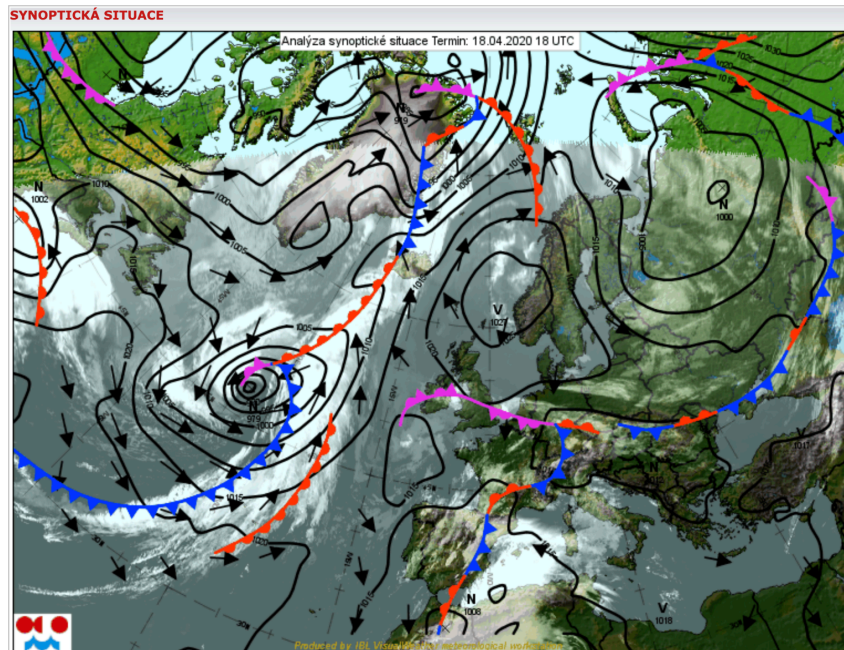
Figure 9 - Synoptics map for 100 02 04 02 [13]

2) Pilot is flying local flight around Benesov Airport, what threats can be identified based on Figure 10 below?
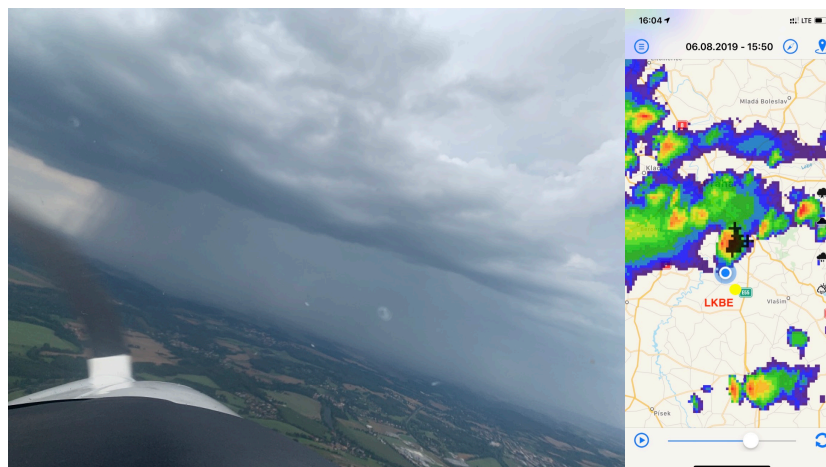
Figure 10 - Cockpit view [source: author] and radar view [11] for 100 02 04 02

080: Use exercises in LOs category **100 03 02 00.**

100 02 04 03

Demonstrate the ability to manage threats, errors and undesirable aircraft states.

033, 050:

1) Situation 1) from previous LO. Flight from Prague to Nurnberg is delayed for 3 hours. Before departure pilot decided to fly IFR instead of VFR, aircraft is capable, pilot is qualified. How to manage this situation based in the Figure 11 below?
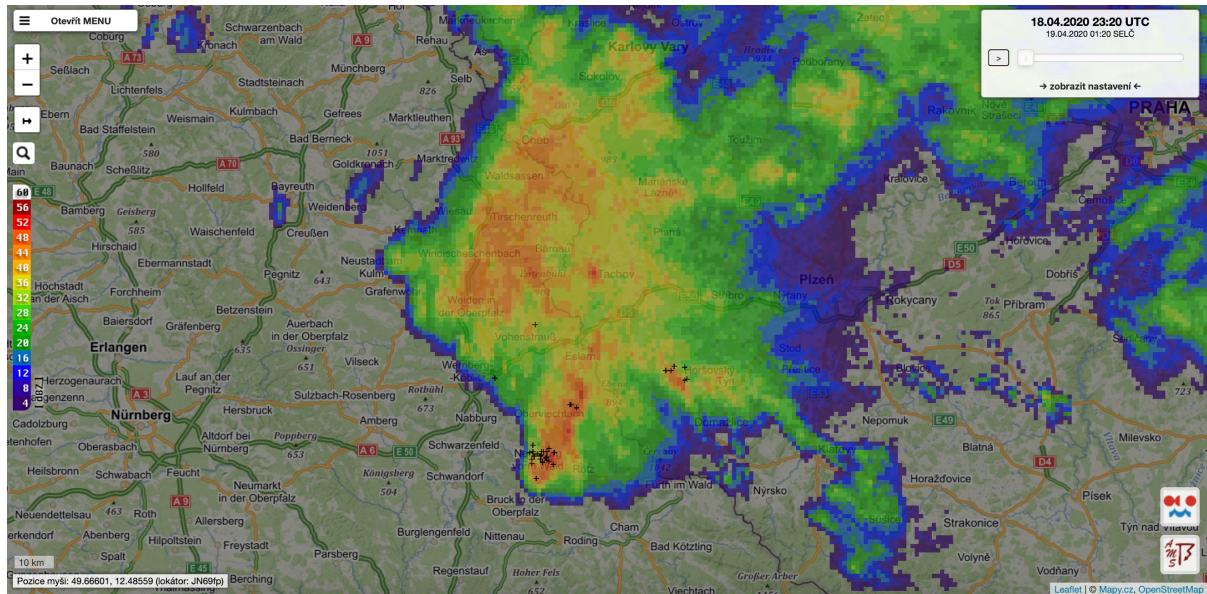
Figure 11 - Radar view for 100 02 04 03 [15]

Solution: Request heading more to south (approx. 200°) and fly around the thunderstorm. Recalculate the fuel, the route will be significantly longer. Decide if it is possible to continue to Nurnberg with final reserve and alternate fuel on board after landing, or pilot must come back to Prague, or land at other suitable airport on route (take into consideration what time is).

080: Use exercises in LOs category **100 03 02 00.**

100 02 05 00 Workload management

100 02 05 01

Show the ability to maintain self-control.

Initial ATP, 040: Pilot must be capable to maintain self-control during all situations which can be encountered during the flight and even during whole pilot's career and life. In every situation – normal, abnormal and emergency – pilot should be professional and reasonably resistant to external and internal influences. During the single pilot operation, it is even more important,

because there is nobody else who can take control of the aircraft if pilot in command is incapacitated due to loss of self-control.

The basic conditions to maintain quality self-control is to gain enough knowledge and skills related to aviation during initial pilot training and have positive attitude.

MCC: In Multi-crew environment self-control must be maintained by all crew members – pilots, engineers and flight attendants as well. In addition to single-pilot operation, in multi-crew, members are controlled by each other and can be noticed from colleague that his/her behaviour is not standard.

Every deviation from positive pilot's self-control have negative influence on crew resource management and degrade the total performance of the crew. It means that management of correct self-control is in the interests of all crew members.

It is recommended to add this LO explanation to Advanced UPRT theory as well, due to maintain self-control during the upsets.

100 02 05 02

Show the ability to plan, prioritise and schedule tasks effectively.

and

100 02 05 03

Show the ability to manage time effectively when carrying out tasks.

Initial ATP: Time management when carrying out tasks is important from the first flights of student. Explain the rule Fly – Navigate – Communicate and its application during normal, abnormal and emergency procedures. For the first phases of pilot training explain to student to focus on basics of flying.

040: Explain to students importance of time management when solving tasks. At first, the pilot should estimate how long each task will take, what is its priority and then make a mental plan how and in which sequence to solve them. Accuracy of estimation will be improved by built experience during pilot's career. Discuss with students how they are successful in time management.

Distance ATP(A)-650 theory course: this LO must be completed within classroom instruction – personally or distance.

033: Explain to students how to manage time in case of pre-flight preparation if time is limited – for example: they got information about the flight 2 hours before Estimated Off-Block Time (EOBT).

061: Explain to student how to manage time during the navigation flight. During pre-flight preparation and briefing, before take-off procedures, navigation flight from airport A to B, after landing procedures and debriefing.

MCC: Focus on time management of tasks in the multi-crew environment based on roles in the crew – pilot flying vs. pilot monitoring, captain vs. first officer. Each role has particular task to complete during the flight which are stated in standard operating procedures of each airline company. Explain how to set priorities during normal, abnormal and emergency situations.

100 02 05 04

Show the ability to offer and accept assistance, delegate when necessary and ask for help early.

Initial ATP: Explain to students how the cooperation with flight instructor will work from the first flights in practical training. Student and flight instructor are the first type of "crew" which student gets to know. Highlight that pilot training is education process in both theoretical and practical sides, so from student is expected that he/she will accept assistance from lector or instructor. When necessary student can ask for help and can expect that help will be provided for sure.

040: Explain to students cooperation not only in the cockpit, but in the environment of the whole aviation company between particular departments: operations department, sales department, flight operations department, technical department, handling, etc. When and how to offer and accept assistance, delegate when necessary and ask for help. Pilot can delegate the tasks which are for example related to pre-flight preparation and don't have to be done solely by pilot in case of time-limiting situations. Or pilot must be able to accept assistance when it's evident that he/she is not able to fulfil all necessary tasks.

090: Repeat with students this LO with focus on radiotelephone communication where pilot must be able to ask for help and accept assistance in case of abnormal or emergency situation. For example, weather deterioration and change the route is necessary for safe continuation of the flight, then pilot asks the air traffic services for new heading out of bad weather. Or when minimum fuel (alternate and final reserve) is expected at destination then priority should be requested from pilot's side to shorten the route as much as possible.

Ability to offer assistance is useful in communication as well, when pilot hears as another aircraft is calling but the ground station not responding. The reason can be too great distance between the stations. In this case offer the assistance to transfer the communication message from aircraft to ground station and vice versa would be convenient.

MCC: Repeat with students this LO with focus on multi-crew cooperation. Highlight the principle of MCC and Crew Resource Management where the formula 1+1=3 is the cornerstone.

100 02 05 05

Show the ability to manage interruptions, distractions, variations and failures effectively.

Initial ATP, 040: Explain to students that it is necessary to concentrate to the task which must be currently performed and all other inputs shall be kept in mind but with appropriate attention based on its importance. For example, during the one-engine flight after engine failure pilot encounter engine fire, so it's emergency situation which requires immediate action. But if in the same situation the flight attendant brings a coffee to cockpit, that's really not important and should be quickly refused to be able to focus on solving the emergency.

100 03 00 00 ADDITIONAL THREAT AND ERROR MANAGEMENT (TEM) RELATED LEARNING OBJECTIVES

100 03 01 00 Application of knowledge

100 03 01 01

Demonstrate the ability to complete pre-flight planning in practical exercises.

Initial ATP: Students make flight planning exercises based on assignments from TKI after went through VFR navigation and flight planning lesson. Use the local ICAO chart, AIP or VFR Manual, AUP/UUP, NOTAMs, meteorological information, training aircraft performance and weight & balance data. Let students to make pre-flight preparation for domestic flight individually and for flight to foreign country in group of 3 students (to build cooperation skills).

Output of this exercise must be fully prepared:

- navigation log
- track in the map
- airport charts
- analysed meteorological information

- analysed NOTAMs and AUP/UUP
- required fuel on board
- computed performance and weight & balance
- flight plan ready to file
- performed threat and error management

033: Students make flight planning exercises based on assignment from TKI after went through IFR navigation and flight planning lesson. Use the local Enroute chart, AIP or other charts provider (like Jeppesen), NOTAMs, meteorological information, training aircraft performance and weight & balance data. Let students to make pre-flight preparation for domestic flight individually and for flight to foreign country in group of 3 students (to build cooperation skills).

Output of this exercise must be fully prepared:

- navigation log/operational flight plan (OFP)
- airport charts
- analysed meteorological information
- analysed NOTAMs
- required fuel on board
- computed performance and weight & balance
- flight plan ready to file
- performed threat and error management

Distance ATP(A)-650 theory course: this LO must be completed personally in ATO.

100 03 01 02

Demonstrate the KSA and TEM relating to phases of flight in the ground training environment.

033: After the pre-flight preparation is completed (previous LO) and checked by TKI, let student to perform the flight on simulator (FNPT or equivalent – certification of simulator is not required). TKI assists to student during the flight and highlight ICAO Core competencies:

- Application of Procedures
- Communication
- Aircraft Flight Path Management, automation
- Aircraft Flight Path Management, manual control
- Leadership and Teamwork
- Problem Solving and Decision Making

- Situation Awareness
- Workload Management

This LO during 033 theory lessons must be completed after student is in advanced phase of the VFR flying to have enough experience in control/handling the aircraft and in navigation or assistance from TKI is required.

Distance ATP(A)-650 theory course: this LO must be completed personally in ATO.

100 03 02 00 Upset prevention and recovery training (UPRT) and resilience

100 03 02 01

Recognise potential upset 'threats' and suggest effective 'threat management' in scenario situations.

080: After completion of subject 022 Instrumentation and LOs in 080 related to aerodynamics, discuss with students potential upset „threats" and request from students to suggest effective „threat management". There are few examples, which can be used for this LO.

Scenario situation 1)

Identify threat and suggest threat management in the Figure 12.
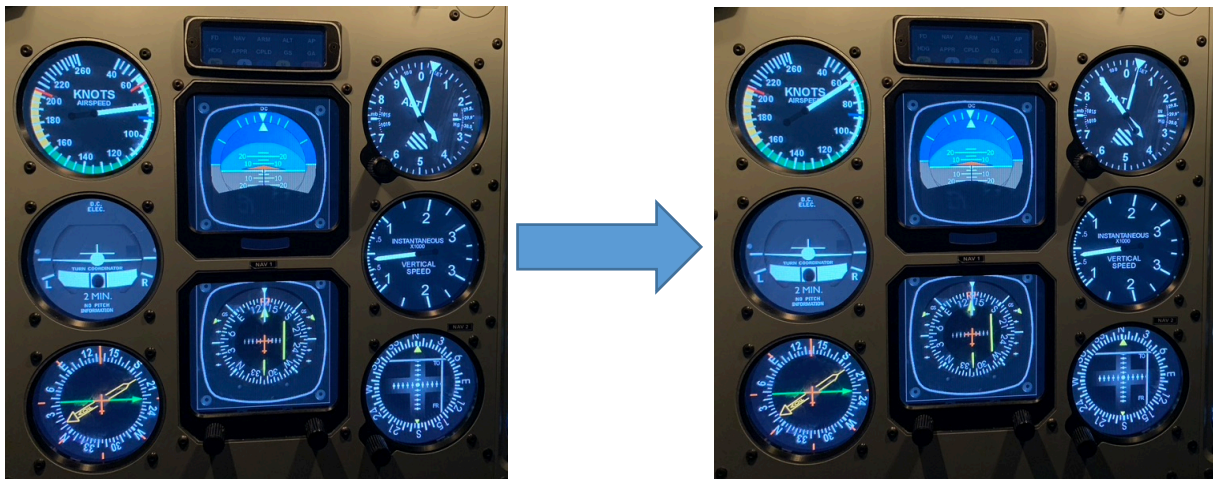
Figure 12 - Scenario situation 1) for 100 03 02 01 [source: author]

Threat: Decreasing airspeed, increasing pitch, up to stall speed and critical angle of attack = **STALL STALL STALL**

Threat management: Pitch down, add full power, increase airspeed, level off, set power, climb back to original altitude.

Note: Pictures of simulator in these exercises can be changed for own ATO's simulator photos which is further used in assessments and practical training (in order to link theory and practice).

Scenario situation 2)

Identify threat and suggest threat management in the Figure 13.
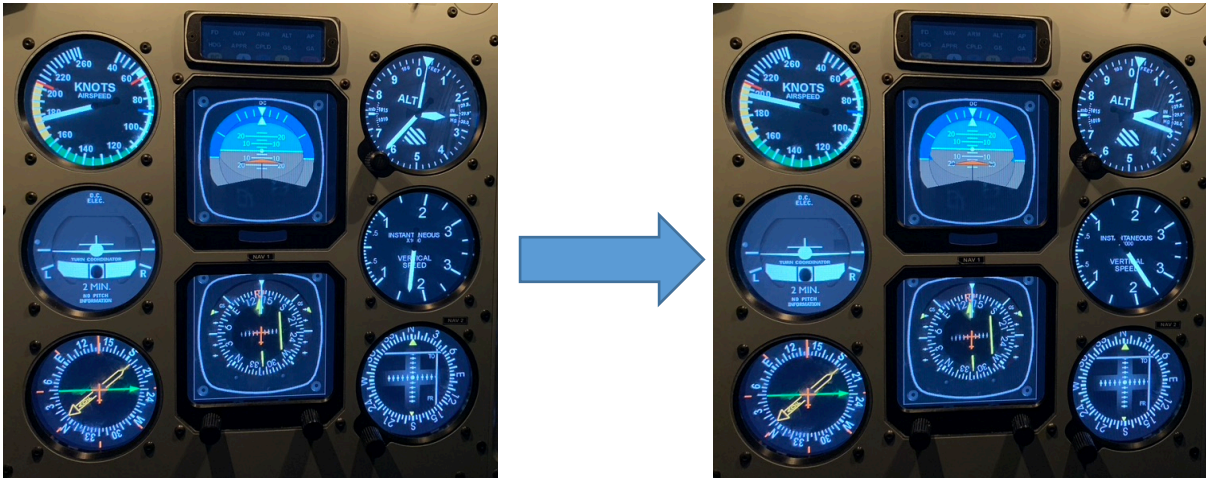
Figure 13 - Scenario situation 2) for 100 03 02 01 [source: author]

Threat: Increasing airspeed, decreasing pitch, up to never exceed airspeed = **AIRCRAFT STRUCTURE DAMAGE**

Threat management: Power IDLE, pitch up, level off, set power, climb back to original altitude.

Scenario situation 3)

Identify threat and suggest threat management (focus on engine instruments) in the Figure 14.

Figure 14 - Scenario situation 3) for 100 03 02 01 [source: author]

Threat: Low fuel in both fuel tanks = **ENGINE SHUT DOWN**

Threat management: Land at nearest suitable airport or land as soon as possible (based on exact amount of the remaining fuel).

100 03 02 02

Recognise potential upset 'errors' and suggest effective 'error management' in scenario situations.

080: After completion of subject 022 Instrumentation and LOs in 080 related to aerodynamics, discuss with students potential upset „errors" and request from students to suggest effective „error management". There are few examples, which can be used for this LO.

Scenario situation 1)

Identify error and suggest error management (keep in mind flying in IMC conditions) in the Figure 15.

Figure 15 - Scenario situation 1) for 100 03 02 02 [source: author]

Error: Too much bank in IMC conditions.

Error management: Decrease bank angle.

Scenario situation 2)

Identify error and suggest error management in the Figure 16.

Figure 16 - Scenario situation 2) for 100 03 02 02 [source: author]

Error: Too much bank, negative pitch and airspeed near to never exceed speed.

Error management: Power IDLE, pitch up, wings level, level off, set power, climb back to original altitude.

Scenario situation 3)

Identify error and suggest error management in the Figure 17.

Figure 17 - Scenario situation 3) for 100 03 02 02 [source: author]

Error: Too much bank, high pitch and airspeed near to stall speed.

Error management: Pitch down, add full power, wings level, level off, set power, climb back to original altitude.

Scenario situation 4)

Identify error and suggest error management in the Figure 18.

Figure 18 - Scenario situation 4) for 100 03 02 02 [source: author]

Error: Slipping turn, can result in spiral dive.

Error management: Add more rudder inside the turn, in this case left rudder, or decrease bank.

Scenario situation 6)

Identify error and suggest error management in the Figure 19.

Figure 19 - Scenario situation 6) for 100 03 02 02 [source: author]

Error: To much yaw at airspeed close to stall speed, can result in spin.

Error management: Controls neutral, pitch down, add full power, wings level, level off, set power, climb back to original altitude.

Scenario situation 7)

Identify error and suggest error management in the Figure 20.

With PAPI   Without PAPI

Figure 20 - Scenario situation 7) for 100 03 02 02 [source: author]

Error: High approach.

Error management: Go around.

Scenario situation 8)

Identify error and suggest error management in the Figure 21.
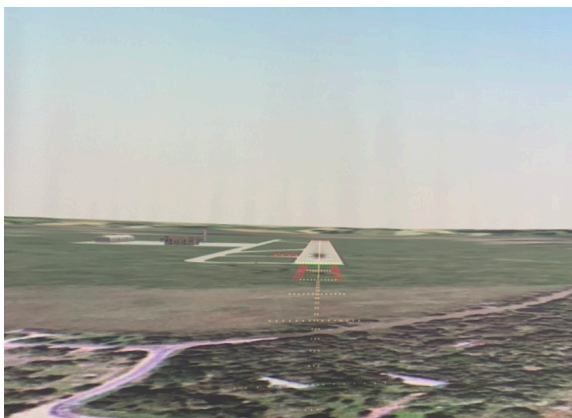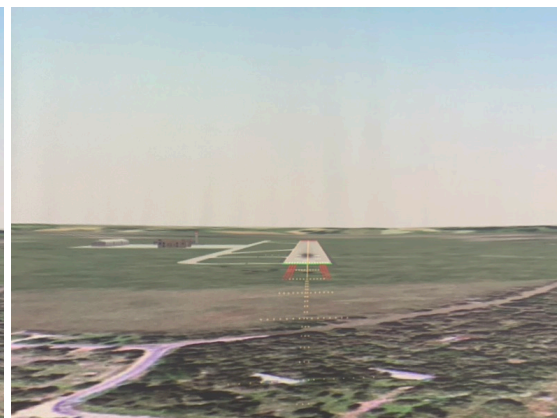
With PAPI   Without PAPI

Figure 21 - Scenario situation 8) for 100 03 02 02 [source: author]

Error: Low approach.

Error management: Go around.

100 03 02 03

Explain the causes of and contributing factors to upsets.

080: Take the situation from previous LOs and discuss with students about the causes and contributing factors for the upsets, like:

- Poor aircraft handling
- Loss of situational awareness
- Not enough attention for aircraft handling (e.g. head down, managing FMS without engaged autopilot)
- Etc.

Discuss as well other upsets which can be encountered during flight.

Distance ATP(A)-650 theory course: this LO must be completed within classroom instruction – personally or distance.

100 03 02 04

Demonstrate resilience during scenario and/or other exercises.

040: Explain to students importance to stay resistant to psychological pressure and the resulting stress during all phases of flight and related activities.

100 03 02 05

Show the ability to identify the signs and discuss the effects of stress, fatigue and aviation lifestyle on situation awareness, and how to cope with them in order to maintain situation awareness.

040: Students can be invited for the last theory lesson in this subject starting at 5 a.m. Tell them in advance that this lesson will be only presentation of experience of airline pilot – they will just listen. This will cause that students will be probably tired (not needed to go sleep earlier day before) – their „duty" will start in window of circadian low (WOCL), which will more increase the fatigue. After start of lesson, give to the students test and tell them who will not pass needs to repeat whole subject with the next course – this will increase level of their stress. Then discuss this LO.

Distance ATP(A)-650 theory course: this LO must be completed personally in ATO.

100 04 00 00 Mental Maths

100 04 00 01

Convert between volumes and masses of fuel using range of units

033: Teach the student in related 033 LOs conversions between volumes and masses of fuel. Focus on two main types of aviation fuel: Avgas and JET A1. Take into account standard conditions.

Litres/3,785 = US gallons	US gallon x 3,785 = litres
Kilograms x 2,205 = pounds	Pounds/2,205 = kilograms
Litres of JET A1 x 0,8 = kilograms	Kilograms of JET A1/0,8 = litres
Litres of JET A1 x 1,76 = pounds	Pounds of JET A1/1,76 = litres
Litres of AVGAS x 0,72 = kilograms	Kilograms of AVGAS/0,72 = litres
Litres of AVGAS x 1,58 = pounds	Pounds of AVGAS/1,58 = litres

100 04 00 02

Estimate time, distance and speed

033: Teach the students in related 033 LOs estimation of time, distance and speed in various scenarios.

Basic formula: distance = speed x time

GS = TAS - headwind + tailwind

100 04 00 03

Estimate the rate of climb or rate of descent, distance and time

061: Teach the students in related 061 LOs to estimate rate of climb, rate of descent, distance and time.

Height to go/(rate of climb/descent) x GS = distance

1 m/s = 200 ft/min (approximately)

Rate of climb = GS x gradient in %

100 04 00 04

Add or subtract time, distance, and fuel mass

033: Teach the students in related 033 LOs the calculation of time, distance and fuel mass based on time or distance spent in the air.

1 hour = 60 minutes

Fuel required = fuel consumption x flight time

100 04 00 05

Calculate fuel burn given time and fuel flow

033: Teach the students in related 033 LOs to calculate fuel burn based on fuel consumption (fuel flow) and time.

Fuel required = fuel consumption x flight time

100 04 00 06

Calculate the time available (for decision-making) given relevant fuel information

033: Teach the students in related 033 LOs to calculate fuel burn based on fuel consumption (fuel flow) and time.

Fuel required = fuel consumption x flight time

100 04 00 07

Determine the top of descent using a simple method that is described by the approved training organisation (ATO).

033: Teach the students in related 033 LOs to calculate top of descent in relevant LOs. Explain two basic methods:

    1. Calculation using predefined rate of descent, for example 500 ft/min.

Distance = difference of height/(rate of descent) x GS (keep in mind deceleration segment if applicable)

Usual ground speeds for training aircraft are mentioned in Table 2 below:

Table 2 - Required NM for descent 500 ft/min based on GS

Ground speed (kts)	NM required to descent 1000 ft
90	3
120	4
150	5
180	6

2. Calculation using rule for 3-degree rate of descent

Distance = difference of height/1000 x 3 (keep in mind deceleration segment if applicable)

In case of different QNH at the airport than standard 1013 hPa, calculate the actual altitude where aircraft is cruising.

100 04 00 08

Determine the values that vary by a percentage, e.g. dry-to-wet landing distance and fuel burn.

032: Repeat with students in related 032 LOs using of percentage, performance factors and their combination.

100 04 00 09

Estimate heights at distances on a 3-degree glideslope.

033: Teach the students in related 033 LOs calculation of height and distances on 3-degree glide slope using simple formula.

Distance = difference of height/1000 x 3

Or 1 NM distance corresponds to 320 ft height loss during descent

100 04 00 10

Estimate headings using the 1-in-60 rule.

061: Teach the students in related 061 LOs to use 1:60 rule for estimation of headings.

1 NM of cross track error for every 60 NM along the track = 1-degree track error angle

$$\frac{NM\ of\ track\ x\ 60}{NM\ flown} = track\ error\ in\ degrees$$

$$\frac{NM \ of \ track \ x \ 60}{NM \ to \ go} = correction \ angle \ in \ degrees$$

100 04 00 11

Estimate headwind and crosswind components given wind speed and direction and runway in use.

032: Teach the students in related 032 LOs to estimate headwind and crosswind components given wind and runway in use. Repeat the sine and cosine goniometric functions for basic angles (see Table 3).

Head/tailwind = cos(wind angle) x wind speed

Crosswind = sin(wind angle) x wind speed

Table 3 - Goniometric functions for basic angles

	Left/Right crosswind	Head/Tailwind
x	sin x	cos x
0°	0	1
30°	0,5	0,87
60°	0,87	0,5
90°	1	0

5.4.2 ASSESSMENTS

ATO shall ensure that there are at least two summative assessments and at least one formative assessment which cover learning objectives in topics 100 02 and 100 03 of Area 100 KSA. Results of summative assessments shall be logged in student's training records and all assessments shall be debriefed with the instructor. [5]

In following chapters I am proposing how the assessments can look like and where approximately in the training plan should be completed. I don't propose the exact position because every ATO can have different syllabus of theoretical training.

Based on GM1 ORA.ATO.230(a) the assessment can have various style:

„ASSESSMENT OF STUDENTS IN AREA 100 KSA

(a) The Area 100 KSA formative assessment(s) and summative assessments may include but not be limited to: written planning exercises combining multiple subjects; practical exercises using training devices (if available); scenario-based oral board (viva voce); scenario-based

communications exercises; written assignments or project work; and preparation and delivery of group or individual presentations.

(b) The format of formative and summative assessment debriefs should be effective, highlighting the student's strengths and weaknesses and enabling future improvement." [5]

The verbs „demonstrate" and „show" used in descriptions of learning objectives of Area 100 KSA have following meaning, which must be correctly understood by the assessor performing the assessments: [4]

- „Demonstrate" means the selection and use of the appropriate knowledge, skills and attitudes within a strategy to achieve an effective outcome. It signifies a high taxonomy level and would normally be assessed using multiple indicators from more than one core competency. [4]
- „Show" means the attainment of knowledge, skill or attitude. It signifies a lower taxonomy level than „demonstrate" and would normally be assessed by a single indicator. [4]

Distance course

EASA allows to ATOs in AMC1 ORA.ATO.300:

"Where an assessment (e.g. planning, written, scenario or practical exercise, or other assessment) is conducted outside the classroom via distance learning, the ATO should have a procedure or process in place to establish that the student themselves have completed the assessment and that the assessment method(s) for that particular exercise has (have) been effective." [5]

But I would recommend to do the assessments and mental maths test during personal visit of student at ATO. For example, together with attendance at consultations with lector. Even if the flight school has all consultations through distance learning, then these assessments and test should be made personally. It's generally not a good idea to learn future professional pilots only through „Skype". We need to focus on competencies of students, their cooperation, presentation, etc. and technical issues related to performance of the assessment through teleconference tools and non-personal contact itself cannot ensure a quality assessment of the relevant competencies. And as a result, it will not completely meet the goal we expect from concept of Area 100 KSA.

5.4.2.1 FORMATIVE ASSESSMENT

Formative assessment should cover most of the learning objectives in 100 02 and 100 03 of Area 100 KSA, in which student has the opportunity to ask questions and develop competencies: [5]

- should be conducted during the training
    - o may be conducted as formative evaluation (continuous assessment) over a specified phase of the course
- should be conducted by instructor who is trained to deliver the formative assessment
- at least 1 per training

As described in ED Decision, formative assessment doesn't count to final student's competencies assessment, but serves as the preparation for summative assessments which are logged to student's training records. [5]

As mentioned above, the formative assessment doesn't need to cover all learning objectives of 100 02 and 100 03 of Area 100 KSA, but only most of them.

When:

- after full completion of subjects: Initial ATP
- completion of all 100 KSA learning objectives in other subjects, like 040, is not necessary for this assessment
- within subject 021, 022 or 050
- before summative assessments

Supporting aids: PC, internet, ATP(A) books, ATO learning materials (only in English)

Content and duration: presentation in group of 3-4 students focus on topic which was covered in the subject 021, 022 or 050

Introduction (0:05) – observe students with focus on following and evaluate in matrix below

1. Explain to students that they will work in groups to prepare presentation on topic from that subject
2. Let students to make groups of 3-4 people
3. Let each group to select the leader
4. Let each group to select the topic from the list (propose three topics to each group – each 3 different)
5. Tell students that style of presentation is up to them (PowerPoint, speech, using table, …)

6. Tell students that every of them shall speak for exactly 5 minutes and they need to cover whole topic together

7. Tell students that every of them must prepare 3 questions for other listening students related to their topic

8. Tell students that they can use only learning materials in English (books, PC, internet)

9. Tell students that they have 1 hour for preparation

10. Ask students if they have any questions/concerns (100 02 02 06)

Preparation of presentation by students (1:00) – observe students with focus on following and evaluate in matrix below

11. Students made plan how to complete the tasks within time limit with appropriate priorities (100 02 02 09, 100 02 05 02)

12. Students resolved conflicts and disagreements in a constructive manner during their cooperation (100 02 02 10)

13. Students created an open communication atmosphere – all of them are involved to solving the issue and take into account non-verbal communication (100 02 02 01, 100 02 01 09)

14. In the group there is a leader who is initiative and gives directions to others (100 02 02 02)

15. Student helps others if necessary (100 02 02 04)

16. Student carries out directions given by lector (100 02 02 05)

17. Student cooperates with others, stronger helps to weaker, distribution of topics is fair (100 02 02 08, 100 02 05 04)

18. Student projects and maintains self-control during fulfilment the task (100 02 02 11, 100 02 05 01)

19. Students fulfil the tasks as planned in group (100 02 05 03)

20. Turn on music loud during the self-preparation of students, observe their behaviour (100 02 05 05)

After 1 hour of preparation allow students to present their topics, group by group.

Presentation (each group: number of students x 5 min) – observe students with focus on the following and evaluate in matrix below

21. Student makes sure that the others are ready to listen before starting the presentation (100 02 01 01)

22. Student selected content and style of presentation appropriate to the type of recipients – students of ATP(A) theory (100 02 01 02)

23. Student presents clearly, accurately and concisely and according to supportive English materials (100 02 01 03, 100 02 01 08, 100 02 01 10)

24. At the end of presentation, student asks the others for questions related to the topic to confirm that recipients understood the presentation (100 02 01 04, 100 02 01 06)

Debriefing (each group: number of students x 30 sec) – observe students when giving feedback to each other (first to second, second to third, third to first)

25. Student gives constructive feedback (100 02 02 07)
    o TKI can add feedback from his/her side

26. Student receives the feedback and comments on it (100 02 01 05, 100 02 02 03, 100 02 02 07)

Assessor: TKI of 021, 022 or 050 (based on within which subject the FA will take place) with instructor's training for Area 100 KSA

- if more than 1 group of students at one time then assistants would be needed to monitor other groups during preparation

Evaluation: Evaluate each LO mentioned in the matrix below as YES or NO based on if student shows/demonstrates or doesn't show/demonstrate the particular LO based on behavioural indicators mentioned above. Then follow procedures in chapter 5.4.2.3.

Matrix of performance indicators for competencies evaluation (Table 4):

Table 4 - Matrix of performance indicators for competencies evaluation for FA [3] [5]

Syllabus reference	Syllabus text	Evaluation (Y/N)
100 02 00 00	CORE COMPETENCIES LEARNING OBJECTIVES	
100 02 01 00	Communication Student demonstrates effective oral, non-verbal and written communication skills in classroom exercise and assessment situations.	min 4x Y
100 02 01 01	Show the ability to identify whether the recipient is ready and able to receive the information.	
100 02 01 02	Show the ability to appropriately select what, when, how and with whom to communicate.	
100 02 01 03	Show the ability to communicate clearly, accurately and concisely.	
100 02 01 04	Show the ability to confirm whether the recipient correctly understands important information.	
100 02 01 05	Show the ability to listen actively and show you understand the information you receive.	
100 02 01 06	Show the ability to ask relevant and effective questions.	
100 02 01 07	Show the ability to adhere to standard radio-telephony phraseology.	N/A
100 02 01 08	Show the ability to accurately read, interpret, construct and respond to given documentation in English.	
100 02 01 09	Show the ability to correctly interpret non-verbal communication.	
100 02 01 10	Show the ability to use appropriate eye contact, body movement and gestures that are consistent with and support verbal messages.	
100 02 02 00	Leadership and teamwork Student displays effective leadership and teamwork.	min 4x Y
100 02 02 01	Show the ability to create an atmosphere of open communication that encourages participation.	
100 02 02 02	Show the initiative and the ability to give directions when required.	
100 02 02 03	Show the ability to admit mistakes and take responsibility.	
100 02 02 04	Show the ability to anticipate and respond appropriately to others' needs.	
100 02 02 05	Show the ability to carry out instructions when directed.	
100 02 02 06	Show the ability to communicate relevant concerns and intentions.	
100 02 02 07	Show the ability to give and receive feedback constructively.	
100 02 02 08	Show empathy, respect and tolerance for others.	
100 02 02 09	Show the ability to engage others in planning and to allocate activities fairly and appropriately according to others' abilities.	
100 02 02 10	Show the ability to address and resolve conflicts and disagreement in a constructive manner.	
100 02 02 11	Show the ability to project self-control.	
100 02 05 00	Workload management Student manages available resources or time to efficiently prioritise and complete or perform tasks in a timely manner.	min 2x Y
100 02 05 01	Show the ability to maintain self-control.	
100 02 05 02	Show the ability to plan, prioritise and schedule tasks effectively.	
100 02 05 03	Show the ability to manage time effectively when carrying out tasks.	
100 02 05 04	Show the ability to offer and accept assistance, delegate when necessary and ask for help early.	
100 02 05 05	Show the ability to manage interruptions, distractions, variations and failures effectively.	

Debriefing (at least 15 minutes): Debrief with the student his/her performance during the whole exercise. Highlight strengths and weaknesses. Focus on performance indicators (LOs), which you marked as „NO" in the matrix and propose student how to improve.

In case of failure, there is no need to repeat the formative assessment, but make very deep debriefing with the student and plan additional lessons from KSA LOs before the next summative assessment will be done.

In case the student appeals against the result, the Head of Training performs an analysis of the evaluation and suggests further action - repetition of the assessment or confirms the TKI's evaluation.

The results just write down to student's training records, there is no need of special certificate in case of formative assessment.

5.4.2.2 SUMMATIVE ASSESSEMENTS

Summative assessments shall cover all of the learning objectives in 100 02 and 100 03 of Area 100 KSA, in which student has the opportunity to demonstrate competencies (each of two summative assessments can cover part of the LOs). [5]

Summative assessments should be completed before the student is recommended by the ATO to sit at final theoretical examination at CAA and the results should be included in the student's training records. As stated in the Annex II to ED Decision 2018/001/R: [5]

„(c) The summative assessments should:

…

(2) be satisfactorily completed before the student is recommended by the ATO for their first attempt to take the final theoretical knowledge examination paper, and the outcome of the assessments should be included in the student's training record;

…" [5]

As you can see in the chapter *5.4.1 KSA LEARNING OBJECTIVES*, learning objectives for Area 100 KSA are spread out in many of subjects in ATP(A) theory. It means, that summative assessment shall be done after all parts of these subjects, in which KSA is mentioned, are completed. Then ATO should send the student for final theoretical knowledge examination.

In some flight schools across the Europe, students are passing the final examination at CAA already during their studies, for example after the first 4 finished subjects are completed. If the ATO wants to keep this procedure, KSA parts, assessments and mental maths test shall be completed in the first half of the course. Otherwise, 100 KSA can be completed in the end of the whole theory course and then student can start the examination process at CAA.

But because this requirement is mentioned as "should", ATO can prepare their own Alternate Means of Compliance without this requirement and submit them to EASA through local CAA. Safety and risk assessment of new proposed AltMoC together with compliance statement with base regulation shall be provided. After that, EASA can approve another "Means of Compliance" and the ATO can use it.

Summative assessment shall be conducted by instructor who is trained to deliver the summative assessment. [5]

As described in Decision, I propose two summative assessments in following chapters.

5.4.2.2.1 SUMMATIVE ASSESSMENT 1

The first summative assessment is focused on Leadership and teamwork competence carried out as group exercise. For more detailed debriefing and as a proof of student's behaviour it is possible to make video recording. Proof is very helpful in case of students who haven't got the ability to admit mistakes and receive feedback yet.

When:

- after full completion of Initial ATP, 033, 040 subjects' lessons where 100 02 02 00 is covered
- after full completion of Formative assessment
- completion of all 100 KSA learning objectives in other subjects is not necessary for this assessment, will be assessed in the second summative assessment
- before Summative assessment 2

Supporting aids: pen

Content and duration: exercise in group of 3-4 students

This exercise is focused on Leadership and teamwork, competence required for summative assessment, and with highlight of difference between ability of individual and team to show student how crew of airliner works. 1+1=3, the sum of "simple" capacities/potentials of individual pilots is LESS than the final potential of the team - for flying multi-crew a KEY issue. Highlight during debriefing. This type of exercise is used usually during screening when hiring new pilots to commercial air transport companies.

I'm proposing to use the exercise from NASA, see instructions below. Prepared on three separate pages to easy print out for students. The whole NASA exercise is used from https://uaf.edu/museum/files/education/community-outreach/Survival-on-the-Moon.pdf with modifications. Explain the exercise to students according to instructions on the first page. [14]

Individual work: give them time limit 15 minutes

Group work: first, tell students, there is no time limit for group solution. But after 5 minutes, give them time limit 10 minutes.

NASA Exercise

«LANDING ON THE MOON»

SITUATION:

Your spaceship module has made a forced landing on the Moon. The module is completely unserviceable. Position of your mother base is 400 km far away on the sunny side of the Moon.

The task of your group is to march back to your base using very limited equipment. Most of your equipment had been damaged as a result of hard landing out of 15 things listed below.

Your crew will survive and will be successful if you manage to take the most important things which you need to stay alive and to overcome 400 km march.

You have to **order** the following things **according to their importance and necessity** to survive on the Moon. (The most important thing mark as No 1, the second No 2 etc. up to No 15).

METHOD OF OPERATION:

At first work on your own and write down your solution (Table 5).

Then cooperate and discuss it in your group and write down your group result (Table 5).

Table 5 - List of stuff/items for NASA exercise

STUFF/ITEM	YOUR SOLUTION	GROUP SOLUTION
Small Box of Matches		
Dry Food		
15 m nylon parachute cord		
Parachute canopy		
Mobile solar heating		
2 guns 11,43 mm		
Box of Dry Milk		
2 oxygen bottles 50 kg		
Map of the Moon		
Self-inflatable rescue dinghy (raft)		
Magnetic compass		
20 litres of drinking water		
Signal Rockets		
First Aid Kit (including needles)		
FM transmitter with solar battery		

SCORE in Table 6:

Table 6 - Score evaluation for NASA exercise

STUFF/ITEM	A NASA solution	B Your solution	C Deviation /A-B/	D Group solution	E Deviation /A-D/
Small Box of Matches	15				
Dry Food	4				
15 m nylon parachute cord	6				
Parachute canopy	8				
Mobile solar heating	13				
2 guns 11,43 mm	11				
Box of Dry Milk	12				
2 oxygen bottles 50 kg	1				
Map of the Moon	3				
Self-inflatable rescue dinghy (raft)	9				
Magnetic compass	14				
20 litres of drinking water	2				
Signal Rockets	10				
First Aid Kit (including needles)	7				
FM transmitter with solar battery	5				
		SUM:		SUM:	

1. Count sum of your own deviations (difference btw your priority and NASA priority – make it in absolute value).

2. The same make for a group result.

3. Make a list of the best results.

   - BEST result = SMALLEST sum C
   - The same for the groups – SUM of E

SCALE:

SUM			NASA EVALUATION
0	-	5	EXCELLENT
6	-	32	GOOD
33	-	45	AVERAGE
46	-	55	WEEK
56	-	70	VERY WEAK
71	-	112	VERY VERY WEAK – Why are you here???

NASA SOLUTION/EXPLANATION in Table 7:

Table 7 - NASA solution/explanation for NASA exercise

STUFF/ITEM	PRIORITY	EXPLANATION
Small Box of Matches	15	There is no oxygen on the moon to make a fire. You do not need them at all.
Dry Food	4	It is a real source of energy.
15 m nylon parachute cord	6	It is useful to overcome the terrain and carry the wounded.
Parachute canopy	8	It protects you from sun radiation.
Mobile solar heating	13	If you are on unlit side of the Moon you do not need that.
2 guns 11,43 mm	11	It is a device to calm down and to solve a conflict in your group.
Box of Dry Milk	12	Very large item to carry with.
2 oxygen bottles 50 kg	1	The most important thing to survive.
Map of the Moon	3	Essential thing for navigation.
Self-inflatable rescue dinghy (raft)	9	We need the bottle with compressed CO_2 and use it as a source of reactive thrust.
Magnetic compass	14	There is not polarized magnetic field on the Moon. You do not need that.
20 litres of drinking water	2	Necessary (compensation for the loss of water on the lit side of the Moon)
Signal Rockets	10	Signal to mother ship.
First Aid Kit (including needles)	7	You can use the needles when necessary for first aid using the vents in special NASA spacesuit.
FM transmitter with solar battery	5	For connection with your mother spaceship.

During the exercise observe the followings in group work:

1. Each student gives opportunity to others to communicate the solution (100 02 02 01)
2. Naturally there will be 1 or 2 leaders (100 02 02 02), passive members and those who try to damage the group outcome
3. Other students follow the instructions (100 02 02 05)
4. Student admits his/her mistake when changing his/her opinion to priorities of Moon items (100 02 02 03)
5. Student communicates relevant concerns and intentions while creating common solution and anticipates and responds appropriately to others' needs for Moon items (100 02 02 04, 100 02 02 06)
6. After the time limit is given, students show the ability to engage others in planning and to allocate activities fairly and appropriately according to others' abilities (100 02 02 09)
7. Students resolved the conflicts and disagreement in a constructive manner during their cooperation (100 02 02 10)
8. Student projected self-control for this exercise (100 02 02 11)

Assessor: TKI with instructor's training for Area 100 KSA

- if more than 1 group of students at one time, then assistants would be needed to monitor other groups during preparation

Evaluation: Evaluate each LO mentioned in the matrix below as YES or NO based on if student shows/demonstrates or doesn't show/demonstrate the particular LO based on behavioural indicators mentioned above. Then follow procedures in chapter 5.4.2.3.

Result of individual and group exercise based on NASA evaluation scale use only as supportive tool during debriefing.

Matrix of performance indicators for competencies evaluation (Table 8):

Table 8 - Matrix of performance indicators for competencies evaluation for SA1 [3] [5]

Syllabus reference	Syllabus text	Evaluation (Y/N)
100 02 00 00	CORE COMPETENCIES LEARNING OBJECTIVES	
100 02 02 00	Leadership and teamwork Student displays effective leadership and teamwork.	min 4x Y
100 02 02 01	Show the ability to create an atmosphere of open communication that encourages participation.	
100 02 02 02	Show the initiative and the ability to give directions when required.	
100 02 02 03	Show the ability to admit mistakes and take responsibility.	
100 02 02 04	Show the ability to anticipate and respond appropriately to others' needs.	
100 02 02 05	Show the ability to carry out instructions when directed.	
100 02 02 06	Show the ability to communicate relevant concerns and intentions.	
100 02 02 07	Show the ability to give and receive feedback constructively.	
100 02 02 08	Show empathy, respect and tolerance for others.	
100 02 02 09	Show the ability to engage others in planning and to allocate activities fairly and appropriately according to others' abilities.	
100 02 02 10	Show the ability to address and resolve conflicts and disagreement in a constructive manner.	
100 02 02 11	Show the ability to project self-control.	

Debriefing (at least 30 minutes): First, make debriefing with all students together, compare groups, highlight strengths and weaknesses of each group. Then discuss individually with each group and highlight synergy effect when they are working together compared to individual results. Ask students for their feedback on group work. Evaluate ability to give and receive feedback constructively but with empathy, respect and tolerance to others (100 02 02 07, 100 02 02 08).

Highlight team effect on improved Threat and Error Management of situation described in this exercise and how Crew Resource Management works.

In case of individual bad results, make individual debriefing with the student and go through his/her performance during whole exercise. Highlight strengths and weaknesses as well. Focus on performance indicators (LOs), which you marked as „NO" in matrix and give student propositions on how to improve.

In case of failure of student, whose performance at one or more competency is below satisfactory standard, make detailed debriefing and focus on weaknesses where student failed. Then report this student to CTKI, who will perform (or appoint TKI for that) additional lesson of soft skills to improve weaknesses and further develop the student's competencies. Minimum 1-hour duration based on range of failure. Then second attempt for summative assessment can be done but choose different types of colleagues for the student in group exercise. If student fails again, then CTKI together with TKIs should propose exclusion of student from training. In this step, Head of Training should be informed and make final decision about exclusion of student.

In case the student appeals against the result, the Head of Training performs an analysis of the evaluation and suggests further action - repetition of the assessment or confirms the TKI's evaluation.

Write down the results to student's training records, final completion certificate will be issued after second summative assessment.

5.4.2.2.2 SUMMATIVE ASSESSMENT 2

The second summative assessment is focused on all 100 KSA learning objectives (except Leadership and teamwork) and is divided into two connected exercises. For more detailed debriefing and as a proof of student's behaviour it is possible to make video recording. Proof is very helpful in case of students who haven't got the ability to admit mistakes and receive feedback yet.

When:

- after full completion of subjects' lessons where 100 KSA LOs 100 02 00 00 and 100 03 00 00 are covered
- after full completion of Formative assessment and Summative assessment 1

<u>The first exercise – pre-flight preparation:</u>

Prepare in advance following documentation for the flight, where weather at destination will require to use 2 alternates. NOTAMs will indicate 1 of 2 runways closed at the destination. Weather on route predicts thunderstorms. Focus the flight on country where training is conducted.

enroute chart, airport charts, NOTAMs, AUP/UUP, METARs and TAFs for all airports in FIR, synoptics chart, weather radar pictures

Supporting aids: enroute chart, airport charts, NOTAMs, AUP/UUP, METARs and TAFs for all airports in FIR, synoptics chart, weather radar pictures, ICAO FPL form, aircraft documentation, nav log, navigation equipment, pen

Content and duration: exercise in group of 3-4 students for 3 hours

This exercise is focused on Pre-flight preparation for IFR flight which students will fly on simulator after that.

Give students instructions to make a pre-flight preparation for an IFR flight from airport A to airport B with 1 passenger + baggage, use a 4-seater aircraft which students are familiar with from practical training. Passenger wants to fly in 4 hours from now. Work in group of 3-4 students. Let the students use all supporting aids mentioned above.

Output of this exercise must be fully prepared:

- navigation log/operational flight plan (OFP)
- airport charts
- analysed meteorological information
- analysed NOTAMs
- required fuel on board
- computed performance and weight & balance
- flight plan ready to file
- performed threat and error management

Highlight that in the beginning of the exercise you want to see how students will discuss the distribution and plan of work. After 2 hours tell students, that the passenger is busy and wants to fly 1 hour earlier.

During the preparation switch on music, start to ask students about their future plans for summer, or disturb them in different way.

During the exercise observe the followings in group work:

1. Student is involved in decisions and set priorities to fulfil this task (100 02 03 06)
2. Observe the communication during the work in complex (100 02 01 01, 100 02 01 02, 100 02 01 03, 100 02 01 04, 100 02 01 05, 100 02 01 06, 100 02 01 09, 100 02 01 10)
3. Student uses and understand the documentation provided for pre-flight preparation (100 02 01 08, 100 02 03 01)
4. Student correctly evaluates all information which can influence safety of flight with respect to threat and error management (100 02 04 01, 100 02 04 02, 100 02 04 03, 100 02 03 09)
5. Student demonstrated the ability to complete pre-flight planning (100 03 01 01)
6. Student manages interruptions, distractions, variations and failures effectively (100 02 05 05)

The second exercise – flight on simulator:

Tell students that each of them will fly the prepared flight on a simulator. But passenger changed his decision and first flight will be after four hours (use this time for review of observed behavioural indicators from pre-flight preparation exercise).

Supporting aids: navigation preparation from previous exercise

Content and duration: flight along the route as planned in previous exercise for 1 hour, each student individually

Highlight that handling and operation of the simulator is not evaluated in this exercise (it can be for the first time, students see the simulator, or they can be in different level of practical experience based on ATO syllabus) – help student with handling and operation of the simulator based on request (100 02 05 04). Require from student standard radio-telephony phraseology.

During the flight provide new ATIS with METAR from destination indicating that weather is below minimums. Observe, if student identifies what and why have gone wrong, how to solve it using problem-solving strategy, evaluates options and makes decisions on time with corrections if needed (100 03 01 02, 100 02 03 02, 100 02 03 03, 100 02 03 05, 100 02 03 07, 100 02 03 08).

During the enroute flight put the simulator close to upsets and directly to upset positions and wait for student's reaction – oral answer is enough, handing not needed (100 02 04 02, 100 02 04 03, 100 03 02 01, 100 03 02 02). Then ask for explanation of upsets (100 03 02 03).

During preparation for landing at alternate airport, observe student how he/she is fulfilling all tasks related to final phase of flight. Ask student (as passenger) for some catering during approach. (100 02 05 02, 100 02 05 03)

In the end of flight ask student for stress and fatigue during the flight and discuss (100 03 02 05).

During whole exercise (Figure 22) observe the followings:

1. Student demonstrates resilience and managing self-control during the exercise (100 03 02 04, 100 02 05 01)
2. Student adheres to standard radio-telephony phraseology (100 02 01 07)
3. Student perseveres in working through problems (100 02 03 04)

Figure 22 - Student flying simulator FNPT II [35]

Assessor: TKI of 033 with instructor's training for Area 100 KSA, CTKI and psychologist (if available)

- if more than 1 group of students at one time then assistants would be needed to monitor other groups during preparation

Evaluation: Evaluate each LO mentioned in the matrix below as YES or NO based on if student shows/demonstrates or doesn't show/demonstrate the particular LO based on behavioural indicators mentioned above. Then follow procedures in chapter 5.4.2.3.

Matrix of performance indicators for competencies evaluation (Table 9):

Table 9 - Matrix of performance indicators for competencies evaluation for SA2 [3] [5]

Syllabus reference	Syllabus text	Evaluation (Y/N)
100 02 00 00	CORE COMPETENCIES LEARNING OBJECTIVES	
100 02 01 00	Communication Student demonstrates effective oral, non-verbal and written communication skills in classroom exercise and assessment situations.	min 4x Y
100 02 01 01	Show the ability to identify whether the recipient is ready and able to receive the information.	
100 02 01 02	Show the ability to appropriately select what, when, how and with whom to communicate.	
100 02 01 03	Show the ability to communicate clearly, accurately and concisely.	
100 02 01 04	Show the ability to confirm whether the recipient correctly understands important information.	
100 02 01 05	Show the ability to listen actively and show you understand the information you receive.	
100 02 01 06	Show the ability to ask relevant and effective questions.	
100 02 01 07	Show the ability to adhere to standard radio-telephony phraseology.	
100 02 01 08	Show the ability to accurately read, interpret, construct and respond to given documentation in English.	
100 02 01 09	Show the ability to correctly interpret non-verbal communication.	
100 02 01 10	Show the ability to use appropriate eye contact, body movement and gestures that are consistent with and support verbal messages.	
100 02 02 00	Leadership and teamwork Student displays effective leadership and teamwork.	SA1
100 02 02 01	Show the ability to create an atmosphere of open communication that encourages participation.	SA1
100 02 02 02	Show the initiative and the ability to give directions when required.	SA1
100 02 02 03	Show the ability to admit mistakes and take responsibility.	SA1
100 02 02 04	Show the ability to anticipate and respond appropriately to others' needs.	SA1
100 02 02 05	Show the ability to carry out instructions when directed.	SA1
100 02 02 06	Show the ability to communicate relevant concerns and intentions.	SA1
100 02 02 07	Show the ability to give and receive feedback constructively.	SA1
100 02 02 08	Show empathy, respect and tolerance for others.	SA1
100 02 02 09	Show the ability to engage others in planning and to allocate activities fairly and appropriately according to others' abilities.	SA1
100 02 02 10	Show the ability to address and resolve conflicts and disagreement in a constructive manner.	SA1
100 02 02 11	Show the ability to project self-control.	SA1
100 02 03 00	Problem-solving and decision-making Student accurately identifies risks and resolves problems. Student uses the appropriate decision-making processes.	min 4x Y
100 02 03 01	Show the ability to seek accurate and adequate information from appropriate sources.	
100 02 03 02	Show the ability to identify and verify what and why things have gone wrong.	
100 02 03 03	Show the ability to employ proper problem-solving strategies.	
100 02 03 04	Show the ability to persevere in working through problems.	
100 02 03 05	Show the ability to use appropriate and timely decision-making processes.	

100 02 03 06	Show the ability to set priorities appropriately.	
100 02 03 07	Show the ability to identify and consider options effectively.	
100 02 03 08	Show the ability to monitor, review and adapt decisions as required.	
100 02 03 09	Show the ability to identify and manage risks.	
100 02 04 00	Situation awareness Student perceives and comprehends all the relevant information available, anticipates what could happen that could affect the exercise or situations discussed in the classroom, and gives effective solutions to resolve the situation.	min 2x Y
100 02 04 01	Demonstrate the ability to identify and assess accurately the general environment as it may affect the operation.	
100 02 04 02	Demonstrate the ability to identify threats, errors and undesirable aircraft states.	
100 02 04 03	Demonstrate the ability to manage threats, errors and undesirable aircraft states.	
100 02 05 00	Workload management Student manages available resources or time to efficiently prioritise and complete or perform tasks in a timely manner.	min 2x Y
100 02 05 01	Show the ability to maintain self-control.	
100 02 05 02	Show the ability to plan, prioritise and schedule tasks effectively.	
100 02 05 03	Show the ability to manage time effectively when carrying out tasks.	
100 02 05 04	Show the ability to offer and accept assistance, delegate when necessary and ask for help early.	
100 02 05 05	Show the ability to manage interruptions, distractions, variations and failures effectively.	
100 03 00 00	ADDITIONAL THREAT AND ERROR MANAGEMENT (TEM) RELATED LEARNING OBJECTIVES	
100 03 01 00 100 03 02 00	Application of knowledge, Upset prevention and recovery training (UPRT) and resilience Student demonstrates correct and deep understanding of the subject(s) and is able to effectively relate this knowledge between subjects and apply the knowledge for effective threat and error management (TEM).	min 3x Y
100 03 01 01	Demonstrate the ability to complete pre-flight planning in practical exercises.	
100 03 01 02	Demonstrate the KSA and TEM relating to phases of flight in the ground training environment.	
100 03 02 01	Recognise potential upset 'threats' and suggest effective 'threat management' in scenario situations.	
100 03 02 02	Recognise potential upset 'errors' and suggest effective 'error management' in scenario situations.	
100 03 02 03	Explain the causes of and contributing factors to upsets.	
100 03 02 04	Demonstrate resilience during scenario and/or other exercises.	
100 03 02 05	Show the ability to identify the signs and discuss the effects of stress, fatigue and aviation lifestyle on situation awareness, and how to cope with them in order to maintain situation awareness.	

Debriefing (at least 30 minutes): First, let student to make self-evaluation of both exercises from his/her point of view. Then provide feedback from your side. Go through his/her performance during the whole exercise. Highlight strengths and weaknesses. Focus on performance indicators (LOs), which you marked as „NO" in the matrix and give students propositions on how to improve.

In case of failure of student whose performance at one or more competency is below satisfactory standard, make detailed debriefing and focus on weaknesses where student failed. Then CTKI will perform (or appoint TKI for that) additional lesson of soft skills to improve weaknesses and further develop the student's competencies. Minimum 1-hour duration based on range of failure. Then, the second attempt for summative assessment can be done, give the student scenario for the different flight (different airports, different weather, …) in the different group of students. If student fails again, then CTKI together with TKIs should propose

exclusion of student from training. In this step, Head of Training should be informed and make final decision about exclusion of student.

In case the student appeals against the result, the Head of Training performs an analysis of the evaluation and suggests further action - repetition of the assessment or confirms the TKI's evaluation.

Write down the results to student's training records and together with results from summative assessment 1 and Mental Maths Test to Certificate of completion of 100 KSA.

5.4.2.3 COMPETENCIES EVALUATION

Assessor shall count how many of performance indicators (LOs) the student showed/demonstrated in each competency related to assessment (see matrix).

Student to be considered as achieved a „Satisfactory" standard, shall: [5]

- meet at least 35 % (which defines the term „some" used in the word pictures) of the indicators relevant to the assessment exercise, in each competency [5]
- have an overall positive effect on the outcome or completion of the exercise without any external input from the instructor, or where the assessment requires the instructor to facilitate the exercise, without the instructor providing any knowledge or corrective input to assist in the completion of the exercise [5]

To assign the achieved competency level follow guidance in Table 10 and description below.

Table 10 - Competencies levels and related word pictures [5]

Competency	General description of each competency level. To be applied to each individual competency in LOs 100 02 and 100 03 of Area 100 KSA.
Level 1 Unsatisfactory	The student's performance in this competency was ineffective or inadequate, which in relation to this competency had a neutral or negative effect on others or on the outcome of the exercise. The student showed none or few of the relevant performance indicators in this competency.
Level 2 Satisfactory	The student's performance in this competency was satisfactory, which had a slightly positive effect on the satisfactory outcome of the exercise, and in group situations had a slightly positive effect on others. The student showed at least some* of the relevant performance indicators in this competency.
Level 3 Good	The student's performance in this competency was effective, which in the case of an exercise where the student is the only participant, significantly contributed to a good outcome. In group situations, the student's contribution had a good effect on others and significantly contributed to the overall outcome of the exercise. The student showed most of the relevant performance indicators to a good standard.
Level 4 Very good	The student's performance in this competency was highly effective, which in the case of an exercise where the student is the only participant, significantly enhanced the very good outcome. In group situations, the student's contribution had a very good effect on others and significantly enhanced the overall outcome of the exercise. The student showed most or all of the relevant performance indicators to a very good standard.
Level 5 Excellent	The student's performance in this competency was exemplary, which in the case of an exercise where the student is the only participant, had an outstanding effect on the excellent outcome of the exercise. In group situations, the student's contribution had an excellent effect on others and had an outstanding effect on the overall outcome of the exercise. The student showed all of the relevant performance indicators to an excellent standard.
* 'Some' is defined as showing at least 35 % of the performance indicators in that competency, which were relevant to that exercise.	

EASA calls the descriptions of the competencies levels as "Word pictures", which create the picture of the student's behaviour and describe the student's performance. Word pictures enable the standardisation of the assessment performance and facilitate inter-rater reliability within an ATO. [5]

The most commonly used word pictures are shown in the Table 10. They are based on performance indicators, which explain what the student should demonstrate in order to attain the specific Area 100 KSA LOs that are addressed by the assessment exercise. Word pictures are formed of elements that contain the following: [5]

1. HOW MANY of the performance indicators in the table relevant to that assessment were observed in that competency

2. HOW WELL the competency was demonstrated in the assessment exercise to have an overall positive effect on the outcome or completion of the assessment exercise

3. The level of success in the OUTCOME of the assessment exercise

The word pictures provide meaningful and standard data to enable identification of individual, crew, class, instructor and ATO trends, which can be analysed in order to provide feedback for further improvement and development according to ISD methodology. [5]

An ATO can establish its own set of word picture descriptions specific for each competency with more detailed descriptions, word pictures, similar to the "Communication" and "Application of knowledge, UPRT and resilience" word pictures examples in Annex II to Decision 2018/001/R. [5]

5.4.2.4 MENTAL MATHS TEST

Mental maths test must cover all learning objectives in area 100 04 00 00 Mental maths with at least 2 questions per each LO. Student must pass at least 1 test per training with minimum pass rate 75 %. [5]

Mental maths test would be the best to make as oral examination to be closer as possible to real situation in flight. At flight deck pilot has to solve the tasks at real time, there is no space to select the easiest one and then more difficult one, like during a written test.

Examiner gives to student the questions orally or written, it can be accompanied by picture or graphic.

When: after full completion of subjects' lessons where 100 KSA LOs 100 04 00 00 are covered

Duration: 1:00 (approx. 2-3 minutes per question)

Content: 22 oral questions, for each LO 100 04 two questions

Supporting aids: NIL (calculator and mathematical tables are not allowed)

Assessor: TKI of 061 or 033 with instructor's training for Area 100 KSA

In the following chapter, I propose set questions to cover Maths test requirements.

5.4.2.4.1 MENTAL MATHS TEST QUESTIONS

100 04 00 01

Convert between volumes and masses of fuel using range of units.

1. Convert 80 litres of AVGAS to kilograms.

   (answer: approx. 60 kgs is acceptable … 0,72 x 80 = 56,7)

2. How many kilograms of fuel you have refuelled if handling tells you have 10000 litres of JET A1?

   (answer: approx. 8000 kgs is acceptable … 0,8 x 10000 = 8000)

3. How many US gallons of AVGAS you can refuel if you have still available 20 kg up to MTOW and fuel tank is not limit?

   (answer: approx. 7 US gallons is acceptable … 20/0,72/3,785 = 7,3)

4. Read the remaining fuel at MFD (Figure 23). How much JET A1 in litres you need to refuel to have 4000 lbs on board in total?

Figure 23 - MFD screen for 100 04 00 01 question 4 [source: author]

(answer: approx. 1300 litres is acceptable … (4000 - 840 - 940 - 5)/1,72 = 1258 litres)

100 04 00 02

Estimate time, distance and speed.

1. You are flying by TAS 90 kts, headwind 10 kts. How long it will take to reach destination which is 60 NM away?

   (answer: 45 minutes … 60/(90-10) = 0,75)

2. You have available 40 litres of fuel with fuel consumption 20 litres per hour. How far you can fly when your ground speed is 100 kts?

   (answer: 200 NM … 40/20 x 100 = 200)

3. How many nautical miles you will reach within 10 minutes, if you fly TAS 105 kts with tailwind 15 kts?

   (answer: 20 NM … (105+15) x (1/6) = 20)

4. You are requested to report time over next waypoint. Actual time is 09:36, ground speed 348 kts and distance to next waypoint is 116 NM. What is estimated time over next waypoint?

    (answer: 09:56 … 116/348 = 20 min)

100 04 00 03

Estimate the rate of climb or rate of descent, distance and time

1. You are flying in altitude 7000 ft, procedure altitude at your destination is 2500 ft. How far from the FAF you need to start descending if you want to maintain 500 ft/min rate of descent, you need 4 nautical miles for deceleration before FAF and your ground speed during descent will be 120 kts?

    (answer: 22 NM … (7000-2500)/500 x 120 + 4 = 22)

2. You are departing from airport and the SID requires a minimum climb gradient of 10 %. What is the minimum rate of climb if ground speed is 150 kts?

    (answer: 1500 ft/min … 10 x 150 = 1500)

3. After departure your rate of climb is 5000 ft/min. When you will reach FL150? Take into account that departure aerodrome is at sea level and QNH is 1013.

    (answer: 3 min … 15000/5000 = 3)

4. Report your rate of climb in m/s if you read at variometer 4000 ft/min.

    (answer: 20 m/s … 4000/200 = 20)

100 04 00 04

Add or subtract time, distance, and fuel mass

1. How much AVGAS in kilograms you need for 100 NM when your speed is 150 kts and fuel consumption is 30 litres per hour?

    (answer: approx. 15 kgs is acceptable … (100/150) x 30 x 0,72 = 14,4)

2. You have 150 NM ahead of you, after 1 hour you pass 200 km, what is the remaining distance in NM?

    (answer: below 50 NM is acceptable … 150 - (200/1,852) = 42 NM)

3. Your block-off time is 16:32LT, take-off time 12:45Z, total block time is 1:27, taxiing in destination took 4 minutes. What is the landing time in UTC? Take into account that taxiing at departure airport wasn't longer than 15 minutes.

    (answer: 13:55Z … 16:32 - 4:00 + 1:27 - 0:04 = 13:55)

4. You read at FMS that 1550 lbs of fuel were used and fuel indicators show 2130 lbs on board. If you had block fuel 3740 lbs, how much fuel is missing?
   (answer: 60 lbs … 3740 - 1550 - 2130 = 60)

100 04 00 05

Calculate fuel burn given time and fuel flow

1. For how long flight you have available fuel if currently 30000 kg of fuel are on board including final reserve and alternate fuel in total 10 tons. Fuel consumption is 2500 kg per hour.
   (answer: 8 hours … (30000 - 10000)/2500 = 8)
2. What would be your final reserve fuel for 45 minutes if fuel consumption is 45 l per hour?
   (answer: approx. 34 litres is acceptable … 0,75 x 45 = 33,75)
3. You have 4000 lbs of fuel on board, fuel consumption is 700 lbs per hour, what will be fuel on board in 15 minutes?
   (answer: 3825 lbs … 4000 - (700 x 0,25) = 3825)
4. How much fuel you will save if the flight was shortened by 10 minutes? Fuel consumption is 80 litres per hour.
   (answer: approx. 13 litres is acceptable … (80/60) x 10 = 13,3)

100 04 00 06

Calculate the time available (for decision-making) given relevant fuel information

1. How much time you can fly with 50 litres on board? Take into account 45 minutes final reserve and fuel consumption 20 litres per hour.
   (answer: 1 h 45 min … (50/20) - 0,75 = 1,75)
2. During flight you have currently 7500 kg of fuel on board. 5000 kg is final reserve and alternate fuel. Weather reports indicate low visibility around minima. How much extra time you have available for decision making when still 30 minutes to destination? Fuel consumption is 2000 kg per hour.
   (answer: 45 minutes … (7500-5000)/2000 - 0,5 = 0,75)
3. During flight you have currently 100 litres of fuel on board. 35 litres are final reserve and alternate fuel. Do you have available at least 30 minutes extra and contingency fuel, when still 1 hour to destination? Fuel consumption is 40 litres per hour.
   (answer: YES … (100-35)/40 - 1 = 0,625)

4. You made go around because runway wasn't in sight in minimums. How much time you have for decision-making in case of 200 lbs extra fuel with fuel consumption 1000 lbs per hour?

    (answer: 12 minutes … 200/1000 = 0,2)

100 04 00 07

Determine the top of descent using a simple method that is described by the approved training organisation (ATO).

1. Determine TOD when your ground speed during descent will be 150 kts and you need to descend 6500 ft. Take into account descent rate 500 ft/min.

    (answer: 32,5 NM … 6500/500 x 150 = 32,5)

2. Determine TOD for 3 degrees descent from current flight level indicated at PFD (Figure 24) if destination airport is 3000 ft AMSL, take into consideration 10 NM for deceleration.

Figure 24 - PFD screen for 100 04 00 07 question 2 [source: author]

(answer: 124 NM … (41000-3000)/1000 x 3 + 10 = 124)

3. Determine TOD for 3 degrees descent from FL350 to airport 1500 ft AMSL, QNH 1003, zero wind.

    (answer: approx. 100 NM is acceptable … (35000-(10hPa x 30) – 1500)/1000 x 3 = 99,6)

4. Determine TOD when your TAS during descent is 150 kts and headwind 30 kts and you need to descend 4000 ft. Take into account descent rate 500 ft/min.

    (answer: 16 NM … 4000/500 x (150-30) = 16)

100 04 00 08

Determine the values that vary by a percentage, e.g. dry-to-wet landing distance and fuel burn.

1. You change the cruise setting from long-range to high speed. Fuel burn increase by 5%. Long-range fuel consumption is 950 lbs per hour. What is new fuel consumption?
    (answer: approx. 997 lbs per hour is acceptable … 950 x 1,05 = 997,5)

2. You have calculated landing distance for dry runway to 400 metres. After rain the runway is wet and landing distance shall be increased by 15 %. What is the new landing distance?
    (answer: 460 metres … 400 x 1,15 = 460)

3. You have calculated 500 metres as take-off distance for dry runway with zero wind. Increase the distance by 30 % for wet grass and by 10 % for 10°C increase of temperature.
    (answer: 715 metres … 500 x 1,3 x 1,1 = 715)

4. Due to tailwind on route, the total fuel burn is decreased by 5 %. What would be the final trip fuel burnt if original calculated was 2430 lbs.
    (answer: approx. 2300 lbs is acceptable … 2430 x 0,95 = 2308,5)

100 04 00 09

Estimate heights at distances on a 3-degree glideslope.

1. What is approximate height above runway when you are on 9 nautical miles final on 3-degree glideslope?
    (answer: 2880 ft … 9 x 320 = 2880)

2. What is approximate height above runway when you are on 5 nautical miles final on 3-degree glideslope?
    (answer: 1600 ft … 5 x 320 = 1600)

3. What is approximate altitude when you are on 12 nautical miles final on 3-degree glideslope? Airport elevation is 1200 ft.
    (answer: 5040 ft … 12 x 320 + 1200 = 5040)

4. You are at 2800 ft AMSL on 7 miles final. What is the height difference from 3-degree glideslope? Airport elevation is 1000 ft.
    (answer: 440 ft below glideslope … (2800-1000) - (7 x 320) = - 440)

100 04 00 10

Estimate headings using the 1-in-60 rule.

1. You are 4 NM left parallel to the track. How you will change your heading to get back to original track in 15 NM?
   (answer: 16° to the right … (4 x 60)/15 = 16°)

2. You are 2 NM right parallel to the track. In how many NM you will reach the original track if you changed heading by 10° to the left?
   (answer: 12 NM … (2 x 60)/10° = 12)

3. You get 5 NM right of the track after you have flown 60 NM. What would be the total change of heading to get back to original track in the same distance?
   (answer: 10° to the left … (5 x 60)/60 + (5 x 60)/60 = 10°)

4. You are 3 NM right parallel to the track. How you will change your heading to get back to original track in 30 NM?
   (answer: 6° to the left … (3 x 60)/30 = 6°)

100 04 00 11

Estimate headwind and crosswind components given wind speed and direction and runway in use.

1. Estimate headwind component in kts when wind is 240/10 at runway 18.
   (answer: 5 kts … cos(60°) x 10 = 5)

2. Estimate crosswind component in kts when wind is 240/10 at runway 15.
   (answer: 10 kts right crosswind … sin(90) x 10 = 10)

3. Estimate headwind component in kts when wind is 320/8 at runway 35.
   (answer: approx. 7 kts is acceptable … cos(30°) x 8 = 6,96)

4. Estimate crosswind component in kts when wind is 090/30 at runway 16.
   (answer: left crosswind between 26 and 29 kts including is acceptable … sin(70) x 30 = 28,2)

Evaluation and debriefing: In case of failure, go through the wrongly answered questions until the student will understand where the mistake was done. Plan another attempt for maths test, not earlier than 2 days later, to provide at least one day for student to recover and repeat the LOs during self-study. For the next attempt use different questions in each LO.

If student fail again during the second attempt, then CTKI together with TKIs should propose exclusion of student from training. In this step, Head of Training should be informed and make final decision about exclusion of student.

Write down the result to student's training records and together with results from summative assessments to Certificate of completion of 100 KSA.

5.4.3 CERTIFICATE OF COMPLETION OF 100 KSA

The official Certificate of completion of Area 100 KSA is provided on the next separate page.

Logo of ATO	Name of ATO
	Certification number of ATO

CERTIFICATE OF COMPLETION OF AREA 100 KSA

Applicant's last name(s):	Last name(s)
First name(s):	First name(s)
Date of birth:	DD/MM/YYYY

The satisfactory completion of 100 KSA assessments within approved ATP(A) theoretical course according to AMC1 to Appendix 3 of Part-FCL requirements is certified below:

Competencies and TEM final assessment *(satisfactory as minimum)*					
Communication	Unsatisfactory	Satisfactory	Good	**Very good**	Excellent
Leadership and teamwork	Unsatisfactory	Satisfactory	**Good**	Very good	Excellent
Problem-solving and decision-making	Unsatisfactory	Satisfactory	**Good**	Very good	Excellent
Situation awareness	Unsatisfactory	Satisfactory	Good	Very good	**Excellent**
Workload management	Unsatisfactory	Satisfactory	**Good**	Very good	Excellent
Application of knowledge, UPRT and resilience	Unsatisfactory	**Satisfactory**	Good	Very good	Excellent

Date of Summative assessment 1	DD/MM/YYYY	Date of Summative assessment 2		DD/MM/YYYY

Mental maths test	Date:	DD/MM/YYYY	Final result: *(75% as minimum pass rate)*	XX %

HT or CTKI recommends the student to final ATP(A) theoretical knowledge examination at CAA.

ATO: Number of ATO certification	At: ATO address	Location and date: Location and date

Name(s), type and number of licence of HT or CTKI:	I agree with the evaluation stated above.
signature of HT or CTKI and ATO stamp	*signature of applicant*

The continuous results of KSA assessments should be provided/available to student's flight instructors as well to make possibility them to build and develop the student's competencies which were on good or satisfactory level only during official assessment. The second reason is to have the concept of competency-based training in completion, if ATO evaluates competencies during the practical pilot training, too.

EASA states in the ED Decision 2018/001/R following:

"Access to the information on Area 100 KSA kept in the student's training records should be restricted to the student and authorised ATO personnel, and should not be disclosed outside the ATO. The information on the record should first be de-identified before it is used to support course design improvements." [5]

Keeping student's training records confidential should be the base rule of each ATO. But in case that student is changing the flight school than new ATO should have the right to require the previous training records/results. Especially when KSA is implemented, then in the conditions for ATO of practical training for enrolment of new student must be requirement to provide Certificate of completion of Area 100 KSA issued by previous ATO. This applies for modular distance course which can be done in other ATO than further IR, MEP, CPL and MCC training.

Final Certificate of completion of theoretical instruction shall include statement that Area 100 KSA was evaluated at Satisfactory level at least and Mental Maths test passed.

5.4.4 COMLIANCE LIST OF SYLLABUS 100 KSA WITH ITS APPLICATION TO THE THEORY TRAINING

Find the compliance list with application of Area 100 KSA learning objectives to the theory training and Assessments in Table 11.

Table 11 - Compliance list of Area 100 KSA syllabus [3]

Syllabus reference	Syllabus text	Application to theory training	Assessment
100 01 00 00	ICAO CORE COMPETENCIES		
100 01 00 01	Recognise the ICAO Core Competencies listed below and the associated competency descriptions (ICAO Doc 9995 'Manual of Evidence-based Training'): • Application of Procedures; • Communication; • Aircraft Flight Path Management, automation; • Aircraft Flight Path Management, manual control; • Leadership and Teamwork; • Problem Solving and Decision Making; • Situation Awareness; • Workload Management.	Initial ATP, 040, MCC	N/A
100 02 00 00	CORE COMPETENCIES LEARNING OBJECTIVES		
100 02 01 00	Communication		
100 02 01 01	Show the ability to identify whether the recipient is ready and able to receive the information.	Initial ATP, 040, 090, MCC	FA, SA2
100 02 01 02	Show the ability to appropriately select what, when, how and with whom to communicate.	Initial ATP, 040, 090, MCC	FA, SA2
100 02 01 03	Show the ability to communicate clearly, accurately and concisely.	Initial ATP, 040, 090, MCC	FA, SA2
100 02 01 04	Show the ability to confirm whether the recipient correctly understands important information.	Initial ATP, 040, 090, MCC	FA, SA2
100 02 01 05	Show the ability to listen actively and show you understand the information you receive.	Initial ATP, 040, 090, MCC	FA, SA2
100 02 01 06	Show the ability to ask relevant and effective questions.	Initial ATP, 040, 090, MCC	FA, SA2
100 02 01 07	Show the ability to adhere to standard radio-telephony phraseology.	Initial ATP, 090	FA, SA2
100 02 01 08	Show the ability to accurately read, interpret, construct and respond to given documentation in English.	010, 020	FA, SA2
100 02 01 09	Show the ability to correctly interpret non-verbal communication.	040, 090, MCC	FA, SA2
100 02 01 10	Show the ability to use appropriate eye contact, body movement and gestures that are consistent with and support verbal messages.	040, 090, MCC	FA, SA2

100 02 02 00	Leadership and teamwork		
100 02 02 01	Show the ability to create an atmosphere of open communication that encourages participation.	033	FA, SA1
100 02 02 02	Show the initiative and the ability to give directions when required.	033	FA, SA1
100 02 02 03	Show the ability to admit mistakes and take responsibility.	033	FA, SA1
100 02 02 04	Show the ability to anticipate and respond appropriately to others' needs.	033	FA, SA1
100 02 02 05	Show the ability to carry out instructions when directed.	033	FA, SA1
100 02 02 06	Show the ability to communicate relevant concerns and intentions.	033	FA, SA1
100 02 02 07	Show the ability to give and receive feedback constructively.	033	FA, SA1
100 02 02 08	Show empathy, respect and tolerance for others.	033	FA, SA1
100 02 02 09	Show the ability to engage others in planning and to allocate activities fairly and appropriately according to others' abilities.	033	FA, SA1
100 02 02 10	Show the ability to address and resolve conflicts and disagreement in a constructive manner.	033	FA, SA1
100 02 02 11	Show the ability to project self-control.	040	FA, SA1
100 02 03 00	Problem-solving and decision-making		
100 02 03 01	Show the ability to seek accurate and adequate information from appropriate sources.	040	SA2
100 02 03 02	Show the ability to identify and verify what and why things have gone wrong.	040	SA2
100 02 03 03	Show the ability to employ proper problem-solving strategies.	040	SA2
100 02 03 04	Show the ability to persevere in working through problems.	040	SA2
100 02 03 05	Show the ability to use appropriate and timely decision-making processes.	040	SA2
100 02 03 06	Show the ability to set priorities appropriately.	040	SA2
100 02 03 07	Show the ability to identify and consider options effectively.	040	SA2
100 02 03 08	Show the ability to monitor, review and adapt decisions as required.	040	SA2
100 02 03 09	Show the ability to identify and manage risks.	040	SA2
100 02 04 00	Situation awareness		
100 02 04 01	Demonstrate the ability to identify and assess accurately the general environment as it may affect the operation.	033	SA2
100 02 04 02	Demonstrate the ability to identify threats, errors and undesirable aircraft states.	033, 050, 080	SA2
100 02 04 03	Demonstrate the ability to manage threats, errors and undesirable aircraft states.	033, 050, 080	SA2

100 02 05 00	Workload management		
100 02 05 01	Show the ability to maintain self-control.	Initial ATP, 040, MCC	FA, SA2
100 02 05 02	Show the ability to plan, prioritise and schedule tasks effectively.	Initial ATP, 040, 033, 061, MCC	FA, SA2
100 02 05 03	Show the ability to manage time effectively when carrying out tasks.	Initial ATP, 040, 033, 061, MCC	FA, SA2
100 02 05 04	Show the ability to offer and accept assistance, delegate when necessary and ask for help early.	Initial ATP, 040, 090, MCC	FA, SA2
100 02 05 05	Show the ability to manage interruptions, distractions, variations and failures effectively.	Initial ATP, 040	FA, SA2
100 03 00 00	ADDITIONAL THREAT AND ERROR MANAGEMENT (TEM) RELATED LEARNING OBJECTIVES		
100 03 01 00	Application of knowledge		
100 03 01 01	Demonstrate the ability to complete pre-flight planning in practical exercises.	Initial ATP, 033	SA2
100 03 01 02	Demonstrate the KSA and TEM relating to phases of flight in the ground training environment.	033	SA2
100 03 02 00	Upset prevention and recovery training (UPRT) and resilience		
100 03 02 01	Recognise potential upset 'threats' and suggest effective 'threat management' in scenario situations.	080	SA2
100 03 02 02	Recognise potential upset 'errors' and suggest effective 'error management' in scenario situations.	080	SA2
100 03 02 03	Explain the causes of and contributing factors to upsets.	080	SA2
100 03 02 04	Demonstrate resilience during scenario and/or other exercises.	040	SA2
100 03 02 05	Show the ability to identify the signs and discuss the effects of stress, fatigue and aviation lifestyle on situation awareness, and how to cope with them in order to maintain situation awareness.	040	SA2
100 04 00 00	MENTAL MATHS		
100 04 00 01	Convert between volumes and masses of fuel using range of units.	033	MT
100 04 00 02	Estimate time, distance and speed.	033	MT
100 04 00 03	Estimate the rate of climb or rate of descent, distance and time.	061	MT
100 04 00 04	Add or subtract time, distance, and fuel mass.	033	MT
100 04 00 05	Calculate fuel burn given time and fuel flow.	033	MT
100 04 00 06	Calculate the time available (for decision-making) given relevant fuel information.	033	MT

100 04 00 07	Determine the top of descent using a simple method that is described by the approved training organisation (ATO).	033	MT
100 04 00 08	Determine the values that vary by a percentage, e.g. dry-to-wet landing distance and fuel burn.	032	MT
100 04 00 09	Estimate heights at distances on a 3-degree glideslope.	033	MT
100 04 00 10	Estimate headings using the 1-in-60 rule.	061	MT
100 04 00 11	Estimate headwind and crosswind components given wind speed and direction and runway in use.	032	MT

In all other subjects to which the KSA LOs aren't particularly implemented, the theoretical knowledge instructor should change the style of his/her teaching with regards to building of students' soft skills, not only knowledge. Attention should be paid to Threat and Error Management. That's the reason why all theoretical knowledge instructors must undergo the 100 KSA training as proposed in the next chapter.

6 INSTRUCTOR'S QUALIFICATION

In general, selection of good and professional Theoretical knowledge instructor is a complex process. The lector must have following qualities besides regulation requirements:

- Perfectly know the subject which is teaching
- Have higher knowledge in the other subject as well, mainly subjects which are connected with his/her one
- Be able to explain and present to students all principles and reasons why?
- Be able to speak in front of large group of students – the whole class
- Be ready to answer questions from students and discuss the related topics
  (but nobody is perfect – lector must be able to say: „I don't know" and prepare the answer for the next lesson)
- Take and feel responsibility for whole subject learning process of the student – from the first page in book till the successful final examination at CAA
- Be able to use tools during the lessons – animations, models, videos, voice records, pictures, games, …
- Be able to manage time during lessons
- Be able to evaluate and check student performance during the lessons
- Focus on the goal which student wants to achieve – to be a professional pilot
- In general, TKI should have all competencies which are required from students in Area 100 KSA at Excellent level

As mentioned above, it is obvious that knowledge is only an essential basis of a lector. What elevates lector to the excellent level are his/her soft skills. CTKI should focus on that during the selection process.

Regulation requirements of the Czech CAA to approve TKI are stated in CAA-ZLP-141. The requirements for TKIs can be evaluated and approved by competent authority after receipt of the FORM 4 of the potential lector with confirmation of the example lecture provided to CTKI. Or this responsibility can be transferred to Compliance Monitoring Manager of ATO who evaluates the requirements instead of CAA. [34]

As I proposed in previous chapters that KSA learning objectives will not be assessed only but taught as well. Then all theoretical knowledge instructors of the ATO shall pass before the introduction of ED Decision 2018/001/R, 2018/011/R and 2019/017/R training related to new implemented changes – they need to know how their students will be assessed after passed theory lessons. These instructors will not be the assessors.

In general, TKI should understand the principle of application Area 100 KSA and the philosophy of the whole teaching process throughout the training:

"Tell me and I forget, teach me and I remember, involve me and I learn" [24]

Initial training can be connected to the nearest recurrent training before the changes are implemented in ATO.

The training should be carried out by CTKI or a person authorized by him.

The content shall include followings (Table 12):

(the reference to the chapter in this diploma thesis is always given in brackets)

Table 12 - Initial Area 100 KSA training for all TKIs [5]

Topic	Duration
Overview of the implemented changes (chapter 3.1, 3.2, 3.3 and 4)	1:00
Explanation of Benjamin Bloom Taxonomy of learning objectives and related learning styles and teaching methods (chapter 3.4)	1:00
Familiarization with the changes of LOs for each subject and with updated learning materials (chapter 5.3) – individually with TKIs for each subject	Based on the extent of the changes in each subject (list can be provided before to self-study and prepare questions/concerns)
Explanation of 100 KSA and its implementation to relevant subjects including learning styles and teaching methods (chapter 5.4) - discuss each KSA LO to fully understand from TKI's side	3:00
Overview of 100 KSA assessments, Mental Maths test, evaluation standards and introduce who will be assessors (chapter 5.4.2) - if the TKI will be the KSA assessor then the initial training in following chapter shall be passed	2:00
Threat and Error Management course	3:00
Crew Resource Management course – introduction	3:00
Practical exercise – try one of Summative assessments (chapter 5.4.2.2) *(with group of students)*	Based on chosen SA

Recurrent training for all theoretical instructors focused on 100 KSA shall be done annually in addition to the standard content (Table 13):

(the reference to the chapter in this diploma thesis is always given in brackets)

Table 13 - Recurrent Area 100 KSA training for all TKIs [5]

Topic	Duration
CTKI or TKIs responsible for 100 KSA assessments shall present the overview of students' results during last year and highlight strengths and weaknesses. Discussion mainly about weaknesses should be done with output what to change in the theoretical training (including KSA LOs) to improve the situation.	3:00
Repetition of 100 KSA evaluation standards (chapter 5.4.2)	1:00

Instructors responsible for assessing Area 100 KSA (Assessors) shall passed the following initial training and recurrent training every year in addition to standard TKI training mentioned above.

6.1 INITIAL TRAINING FOR INSTRUCTORS RESPONSIBLE FOR ASSESSING AREA 100 KSA

Instructors qualified to deliver the Formative, Summative assessments and/or Mental Maths test need to receive appropriate training for these tasks. As practice in selection of flight instructors to conducting progress exams/checks, usually instructors with the wide experience in aviation training environment and approved by ATO management (Head of Training or Chief Flight Instructor) – I propose to use the same selection procedure for instructors responsible for assessing Area 100 KSA. In that case approved by HT and Chief Theoretical Knowledge Instructor. In addition, if possible, it would be convenient if selected instructor has experience with:

- Crew/Cockpit/Company Resource Management – as lector or as pilot
- Threat and Error Management – as lector or as pilot
- Multi-crew Cooperation – as instructor or as pilot
- Commercial air transport environment
- Competency based training
- Theoretical and/or practical examinations

When instructors are selected, completion of initial training is required in addition to training provided to all TKIs as mentioned above. Authorization of the TKI to assess Area 100 KSA

doesn't count to maximum ATP(A) subjects, which instructor can teach and is not subject to approval by CAA. [5]

For the purpose of simplification for ATO operations, I would recommend to give to instructors the right to perform Formative + Summative assessments, or Mental Maths test or both. Not only Formative, or only Summative assessments. Instructors responsible for Mental Maths test must be approved TKI for 033 or 061 as well.

The training should be carried out by CTKI or a person authorized by him.

The content shall include followings (Table 14):

(the reference to the chapter in this diploma thesis is always given in brackets)

Table 14 - Initial Area 100 KSA training for assessors [5]

Topic	Duration
Explanation of Formative assessment and related behavioural indicators for evaluation (chapter 5.4.2.1)	1:00
Explanation of Summative assessments and related behavioural indicators for evaluation (chapter 5.4.2.2)	1:30
Explanation of competencies levels and word pictures (chapter 5.4.2.3)	2:00
Explanation of Mental Maths test and evaluation (chapter 5.4.2.4)	1:00
Explanation of debriefing methods (chapter 5.4.2.1, 2, 4)	1:00
Explanation of filling of training records of each assessment and test and Certificate of completion of 100 KSA (chapter 5.4.2.1, 2, 4, 5.4.3)	0:20
Practical exercise – try Formative assessment (chapter 5.4.2.1) *(with group of students)*	Based on chosen FA
Practical exercise – try one of Summative assessments (chapter 5.4.2.2) *(with group of students)*	Based on chosen SA

We can call these instructors as assessors, 100 KSA assessors.

To the list of approved TKIs in OM-D include information, if TKI is responsible for 100 KSA Assessments or not and if his/her 100 KSA training is valid based on regular attendance at recurrent training – see below.

6.2 RECURRENT TRAINING FOR INSTRUCTORS RESPONSIBLE FOR ASSESSING AREA 100 KSA

Instructor who is responsible for Area 100 KSA based on completing the initial training as described in the previous chapter, is obliged to go through recurrent training at least every year. It is important to keep the instructor proficient and standardised in the 100 KSA assessments across the ATO. The best solution is to include 100 KSA refresher to regular annual TKI standardisation meeting. I would recommend to require from 100 KSA assessors to make at least 2 Formative assessments, 2 Summative assessments and/or 2 Mental Maths tests per year (based on instructor approval), otherwise they shall undergo the initial training again. [5]

Recurrent training for instructor responsible for assessing Area 100 KSA shall be done annually in addition to the standard content and to recurrent of 100 KSA for all TKIs (Table 15):

(the reference to the chapter in this diploma thesis is always given in brackets)

Table 15 - Recurrent Area 100 KSA training for assessors [5]

Topic	Duration
Discussion about experience with all types of assessments and tests during last year (continue in discussion from recurrent training with all TKIs). If deficiencies are found in assessments and mental maths test, together suggest changes to improve the situation.	2:00
Discussion about students which failed or obtained only Satisfactory level of competencies during last year. Together propose changes to the theoretical training (including KSA LOs) to improve the situation.	2:00
Repetition of 100 KSA evaluation standards, behavioural indicators and debriefing methods for each assessment focused on inter-rater reliability (chapter 5.4.2)	1:00
Practical exercise – try one of Summative assessments (chapter 5.4.2.2) *(with group of students)*	Based on chosen SA

7 ATO DOCUMENTATION CHANGES

This chapter contains brief overview of changes which shall be implemented by ATOs to documentation before submitting new theoretical course changes including 100 KSA to respective CAA. Where applicable change includes reference to chapter of this diploma thesis. If not already implemented, whole training courses development process under ATO shall follow ISD methodology (chapter 5.2).

7.1 TRAINING MANUAL

Following changes are proposed based on ED Decision 2018/001/R and Training manual Integrated course ATP(A) – theoretical part of F AIR, CZ/ATO-001. Training manual of modular distance-learning course has the same chapters/parts related to changes connected with Area 100 KSA. [2][7][8]

- **Objectives of the course**
  - Course objectives shall be extended by:
    - Student shall be able to understand and apply the subject knowledge in order to be able to identify and manage threats and errors effectively. [4]
    - Student shall meet at least the Area 100 KSA minimum standard. [4]
- **Training syllabus and organization of the course**
  - Training syllabus shall be updated based on:
    - updated learning objectives of each subject (chapter 5.3)
    - exact implementation of 100 KSA learning objectives into particular subjects (chapter 5.4.1)
    - formative, summative assessments and mental maths test shall be included to syllabus at correct positions (chapter 5.4.2)
- **Training records**
  - Training records shall include:
    - form for formative, summative assessments and mental maths test evaluation (chapter 5.4.2), add to student's logbook if applicable
    - final Certificate of completion of Area 100 KSA (chapter 5.4.3), add as appendix to the training manual
  - final Certificate of completion of theoretical instruction shall include statement that Area 100 KSA was evaluated at Satisfactory level at least and Mental Maths test was passed

- o If not already implemented, it shall be stated that student's training records shall be available to the student and authorised ATO personnel, and shall not be disclosed outside the ATO without student's approval.
- **Theoretical tests and exams**
  - o "Theoretical tests and exams" shall be renamed to "Theoretical tests, exams and assessments" or similarly
  - o Chapter for Area 100 KSA Assessment shall be added
    - ▪ including description of formative and summative assessments (chapter 5.4.2) including evaluation and debriefing (chapter 5.4.2.3)
    - ▪ including supporting materials in appendices of training manual (chapter 5.4.2)
  - o Chapter for Tests
    - ▪ add description of mental maths test including evaluation (chapter 5.4.2.4)
    - ▪ including list of questions and supporting materials in appendices of training manual (chapter 5.4.2.4)
- **Responsibilities**
  - o In description of responsibilities of AM, HT, CTKI, TKI, etc. shall be added:
    - ▪ 100 KSA Assessor is responsible for performing formative and summative assessments according to theoretical training schedule and ensures that at least satisfactory level of competencies is achieved.
    - ▪ 100 KSA Assessor as TKI for 061 or 033 is responsible for performing mental maths test according to theoretical training schedule and ensures that required level of success is achieved.
- **Student's progress**
  - o Requirements for student's progress shall be extended by completing of 100 KSA Assessments and Mental Maths test
  - o Before the first Certificate of completion of theoretical instruction is issued by ATO for final examination at CAA, the Mental Maths test shall be passed, and Summative assessments passed at Satisfactory level at least
  - o Identification of unsuccessful student's progress
    - ▪ 100 KSA Assessments and Mental Maths test shall be added as other indicators of unsuccessful student's progress based on their evaluation and debriefing with student (chapter 5.4.2)

- o Procedures for rejecting the student from training
    - ▪ Procedures for rejecting the student from training based on failure of 100 KSA Assessments and Mental Maths test shall be added (chapter 5.4.2)
- **Teaching methods**
    - o Extend teaching methods by all means available based on ED Decision 2018/001/R, if applicable in ATO: [4]
        - ▪ classroom work
        - ▪ lessons
        - ▪ tutorials
        - ▪ demonstrations, including those supported by demonstration equipment
        - ▪ exercises carried out as groups or individuals and based on pre-flight and en-route planning, communications, presentations and projects
        - ▪ exercises that use demonstration equipment or training devices
        - ▪ directed study including workbook exercises or assignments
        - ▪ aerodrome or aviation industry field trips
        - ▪ computer-based training and e-learning elements
        - ▪ progress tests, Area 100 KSA assessments and mental maths test(s)
        - ▪ (other training methods, media and tools approved by the competent authority)
    - o include information about new/updated learning materials covering changes in learning objectives (chapter 5.3.1)

7.2 OPERATIONS MANUAL PART D – STAFF TRAINING

Following changes are proposed based on Operations manual Part D – Staff training of F AIR, CZ/ATO-001. OM-D of other flight schools should have the similar chapters/parts. [16]

- **Theoretical Knowledge Instructors**
    - o Whole section for Theoretical Knowledge Instructors shall be extended by chapter 6 of this diploma thesis
        - ▪ Initial training for all TKIs
        - ▪ Recurrent training for all TKIs
        - ▪ Initial training for TKIs responsible for assessing Area 100 KSA
        - ▪ Recurrent training for TKIs responsible for assessing Area 100 KSA

8 CONCLUSIONS

As mentioned in the introduction, the main goal of this diploma thesis is a specific incorporation of Area 100 KSA into ATP(A) theory training including related formative and summative assessments and mental maths test. Together with the necessary guidance for training of Theoretical knowledge instructors and changes to ATO training documentation. The goal is achieved on the previous pages by chapters 5, 6 and 7 and can fully serve to ATOs to incorporate 100 KSA requirements into their training courses. In addition, other requirements arising from related ED Decisions are briefly summarized in order to fully understand the issues and the complexity of the solution offered.

I would like to summarize the importance of changes once again with regard to flight training experience. It was decided by EASA and working groups, that it is necessary to build, develop and enhance soft skills and assess competencies of students who are already undergoing basic pilot training. To fulfil this intent, the subject of 100 KSA was introduced into theoretical training and requirements for competency assessment are gradually introduced into practical training as well (e.g. Advanced UPRT), as transition from Hours-based Training, as we know it now. We can say that Threat and Error Management and Crew/Cockpit/Company Resource Management training, which were originally completed in the airline environment are now incorporated into initial pilot training as well, which makes students-pilots far more prepared for their future career. Based on my experience in the training of professional pilots, I concur with this regulation and acknowledge the need for this requirement to assess the competencies and build soft skills that are necessary for a pilot. Some students come to flight schools with a good foundation of soft skills, some build them during training, but unfortunately there are some, who are not suitable candidates for a professional pilot from this standpoint. The introduction of KSA assessment is therefore appropriate.

I decided for this topic of the diploma thesis in order to be able to process the requirements of EASA and put them into practice, or specifically to indicate how to implement teaching and assessment of competencies in theoretical training.

A majority of these specific and similar solutions and practical applications which I have outlined in the diploma thesis, I have tested in practice on several occasions, and therefore I am convinced of their benefits for the quality of flight training. Occasions such as:

- I participated in the implementation of Threat and Error Management in pre-flight preparation during training flights
- I participated in the implementation of Threat and Error Management in the integrated ATP course on the basis of the regulation on the implementation of Basic and Advanced UPRT

- I participated in the implementation of the syllabus and materials for teaching CRM and MCC theory
- I conducted a number of screenings of individual students and larger groups, including oral interviews, with evaluation of their attitude to aviation
- I have trained new TKIs and FIs to the operation of the flight school
    - I perform periodic trainings
    - As CTKI, I lead and provide TKI training
- I participate in the decision to grant FI authorization to perform examinations before the first solo flights, progress tests/exams, etc.
- In theory lessons, I work with groups of students, I give them various group exercises in which their behaviour can be observed.
    - Presentations on a given topic within the theory lesson
    - Specifically, NASA exercises verified on three groups of students of different performance… individual indicators can be observed on their behaviour during the exercise ("behavioural indicator") and evaluate the resulting level of competence Leadership and Teamwork

I have discussed solutions, outlined in this thesis, with the CAA, so whole proposed concept is ready for official approval and after that for the immediate use in flight school operations.

The whole concept should be verified in practice for the longer term on the entire class or group of students, where the complete training lasts at least 18 months, including screening, initial theory and final exams. I will introduce it to the ATO operations this year and test until the end of 2021, then modify, if needed, and make it fully applicable from January 2022. This process follows ISD methodology required by EASA.

Finally, improved level of theoretical knowledge training will definitely help pilots in smoother transition from initial training to commercial operator. It can be reflected in shorter operator conversion courses and introduction to aviation company, which saves money and time. In general, thanks greater emphasis on a higher level of technical and non-technical skills, flight safety will be significantly increased.

We will be able to observe a measurable improvement in the situation a few years after the introduction of this concept into practice across Europe, when we will compare the performance of first officers in line training after completed this new concept including 100 KSA and current beginning pilots. But as I write above, I believe that the improvement will be significant.

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